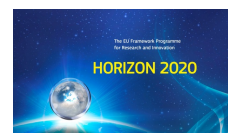




**EUROPEAN COMMISSION**  
 Communications Networks, Contents & technology  
 Digital Industry  
 Technologies & Systems for Digitising Industry



## GRANT AGREEMENT

**NUMBER — 723710 — vf-OS**

This **Agreement** ('the Agreement') is **between** the following parties:

**on the one part,**

*the **European Union** ('the EU'), represented by the European Commission ('the Commission')<sup>1</sup>,*

represented for the purposes of signature of this Agreement by Head of Unit, authorised representative of the Director General, Communications Networks, Contents & technology, Digital Industry, Administration and Finance, Ales FIALA,

**and**

**on the other part,**

1. 'the coordinator':

**INFORMATION CATALYST FOR ENTERPRISE LTD (ICE) LTD**, 7582660, established in St Georges Court, Winnington Avenue, Northwich CW8 4EE, United Kingdom, GB203780724, represented for the purposes of signing the Agreement by Director and CEO, Stuart CAMPBELL

and the following other beneficiaries, if they sign their 'Accession Form' (see Annex 3 and Article 56):

2. **IKERLAN SCL (IKERLAN) S.COOP.**, 1282, established in P JOSE MARIA ARIZMENDIARRIETA 2, MONDRAGON 20500, Spain, ESF20079828,

3. **UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS-ASSOCIACAO (UNINOVA) IPSS**, not applicable, established in CAMPUS DA CAPARICA QUINTA DA TORRE, CAPARICA 2829-516, Portugal, PT501797173,

4. **UNIVERSITAT POLITECNICA DE VALENCIA (UPV)**, 027/46014816, established in CAMINO DE VERA SN EDIFICIO 3A, VALENCIA 46022, Spain, ESQ4618002B,

5. **CAIXA MAGICA SOFTWARE LDA (CMS) LDA**, 506945901, established in RUA SOEIRO PEREIRA GOMES LOTE 1 4 B EDIFICIO ESPANHA, LISBOA 1600 196, Portugal, PT506945901,

6. **UNIVERSITE LUMIERE LYON 2 (LYON2)**, 196917751, established in 86 RUE PASTEUR, LYON CEDEX 07 69365, France, FR82196917751,

7. **ASCORA GMBH (ASC) GMBH**, HRB201973, established in BIRKENALLEE 43, GANDERKESEE 27777, Germany, DE257809394,

8. **ALMENDE B.V. (ALM) BV**, 24307997, established in STATIONSPLEIN 45 UNIT A1.205-207, ROTTERDAM 3013 AK, Netherlands, NL809028736B01,

9. **MONDRAGON ASSEMBLY SOCIEDAD COOPERATIVA (MASS) S.COOP.**, SS621, established in POLIGONO INDUSTRIAL BAINETXE 5A, ARETXABALETETA 20550, Spain, ESF20165940,

<sup>1</sup> Text in *italics* shows the options of the Model Grant Agreement that are applicable to this Agreement.



10. **VIA SOLIS UAB (VS)** UAB, 302430053, established in NAUJOJI GATVE 138 G, ALYTUS 62175, Lithuania, LT100005604112,
11. **CONSULGAL - CONSULTORES DE ENGENHARIA E GESTAO SA (CONSULGAL)** SA, 501515011, established in AV SALVADOR ALLENDE 25, OEIRAS 2780 163, Portugal, PT501515011,
12. **KNOWLEDGEBIZ CONSULTING-SOCIEDADE DE CONSULTORIA EM GASTAO LDA (KBZ)** LDA, 507888367, established in CAMPUS FACULDADE DE CIENCIA E TECNOLOGIA/UNIVERSID DE LISBOA, EDIFICIO UNINOVA, CAPARICA 2829 516, Portugal, PT507888367,
13. **APPLICATIONS PLASTIQUES DU RHONE SAS (APR)** SAS, 972501571, established in RUE JULES FERRY 21 ZI DU BAS PONTET, ST SYMPHORIEN D OZON 69360, France, FR29972501571,
14. **ETABLISSEMENTS TARDY (Tardy)** SAS, 305832263, established in 409 RUE DU CANAL, LA GRAND-CROIX 42320, France, FR88305832263,

Unless otherwise specified, references to ‘beneficiary’ or ‘beneficiaries’ include the coordinator.

The parties referred to above have agreed to enter into the Agreement under the terms and conditions below.

By signing the Agreement or the Accession Form, the beneficiaries accept the grant and agree to implement it under their own responsibility and in accordance with the Agreement, with all the obligations and conditions it sets out.

The Agreement is composed of:

#### Terms and Conditions

Annex 1	Description of the action
Annex 2	Estimated budget for the action
Annex 3	Accession Forms
Annex 4	Model for the financial statements
Annex 5	Model for the certificate on the financial statements
Annex 6	Model for the certificate on the methodology



# TERMS AND CONDITIONS

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## **CHAPTER 1 GENERAL**

### **ARTICLE 1 — SUBJECT OF THE AGREEMENT**

This Agreement sets out the rights and obligations and the terms and conditions applicable to the grant awarded to the beneficiaries for implementing the action set out in Chapter 2.

## **CHAPTER 2 ACTION**

### **ARTICLE 2 — ACTION TO BE IMPLEMENTED**

The grant is awarded for the action entitled ‘*Virtual Factory Open Operating System — vf-OS*’ (**‘action’**), as described in Annex 1.

### **ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION**

The duration of the action will be **36 months** as of *1 October 2016* (**‘starting date of the action’**).

### **ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS**

#### **4.1 Estimated budget**

The **‘estimated budget’** for the action is set out in Annex 2.

It contains the estimated eligible costs and the forms of costs, broken down by beneficiary and budget category (see Articles 5, 6).

#### **4.2 Budget transfers**

The estimated budget breakdown indicated in Annex 2 may be adjusted by transfers of amounts between beneficiaries or between budget categories (or both). This does not require an amendment according to Article 55, if the action is implemented as described in Annex 1.

However, the beneficiaries may not add costs relating to subcontracts not provided for in Annex 1, unless such additional subcontracts are approved by an amendment or in accordance with Article 13.

## **CHAPTER 3 GRANT**

### **ARTICLE 5 — GRANT AMOUNT, FORM OF GRANT, REIMBURSEMENT RATES AND FORMS OF COSTS**

#### **5.1 Maximum grant amount**

The **‘maximum grant amount’** is **EUR 7,758,580.00** (seven million seven hundred and fifty eight thousand five hundred and eighty EURO).



## 5.2 Form of grant, reimbursement rates and forms of costs

The grant reimburses **100% of the action's eligible costs** (see Article 6) (**'reimbursement of eligible costs grant'**) (see Annex 2).

The estimated eligible costs of the action are EUR **7,758,580.00** (seven million seven hundred and fifty eight thousand five hundred and eighty EURO).

Eligible costs (see Article 6) must be declared under the following forms (**'forms of costs'**):

(a) for **direct personnel costs**:

- as actually incurred costs (**'actual costs'**) or
- on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (**'unit costs'**).

Personnel **costs for SME owners or beneficiaries that are natural persons** not receiving a salary (see Article 6.2, Points A.4 and A.5) must be declared on the basis of the amount per unit set out in Annex 2 (**'unit costs'**);

(b) for **direct costs for subcontracting**: as actually incurred costs (**'actual costs'**);

(c) for **direct costs of providing financial support to third parties**: *not applicable*;

(d) for **other direct costs**: as actually incurred costs (**'actual costs'**);

(e) for **indirect costs**: on the basis of a flat-rate applied as set out in Article 6.2, Point E (**'flat-rate costs'**);

(f) *specific cost category(ies): not applicable*.

## 5.3 Final grant amount — Calculation

The **'final grant amount'** depends on the actual extent to which the action is implemented in accordance with the Agreement's terms and conditions.

This amount is calculated by the *Commission* — when the payment of the balance is made (see Article 21.4) — in the following steps:

Step 1 – Application of the reimbursement rates to the eligible costs

Step 2 – Limit to the maximum grant amount

Step 3 – Reduction due to the no-profit rule

Step 4 – Reduction due to improper implementation or breach of other obligations

### 5.3.1 Step 1 — Application of the reimbursement rates to the eligible costs

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) declared by the beneficiaries (see Article 20) and approved by the *Commission* (see Article 21).



### 5.3.2 Step 2 — Limit to the maximum grant amount

If the amount obtained following Step 1 is higher than the maximum grant amount set out in Article 5.1, it will be limited to the latter.

### 5.3.3 Step 3 — Reduction due to the no-profit rule

The grant must not produce a profit.

‘**Profit**’ means the surplus of the amount obtained following Steps 1 and 2 plus the action’s total receipts, over the action’s total eligible costs.

The ‘**action’s total eligible costs**’ are the consolidated total eligible costs approved by the *Commission*.

The ‘**action’s total receipts**’ are the consolidated total receipts generated during its duration (see Article 3).

The following are considered **receipts**:

- (a) income generated by the action; if the income is generated from selling equipment or other assets purchased under the Agreement, the receipt is up to the amount declared as eligible under the Agreement;
- (b) financial contributions given by third parties to the beneficiary specifically to be used for the action, and
- (c) in-kind contributions provided by third parties free of charge and specifically to be used for the action, if they have been declared as eligible costs.

The following are however not considered receipts:

- (a) income generated by exploiting the action’s results (see Article 28);
- (b) financial contributions by third parties, if they may be used to cover costs other than the eligible costs (see Article 6);
- (c) financial contributions by third parties with no obligation to repay any amount unused at the end of the period set out in Article 3.

If there is a profit, it will be deducted from the amount obtained following Steps 1 and 2.

### 5.3.4 Step 4 — Reduction due to improper implementation or breach of other obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the *Commission* will calculate the reduced grant amount by deducting the amount of the reduction (calculated in proportion to the improper implementation of the action or to the seriousness of the breach of obligations in accordance with Article 43.2) from the maximum grant amount set out in Article 5.1.

The final grant amount will be the lower of the following two:



- the amount obtained following Steps 1 to 3 or
- the reduced grant amount following Step 4.

#### 5.4 Revised final grant amount — Calculation

If — after the payment of the balance (in particular, after checks, reviews, audits or investigations; see Article 22) — the *Commission* rejects costs (see Article 42) or reduces the grant (see Article 43), it will calculate the ‘**revised final grant amount**’ for the beneficiary concerned by the findings.

This amount is calculated by the *Commission* on the basis of the findings, as follows:

- in case of **rejection of costs**: by applying the reimbursement rate to the revised eligible costs approved by the *Commission* for the beneficiary concerned;
- in case of **reduction of the grant**: by calculating the concerned beneficiary’s share in the grant amount reduced in proportion to its improper implementation of the action or to the seriousness of its breach of obligations (see Article 43.2).

In case of **rejection of costs and reduction of the grant**, the revised final grant amount for the beneficiary concerned will be the lower of the two amounts above.

### ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

#### 6.1 General conditions for costs to be eligible

‘**Eligible costs**’ are costs that meet the following criteria:

(a) for **actual costs**:

- (i) they must be actually incurred by the beneficiary;
- (ii) they must be incurred in the period set out in Article 3, with the exception of costs relating to the submission of the periodic report for the last reporting period and the final report (see Article 20);
- (iii) they must be indicated in the estimated budget set out in Annex 2;
- (iv) they must be incurred in connection with the action as described in Annex 1 and necessary for its implementation;
- (v) they must be identifiable and verifiable, in particular recorded in the beneficiary’s accounts in accordance with the accounting standards applicable in the country where the beneficiary is established and with the beneficiary’s usual cost accounting practices;
- (vi) they must comply with the applicable national law on taxes, labour and social security, and
- (vii) they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency;

(b) for **unit costs**:



(i) they must be calculated as follows:

{amounts per unit set out in Annex 2 or calculated by the beneficiary in accordance with its usual cost accounting practices (see Article 6.2, Point A)

multiplied by

the number of actual units};

(ii) the number of actual units must comply with the following conditions:

- the units must be actually used or produced in the period set out in Article 3;
- the units must be necessary for implementing the action or produced by it, and
- the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 18);

(c) for **flat-rate costs**:

(i) they must be calculated by applying the flat-rate set out in Annex 2, and

(ii) the costs (actual costs or unit costs) to which the flat-rate is applied must comply with the conditions for eligibility set out in this Article.

## 6.2 Specific conditions for costs to be eligible

Costs are eligible if they comply with the general conditions (see above) and the specific conditions set out below for each of the following budget categories:

- A. direct personnel costs;
- B. direct costs of subcontracting;
- C. *not applicable*;
- D. other direct costs;
- E. indirect costs;
- F. *not applicable*.

‘Direct costs’ are costs that are directly linked to the action implementation and can therefore be attributed to it directly. They must not include any indirect costs (see Point E below).

‘Indirect costs’ are costs that are not directly linked to the action implementation and therefore cannot be attributed directly to it.

### A. Direct personnel costs

#### Types of eligible personnel costs

A.1 **Personnel costs** are eligible, if they are related to personnel working for the beneficiary under an employment contract (or equivalent appointing act) and assigned to the action (**‘costs for employees (or equivalent)’**). They must be limited to salaries (including during parental leave), social security contributions, taxes and other costs included in the **remuneration**, if they arise from national law or the employment contract (or equivalent appointing act).



Beneficiaries that are non-profit legal entities<sup>2</sup> may also declare as personnel costs **additional remuneration** for personnel assigned to the action (including payments on the basis of supplementary contracts regardless of their nature), if:

- (a) it is part of the beneficiary's usual remuneration practices and is paid in a consistent manner whenever the same kind of work or expertise is required;
- (b) the criteria used to calculate the supplementary payments are objective and generally applied by the beneficiary, regardless of the source of funding used.

Additional remuneration for personnel assigned to the action is eligible up to the following amount:

- (a) if the person works full time and exclusively on the action during the full year: up to EUR 8 000;
- (b) if the person works exclusively on the action but not full-time or not for the full year: up to the corresponding pro-rata amount of EUR 8 000, or
- (c) if the person does not work exclusively on the action: up to a pro-rata amount calculated as follows:

{ {EUR 8 000

divided by

the number of annual productive hours (see below)},

multiplied by

the number of hours that the person has worked on the action during the year}.

A.2 The **costs for natural persons working under a direct contract** with the beneficiary other than an employment contract are eligible personnel costs, if:

- (a) the person works under the beneficiary's instructions and, unless otherwise agreed with the beneficiary, on the beneficiary's premises;
- (b) the result of the work carried out belongs to the beneficiary, and
- (c) the costs are not significantly different from those for personnel performing similar tasks under an employment contract with the beneficiary.

A.3 The **costs of personnel seconded by a third party against payment** are eligible personnel costs, if the conditions in Article 11.1 are met.

<sup>2</sup> For the definition, see Article 2.1(14) of the Rules for Participation Regulation No 1290/2013: '**non-profit legal entity**' means a legal entity which by its legal form is non-profit-making or which has a legal or statutory obligation not to distribute profits to its shareholders or individual members.



**A.4 Costs of owners** of beneficiaries that are small and medium-sized enterprises (**‘SME owners’**) who are working on the action and who do not receive a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2 multiplied by the number of actual hours worked on the action.

**A.5 Costs of ‘beneficiaries that are natural persons’** not receiving a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2 multiplied by the number of actual hours worked on the action.

### **Calculation**

Personnel costs must be calculated by the beneficiaries as follows:

{ {hourly rate  
multiplied by  
the number of actual hours worked on the action},  
plus  
for non-profit legal entities: additional remuneration to personnel assigned to the action under the conditions set out above (Point A.1)}.

The number of actual hours declared for a person must be identifiable and verifiable (see Article 18).

The total number of hours declared in EU or Euratom grants, for a person for a year, cannot be higher than the annual productive hours used for the calculations of the hourly rate. Therefore, the maximum number of hours that can be declared for the grant is:

{the number of annual productive hours for the year (see below)  
minus  
total number of hours declared by the beneficiary for that person in that year for other EU or Euratom grants}.

The **‘hourly rate’** is one of the following:

(a) for personnel costs declared as **actual costs**: the hourly rate is the amount calculated as follows:

{actual annual personnel costs (excluding additional remuneration) for the person  
divided by  
number of annual productive hours}.

The beneficiaries must use the annual personnel costs and the number of annual productive hours for each financial year covered by the reporting period. If a financial year is not closed at the end of the reporting period, the beneficiaries must use the hourly rate of the last closed financial year available.

For the ‘number of annual productive hours’, the beneficiaries may choose one of the following:

(i) ‘fixed number of hours’: 1 720 hours for persons working full time (or corresponding pro-rata for persons not working full time);



- (ii) ‘individual annual productive hours’: the total number of hours worked by the person in the year for the beneficiary, calculated as follows:

{annual workable hours of the person (according to the employment contract, applicable collective labour agreement or national law)

plus

overtime worked

minus

absences (such as sick leave and special leave)}.

‘Annual workable hours’ means the period during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.

If the contract (or applicable collective labour agreement or national working time legislation) does not allow to determine the annual workable hours, this option cannot be used;

- (iii) ‘standard annual productive hours’: the ‘standard number of annual hours’ generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the ‘standard annual workable hours’.

If there is no applicable reference for the standard annual workable hours, this option cannot be used.

For all options, the actual time spent on **parental leave** by a person assigned to the action may be deducted from the number of annual productive hours;

- (b) for personnel costs declared on the basis of **unit costs**: the hourly rate is one of the following:

- (i) for SME owners or beneficiaries that are natural persons: the hourly rate set out in Annex 2 (see Points A.4 and A.5 above), or
- (ii) for personnel costs declared on the basis of the beneficiary’s usual cost accounting practices: the hourly rate calculated by the beneficiary in accordance with its usual cost accounting practices, if:
  - the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;
  - the hourly rate is calculated using the actual personnel costs recorded in the beneficiary’s accounts, excluding any ineligible cost or costs included in other budget categories.

The actual personnel costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating



the personnel costs, reasonable and correspond to objective and verifiable information;

and

- the hourly rate is calculated using the number of annual productive hours (see above).

**B. Direct costs of subcontracting** (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if the conditions in Article 13.1.1 are met.

**C. Direct costs of providing financial support to third parties** *not applicable*.

**D. Other direct costs**

**D.1 Travel costs and related subsistence allowances** (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if they are in line with the beneficiary's usual practices on travel.

**D.2 The depreciation costs of equipment, infrastructure or other assets** *(new or second-hand) as recorded in the beneficiary's accounts are eligible, if they were purchased in accordance with Article 10.1.1 and written off in accordance with international accounting standards and the beneficiary's usual accounting practices.*

*The costs of renting or leasing equipment, infrastructure or other assets (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are also eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets and do not include any financing fees.*

*The costs of equipment, infrastructure or other assets **contributed in-kind against payment** are eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets, do not include any financing fees and if the conditions in Article 11.1 are met.*

*The only portion of the costs that will be taken into account is that which corresponds to the duration of the action and rate of actual use for the purposes of the action.*

**D.3 Costs of other goods and services** (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible, if they are:

- (a) purchased specifically for the action and in accordance with Article 10.1.1 or
- (b) contributed in kind against payment and in accordance with Article 11.1.

Such goods and services include, for instance, consumables and supplies, dissemination (including open access), protection of results, certificates on the financial statements (if they are required by the Agreement), certificates on the methodology, translations and publications.



**D.4 Capitalised and operating costs of ‘large research infrastructure’<sup>3</sup> directly used for the action are eligible, if:**

- (a) *the value of the large research infrastructure represents at least 75% of the total fixed assets (at historical value in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure<sup>4</sup>);*
- (b) *the beneficiary’s methodology for declaring the costs for large research infrastructure has been positively assessed by the Commission (‘ex-ante assessment’);*
- (c) *the beneficiary declares as direct eligible costs only the portion which corresponds to the duration of the action and the rate of actual use for the purposes of the action, and*
- (d) *they comply with the conditions as further detailed in the annotations to the H2020 grant agreements.*

**E. Indirect costs**

**Indirect costs** are eligible if they are declared on the basis of the flat-rate of 25% of the eligible direct costs (see Article 5.2 and Points A to D above), from which are excluded:

- (a) costs of subcontracting and
- (b) costs of in-kind contributions provided by third parties which are not used on the beneficiary’s premises;
- (c) *not applicable;*
- (d) *not applicable.*

Beneficiaries receiving an operating grant<sup>5</sup> financed by the EU or Euratom budget cannot declare indirect costs for the period covered by the operating grant.

<sup>3</sup> ‘**Large research infrastructure**’ means research infrastructure of a total value of at least EUR 20 million, for a beneficiary, calculated as the sum of historical asset values of each individual research infrastructure of that beneficiary, as they appear in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure.

<sup>4</sup> For the definition, see Article 2(6) of Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) (OJ L 347, 20.12.2013 p.104) (‘**Horizon 2020 Framework Programme Regulation No 1291/2013**’): ‘**Research infrastructure**’ are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, e.g. for education or public services. They include: major scientific equipment (or sets of instruments); knowledge-based resources such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieve excellence in research and innovation. Such infrastructures may be ‘single-sited’, ‘virtual’ or ‘distributed’.

<sup>5</sup> For the definition, see Article 121(1)(b) of Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 218, 26.10.2012, p.1) (‘**Financial Regulation No 966/2012**’): ‘**operating grant**’ means direct financial contribution, by way of donation, from the budget in order to finance the functioning of a body which pursues an aim of general EU interest or has an objective forming part of and supporting an EU policy.



**F. Specific cost category(ies)**

*Not applicable*

**6.3 Conditions for costs of linked third parties to be eligible**

*not applicable*

**6.4 Conditions for in-kind contributions provided by third parties free of charge to be eligible**

**In-kind contributions provided free of charge** are eligible direct costs (for the beneficiary), if the costs incurred by the third party fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 12.1.

**6.5 Ineligible costs**

‘Ineligible costs’ are:

(a) costs that do not comply with the conditions set out above (Article 6.1 to 6.4), in particular:

- (i) costs related to return on capital;
- (ii) debt and debt service charges;
- (iii) provisions for future losses or debts;
- (iv) interest owed;
- (v) doubtful debts;
- (vi) currency exchange losses;
- (vii) bank costs charged by the beneficiary’s bank for transfers from the *Commission*;
- (viii) excessive or reckless expenditure;
- (ix) deductible VAT;
- (x) costs incurred during suspension of the implementation of the action (see Article 49);

(b) costs declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU or Euratom budget and grants awarded by bodies other than the *Commission* for the purpose of implementing the EU or Euratom budget); in particular, indirect costs if the beneficiary is already receiving an operating grant financed by the EU or Euratom budget in the same period.

**6.6 Consequences of declaration of ineligible costs**

Declared costs that are ineligible will be rejected (see Article 42).

This may also lead to any of the other measures described in Chapter 6.



## **CHAPTER 4 RIGHTS AND OBLIGATIONS OF THE PARTIES**

### **SECTION 1 RIGHTS AND OBLIGATIONS RELATED TO IMPLEMENTING THE ACTION**

#### **ARTICLE 7 — GENERAL OBLIGATION TO PROPERLY IMPLEMENT THE ACTION**

##### **7.1 General obligation to properly implement the action**

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement and all legal obligations under applicable EU, international and national law.

##### **7.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

#### **ARTICLE 8 — RESOURCES TO IMPLEMENT THE ACTION — THIRD PARTIES INVOLVED IN THE ACTION**

The beneficiaries must have the appropriate resources to implement the action.

If it is necessary to implement the action, the beneficiaries may:

- purchase goods, works and services (see Article 10);
- use in-kind contributions provided by third parties against payment (see Article 11);
- use in-kind contributions provided by third parties free of charge (see Article 12);
- call upon subcontractors to implement action tasks described in Annex 1 (see Article 13);
- call upon linked third parties to implement action tasks described in Annex 1 (see Article 14).

In these cases, the beneficiaries retain sole responsibility towards the *Commission* and the other beneficiaries for implementing the action.

#### **ARTICLE 9 — IMPLEMENTATION OF ACTION TASKS BY BENEFICIARIES NOT RECEIVING EU FUNDING**

*Not applicable*

#### **ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES**

##### **10.1 Rules for purchasing goods, works or services**

10.1.1 If necessary to implement the action, the beneficiaries may purchase goods, works or services.



The beneficiaries must make such purchases ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their contractors.

10.1.2 Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC<sup>6</sup> or ‘contracting entities’ within the meaning of Directive 2004/17/EC<sup>7</sup> must comply with the applicable national law on public procurement.

## **10.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under Article 10.1.1, the costs related to the contract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 10.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## **ARTICLE 11 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES AGAINST PAYMENT**

### **11.1 Rules for the use of in-kind contributions against payment**

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties against payment.

The beneficiaries may declare costs related to the payment of in-kind contributions as eligible (see Article 6.1 and 6.2), up to the third parties’ costs for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services.

The third parties and their contributions must be set out in Annex 1. The *Commission* may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

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<sup>6</sup> Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public work contracts, public supply contracts and public service contracts (OJ L 134, 30.04.2004, p. 114).

<sup>7</sup> Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (OJ L 134, 30.04.2004, p. 1).



## **11.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the costs related to the payment of the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

## **ARTICLE 12 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES FREE OF CHARGE**

### **12.1 Rules for the use of in-kind contributions free of charge**

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties free of charge.

The beneficiaries may declare costs incurred by the third parties for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services as eligible in accordance with Article 6.4.

The third parties and their contributions must be set out in Annex 1. The *Commission* may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

### **12.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the costs incurred by the third parties related to the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

## **ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS**

### **13.1 Rules for subcontracting action tasks**

13.1.1 If necessary to implement the action, the beneficiaries may award subcontracts covering the implementation of certain action tasks described in Annex 1.

Subcontracting may cover only a limited part of the action.

The beneficiaries must award the subcontracts ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The tasks to be implemented and the estimated cost for each subcontract must be set out in Annex 1 and the total estimated costs of subcontracting per beneficiary must be set out in Annex 2. The



*Commission* may however approve subcontracts not set out in Annex 1 and 2 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- they do not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their subcontractors.

13.1.2 The beneficiaries must ensure that their obligations under Articles 35, 36, 38 and 46 also apply to the subcontractors.

Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC or ‘contracting entities’ within the meaning of Directive 2004/17/EC must comply with the applicable national law on public procurement.

### **13.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under Article 13.1.1, the costs related to the subcontract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 13.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## **ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES**

*Not applicable*

## **ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES**

### **15.1 Rules for providing financial support to third parties**

*Not applicable*

### **15.2 Financial support in the form of prizes**

*Not applicable*

### **15.3 Consequences of non-compliance**

*Not applicable*



## **ARTICLE 16 — PROVISION OF TRANS-NATIONAL OR VIRTUAL ACCESS TO RESEARCH INFRASTRUCTURE**

### **16.1 Rules for providing trans-national access to research infrastructure**

*Not applicable*

### **16.2 Rules for providing virtual access to research infrastructure**

*Not applicable*

### **16.3 Consequences of non-compliance**

*Not applicable*

## **SECTION 2 RIGHTS AND OBLIGATIONS RELATED TO THE GRANT ADMINISTRATION**

## **ARTICLE 17 — GENERAL OBLIGATION TO INFORM**

### **17.1 General obligation to provide information upon request**

The beneficiaries must provide — during implementation of the action or afterwards and in accordance with Article 41.2 — any information requested in order to verify eligibility of the costs, proper implementation of the action and compliance with any other obligation under the Agreement.

### **17.2 Obligation to keep information up to date and to inform about events and circumstances likely to affect the Agreement**

Each beneficiary must keep information stored in the 'Beneficiary Register' (via the electronic exchange system; see Article 52) up to date, in particular, its name, address, legal representatives, legal form and organisation type.

Each beneficiary must immediately inform the coordinator — which must immediately inform the *Commission* and the other beneficiaries — of any of the following:

- (a) **events** which are likely to affect significantly or delay the implementation of the action or the EU's financial interests, in particular:
  - (i) changes in its legal, financial, technical, organisational or ownership situation
- (b) **circumstances** affecting:
  - (i) the decision to award the grant or
  - (ii) compliance with requirements under the Agreement.



### 17.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION

### 18.1 Obligation to keep records and other supporting documentation

The beneficiaries must — for a period of *five* years after the payment of the balance — keep records and other supporting documentation in order to prove the proper implementation of the action and the costs they declare as eligible.

They must make them available upon request (see Article 17) or in the context of checks, reviews, audits or investigations (see Article 22).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Articles 22), the beneficiaries must keep the records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The *Commission* may accept non-original documents if it considers that they offer a comparable level of assurance.

#### 18.1.1 Records and other supporting documentation on the scientific and technical implementation

The beneficiaries must keep records and other supporting documentation on scientific and technical implementation of the action in line with the accepted standards in the respective field.

#### 18.1.2 Records and other documentation to support the costs declared

The beneficiaries must keep the records and documentation supporting the costs declared, in particular the following:

- (a) for **actual costs**: adequate records and other supporting documentation to prove the costs declared, such as contracts, subcontracts, invoices and accounting records. In addition, the beneficiaries' usual cost accounting practices and internal control procedures must enable direct reconciliation between the amounts declared, the amounts recorded in their accounts and the amounts stated in the supporting documentation;
- (b) for **unit costs**: adequate records and other supporting documentation to prove the number of units declared. Beneficiaries do not need to identify the actual eligible costs covered or to keep or provide supporting documentation (such as accounting statements) to prove the amount per unit.

In addition, for **direct personnel costs declared as unit costs calculated in accordance with the beneficiary's usual cost accounting practices**, the beneficiaries must keep adequate



records and documentation to prove that the cost accounting practices used comply with the conditions set out in Article 6.2, Point A.

The beneficiaries may submit to the Commission, for approval, a certificate (drawn up in accordance with Annex 6) stating that their usual cost accounting practices comply with these conditions (**‘certificate on the methodology’**). If the certificate is approved, costs declared in line with this methodology will not be challenged subsequently, unless the beneficiaries have concealed information for the purpose of the approval.

- (c) for **flat-rate costs**: adequate records and other supporting documentation to prove the eligibility of the costs to which the flat-rate is applied. The beneficiaries do not need to identify the costs covered or provide supporting documentation (such as accounting statements) to prove the amount declared at a flat-rate.

In addition, for **personnel costs** (declared as actual costs or on the basis of unit costs), the beneficiaries must keep **time records** for the number of hours declared. The time records must be in writing and approved by the persons working on the action and their supervisors, at least monthly. In the absence of reliable time records of the hours worked on the action, the *Commission* may accept alternative evidence supporting the number of hours declared, if it considers that it offers an adequate level of assurance.

As an exception, for **persons working exclusively on the action**, there is no need to keep time records, if the beneficiary signs a **declaration** confirming that the persons concerned have worked exclusively on the action.

## 18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 42), and the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 19 — SUBMISSION OF DELIVERABLES

### 19.1 Obligation to submit deliverables

The coordinator must submit the **‘deliverables’** identified in Annex 1, in accordance with the timing and conditions set out in it.

### 19.2 Consequences of non-compliance

If the coordinator breaches any of its obligations under this Article, the *Commission* may apply any of the measures described in Chapter 6.





## ARTICLE 20 — REPORTING — PAYMENT REQUESTS

### 20.1 Obligation to submit reports

The coordinator must submit to the *Commission* (see Article 52) the technical and financial reports set out in this Article. These reports include requests for payment and must be drawn up using the forms and templates provided in the electronic exchange system (see Article 52).

### 20.2 Reporting periods

The action is divided into the following ‘**reporting periods**’:

- RP1: from month 1 to month 18
- RP2: *from month 19 to month 36*

### 20.3 Periodic reports — Requests for interim payments

The coordinator must submit a periodic report within 60 days following the end of each reporting period.

The **periodic report** must include the following:

(a) a ‘**periodic technical report**’ containing:

- (i) an **explanation of the work carried out** by the beneficiaries;
- (ii) an **overview of the progress** towards the objectives of the action, including milestones and deliverables identified in Annex 1.

This report must include explanations justifying the differences between work expected to be carried out in accordance with Annex 1 and that actually carried out.

The report must also detail the exploitation and dissemination of the results and — if required in Annex 1 — an updated ‘**plan for the exploitation and dissemination of the results**’;

- (iii) a **summary** for publication by the *Commission*;
- (iv) the answers to the ‘**questionnaire**’, covering issues related to the action implementation and the economic and societal impact, notably in the context of the Horizon 2020 key performance indicators and the Horizon 2020 monitoring requirements;

(b) a ‘**periodic financial report**’ containing:

- (i) an ‘**individual financial statement**’ (see Annex 4) from each beneficiary, for the reporting period concerned.

The individual financial statement must detail the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) for each budget category (see Annex 2).

The beneficiaries must declare all eligible costs, even if — for actual costs, unit costs and flat-rate costs — they exceed the amounts indicated in the estimated budget (see Annex 2).



Amounts which are not declared in the individual financial statement will not be taken into account by the *Commission*.

If an individual financial statement is not submitted for a reporting period, it may be included in the periodic financial report for the next reporting period.

The individual financial statements of the last reporting period must also detail the **receipts of the action** (see Article 5.3.3).

Each beneficiary must **certify** that:

- the information provided is full, reliable and true;
  - the costs declared are eligible (see Article 6);
  - the costs can be substantiated by adequate records and supporting documentation (see Article 18) that will be produced upon request (see Article 17) or in the context of checks, reviews, audits and investigations (see Article 22), and
  - for the last reporting period: that all the receipts have been declared (see Article 5.3.3);
- (ii) an **explanation of the use of resources** and the information on subcontracting (see Article 13) and in-kind contributions provided by third parties (see Articles 11 and 12) from each beneficiary, for the reporting period concerned;
- (iii) *not applicable*;
- (iv) a '**periodic summary financial statement**' (see Annex 4), created automatically by the electronic exchange system, consolidating the individual financial statements for the reporting period concerned and including — except for the last reporting period — the **request for interim payment**.

#### 20.4 Final report — Request for payment of the balance

In addition to the periodic report for the last reporting period, the coordinator must submit the final report within 60 days following the end of the last reporting period.

The **final report** must include the following:

- (a) a '**final technical report**' with a **summary** for publication containing:
- (i) an overview of the results and their exploitation and dissemination;
  - (ii) the conclusions on the action, and
  - (iii) the socio-economic impact of the action;
- (b) a '**final financial report**' containing:



- (i) a ‘**final summary financial statement**’ (see Annex 4), created automatically by the electronic exchange system, consolidating the individual financial statements for all reporting periods and including the **request for payment of the balance** and
- (ii) a ‘**certificate on the financial statements**’ (drawn up in accordance with Annex 5) for each beneficiary, if it requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 5.2 and Article 6.2, Point A).

## 20.5 Information on cumulative expenditure incurred

*Not applicable*

## 20.6 Currency for financial statements and conversion into euro

Financial statements must be drafted in euro.

Beneficiaries with accounting established in a currency other than the euro must convert the costs recorded in their accounts into euro, at the average of the daily exchange rates published in the C series of the *Official Journal of the European Union*, calculated over the corresponding reporting period.

If no daily euro exchange rate is published in the *Official Journal of the European Union* for the currency in question, they must be converted at the average of the monthly accounting rates published on the Commission’s website, calculated over the corresponding reporting period.

Beneficiaries with accounting established in euro must convert costs incurred in another currency into euro according to their usual accounting practices.

## 20.7 Language of reports

All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

## 20.8 Consequences of non-compliance — Suspension of the payment deadline — Termination

If the reports submitted do not comply with this Article, the *Commission* may suspend the payment deadline (see Article 47) and apply any of the other measures described in Chapter 6.

If the coordinator breaches its obligation to submit the reports and if it fails to comply with this obligation within 30 days following a written reminder sent by the *Commission*, the Agreement may be terminated (see Article 50).

# ARTICLE 21 — PAYMENTS AND PAYMENT ARRANGEMENTS

## 21.1 Payments to be made

The following payments will be made to the coordinator:

- one **pre-financing payment**;



- one or more **interim payments**, on the basis of the request(s) for interim payment (see Article 20), and
- one **payment of the balance**, on the basis of the request for payment of the balance (see Article 20).

## 21.2 Pre-financing payment — Amount — Amount retained for the Guarantee Fund

The aim of the pre-financing is to provide the beneficiaries with a float.

It remains the property of the *EU* until the payment of the balance.

The amount of the pre-financing payment will be EUR **6,206,864.00** (six million two hundred and six thousand eight hundred and sixty four EURO).

The *Commission* will — except if Article 48 applies — make the pre-financing payment to the coordinator within 30 days either from the entry into force of the Agreement (see Article 58) or from 10 days before the starting date of the action (see Article 3), whichever is the latest.

An amount of EUR **387,929.00** (three hundred and eighty seven thousand nine hundred and twenty nine EURO), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the *Commission* from the pre-financing payment and transferred into the '**Guarantee Fund**'.

## 21.3 Interim payments — Amount — Calculation

Interim payments reimburse the eligible costs incurred for the implementation of the action during the corresponding reporting periods.

The *Commission* will pay to the coordinator the amount due as interim payment within 90 days from receiving the periodic report (see Article 20.3), except if Articles 47 or 48 apply.

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as interim payment** is calculated by the *Commission* in the following steps:

Step 1 – Application of the reimbursement rates

Step 2 – Limit to 90% of the maximum grant amount

### 21.3.1 Step 1 — Application of the reimbursement rates

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs ; see Article 6) declared by the beneficiaries (see Article 20) and approved by the *Commission* (see above) for the concerned reporting period.

### 21.3.2 Step 2 — Limit to 90% of the maximum grant amount

The total amount of pre-financing and interim payments must not exceed 90% of the maximum grant amount set out in Article 5.1. The maximum amount for the interim payment will be calculated as follows:



{90% of the maximum grant amount (see Article 5.1)}

minus

{pre-financing and previous interim payments}}.

## **21.4 Payment of the balance — Amount — Calculation — Release of the amount retained for the Guarantee Fund**

The payment of the balance reimburses the remaining part of the eligible costs incurred by the beneficiaries for the implementation of the action.

If the total amount of earlier payments is greater than the final grant amount (see Article 5.3), the payment of the balance takes the form of a recovery (see Article 44).

If the total amount of earlier payments is lower than the final grant amount, the *Commission* will pay the balance within 90 days from receiving the final report (see Article 20.4), except if Articles 47 or 48 apply.

Payment is subject to the approval of the final report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as the balance** is calculated by the *Commission* by deducting the total amount of pre-financing and interim payments (if any) already made, from the final grant amount determined in accordance with Article 5.3:

{final grant amount (see Article 5.3)}

minus

{pre-financing and interim payments (if any) made}}.

At the payment of the balance, the amount retained for the Guarantee Fund (see above) will be released and:

- if the balance is positive: the amount released will be paid in full to the coordinator together with the amount due as the balance;
- if the balance is negative (payment of the balance taking the form of recovery): it will be deducted from the amount released (see Article 44.1.2). If the resulting amount:
  - is positive, it will be paid to the coordinator
  - is negative, it will be recovered.

The amount to be paid may however be offset — without the beneficiary's consent — against any other amount owed by the beneficiary to the Commission or an executive agency (under the EU or Euratom budget), up to the maximum EU contribution indicated, for that beneficiary, in the estimated budget (see Annex 2).



### **21.5 Notification of amounts due**

When making payments, the *Commission* will formally notify to the coordinator the amount due, specifying whether it concerns an interim payment or the payment of the balance.

For the payment of the balance, the notification will also specify the final grant amount.

In the case of reduction of the grant or recovery of undue amounts, the notification will be preceded by the contradictory procedure set out in Articles 43 and 44.

### **21.6 Currency for payments**

The *Commission* will make all payments in euro.

### **21.7 Payments to the coordinator — Distribution to the beneficiaries**

Payments will be made to the coordinator.

Payments to the coordinator will discharge the *Commission* from its payment obligation.

The coordinator must distribute the payments between the beneficiaries without unjustified delay.

Pre-financing may however be distributed only:

- (a) if the minimum number of beneficiaries set out in the call for proposals has acceded to the Agreement (see Article 56) and
- (b) to beneficiaries that have acceded to the Agreement (see Article 56).

### **21.8 Bank account for payments**

All payments will be made to the following bank account:

Name of bank: LLOYDS BANK PLC

Address of branch: FOUNTAIN SQUARE STOKE-ON-TRENT, United Kingdom

Full name of the account holder: INFORMATION CATALYST FOR ENTERPRISE LTD

Full account number (including bank codes):

IBAN code: GB26LOYD30938386536038

### **21.9 Costs of payment transfers**

The cost of the payment transfers is borne as follows:

- the *Commission* bears the cost of transfers charged by its bank;
- the beneficiary bears the cost of transfers charged by its bank;
- the party causing a repetition of a transfer bears all costs of the repeated transfer.

### **21.10 Date of payment**

Payments by the *Commission* are considered to have been carried out on the date when they are debited to its account.



## 21.11 Consequences of non-compliance

21.11.1 If the *Commission* does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus three and a half points. The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only upon request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

Suspension of the payment deadline or payments (see Articles 47 and 48) will not be considered as late payment.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

21.11.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or the participation of the coordinator may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 22 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

### 22.1 Checks, reviews and audits by the Commission

#### 22.1.1 Right to carry out checks

The Commission will — during the implementation of the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing deliverables and reports.

For this purpose the Commission may be assisted by external persons or bodies.

The Commission may also request additional information in accordance with Article 17. The Commission may request beneficiaries to provide such information to it directly.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

#### 22.1.2 Right to carry out reviews

The Commission may — during the implementation of the action or afterwards — carry out reviews on the proper implementation of the action (including assessment of deliverables and reports),

compliance with the obligations under the Agreement and continued scientific or technological relevance of the action.

Reviews may be started **up to two years after the payment of the balance**. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the review is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Commission may carry out reviews directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted (including information on the use of resources). The Commission may request beneficiaries to provide such information to it directly.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with external experts.

For **on-the-spot** reviews, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a '**review report**' will be drawn up.

The Commission will formally notify the review report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory review procedure**').

Reviews (including review reports) are in the language of the Agreement.

### **22.1.3 Right to carry out audits**

The Commission may — during the implementation of the action or afterwards — carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Audits may be started **up to two years after the payment of the balance**. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the audit is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Commission may carry out audits directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the





identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. The Commission may request beneficiaries to provide such information to it directly.

For **on-the-spot** audits, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a '**draft audit report**' will be drawn up.

The Commission will formally notify the draft audit report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory audit procedure**'). This period may be extended by the Commission in justified cases.

The '**final audit report**' will take into account observations by the coordinator or beneficiary concerned. The report will be formally notified to it.

Audits (including audit reports) are in the language of the Agreement.

The Commission may also access the beneficiaries' statutory records for the periodical assessment of unit costs or flat-rate amounts.

## 22.2 Investigations by the European Anti-Fraud Office (OLAF)

Under Regulations No 883/2013<sup>15</sup> and No 2185/96<sup>16</sup> (and in accordance with their provisions and procedures), the European Anti-Fraud Office (OLAF) may — at any moment during implementation of the action or afterwards — carry out investigations, including on-the-spot checks and inspections, to establish whether there has been fraud, corruption or any other illegal activity affecting the financial interests of the EU.

## 22.3 Checks and audits by the European Court of Auditors (ECA)

Under Article 287 of the Treaty on the Functioning of the European Union (TFEU) and Article 161 of the Financial Regulation No 966/2012<sup>17</sup>, the European Court of Auditors (ECA) may — at any moment during implementation of the action or afterwards — carry out audits.

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<sup>15</sup> Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18.09.2013, p. 1).

<sup>16</sup> Council Regulation (Euratom, EC) No 2185/1996 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15.11.1996, p. 2).

<sup>17</sup> Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 298, 26.10.2012, p. 1).



The ECA has the right of access for the purpose of checks and audits.

## 22.4 Checks, reviews, audits and investigations for international organisations

*Not applicable*

## 22.5 Consequences of findings in checks, reviews, audits and investigations — Extension of findings

### 22.5.1 Findings in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to the rejection of ineligible costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44) or to any of the other measures described in Chapter 6.

Rejection of costs or reduction of the grant after the payment of the balance will lead to a revised final grant amount (see Article 5.4).

Findings in checks, reviews, audits or investigations may lead to a request for amendment for the modification of Annex 1 (see Article 55).

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations may also lead to consequences in other EU or Euratom grants awarded under similar conditions (**‘extension of findings from this grant to other grants’**).

Moreover, findings arising from an OLAF investigation may lead to criminal prosecution under national law.

### 22.5.2 Findings in other grants

The Commission may extend findings from other grants to this grant (**‘extension of findings from other grants to this grant’**), if:

- (a) the beneficiary concerned is found, in other EU or Euratom grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and
- (b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — no later than two years after the payment of the balance of this grant.

The extension of findings may lead to the rejection of costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44), suspension of payments (see Article 48), suspension of the action implementation (see Article 49) or termination (see Article 50).

### 22.5.3 Procedure

The Commission will formally notify the beneficiary concerned the systemic or recurrent errors and its intention to extend these audit findings, together with the list of grants affected.

22.5.3.1 If the findings concern **eligibility of costs**: the formal notification will include:



- (a) an invitation to submit observations on the list of grants affected by the findings;
- (b) the request to submit **revised financial statements** for all grants affected;
- (c) the **correction rate for extrapolation** established by the Commission on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected if the beneficiary concerned:
  - (i) considers that the submission of revised financial statements is not possible or practicable or
  - (ii) does not submit revised financial statements.

The beneficiary concerned has 90 days from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method**. This period may be extended by the Commission in justified cases.

The amounts to be rejected will be determined on the basis of the revised financial statements, subject to their approval.

If the Commission does not receive any observations or revised financial statements, does not accept the observations or the proposed alternative correction method or does not approve the revised financial statements, it will formally notify the beneficiary concerned the application of the initially notified correction rate for extrapolation.

If the Commission accepts the alternative correction method proposed by the beneficiary concerned, it will formally notify the application of the accepted alternative correction method.

22.5.3.2 If the findings concern **improper implementation** or a **breach of another obligation**: the formal notification will include:

- (a) an invitation to submit observations on the list of grants affected by the findings and
- (b) the flat-rate the Commission intends to apply according to the principle of proportionality.

The beneficiary concerned has 90 days from receiving notification to submit observations or to propose a duly substantiated alternative flat-rate.

If the Commission does not receive any observations or does not accept the observations or the proposed alternative flat-rate, it will formally notify the beneficiary concerned the application of the initially notified flat-rate.

If the Commission accepts the alternative flat-rate proposed by the beneficiary concerned, it will formally notify the application of the accepted alternative flat-rate.

## 22.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, any insufficiently substantiated costs will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.



## **ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION**

### **23.1 Right to evaluate the impact of the action**

The Commission may carry out interim and final evaluations of the impact of the action measured against the objective of the *EU* programme.

Evaluations may be started during implementation of the action and up to *five* years after the payment of the balance. The evaluation is considered to start on the date of the formal notification to the coordinator or beneficiaries.

The Commission may make these evaluations directly (using its own staff) or indirectly (using external bodies or persons it has authorised to do so).

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

### **23.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the *Commission* may apply the measures described in Chapter 6.

## **SECTION 3 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND AND RESULTS**

### **SUBSECTION 1 GENERAL**

#### **ARTICLE 23a — MANAGEMENT OF INTELLECTUAL PROPERTY**

##### **23a.1 Obligation to take measures to implement the Commission Recommendation on the management of intellectual property in knowledge transfer activities**

Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities<sup>18</sup>.

This does not change the obligations set out in Subsections 2 and 3 of this Section.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

##### **23a.2 Consequences of non-compliance**

If a beneficiary breaches its obligations under this Article, the *Commission* may apply any of the measures described in Chapter 6.

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<sup>18</sup> Commission Recommendation C (2008) 1329 of 10.4.2008 on the management of intellectual property in knowledge transfer activities and the Code of Practice for universities and other public research institutions attached to this recommendation.



## **SUBSECTION 2 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND**

### **ARTICLE 24 — AGREEMENT ON BACKGROUND**

#### **24.1 Agreement on background**

The beneficiaries must identify and agree (in writing) on the background for the action (**‘agreement on background’**).

**‘Background’** means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that:

- (a) is held by the beneficiaries before they acceded to the Agreement, and
- (b) is needed to implement the action or exploit the results.

#### **24.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

### **ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND**

#### **25.1 Exercise of access rights — Waiving of access rights — No sub-licensing**

To exercise access rights, this must first be requested in writing (**‘request for access’**).

**‘Access rights’** means rights to use results or background under the terms and conditions laid down in this Agreement.

Waivers of access rights are not valid unless in writing.

Unless agreed otherwise, access rights do not include the right to sub-license.

#### **25.2 Access rights for other beneficiaries, for implementing their own tasks under the action**

The beneficiaries must give each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

- (a) informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel), or
- (b) agreed with the other beneficiaries that access would not be on a royalty-free basis.

#### **25.3 Access rights for other beneficiaries, for exploiting their own results**

The beneficiaries must give each other access — under fair and reasonable conditions — to background needed for exploiting their own results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its



background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel).

‘**Fair and reasonable conditions**’ means appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

#### 25.4 Access rights for affiliated entities

Unless otherwise agreed in the consortium agreement, access to background must also be given — under fair and reasonable conditions (see above; Article 25.3) and unless it is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel) — to affiliated entities<sup>19</sup> established in an EU Member State or ‘**associated country**’<sup>20</sup>, if this is needed to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 25.1), the affiliated entity concerned must make the request directly to the beneficiary that holds the background.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

#### 25.5 Access rights for third parties

*Not applicable*

#### 25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

<sup>19</sup> For the definition, see Article 2.1(2) of the Rules for Participation Regulation No 1290/2013: ‘**affiliated entity**’ means any legal entity that is under the direct or indirect control of a participant, or under the same direct or indirect control as the participant, or that is directly or indirectly controlling a participant.

‘Control’ may take any of the following forms:

- (a) the direct or indirect holding of more than 50% of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;
- (b) the direct or indirect holding, in fact or in law, of decision-making powers in the legal entity concerned.

However the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:

- (a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50% of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;
- (b) the legal entities concerned are owned or supervised by the same public body.

<sup>20</sup> For the definition, see Article 2.1(3) of the Rules for Participation Regulation No 1290/2013: ‘**associated country**’ means a third country which is party to an international agreement with the Union, as identified in *Article 7 of Horizon 2020 Framework Programme Regulation No 1291/2013. Article 7 sets out the conditions for association of non-EU countries to Horizon 2020.*



## SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS

### ARTICLE 26 — OWNERSHIP OF RESULTS

#### 26.1 Ownership by the beneficiary that generates the results

Results are owned by the beneficiary that generates them.

‘**Results**’ means any (tangible or intangible) output of the action such as data, knowledge or information — whatever its form or nature, whether it can be protected or not — that is generated in the action, as well as any rights attached to it, including intellectual property rights.

#### 26.2 Joint ownership by several beneficiaries

Two or more beneficiaries own results jointly if:

- (a) they have jointly generated them and
- (b) it is not possible to:
  - (i) establish the respective contribution of each beneficiary, or
  - (ii) separate them for the purpose of applying for, obtaining or maintaining their protection (see Article 27).

The joint owners must agree (in writing) on the allocation and terms of exercise of their joint ownership (**‘joint ownership agreement’**), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement, each joint owner may grant non-exclusive licences to third parties to exploit jointly-owned results (without any right to sub-license), if the other joint owners are given:

- (a) at least 45 days advance notice and
- (b) fair and reasonable compensation.

Once the results have been generated, joint owners may agree (in writing) to apply another regime than joint ownership (such as, for instance, transfer to a single owner (see Article 30) with access rights for the others).

#### 26.3 Rights of third parties (including personnel)

If third parties (including personnel) may claim rights to the results, the beneficiary concerned must ensure that it complies with its obligations under the Agreement.

If a third party generates results, the beneficiary concerned must obtain all necessary rights (transfer, licences or other) from the third party, in order to be able to respect its obligations as if those results were generated by the beneficiary itself.

If obtaining the rights is impossible, the beneficiary must refrain from using the third party to generate the results.





## 26.4 *EU* ownership, to protect results

26.4.1 *The EU* may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to disseminate its results without protecting them, except in any of the following cases:

- (a) the lack of protection is because protecting the results is not possible, reasonable or justified (given the circumstances);
- (b) the lack of protection is because there is a lack of potential for commercial or industrial exploitation, or
- (c) the beneficiary intends to transfer the results to another beneficiary or third party established in an EU Member State or associated country, which will protect them.

Before the results are disseminated and unless any of the cases above under Points (a), (b) or (c) applies, the beneficiary must formally notify the *Commission* and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the *Commission* decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

No dissemination relating to these results may before the end of this period or, if the *Commission* takes a positive decision, until it has taken the necessary steps to protect the results.

26.4.2 *The EU* may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to stop protecting them or not to seek an extension of protection, except in any of the following cases:

- (a) the protection is stopped because of a lack of potential for commercial or industrial exploitation;
- (b) an extension would not be justified given the circumstances.

A beneficiary that intends to stop protecting results or not seek an extension must — unless any of the cases above under Points (a) or (b) applies — formally notify the *Commission* at least 60 days before the protection lapses or its extension is no longer possible and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the *Commission* decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

## 26.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to the any of the other measures described in Chapter 6.





## ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING

### 27.1 Obligation to protect the results

Each beneficiary must examine the possibility of protecting its results and must adequately protect them — for an appropriate period and with appropriate territorial coverage — if:

- (a) the results can reasonably be expected to be commercially or industrially exploited and
- (b) protecting them is possible, reasonable and justified (given the circumstances).

When deciding on protection, the beneficiary must consider its own legitimate interests and the legitimate interests (especially commercial) of the other beneficiaries.

### 27.2 EU ownership, to protect the results

If a beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, *the EU* may — under certain conditions (see Article 26.4) — assume ownership to ensure their (continued) protection.

### 27.3 Information on EU funding

Applications for protection of results (including patent applications) filed by or on behalf of a beneficiary must — unless the *Commission* requests or agrees otherwise or unless it is impossible — include the following:

*“The project leading to this application has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723710”.*

### 27.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

## ARTICLE 28 — EXPLOITATION OF RESULTS

### 28.1 Obligation to exploit the results

Each beneficiary must — up to four years after the period set out in Article 3 — take measures aiming to ensure ‘**exploitation**’ of its results (either directly or indirectly, in particular through transfer or licensing; see Article 30) by:

- (a) using them in further research activities (outside the action);
- (b) developing, creating or marketing a product or process;
- (c) creating and providing a service, or
- (d) using them in standardisation activities.



This does not change the security obligations in Article 37, which still apply.

## **28.2 Results that could contribute to European or international standards — Information on EU funding**

If results are incorporated in a standard, the beneficiary concerned must — unless the *Commission* requests or agrees otherwise or unless it is impossible — ask the standardisation body to include the following statement in (information related to) the standard:

*“Results incorporated in this standard received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723710”.*

## **28.3 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced in accordance with Article 43.

Such a breach may also lead to any of the other measures described in Chapter 6.

# **ARTICLE 29 — DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING**

## **29.1 Obligation to disseminate results**

Unless it goes against their legitimate interests, each beneficiary must — as soon as possible — ‘**disseminate**’ its results by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in scientific publications (in any medium).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of — unless agreed otherwise — at least 45 days, together with sufficient information on the results it will disseminate.

Any other beneficiary may object within — unless agreed otherwise — 30 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests.

If a beneficiary intends not to protect its results, it may — under certain conditions (see Article 26.4.1) — need to formally notify the *Commission* before dissemination takes place.

## **29.2 Open access to scientific publications**

Each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results.

In particular, it must:



- (a) as soon as possible and at the latest on publication, deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications;

Moreover, the beneficiary must aim to deposit at the same time the research data needed to validate the results presented in the deposited scientific publications.

- (b) ensure open access to the deposited publication — via the repository — at the latest:
- (i) on publication, if an electronic version is available for free via the publisher, or
  - (ii) within six months of publication (twelve months for publications in the social sciences and humanities) in any other case.
- (c) ensure open access — via the repository — to the bibliographic metadata that identify the deposited publication.

The bibliographic metadata must be in a standard format and must include all of the following:

- the terms “*European Union (EU)*” and “*Horizon 2020*”;
- the name of the action, acronym and grant number;
- the publication date, and length of embargo period if applicable, and
- a persistent identifier.

### 29.3 Open access to research data

*Not applicable*

### 29.4 Information on EU funding — Obligation and right to use the EU emblem

Unless the *Commission* requests or agrees otherwise or unless it is impossible, any dissemination of results (in any form, including electronic) must:

- (a) display the EU emblem and
- (b) include the following text:

*“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723710”.*

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the *Commission*.

This does not however give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.



## **29.5 Disclaimer excluding *Commission* responsibility**

Any dissemination of results must indicate that it reflects only the author's view and that the *Commission* is not responsible for any use that may be made of the information it contains.

## **29.6 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

# **ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS**

## **30.1 Transfer of ownership**

Each beneficiary may transfer ownership of its results.

It must however ensure that its obligations under Articles 26.2, 26.4, 27, 28, 29, 30 and 31 also apply to the new owner and that this owner has the obligation to pass them on in any subsequent transfer.

This does not change the security obligations in Article 37, which still apply.

Unless agreed otherwise (in writing) for specifically-identified third parties or unless impossible under applicable EU and national laws on mergers and acquisitions, a beneficiary that intends to transfer ownership of results must give at least 45 days advance notice (or less if agreed in writing) to the other beneficiaries that still have (or still may request) access rights to the results. This notification must include sufficient information on the new owner to enable any beneficiary concerned to assess the effects on its access rights.

Unless agreed otherwise (in writing) for specifically-identified third parties, any other beneficiary may object within 30 days of receiving notification (or less if agreed in writing), if it can show that the transfer would adversely affect its access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

## **30.2 Granting licenses**

Each beneficiary may grant licences to its results (or otherwise give the right to exploit them), if:

- (a) this does not impede the rights under Article 31 and
- (b) *not applicable*.

In addition to Points (a) and (b), exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights (see Article 31.1).

This does not change the dissemination obligations in Article 29 or security obligations in Article 37, which still apply.

## **30.3 *Commission* right to object to transfers or licensing**

*Not applicable*



### **30.4 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

## **ARTICLE 31 — ACCESS RIGHTS TO RESULTS**

### **31.1 Exercise of access rights — Waiving of access rights — No sub-licensing**

The conditions set out in Article 25.1 apply.

The obligations set out in this Article do not change the security obligations in Article 37, which still apply.

### **31.2 Access rights for other beneficiaries, for implementing their own tasks under the action**

The beneficiaries must give each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

### **31.3 Access rights for other beneficiaries, for exploiting their own results**

The beneficiaries must give each other — under fair and reasonable conditions (see Article 25.3) — access to results needed for exploiting their own results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

### **31.4 Access rights of affiliated entities**

Unless agreed otherwise in the consortium agreement, access to results must also be given — under fair and reasonable conditions (Article 25.3) — to affiliated entities established in an EU Member State or associated country, if this is needed for those entities to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 31.1), the affiliated entity concerned must make any such request directly to the beneficiary that owns the results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

### **31.5 Access rights for the EU institutions, bodies, offices or agencies and EU Member States**

*The beneficiaries must give access to their results — on a royalty-free basis — to EU institutions, bodies, offices or agencies, for developing, implementing or monitoring EU policies or programmes.*

*Such access rights are limited to non-commercial and non-competitive use.*

*This does not change the right to use any material, document or information received from the beneficiaries for communication and publicising activities (see Article 38.2).*



### **31.6 Access rights for third parties**

*Not applicable*

### **31.7 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## **SECTION 4 OTHER RIGHTS AND OBLIGATIONS**

### **ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RESEARCHERS**

#### **32.1 Obligation to take measures to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers**

The beneficiaries must take all measures to implement the principles set out in the Commission Recommendation on the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers<sup>22</sup>, in particular regarding:

- working conditions;
- transparent recruitment processes based on merit, and
- career development.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

#### **32.2 Consequences of non-compliance**

If a beneficiary breaches its obligations under this Article, the *Commission* may apply any of the measures described in Chapter 6.

### **ARTICLE 33 — GENDER EQUALITY**

#### **33.1 Obligation to aim for gender equality**

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

#### **33.2 Consequences of non-compliance**

If a beneficiary breaches its obligations under this Article, the *Commission* may apply any of the measures described in Chapter 6.

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<sup>22</sup> Commission Recommendation 2005/251/EC of 11 March 2005 on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers (OJ L 75, 22.3.2005, p. 67).



## ARTICLE 34 — ETHICS

### 34.1 Obligation to comply with ethical principles

The beneficiaries must carry out the action in compliance with:

- (a) ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity<sup>23</sup> — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct) and
- (b) applicable international, EU and national law.

Funding will not be granted for activities carried out outside the EU if they are prohibited in all Member States.

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

- (a) aim at human cloning for reproductive purposes;
- (b) intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or
- (c) intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.

### 34.2 Activities raising ethical issues

Activities raising ethical issues must comply with the ‘**ethics requirements**’ set out in Annex 1.

Before the beginning of an activity raising an ethical issue, the coordinator must submit (see Article 52) to the *Commission* copy of:

- (a) any ethics committee opinion required under national law and
- (b) any notification or authorisation for activities raising ethical issues required under national law.

If these documents are not in English, the coordinator must also submit an English summary of the submitted opinions, notifications and authorisations (containing, if available, the conclusions of the committee or authority concerned).

If these documents are specifically requested for the action, the request must contain an explicit reference to the action title. The coordinator must submit a declaration by each beneficiary concerned that all the submitted documents cover the action tasks.

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<sup>23</sup> The European Code of Conduct for Research Integrity of ALLEA (All European Academies) and ESF (European Science Foundation) of March 2011.

[http://www.esf.org/fileadmin/Public\\_documents/Publications/Code\\_Conduct\\_ResearchIntegrity.pdf](http://www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf)



### 34.3 Activities involving human embryos or human embryonic stem cells

Activities involving research on human embryos or human embryonic stem cells may be carried out only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the *Commission* (see Article 52).

### 34.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 35 — CONFLICT OF INTERESTS

### 35.1 Obligation to avoid a conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the action is compromised for reasons involving economic interest, political or national affinity, family or emotional ties or any other shared interest (**‘conflict of interests’**).

They must formally notify to the *Commission* without delay any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The *Commission* may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

### 35.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 36 — CONFIDENTIALITY

### 36.1 General obligation to maintain confidentiality

During implementation of the action and for four years after the period set out in Article 3, the parties must keep confidential any data, documents or other material (in any form) that is identified as confidential at the time it is disclosed (**‘confidential information’**).

If a beneficiary requests, the *Commission* may agree to keep such information confidential for an additional period beyond the initial four years.

If information has been identified as confidential only orally, it will be considered to be confidential only if this is confirmed in writing within 15 days of the oral disclosure.





Unless otherwise agreed between the parties, they may use confidential information only to implement the Agreement.

The beneficiaries may disclose confidential information to their personnel or third parties involved in the action only if they:

- (a) need to know to implement the Agreement and
- (b) are bound by an obligation of confidentiality.

This does not change the security obligations in Article 37, which still apply.

The *Commission* may disclose confidential information to its staff, other EU institutions and bodies or third parties, if:

- (a) this is necessary to implement the Agreement or safeguard the EU's financial interests and
- (b) the recipients of the information are bound by an obligation of confidentiality.

Under the conditions set out in Article 4 of the Rules for Participation Regulation No 1290/2013<sup>24</sup>, the Commission must moreover make available information on the results to other EU institutions, bodies, offices or agencies as well as Member States or associated countries.

The confidentiality obligations no longer apply if:

- (a) the disclosing party agrees to release the other party;
- (b) the information was already known by the recipient or is given to him without obligation of confidentiality by a third party that was not bound by any obligation of confidentiality;
- (c) the recipient proves that the information was developed without the use of confidential information;
- (d) the information becomes generally and publicly available, without breaching any confidentiality obligation, or
- (e) the disclosure of the information is required by EU or national law.

### **36.2 Consequences of non-compliance**

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

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<sup>24</sup> Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" (OJ L 347, 20.12.2013 p.81).

**ARTICLE 37 — SECURITY-RELATED OBLIGATIONS****37.1 Results with a security recommendation**

*Not applicable*

**37.2 Classified results**

*Not applicable*

**37.3 Activities involving dual-use goods or dangerous materials and substances**

*Not applicable*

**37.4 Consequences of non-compliance**

*Not applicable*

**ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING****38.1 Communication activities by beneficiaries****38.1.1 Obligation to promote the action and its results**

The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.

This does not change the dissemination obligations in Article 29, the confidentiality obligations in Article 36 or the security obligations in Article 37, all of which still apply.

Before engaging in a communication activity expected to have a major media impact, the beneficiaries must inform the *Commission* (see Article 52).

**38.1.2 Information on EU funding — Obligation and right to use the EU emblem**

Unless the *Commission* requests or agrees otherwise or unless it is impossible, any communication activity related to the action (including in electronic form, via social media, etc.) and any infrastructure, equipment and major results funded by the grant must:

- (a) display the EU emblem and
- (b) include the following text:

For communication activities: *“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723710”.*

For infrastructure, equipment and major results: *“This [infrastructure][equipment][insert type of result] is part of a project that has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723710”.*

When displayed together with another logo, the EU emblem must have appropriate prominence.



For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the *Commission*.

This does not, however, give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

### **38.1.3 Disclaimer excluding *Commission* responsibility**

Any communication activity related to the action must indicate that it reflects only the author's view and that the *Commission* is not responsible for any use that may be made of the information it contains.

## **38.2 Communication activities by the *Commission***

### **38.2.1 Right to use beneficiaries' materials, documents or information**

The *Commission* may use, for its communication and publicising activities, information relating to the action, documents notably summaries for publication and public deliverables as well as any other material, such as pictures or audio-visual material that it receives from any beneficiary (including in electronic form).

This does not change the confidentiality obligations in Article 36 and the security obligations in Article 37, all of which still apply.

However, if the *Commission's* use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the *Commission* not to use it (see Article 52).

The right to use a beneficiary's materials, documents and information includes:

- (a) **use for its own purposes** (in particular, making them available to persons working for the *Commission* or any other EU institution, body, office or agency or body or institutions in EU Member States; and copying or reproducing them in whole or in part, in unlimited numbers);
- (b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes);
- (c) **editing or redrafting** for communication and publicising activities (including shortening, summarising, inserting other elements (such as meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation);
- (d) **translation**;
- (e) giving **access in response to individual requests** under Regulation No 1049/2001<sup>25</sup>, without the right to reproduce or exploit;

<sup>25</sup> Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents, OJ L 145, 31.5.2001, p. 43.



- (f) **storage** in paper, electronic or other form;
- (g) **archiving**, in line with applicable document-management rules, and
- (h) the right to authorise **third parties** to act on its behalf or sub-license the modes of use set out in Points (b),(c),(d) and (f) to third parties if needed for the communication and publicising activities of the *Commission*.

If the right of use is subject to rights of a third party (including personnel of the beneficiary), the beneficiary must ensure that it complies with its obligations under this Agreement (in particular, by obtaining the necessary approval from the third parties concerned).

Where applicable (and if provided by the beneficiaries), the *Commission* will insert the following information:

“© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the *European Union (EU)* under conditions.”

### 38.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

## ARTICLE 39 — PROCESSING OF PERSONAL DATA

### 39.1 Processing of personal data by the Commission

Any personal data under the Agreement will be processed by the Commission under Regulation No 45/2001<sup>26</sup> and according to the ‘notifications of the processing operations’ to the Data Protection Officer (DPO) of the Commission (publicly accessible in the DPO register).

Such data will be processed by the ‘**data controller**’ of the Commission for the purposes of implementing, managing and monitoring the Agreement or protecting the financial interests of the EU or Euratom (including checks, reviews, audits and investigations; see Article 22).

The persons whose personal data are processed have the right to access and correct their own personal data. For this purpose, they must send any queries about the processing of their personal data to the data controller, via the contact point indicated in the ‘service specific privacy statement(s) (SSPS)’ that are published on the Commission websites.

They also have the right to have recourse at any time to the European Data Protection Supervisor (EDPS).

<sup>26</sup> Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data (OJ L 8, 12.01.2001, p. 1).



### 39.2 Processing of personal data by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with applicable EU and national law on data protection (including authorisations or notification requirements).

The beneficiaries may grant their personnel access only to data that is strictly necessary for implementing, managing and monitoring the Agreement.

The beneficiaries must inform the personnel whose personal data are collected and processed by the Commission. For this purpose, they must provide them with the service specific privacy statement (SSPS) (see above), before transmitting their data to the Commission.

### 39.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 39.2, the *Commission* may apply any of the measures described in Chapter 6.

## ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE COMMISSION

The beneficiaries may not assign any of their claims for payment against the *Commission* to any third party, except if approved by the *Commission* on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the *Commission* has not accepted the assignment or the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the *Commission*.

## CHAPTER 5 DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES

### ARTICLE 41 — DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

#### 41.1 Roles and responsibilities towards the *Commission*

The beneficiaries have full responsibility for implementing the action and complying with the Agreement.

The beneficiaries are jointly and severally liable for the **technical implementation** of the action as described in Annex 1. If a beneficiary fails to implement its part of the action, the other beneficiaries become responsible for implementing this part (without being entitled to any additional EU funding for doing so), unless the *Commission* expressly relieves them of this obligation.

The **financial responsibility** of each beneficiary is governed by Articles 44, 45 and 46.



## 41.2 Internal division of roles and responsibilities

The internal roles and responsibilities of the beneficiaries are divided as follows:

(a) Each **beneficiary** must:

- (i) keep information stored in the 'Beneficiary Register' (via the electronic exchange system) up to date (see Article 17);
- (ii) inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);
- (iii) submit to the coordinator in good time:
  - individual financial statements for itself and, if required, certificates on the financial statements (see Article 20);
  - the data needed to draw up the technical reports (see Article 20);
  - ethics committee opinions and notifications or authorisations for activities raising ethical issues (see Article 34);
  - any other documents or information required by the Commission under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the Commission.

(b) The **coordinator** must:

- (i) monitor that the action is implemented properly (see Article 7);
- (ii) act as the intermediary for all communications between the beneficiaries and the *Commission* (in particular, providing the *Commission* with the information described in Article 17), unless the Agreement specifies otherwise;
- (iii) request and review any documents or information required by the *Commission* and verify their completeness and correctness before passing them on to the *Commission*;
- (iv) submit the deliverables and reports to the *Commission* (see Articles 19 and 20);
- (v) ensure that all payments are made to the other beneficiaries without unjustified delay (see Article 21);
- (vi) inform the *Commission* of the amounts paid to each beneficiary, when required under the Agreement (see Articles 44 and 50) or requested by the *Commission*.

The coordinator may not delegate the above-mentioned tasks to any other beneficiary or subcontract them to any third party.

**41.3 Internal arrangements between beneficiaries — Consortium agreement**

*The beneficiaries must have internal arrangements regarding their operation and co-ordination to ensure that the action is implemented properly. These internal arrangements must be set out in a written ‘consortium agreement’ between the beneficiaries, which may cover:*

- *internal organisation of the consortium;*
- *management of access to the electronic exchange system;*
- *distribution of EU funding;*
- *additional rules on rights and obligations related to background and results (including whether access rights remain or not, if a beneficiary is in breach of its obligations) (see Section 3 of Chapter 4);*
- *settlement of internal disputes;*
- *liability, indemnification and confidentiality arrangements between the beneficiaries.*

*The consortium agreement must not contain any provision contrary to the Agreement.*

**41.4 Relationship with complementary beneficiaries — Collaboration agreement**

*Not applicable*

**41.5 Relationship with partners of a joint action — Coordination agreement**

*Not applicable*

## **CHAPTER 6 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE**

### **SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — PENALTIES**

**ARTICLE 42 — REJECTION OF INELIGIBLE COSTS****42.1 Conditions**

42.1.1 The *Commission* will — at the time of an **interim payment**, **at the payment of the balance** or **afterwards** — reject any costs which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 22).

42.1.2 The rejection may also be based on the **extension of findings from other grants to this grant**, under the conditions set out in Article 22.5.2.

**42.2 Ineligible costs to be rejected — Calculation — Procedure**

Ineligible costs will be rejected in full.



If the *Commission* rejects costs **without reduction of the grant** (see Article 43) or **recovery of undue amounts** (see Article 44), it will formally notify the coordinator or beneficiary concerned the rejection of costs, the amounts and the reasons why (if applicable, together with the notification of amounts due; see Article 21.5). The coordinator or beneficiary concerned may — within 30 days of receiving notification — formally notify the *Commission* of its disagreement and the reasons why.

If the *Commission* rejects costs **with reduction of the grant** or **recovery of undue amounts**, it will formally notify the rejection in the ‘**pre-information letter**’ on reduction or recovery set out in Articles 43 and 44.

### 42.3 Effects

If the *Commission* rejects costs at the time of an **interim payment** or **the payment of the balance**, it will deduct them from the total eligible costs declared, for the action, in the periodic or final summary financial statement (see Articles 20.3 and 20.4). It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the *Commission* — **after an interim payment but before the payment of the balance** — rejects costs declared in a periodic summary financial statement, it will deduct them from the total eligible costs declared, for the action, in the next periodic summary financial statement or in the final summary financial statement. It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the *Commission* rejects costs **after the payment of the balance**, it will deduct the amount rejected from the total eligible costs declared, by the beneficiary, in the final summary financial statement. It will then calculate the revised final grant amount as set out in Article 5.4.

## ARTICLE 43 — REDUCTION OF THE GRANT

### 43.1 Conditions

43.1.1 The *Commission* may — **at the payment of the balance** or **afterwards** — reduce the maximum grant amount (see Article 5.1), if the action has not been implemented properly as described in Annex 1 or another obligation under the Agreement has been breached.

43.1.2 The *Commission* may also reduce the maximum grant amount on the basis of the **extension of findings from other grants to this grant**, under the conditions set out in Article 22.5.2.

### 43.2 Amount to be reduced — Calculation — Procedure

The amount of the reduction will be proportionate to the improper implementation of the action or to the seriousness of the breach.

Before reduction of the grant, the *Commission* will formally notify a ‘**pre-information letter**’ to the coordinator or beneficiary concerned:

- informing it of its intention to reduce the grant, the amount it intends to reduce and the reasons why and
- inviting it to submit observations within 30 days of receiving notification





If the *Commission* does not receive any observations or decides to pursue reduction despite the observations it has received, it will formally notify **confirmation** of the reduction (if applicable, together with the notification of amounts due; see Article 21).

### 43.3 Effects

If the *Commission* reduces the grant at the time of **the payment of the balance**, it will calculate the reduced grant amount for the action and then determine the amount due as payment of the balance (see Articles 5.3.4 and 21.4).

If the *Commission* reduces the grant **after the payment of the balance**, it will calculate the revised final grant amount for the beneficiary concerned (see Article 5.4). If the revised final grant amount for the beneficiary concerned is lower than its share of the final grant amount, the *Commission* will recover the difference (see Article 44).

## ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

### 44.1 Amount to be recovered — Calculation — Procedure

The *Commission* will — after **termination of the participation of a beneficiary, at the payment of the balance or afterwards** — claim back any amount that was paid but is not due under the Agreement.

Each beneficiary's financial responsibility in case of recovery is limited to its own debt, except for the amount retained for the Guarantee Fund (see Article 21.4).

#### 44.1.1 Recovery after termination of a beneficiary's participation

If recovery takes place after termination of a beneficiary's participation (including the coordinator), the *Commission* will claim back the undue amount from the beneficiary concerned, by formally notifying it a debit note (see Article 50.2 and 50.3). This note will specify the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Commission will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Commission* may offset before the payment date specified in the debit note;

- (b) *not applicable*;

- (c) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial regulation No 966/2012.

If payment is not made by the date specified in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following



the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC<sup>27</sup> applies.

#### 44.1.2 Recovery at payment of the balance

If the payment of the balance takes the form of a recovery (see Article 21.4), the *Commission* will formally notify a ‘**pre-information letter**’ to the coordinator:

- informing it of its intention to recover, the amount due as the balance and the reasons why;
- specifying that it intends to deduct the amount to be recovered from the amount retained for the Guarantee Fund;
- requesting the coordinator to submit a report on the distribution of payments to the beneficiaries within 30 days of receiving notification, and
- inviting the coordinator to submit observations within 30 days of receiving notification.

If no observations are submitted or the *Commission* decides to pursue recovery despite the observations it has received, it will **confirm recovery** (together with the notification of amounts due; see Article 21.5) and:

- pay the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is positive** or
- formally notify to the coordinator a **debit note** for the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is negative**. This note will also specify the terms and the date for payment.

If the coordinator does not repay the *Commission* by the date in the debit note and has not submitted the report on the distribution of payments: the Commission will **recover** the amount set out in the debit note from the coordinator (see below).

If the coordinator does not repay the *Commission* by the date in the debit note, but has submitted the report on the distribution of payments: the *Commission* will:

- (a) identify the beneficiaries for which the amount calculated as follows is negative:

{{{beneficiary's costs declared in the final summary financial statement and approved by the *Commission* multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned}}

<sup>27</sup> Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market amending Directives 97/7/EC, 2002/65/EC, 2005/60/EC and 2006/48/EC and repealing Directive 97/5/EC (OJ L 319, 05.12.2007, p. 1).



divided by

the EU contribution for the action calculated according to Article 5.3.1 }

multiplied by

the final grant amount (see Article 5.3) } ,

minus

{pre-financing and interim payments received by the beneficiary} } .

- (b) formally notify to each beneficiary identified according to point (a) a **debit note** specifying the terms and date for payment. The amount of the debit note is calculated as follows:

{ {amount calculated according to point (a) for the beneficiary concerned

divided by

the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a) }

multiplied by

the amount set out in the debit note formally notified to the coordinator} .

If payment is not made by the date specified in the debit note, the *Commission* will **recover** the amount:

- (a) by ‘**offsetting**’ it — without the beneficiary’s consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU’s financial interests, the *Commission* may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) *not applicable*;

(ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.



Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

#### 44.1.3 Recovery of amounts after payment of the balance

If, for a beneficiary, the revised final grant amount (see Article 5.4) is lower than its share of the final grant amount, it must repay the difference to the *Commission*.

The beneficiary's share of the final grant amount is calculated as follows:

$\{ \{ \text{beneficiary's costs declared in the final summary financial statement and approved by the } Commission \text{ multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned} \}$

divided by

$\{ \text{the EU contribution for the action calculated according to Article 5.3.1} \}$

multiplied by

$\{ \text{the final grant amount (see Article 5.3)} \}$ .

If the coordinator has not distributed amounts received (see Article 21.7), the *Commission* will also recover these amounts.

The *Commission* will formally notify a **pre-information letter** to the beneficiary concerned:

- informing it of its intention to recover, the due amount and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If no observations are submitted or the *Commission* decides to pursue recovery despite the observations it has received, it will **confirm** the amount to be recovered and formally notify to the beneficiary concerned a **debit note**. This note will also specify the terms and the date for payment.

If payment is not made by the date specified in the debit note, the *Commission* will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Commission* may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) *not applicable*;



- (ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the date for payment in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

## ARTICLE 45 — ADMINISTRATIVE AND FINANCIAL PENALTIES

### 45.1 Conditions

Under Articles 109 and 131(4) of the Financial Regulation No 966/2012, the *Commission* may impose **administrative** and **financial penalties** if a beneficiary:

- (a) has committed substantial errors, irregularities or fraud or is in serious breach of its obligations under the Agreement or
- (b) has made false declarations about information required under the Agreement or for the submission of the proposal (or has not supplied such information).

Each beneficiary is responsible for paying the financial penalties imposed on it.

Under Article 109(3) of the Financial Regulation No 966/2012, the Commission may — under certain conditions and limits — publish decisions imposing administrative or financial penalties.

### 45.2 Duration — Amount of penalty — Calculation

**Administrative penalties** exclude the beneficiary from all contracts and grants financed from the EU or Euratom budget for a maximum of five years from the date the infringement is established by the *Commission*.

If the beneficiary commits another infringement within five years of the date the first infringement is established, the *Commission* may extend the exclusion period up to 10 years.

**Financial penalties** will be between 2% and 10% of the maximum EU contribution indicated, for the beneficiary concerned, in the estimated budget (see Annex 2).

If the beneficiary commits another infringement within five years of the date the first infringement is established, the *Commission* may increase the rate of financial penalties to between 4% and 20%.

### 45.3 Procedure

Before applying a penalty, the *Commission* will formally notify the beneficiary concerned:



- informing it of its intention to impose a penalty, its duration or amount and the reasons why and
- inviting it to submit observations within 30 days.

If the *Commission* does not receive any observations or decides to impose the penalty despite of observations it has received, it will formally notify **confirmation** of the penalty to the beneficiary concerned and — in case of financial penalties — deduct the penalty from the payment of the balance or formally notify a **debit note**, specifying the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Commission may **recover** the amount:

- (a) by ‘**offsetting**’ it — without the beneficiary’s consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU’s financial interests, the *Commission* may offset before the payment date specified in the debit note;

- (b) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

## **SECTION 2 LIABILITY FOR DAMAGES**

### **ARTICLE 46 — LIABILITY FOR DAMAGES**

#### **46.1 Liability of the *Commission***

The *Commission* cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of implementing the Agreement, including for gross negligence.

The *Commission* cannot be held liable for any damage caused by any of the beneficiaries or third parties involved in the action, as a consequence of implementing the Agreement.



## 46.2 Liability of the beneficiaries

### 46.2.1 Conditions

Except in case of force majeure (see Article 51), the beneficiaries must compensate the *Commission* for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement.

Each beneficiary is responsible for paying the damages claimed from it.

### 46.2.2 Amount of damages - Calculation

The amount the *Commission* can claim from a beneficiary will correspond to the damage caused by that beneficiary.

### 46.2.3 Procedure

Before claiming damages, the *Commission* will formally notify the beneficiary concerned:

- informing it of its intention to claim damages, the amount and the reasons why and
- inviting it to submit observations within 30 days.

If the *Commission* does not receive any observations or decides to claim damages despite the observations it has received, it will formally notify **confirmation** of the claim for damages and a **debit note**, specifying the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Commission may **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the *Commission* may offset before the payment date specified in the debit note;

- (b) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.



## **SECTION 3 SUSPENSION AND TERMINATION**

### **ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE**

#### **47.1 Conditions**

The *Commission* may — at any moment — suspend the payment deadline (see Article 21.2 to 21.4) if a request for payment (see Article 20) cannot be approved because:

- (a) it does not comply with the provisions of the Agreement (see Article 20);
- (b) the technical reports or financial reports have not been submitted or are not complete or additional information is needed, or
- (c) there is doubt about the eligibility of the costs declared in the financial statements and additional checks, reviews, audits or investigations are necessary.

#### **47.2 Procedure**

The *Commission* will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day notification is sent by the *Commission* (see Article 52).

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining period will resume.

If the suspension exceeds two months, the coordinator may request the *Commission* if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the technical or financial reports (see Article 20) and the revised report or statement is not submitted or was submitted but is also rejected, the *Commission* may also terminate the Agreement or the participation of the beneficiary (see Article 50.3.1(l)).

### **ARTICLE 48 — SUSPENSION OF PAYMENTS**

#### **48.1 Conditions**

The *Commission* may — at any moment — suspend, in whole or in part, the pre-financing payment and interim payments for one or more beneficiaries or the payment of the balance for all beneficiaries, if a beneficiary:

- (a) has committed or is suspected of having committed substantial errors, irregularities, fraud or serious breach of obligations in the award procedure or under this Agreement or
- (b) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).





## 48.2 Procedure

Before suspending payments, the *Commission* will formally notify the coordinator:

- informing it of its intention to suspend payments and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the *Commission* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the suspension procedure is not continued.

The suspension will **take effect** the day the confirmation notification is sent by the *Commission*.

If the conditions for resuming payments are met, the suspension will be **lifted**. The *Commission* will formally notify the coordinator.

During the suspension, the periodic report(s) (see Article 20.3) must not contain any individual financial statements from the beneficiary concerned. When the *Commission* resumes payments, the coordinator may include them in the next periodic report.

The beneficiaries may suspend implementation of the action (see Article 49.1) or terminate the Agreement or the participation of the beneficiary concerned (see Article 50.1 and 50.2).

## ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

### 49.1 Suspension of the action implementation, by the beneficiaries

#### 49.1.1 Conditions

The beneficiaries may suspend implementation of the action or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 51) — make implementation impossible or excessively difficult.

#### 49.1.2 Procedure

The coordinator must immediately formally notify to the *Commission* the suspension (see Article 52), stating:

- the reasons why and
- the expected date of resumption.

The suspension will **take effect** the day this notification is received by the *Commission*.

Once circumstances allow for implementation to resume, the coordinator must immediately formally notify the *Commission* and request an **amendment** of the Agreement to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement or the participation of a beneficiary has been terminated (see Article 50).



The suspension will be **lifted** with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension of the action implementation are not eligible (see Article 6).

## **49.2 Suspension of the action implementation, by the *Commission***

### **49.2.1 Conditions**

The *Commission* may suspend implementation of the action or any part of it:

- (a) if a beneficiary has committed or is suspected of having committed substantial errors, irregularities, fraud or serious breach of obligations in the award procedure or under this Agreement;
- (b) if a beneficiary has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2), or
- (c) if the action is suspected of having lost its scientific or technological relevance.

### **49.2.2 Procedure**

Before suspending implementation of the action, the *Commission* will formally notify the coordinator:

- informing it of its intention to suspend the implementation and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the *Commission* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the procedure is not continued.

The suspension will **take effect** five days after confirmation notification is received by the coordinator (or on a later date specified in the notification).

It will be **lifted** if the conditions for resuming implementation of the action are met.

The coordinator will be formally notified of the lifting and the Agreement will be **amended** to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement has already been terminated (see Article 50).

The suspension will be lifted with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension are not eligible (see Article 6).

The beneficiaries may not claim damages due to suspension by the *Commission* (see Article 46).



Suspension of the action implementation does not affect the *Commission's* right to terminate the Agreement or participation of a beneficiary (see Article 50), reduce the grant or recover amounts unduly paid (see Articles 43 and 44).

## **ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES**

### **50.1 Termination of the Agreement by the beneficiaries**

#### **50.1.1 Conditions and procedure**

The beneficiaries may terminate the Agreement.

The coordinator must formally notify termination to the *Commission* (see Article 52), stating:

- the reasons why and
- the date the termination will take effect. This date must be after the notification.

If no reasons are given or if the *Commission* considers the reasons do not justify termination, the Agreement will be considered to have been '**terminated improperly**'.

The termination will **take effect** on the day specified in the notification.

#### **50.1.2 Effects**

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the open reporting period until termination; see Article 20.3) and
- (ii) the final report (see Article 20.4).

If the *Commission* does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The *Commission* will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Improper termination may lead to a reduction of the grant (see Article 43).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

### **50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries**

#### **50.2.1 Conditions and procedure**

The participation of one or more beneficiaries may be terminated by the coordinator, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must formally notify termination to the *Commission* (see Article 52) and inform the beneficiary concerned.



If the coordinator's participation is terminated without its agreement, the formal notification must be done by another beneficiary (acting on behalf of the other beneficiaries).

The notification must include:

- the reasons why;
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing);
- the date the termination takes effect. This date must be after the notification, and
- a request for amendment (see Article 55), with a proposal for reallocation of the tasks and the estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination takes effect after the period set out in Article 3, no request for amendment must be included unless the beneficiary concerned is the coordinator. In this case, the request for amendment must propose a new coordinator.

If this information is not given or if the *Commission* considers that the reasons do not justify termination, the participation will be considered to have been **terminated improperly**.

The termination will **take effect** on the day specified in the notification.

### 50.2.2 Effects

The coordinator must — within 30 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned and
- (ii) if termination takes effect during the period set out in Article 3, a '**termination report**' from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Articles 20.3 and 20.4).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the *Commission*, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the *Commission*, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The *Commission* will **calculate** — on the basis of the periodic reports, the termination report and the report on the distribution of payments — if the (pre-financing and interim) payments received by the beneficiary concerned exceed the beneficiary's EU contribution (calculated by applying the reimbursement rate(s) to the eligible costs declared by the beneficiary and approved by the *Commission*). Only costs incurred by the beneficiary concerned until termination takes effect are



eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

- If the payments received **exceed the amounts due**:
  - if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The *Commission* will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the *Commission* will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
  - in all other cases (in particular if termination takes effect after the period set out in Article 3), the *Commission* will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Commission* the amount due and the *Commission* will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
  - if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:
    - termination is after an interim payment and
    - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

In this case, the *Commission* will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Commission* the amount due. The *Commission* will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

- If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the *Commission* does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the *Commission* does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

Improper termination may lead to a reduction of the grant (see Article 43) or termination of the Agreement (see Article 50).

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.



### **50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the *Commission***

#### **50.3.1 Conditions**

The *Commission* may terminate the Agreement or the participation of one or more beneficiaries, if:

- (a) one or more beneficiaries do not accede to the Agreement (see Article 56);
- (b) a change to their legal, financial, technical, organisational or ownership situation is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;
- (c) following termination of participation for one or more beneficiaries (see above), the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants (see Article 55);
- (d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the coordinator (see Article 49.1) and either:
  - (i) resumption is impossible, or
  - (ii) the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants;
- (e) a beneficiary is declared bankrupt, being wound up, having its affairs administered by the courts, has entered into an arrangement with creditors, has suspended business activities, or is subject to any other similar proceedings or procedures under national law;
- (f) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has been found guilty of professional misconduct, proven by any means;
- (g) a beneficiary does not comply with the applicable national law on taxes and social security;
- (h) the action has lost scientific or technological relevance;
- (i) *not applicable*;
- (j) *not applicable*;
- (k) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed fraud, corruption, or is involved in a criminal organisation, money laundering or any other illegal activity affecting the EU's financial interests;
- (l) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has — in the award procedure or under the Agreement — committed:
  - (i) substantial errors, irregularities, fraud or
  - (ii) serious breach of obligations, including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles;



- (m) a beneficiary has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**‘extension of findings from other grants to this grant’**).

### 50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the *Commission* will formally notify the coordinator:

- informing it of its intention to terminate and the reasons why and
- inviting it, within 30 days of receiving notification, to submit observations and — in case of Point (l.ii) above — to inform the *Commission* of the measures to ensure compliance with the obligations under the Agreement.

If the *Commission* does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the coordinator **confirmation** of the termination and the date it will take effect. Otherwise, it will formally notify that the procedure is not continued.

The termination will **take effect**:

- for terminations under Points (b), (c), (e), (g), (h), (j), and (l.ii) above: on the day specified in the notification of the confirmation (see above);
- for terminations under Points (a), (d), (f), (i), (k), (l.i) and (m) above: on the day after the notification of the confirmation is received by the coordinator.

### 50.3.3 Effects

- (a) for **termination of the Agreement**:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the last open reporting period until termination; see Article 20.3) and
- (ii) a final report (see Article 20.4).

If the Agreement is terminated for breach of the obligation to submit the reports (see Articles 20.8 and 50.3.1(l)), the coordinator may not submit any reports after termination.

If the *Commission* does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The *Commission* will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

This does not affect the *Commission's* right to reduce the grant (see Article 43) or to impose administrative and financial penalties (Article 45).





The beneficiaries may not claim damages due to termination by the *Commission* (see Article 46).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

(b) for **termination of the participation of one or more beneficiaries**:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned;
- (ii) a request for amendment (see Article 55), with a proposal for reallocation of the tasks and estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination is notified after the period set out in Article 3, no request for amendment must be submitted unless the beneficiary concerned is the coordinator. In this case the request for amendment must propose a new coordinator, and
- (iii) if termination takes effect during the period set out in Article 3, a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Article 20).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the *Commission* (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the *Commission*, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The *Commission* will **calculate** — on the basis of the periodic reports, the termination report and the report on the distribution of payments — if the (pre-financing and interim) payments received by the beneficiary concerned exceed the beneficiary's EU contribution (calculated by applying the reimbursement rate(s) to the eligible costs declared by the beneficiary and approved by the *Commission*). Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

- If the payments received **exceed the amounts due**:
  - if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The *Commission* will formally notify the amount unduly





received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the *Commission* will draw upon the Guarantee Fund to pay the coordinator and then notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- in all other cases, in particular if termination takes effect after the period set out in Article 3, the *Commission* will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Commission* the amount due and the *Commission* will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
- if the beneficiary concerned is the former coordinator, it must repay the new coordinator the amount unduly received, unless:
  - termination takes effect after an interim payment and
  - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7)

In this case, the *Commission* will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the *Commission* the amount due. The *Commission* will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

- If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the *Commission* does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the *Commission* does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned, and that
- the beneficiary concerned must not repay any amount to the coordinator.

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38 and 40) continue to apply.

## **SECTION 4 FORCE MAJEURE**

### **ARTICLE 51 — FORCE MAJEURE**

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,



- was unforeseeable, exceptional situation and beyond the parties' control,
- was not due to error or negligence on their part (or on the part of third parties involved in the action), and
- proves to be inevitable in spite of exercising all due diligence.

The following cannot be invoked as force majeure:

- any default of a service, defect in equipment or material or delays in making them available, unless they stem directly from a relevant case of force majeure,
- labour disputes or strikes, or
- financial difficulties.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

The party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

## **CHAPTER 7 FINAL PROVISIONS**

### **ARTICLE 52 — COMMUNICATION BETWEEN THE PARTIES**

#### **52.1 Form and means of communication**

Communication under the Agreement (information, requests, submissions, 'formal notifications', etc.) must:

- be made in writing and
- bear the number of the Agreement.

**Until the payment of the balance:** all communication must be made through the electronic exchange system and using the forms and templates provided there.

**After the payment of the balance:** formal notifications must be made by registered post with proof of delivery ('formal notification on paper').

Communications in the electronic exchange system must be made by persons authorised according to the 'Terms and Conditions of Use of the electronic exchange system'. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a 'Legal Entity Appointed Representative (LEAR)'. The role and tasks of the LEAR are stipulated in his/her appointment letter (see Terms and Conditions of Use of the electronic exchange system).



If the electronic exchange system is temporarily unavailable, instructions will be given on the Commission websites.

## 52.2 Date of communication

**Communications** are considered to have been made when they are sent by the sending party (i.e. on the date and time they are sent through the electronic exchange system).

**Formal notifications** through the **electronic** exchange system are considered to have been made when they are received by the receiving party (i.e. on the date and time of acceptance by the receiving party, as indicated by the time stamp). A formal notification that has not been accepted within 10 days after sending is considered to have been accepted.

Formal notifications **on paper** sent by **registered post** with proof of delivery (only after the payment of the balance) are considered to have been made on either:

- the delivery date registered by the postal service or
- the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

## 52.3 Addresses for communication

The **electronic** exchange system must be accessed via the following URL:

<https://ec.europa.eu/research/participants/portal/desktop/en/projects/>

The *Commission* will formally notify the coordinator and beneficiaries in advance any changes to this URL.

**Formal notifications on paper** (only after the payment of the balance) addressed **to the Commission** must be sent to the following address:

*European Commission  
Communications Networks, Contents & technology  
Technologies & Systems for Digitising Industry  
BU33 01/50  
B-1049 Brussels Belgium*

Formal notifications on paper (only after the payment of the balance) addressed **to the beneficiaries** must be sent to their legal address as specified in the 'Beneficiary Register'.

## ARTICLE 53 — INTERPRETATION OF THE AGREEMENT

### 53.1 Precedence of the Terms and Conditions over the Annexes

The provisions in the Terms and Conditions of the Agreement take precedence over its Annexes.

Annex 2 takes precedence over Annex 1.



## 53.2 Privileges and immunities

*Not applicable*

## ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71<sup>28</sup>, periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

## ARTICLE 55 — AMENDMENTS TO THE AGREEMENT

### 55.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

### 55.2 Procedure

The party requesting an amendment must submit a request for amendment signed in the electronic exchange system (see Article 52).

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3).

If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why;
- the appropriate supporting documents;
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The *Commission* may request additional information.

If the party receiving the request agrees, it must sign the amendment in the electronic exchange system within 45 days of receiving notification (or any additional information the *Commission* has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected

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<sup>28</sup> Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8.6.1971, p. 1).



An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date agreed by the parties or, in the absence of such an agreement, on the date on which the amendment enters into force.

## **ARTICLE 56 — ACCESSION TO THE AGREEMENT**

### **56.1 Accession of the beneficiaries mentioned in the Preamble**

The other beneficiaries must accede to the Agreement by signing the Accession Form (see Annex 3) in the electronic exchange system (see Article 52) within 30 days after its entry into force (see Article 58).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 58).

If a beneficiary does not accede to the Agreement within the above deadline, the coordinator must — within 30 days — request an amendment to make any changes necessary to ensure proper implementation of the action. This does not affect the *Commission's* right to terminate the Agreement (see Article 50).

### **56.2 Addition of new beneficiaries**

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 55. It must include an Accession Form (see Annex 3) signed by the new beneficiary in the electronic exchange system (see Article 52).

New beneficiaries must assume the rights and obligations under the Agreement with effect from the date of their accession specified in the Accession Form (see Annex 3).

## **ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES**

### **57.1 Applicable law**

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

### **57.2 Dispute settlement**

If a dispute concerning the interpretation, application or validity of the Agreement cannot be settled amicably, the General Court — or, on appeal, the Court of Justice of the European Union — has sole jurisdiction. Such actions must be brought under Article 272 of the Treaty on the Functioning of the EU (TFEU).

If a dispute concerns administrative or financial penalties, offsetting or an enforceable decision under Article 299 TFEU (see Articles 44, 45 and 46), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice of the European Union — under Article 263 TFEU.

## **ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT**

The Agreement will enter into force on the day of signature by the *Commission* or the coordinator, depending on which is later.

### **SIGNATURES**

For the coordinator

For the *Commission*



**EUROPEAN COMMISSION**  
Communications Networks, Contents & technology  
Technologies & Systems for Digitising Industry



## **ANNEX 1 (part A)**

**Research and Innovation action**

**NUMBER — 723710 — vf-OS**

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## 1.1. The project summary

Project Number <sup>1</sup>	723710	Project Acronym <sup>2</sup>	vf-OS
<b>One form per project</b>			
<b>General information</b>			
Project title <sup>3</sup>	Virtual Factory Open Operating System		
Starting date <sup>4</sup>	01/10/2016		
Duration in months <sup>5</sup>	36		
Call (part) identifier <sup>6</sup>	H2020-FOF-2016		
Topic	FOF-11-2016 Digital automation		
Fixed EC Keywords	Cloud Computing models		
Free keywords	Virtual Factory, Operating System, Open Source, Cloud, Multi-sided Platform, Manufacturing Apps Store, Manufacturing and Logistics Processes, Collaborative Infrastructures, Interoperability, Security		
<b>Abstract <sup>7</sup></b>			
<p>The primary outcomes of vf-OS are an:</p> <ul style="list-style-type: none"> <li>- Open Operating System (vf-OS) and Software Development Kit (OAK) for Factories of the Future that aims to be the reference system software for collaborative manufacturing and logistics processes including its associated resources and data</li> <li>- Open vf-OS Platform, including a Multi-sided application marketplace and development studio, that aims to become the Apps Store for Manufacturing industry</li> </ul> <p>The multi-sided marketplace will allow Manufacturing Users, Manufacturing Resource providers, Service Providers and Software Developers to cooperate and demand, build, select, and use vf-OS applications with the vf-OS exploiters, like classical App stores, having a business model based on taking a share of purchases of applications and services from the platform.</p> <p>vf-OS is composed of a Virtual Factory System Kernel (vf-SK), a Virtual Factory Application Programming Interface (vf-API) and a Virtual Factory Middleware (vf-MW) for interoperable and secure collaboration among supply networks, enterprises, machines, data and objects. The Virtual Factory Platform (vf-P) will be a infrastructure, either in-cloud or on-premise, that supports the Manufacturing Apps Store and Virtual Machines. vf-OS especially addresses SMEs by providing a full functionality at affordable cost and with Cloud availability.</p> <p>The Manufacturing Apps will be developed with an Open Applications Development Kit (vf-OAK), freely provided to software developers, for rapid and cost effective deployment of advanced industrial applications running over vf-OS, allowing fast time-to-market and world-wide base industrial clients.</p>			

## 1.2. List of Beneficiaries

Project Number <sup>1</sup>	723710	Project Acronym <sup>2</sup>	vf-OS
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### List of Beneficiaries

No	Name	Short name	Country	Project entry month <sup>8</sup>	Project exit month
1	INFORMATION CATALYST FOR ENTERPRISE LTD	ICE	United Kingdom	1	36
2	IKERLAN SCL	IKERLAN	Spain	1	36
3	UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS-ASSOCIACAO	UNINOVA	Portugal	1	36
4	UNIVERSITAT POLITECNICA DE VALENCIA	UPV	Spain	1	36
5	CAIXA MAGICA SOFTWARE LDA	CMS	Portugal	1	36
6	UNIVERSITE LUMIERE LYON 2	LYON2	France	1	36
7	ASCORA GMBH	ASC	Germany	1	36
8	ALMENDE B.V.	ALM	Netherlands	1	36
9	MONDRAGON ASSEMBLY SOCIEDAD COOPERATIVA	MASS	Spain	1	36
10	VIA SOLIS UAB	VS	Lithuania	1	36
11	CONSULGAL - CONSULTORES DE ENGENHARIA E GESTAO SA	CONSULGAL	Portugal	1	36
12	KNOWLEDGEBIZ CONSULTING-SOCIEDADE DE CONSULTORIA EM GASTAO LDA	KBZ	Portugal	1	36
13	APPLICATIONS PLASTIQUES DU RHONE SAS	APR	France	1	36
14	ETABLISSEMENTS TARDY	Tardy	France	1	36

## 1.3. Workplan Tables - Detailed implementation

### 1.3.1. WT1 List of work packages

WP Number <sup>9</sup>	WP Title	Lead beneficiary <sup>10</sup>	Person-months <sup>11</sup>	Start month <sup>12</sup>	End month <sup>13</sup>
WP1	Vision, Scenarios and Requirements	4 - UPV	67.00	1	30
WP2	Virtual Factory Operating System Architecture	7 - ASC	75.00	3	12
WP3	Virtual Factory System Kernel	3 - UNINOVA	86.00	5	24
WP4	Virtual Factory I/O	4 - UPV	74.00	7	33
WP5	Virtual Factory Data and Connect	1 - ICE	94.00	13	30
WP6	Open Applications Development Kit (OAK)	5 - CMS	106.00	16	36
WP7	Platform and Integration	8 - ALM	107.00	4	36
WP8	vf-OS Smart Application Piloting and Validation	9 - MASS	132.00	3	36
WP9	Business Model and Exploitation	2 - IKERLAN	41.00	1	36
WP10	Impact	12 - KBZ	60.50	1	36
WP11	Project and RTD Management	1 - ICE	59.50	1	36
<b>Total</b>			<b>902.00</b>		

### 1.3.2. WT2 list of deliverables

<b>Deliverable Number</b> <sup>14</sup>	<b>Deliverable Title</b>	<b>WP number</b> <sup>9</sup>	<b>Lead beneficiary</b>	<b>Type</b> <sup>15</sup>	<b>Dissemination level</b> <sup>16</sup>	<b>Due Date (in months)</b> <sup>17</sup>
D1.1	vfOS - ID1.1 - Vision Consensus(M3)	WP1	1 - ICE	Report	Public	3
D1.2	vfOS - ID1.2 - Users scenarios characterisation(M4)	WP1	9 - MASS	Report	Public	4
D1.3	vfOS - ID1.3 - Providers scenarios characterisation(M4)	WP1	8 - ALM	Report	Public	4
D1.4	vfOS - ID1.4a - Existing SOTA Analysis(M6)	WP1	4 - UPV	Other	Public	6
D1.5	vfOS - ID1.4b - Existing SOTA Analysis(M18)	WP1	4 - UPV	Other	Public	18
D1.6	vfOS - ID1.4c - Existing SOTA Analysis(M30)	WP1	4 - UPV	Other	Public	30
D1.7	vfOS - ID1.5 - Requirements Specification(M6)	WP1	5 - CMS	Report	Public	6
D2.1	vfOS - ID2.1 - Global Architecture Definition(M7)	WP2	1 - ICE	Report	Public	7
D2.2	vfOS - ID2.2 - Functional Specification & Mockups(M9)	WP2	4 - UPV	Report	Public	9
D2.3	vfOS - ID2.3 - Technical Specification(M12)	WP2	7 - ASC	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D2.4	vfOS - ID2.4 - Holistic Security and Privacy Concept(M10)	WP2	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	10
D3.1	vfOS - ID3.1 - vf-OS Kernel and FI-WARE Framework(M10)	WP3	3 - UNINOVA	Other	Public	10
D3.2	vfOS - ID3.2a - FI-WARE Generic Enablers(M12)	WP3	3 - UNINOVA	Other	Public	12

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D3.3	vfOS - ID3.2b - FI-WARE Generic Enablers(M18)	WP3	3 - UNINOVA	Other	Public	18
D3.4	vfOS - ID3.2c - FI-WARE Generic Enablers(M24)	WP3	3 - UNINOVA	Other	Public	24
D3.5	vfOS - ID3.3a - FI-WARE Manufacturing Enablers(M12)	WP3	6 - LYON2	Other	Public	12
D3.6	vfOS - ID3.3b - FI-WARE Manufacturing Enablers(M18)	WP3	6 - LYON2	Other	Public	18
D3.7	vfOS - ID3.3c - FI-WARE Manufacturing Enablers(M24)	WP3	6 - LYON2	Other	Public	24
D3.8	vfOS - ID3.4a - vf-OS Enablers(M12)	WP3	12 - KBZ	Other	Public	12
D3.9	vfOS - ID3.4b - vf-OS Enablers(M18)	WP3	12 - KBZ	Other	Public	18
D3.10	vfOS - ID3.4c - vf-OS Enablers(M24)	WP3	12 - KBZ	Other	Public	24
D3.11	vfOS - ID3.5a - vf-OS Process Enabler(M12)	WP3	1 - ICE	Other	Public	12
D3.12	vfOS - ID3.5b - vf-OS Process Enabler(M18)	WP3	1 - ICE	Other	Public	18
D3.13	vfOS - ID3.5c - vf-OS Process Enabler(M24)	WP3	1 - ICE	Other	Public	24
D4.1	vfOS - ID4.1.1 - Devices Driver/ API Toolkit - Specifications(M12)	WP4	4 - UPV	Report	Public	12
D4.2	vfOS - ID4.1.2a - Devices Driver/ API Toolkit - Software(M18)	WP4	4 - UPV	Other	Public	18
D4.3	vfOS - ID4.1.2b - Devices Driver/ API Toolkit - Software(M24)	WP4	4 - UPV	Other	Public	24
D4.4	vfOS - ID4.2a - Devices Drivers(M24)	WP4	4 - UPV	Other	Public	24
D4.5	vfOS - ID4.2b - Devices Drivers(M30)	WP4	4 - UPV	Other	Public	30
D4.6	vfOS - ID4.2c - Devices Drivers(M33)	WP4	4 - UPV	Other	Public	33

<b>Deliverable Number</b> <sup>14</sup>	<b>Deliverable Title</b>	<b>WP number</b> <sup>9</sup>	<b>Lead beneficiary</b>	<b>Type</b> <sup>15</sup>	<b>Dissemination level</b> <sup>16</sup>	<b>Due Date (in months)</b> <sup>17</sup>
D4.7	vfOS - ID4.3a - APIs Connectors(M24)	WP4	6 - LYON2	Other	Public	24
D4.8	vfOS - ID4.3b - APIs Connectors(M30)	WP4	6 - LYON2	Other	Public	30
D4.9	vfOS - ID4.3c - APIs Connectors(M33)	WP4	6 - LYON2	Other	Public	33
D4.10	vfOS - ID4.4a - Security & Data Access(M18)	WP4	2 - IKERLAN	Other	Public	18
D4.11	vfOS - ID4.4b - Security & Data Access(M24)	WP4	2 - IKERLAN	Other	Public	24
D5.1	vfOS - ID5.1a - Data Infrastructure Middleware(M18)	WP5	3 - UNINOVA	Other	Public	18
D5.2	vfOS - ID5.1b - Data Infrastructure Middleware(M24)	WP5	3 - UNINOVA	Other	Public	24
D5.3	vfOS - ID5.1c - Data Infrastructure Middleware(M30)	WP5	3 - UNINOVA	Other	Public	30
D5.4	vfOS - ID5.2a - Data Storage(M18)	WP5	2 - IKERLAN	Other	Public	18
D5.5	vfOS - ID5.2b - Data Storage(M24)	WP5	2 - IKERLAN	Other	Public	24
D5.6	vfOS - ID5.2c - Data Storage(M30)	WP5	2 - IKERLAN	Other	Public	30
D5.7	vfOS - ID5.3a - Data Harmonisation(M18)	WP5	1 - ICE	Other	Public	18
D5.8	vfOS - ID5.3b - Data Harmonisation(M24)	WP5	1 - ICE	Other	Public	24
D5.9	vfOS - ID5.3c - Data Harmonisation(M30)	WP5	1 - ICE	Other	Public	30
D5.10	vfOS - ID5.4a - Data Analytics(M18)	WP5	1 - ICE	Other	Public	18
D5.11	vfOS - ID5.4b - Data Analytics(M24)	WP5	1 - ICE	Other	Public	24
D5.12	vfOS - ID5.4c - Data Analytics(M30)	WP5	1 - ICE	Other	Public	30
D6.1	vfOS - ID6.1.1a - OAK SDK - Software(M24)	WP6	5 - CMS	Other	Public	24

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D6.2	vfOS - ID6.1.1b - OAK SDK - Software(M30)	WP6	5 - CMS	Other	Public	30
D6.3	vfOS - ID6.1.1c - OAK SDK - Software(M36)	WP6	5 - CMS	Other	Public	36
D6.4	vfOS - ID6.1.2a - OAK SDK - Documentation(M24)	WP6	5 - CMS	Report	Public	24
D6.5	vfOS - ID6.1.2b - OAK SDK - Documentation(M30)	WP6	5 - CMS	Report	Public	30
D6.6	vfOS - ID6.1.2c - OAK SDK - Documentation(M36)	WP6	5 - CMS	Report	Public	36
D6.7	vfOS - ID6.2a - OAK System Dashboard(M24)	WP6	8 - ALM	Other	Public	24
D6.8	vfOS - ID6.2b - OAK System Dashboard(M30)	WP6	8 - ALM	Other	Public	30
D6.9	vfOS - ID6.2c - OAK System Dashboard(M36)	WP6	8 - ALM	Other	Public	36
D6.10	vfOS - ID6.3a - OAK Front End(M24)	WP6	7 - ASC	Other	Public	24
D6.11	vfOS - ID6.3b - OAK Front End(M30)	WP6	7 - ASC	Other	Public	30
D6.12	vfOS - ID6.3c - OAK Front End(M36)	WP6	7 - ASC	Other	Public	36
D6.13	vfOS - ID6.4a - OAK Studio(M30)	WP6	5 - CMS	Other	Public	30
D6.14	vfOS - ID6.4b - OAK Studio(M36)	WP6	5 - CMS	Other	Public	36
D6.15	vfOS - ID6.5a - OAK Developer Engagement Hub(M30)	WP6	5 - CMS	Other	Public	30
D6.16	vfOS - ID6.5b - OAK Developer Engagement Hub(M36)	WP6	5 - CMS	Other	Public	36
D7.1	vfOS - ID7.1a - vf-Platform Environment(M24)	WP7	8 - ALM	Other	Public	24

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D7.2	vfOS - ID7.1b - vf-Platform Environment(M30)	WP7	8 - ALM	Other	Public	30
D7.3	vfOS - ID7.1c - vf-Platform Environment(M36)	WP7	8 - ALM	Other	Public	36
D7.4	vfOS - ID7.2a - vf- mApp Store & Marketplace(M24)	WP7	7 - ASC	Other	Public	24
D7.5	vfOS - ID7.2b - vf- mApp Store & Marketplace(M30)	WP7	7 - ASC	Other	Public	30
D7.6	vfOS - ID7.2c - vf- mApp Store & Marketplace(M36)	WP7	7 - ASC	Other	Public	36
D7.7	vfOS - ID7.3a - vf-Service Provision Framework(M24)	WP7	8 - ALM	Other	Public	24
D7.8	vfOS - ID7.3b - vf-Service Provision Framework(M30)	WP7	8 - ALM	Other	Public	30
D7.9	vfOS - ID7.3c - vf-Service Provision Framework(M36)	WP7	8 - ALM	Other	Public	36
D7.10	vfOS - ID7.4 - Developer Engagement & Training(M36)	WP7	5 - CMS	Other	Public	36
D7.11	vfOS - ID7.5 - Software Integration Report(M36)	WP7	7 - ASC	Other	Public	36
D8.1	vfOS - ID8.1a - Validation Scenarios(M6)	WP8	4 - UPV	Report	Public	6
D8.2	vfOS - ID8.1b - Validation Scenarios(M12)	WP8	4 - UPV	Report	Public	12
D8.3	vfOS - ID8.1c - Validation Scenarios(M24)	WP8	4 - UPV	Report	Public	24
D8.4	vfOS - ID8.1d - Validation Scenarios(M36)	WP8	4 - UPV	Report	Public	36
D8.5	vfOS - ID8.2a - Pilot 1: Manufacturing	WP8	9 - MASS	Demonstration	Confidential, only for members of the consortium	24



<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
	& Logistic – Automation(M24)				(including the Commission Services)	
D8.6	vfOS - ID8.2b - Pilot 1: Manufacturing & Logistic – Automation(M30)	WP8	9 - MASS	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.7	vfOS - ID8.2c - Pilot 1: Manufacturing & Logistic – Automation(M36)	WP8	9 - MASS	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	36
D8.8	vfOS - ID8.3a - Pilot 2: Construction – Industrialisation(M24)	WP8	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	24
D8.9	vfOS - ID8.3b - Pilot 2: Construction – Industrialisation(M30)	WP8	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.10	vfOS - ID8.3c - Pilot 2: Construction – Industrialisation(M36)	WP8	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	36
D8.11	vfOS - ID8.4a - Pilot 3: Manufacturing Assembly: Collaboration(M24)	WP8	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	24
D8.12	vfOS - ID8.4b - Pilot 3: Manufacturing Assembly: Collaboration(M30)	WP8	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.13	vfOS - ID8.4c - Pilot 3: Manufacturing Assembly: Collaboration(M36)	WP8	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the	36

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
					Commission Services)	
D9.1	vfOS - ID9.1 - Business Case Opportunities and Value Mapping(M6)	WP9	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D9.2	vfOS - ID9.2 - Exploitation Business Models(M9)	WP9	12 - KBZ	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D9.3	vfOS - ID9.3 - Exploitation Strategy(M9)	WP9	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D9.4	vfOS - ID9.4a - Collaborative and Partner Value Propositions and Exploitation plans(M9)	WP9	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D9.5	vfOS - ID9.4b - Collaborative and Partner Value Propositions and Exploitation plans(M18)	WP9	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D9.6	vfOS - ID9.4c - Collaborative and Partner Value Propositions and Exploitation plans(M36)	WP9	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D10.1	vfOS - ID10.1 - Impact Strategy and Plan(M3)	WP10	12 - KBZ	Report	Public	3
D10.2	vfOS - ID10.2a - Dissemination Report(M3)	WP10	4 - UPV	Websites, patents filling, etc.	Public	3
D10.3	vfOS - ID10.2b - Dissemination Report(M9)	WP10	4 - UPV	Websites, patents filling, etc.	Public	9

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D10.4	vfOS - ID10.2c - Dissemination Report(M18)	WP10	4 - UPV	Websites, patents filling, etc.	Public	18
D10.5	vfOS - ID10.2d - Dissemination Report(M36)	WP10	4 - UPV	Websites, patents filling, etc.	Public	36
D10.6	vfOS - ID10.3a - Impact Activity Reports(M9)	WP10	12 - KBZ	Report	Public	9
D10.7	vfOS - ID10.3b - Impact Activity Reports(M18)	WP10	12 - KBZ	Report	Public	18
D10.8	vfOS - ID10.3c - Impact Activity Reports(M36)	WP10	12 - KBZ	Report	Public	36
D10.9	vfOS - ID10.4a - Workshops Reports(M26)	WP10	3 - UNINOVA	Report	Public	26
D10.10	vfOS - ID10.4b - Workshops Reports(M35)	WP10	3 - UNINOVA	Report	Public	35
D11.1	vfOS - ID11.1 - Project Handbook & Quality Plan(M2)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	2
D11.2	vfOS - ID11.3.1a - Quarterly Reports(M3)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	3
D11.3	vfOS - ID11.3.1b - Quarterly Reports(M6)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D11.4	vfOS - ID11.3.1c - Quarterly Reports(M9)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	9

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D11.5	vfOS - ID11.3.1d - Quarterly Reports(M12)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D11.6	vfOS - ID11.3.1e - Quarterly Reports(M15)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	15
D11.7	vfOS - ID11.3.1f - Quarterly Reports(M18)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D11.8	vfOS - ID11.3.1g - Quarterly Reports(M21)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	21
D11.9	vfOS - ID11.3.1h - Quarterly Reports(M24)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	24
D11.10	vfOS - ID11.3.1i - Quarterly Reports(M27)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	27
D11.11	vfOS - ID11.3.1j - Quarterly Reports(M30)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D11.12	vfOS - ID11.3.1k - Quarterly Reports(M33)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	33

<b>Deliverable Number <sup>14</sup></b>	<b>Deliverable Title</b>	<b>WP number <sup>9</sup></b>	<b>Lead beneficiary</b>	<b>Type <sup>15</sup></b>	<b>Dissemination level <sup>16</sup></b>	<b>Due Date (in months) <sup>17</sup></b>
D11.13	vfOS - ID11.3.11 - Quarterly Reports(M36)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D11.14	vfOS - ID11.3.2a - Period Reports(M9)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D11.15	vfOS - ID11.3.2b - Period Reports(M18)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D11.16	vfOS - ID11.3.2c - Period Reports(M36)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D11.17	vfOS - ID11.3.3 - Final Reports(M36)	WP11	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D11.18	vfOS - ID11.5 - Technical Set Up and Quality Toolset (M12 & Ongoing)	WP11	7 - ASC	Other	Confidential, only for members of the consortium (including the Commission Services)	12

### 1.3.3. WT3 Work package descriptions

<b>Work package number</b> <sup>9</sup>	WP1	<b>Lead beneficiary</b> <sup>10</sup>	4 - UPV
<b>Work package title</b>	Vision, Scenarios and Requirements		
<b>Start month</b>	1	<b>End month</b>	30

#### Objectives

O1 To reassert the project vision, defining the reference framework, and the overall requirements depicting the envisioned Virtual Factory Operating System

The following specific objectives are targeted:

O1.1 To synchronise the project vision, including to overview the target audience and the target market sector

O1.2 To collect and characterise the requirements of the vf-OS final users (industry) for supporting collaboration in the different stages of manufacturing and logistics processes in an efficient manner

O1.3 To collect and characterise the requirements of the vf-OS app builders (software developers) for supporting efficient software development and easy integration in the vf-OS platform

O1.4 To obtain an exhaustive map of existing architectures, technologies and solutions, and to support collaboration in manufacturing and logistics processes

O1.5 To define the requirements of the project based on the pilot scenarios

Although the Description of Action (DOA) gives a clear narrative of what the project will achieve and how the achievements will happen, there are naturally questions that need to be clarified when it comes to details for the different tasks, and thus these will be finalised in this work package through a “vision consensus document”. In addition, the stakeholders of vf-OS and their participation in the multisided market ecosystem around the vf-OS platform will be identified: Manufacturing users (industry), providers (software developers), manufacturing systems (connections) and service providers. Cases will be explored and defined to guarantee the success of the vf-OS exploitation based on the fulfilment of the need of all sides and in conjunction with WP9. Within this WP, existing solutions and technologies are assessed to highlight to what extent they can be integrated with vf-OS. Thanks to the close interaction of the RTD partners, IT developers, and end users, the detailed definition and requirements of the Virtual Factory Smart Applications and validation scenarios from WP8 will also be developed in this WP.

#### Description of work and role of partners

**WP1 - Vision, Scenarios and Requirements** [Months: 1-30]

**UPV, ICE, IKERLAN, UNINOVA, CMS, LYON2, ASC, ALM, MASS, VS, CONSULGAL, KBZ, APR, Tardy**

The WP kicks-off the project through the Vision Consensus (T1.1), which confirms and provides additional detail on the DOA. In parallel, the User and Developer Characterisation Scenarios (T1.2 and T1.3) will both feed and extend this, as will the solutions/technology identification (T1.4). The WP concludes with the requirements that stem from these documents (T1.5) and most importantly from the pilot scenario of WP8, which will also be running simultaneously.

T1.1 Vision Consensus ICE M1-3

D1.1 Vision Consensus R CO 3 R1

The task will provide a balanced guide document as a deliverable, which acts as a reference for the project and will be used by all partners to stay focused on the main ideas and goals of the project, even in complex and technical phases. The document will also be used internally to keep the single RTD tasks (and personnel) in synchronisation with the overall idea of the project. It may also be used by the partners as a source for documents, deliverables and presentations to third parties, eg during the dissemination activities, and by interested third parties to get an early overview of the project. In addition this document will include an initial risk table, upgraded from the DOA, which itemises RTD risks in particular and including integration.

Roles: All partners will be involved in this task to provide their business and technical insights and to ensure a holistic buy-in to the project vision. ICE will lead this task as project visionary.

T1.2 Users Scenarios Characterisation MASS M1-4

D1.2 Users Scenarios Characterisation R PU 4 R1

This task will deal with data and information collection, taking into account criteria such as targeted industrial sectors, industry types, supply chain processes, and management strategies. A comparative analysis of the current status of the main manufacturing and logistics environments will be performed, with particular attention to the needs for supporting

collaboration in the supply chain and to classify the different industrial scenarios that will address the vf-OS Platform and its Smart Applications. The characterisation of the pilot Industrial Scenarios will represent the starting point for the setting-up of the innovative solutions that the vf-OS project aims to develop.

Roles: MASS leads this task as an industrial company with significant experience in industrial projects and due to leadership of WP8. All the other industrial partners will contribute in the characterisation of their user scenarios.

#### T1.3 Providers Scenarios Characterisation ALM M1-4

##### D1.3 Providers Scenarios Characterisation R PU 4 R1

This task will deal with the identification of the potential software application developers, the understanding of their needs and expected business models. This will guarantee their participation in expanding the vf-OS Platform with Smart Applications. The classification performed in Task 1.2 will be complemented with the main features of vf-OS Platform and its Smart Applications in order to identify market opportunities for future vf-OS results exploitation by the solutions providers.

Roles: ALM leads this task as an industrial provider with recognised experience in supervising industrial projects. All the other industrial partners will contribute in the characterisation of their providers' scenarios.

#### T1.4 Existing Solutions and Technology Identification/Analysis UPV M1-30

##### D1.4abc Existing SOTA Analysis OTHER PU 6, 18, 30 Ongoing

This task deals with a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain. It will also study the current state of relevant technologies, including cloud computing, IOT, embedded systems, sensors and CPS components, data analytics, Big Data sources, Security, and mobile data sources. The investigation of the data sources will be carried out in close cooperation with the end users and the solutions providers. Another important aspect to be considered for analysis is "public enablers" such as the generic enablers of the FI-WARE and FI-PPP initiative and existing industry solutions such as the up-and-coming IBM Bluemix. The execution of this task will be through a Wiki, with access provided to other projects and contributors in a moderated way.

Roles: All partners contribute to this task, providing their knowledge about existing solutions and technology. UPV will lead this task as an expert in the state of the art in the collaboration in manufacturing and logistics domain.

#### T1.5 Requirements Specification CMS M1-6

##### D1.5 Requirements Specification R PU 6 R1

The requirements analysis is the borderline between the business/requirements aspects mentioned in tasks T1.2, T4 and in WP8, and the software engineering process of the project detailed in WP2. The specification will take into account the DOA, the functional requirements from the target user and provider scenarios, requirements arising from the preliminary scenarios defined within WP8, the state of the art analysis, the partners' further knowledge and expertise and particularly in the case of WP4 drivers/API "popular" systems which manufacturers might wish to connect to – eg ERPs such as SAP ERP, SME Cloud Resources (eg Toggl), Sensor types, etc.

Roles: CMS will lead this user-orientated task but all partners will be in it – user partners will have the main role to specify their requirements, and technical partners to start the "translation" of these requirements into more 'exactly phrased' requirements. Researchers will also have a role to ensure the technology is at least state of the art and moving forward in many areas.

### Participation per Partner

Partner number and short name	WP1 effort
1 - ICE	5.50
2 - IKERLAN	3.50
3 - UNINOVA	6.00
4 - UPV	8.00
5 - CMS	5.50
6 - LYON2	2.00
7 - ASC	3.00
8 - ALM	4.50

Partner number and short name	WP1 effort
9 - MASS	7.50
10 - VS	4.50
11 - CONSULGAL	3.50
12 - KBZ	4.50
13 - APR	4.50
14 - Tardy	4.50
<b>Total</b>	<b>67.00</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D1.1	vfOS - ID1.1 - Vision Consensus(M3)	1 - ICE	Report	Public	3
D1.2	vfOS - ID1.2 - Users scenarios characterisation(M4)	9 - MASS	Report	Public	4
D1.3	vfOS - ID1.3 - Providers scenarios characterisation(M4)	8 - ALM	Report	Public	4
D1.4	vfOS - ID1.4a - Existing SOTA Analysis(M6)	4 - UPV	Other	Public	6
D1.5	vfOS - ID1.4b - Existing SOTA Analysis(M18)	4 - UPV	Other	Public	18
D1.6	vfOS - ID1.4c - Existing SOTA Analysis(M30)	4 - UPV	Other	Public	30
D1.7	vfOS - ID1.5 - Requirements Specification(M6)	5 - CMS	Report	Public	6

#### Description of deliverables

##### D1.1 : vfOS - ID1.1 - Vision Consensus(M3) [3]

The task will provide a balanced guide document as a deliverable, which acts as a reference for the project and will be used by all partners to stay focused on the main ideas and goals of the project, even in complex and technical phases. The document will also be used internally to keep the single RTD tasks (and personnel) in synchronisation with the overall idea of the project. It may also be used by the partners as a source for documents, deliverables and presentations to third parties, eg during the dissemination activities, and by interested third parties to get an early overview of the project. In addition this document will include an initial risk table, upgraded from the DOA, which itemises RTD risks in particular and including integration.

##### D1.2 : vfOS - ID1.2 - Users scenarios characterisation(M4) [4]



The deliverable document is a report that includes the characterisation of the main industrial scenarios. The deliverable will also detail and explain the aims identified and expected in 2.1.3

#### D1.3 : vfOS - ID1.3 - Providers scenarios characterisation(M4) [4]

The deliverable document is thus a report that includes the characterisation of the main of main software developer scenarios that will use the vf-OS Platform for developing Smart Applications.

#### D1.4 : vfOS - ID1.4a - Existing SOTA Analysis(M6) [6]

This task deals with a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain. It will also study the current state of relevant technologies, including cloud computing, IOT, embedded systems, sensors and CPS components, data analytics, Big Data sources, Security, and mobile data sources. The investigation of the data sources will be carried out in close cooperation with the end users and the solutions providers. Another important aspect to be considered for analysis is “public enablers” such as the generic enablers of the FI-WARE and FI-PPP initiative and existing industry solutions such as the up-and-coming IBM Bluemix. The execution of this task will be through a Wiki, with access provided to other projects and contributors in a moderated way.

#### D1.5 : vfOS - ID1.4b - Existing SOTA Analysis(M18) [18]

Update of the previous deliverable

#### D1.6 : vfOS - ID1.4c - Existing SOTA Analysis(M30) [30]

Update of the previous deliverable

#### D1.7 : vfOS - ID1.5 - Requirements Specification(M6) [6]

This deliverable will be a joint document for the requirements of all project components, divided into strategic, high level functional and technical requirements. It will also further detail, where applicable, the KPIs of Section 2.1.2

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP2	<b>Lead beneficiary</b> <sup>10</sup>	7 - ASC
<b>Work package title</b>	Virtual Factory Operating System Architecture		
<b>Start month</b>	3	<b>End month</b>	12

### Objectives

O2 To detail the software engineering aspects including all major specifications

O2.1 To define a global architecture for vf-OS

O2.2 To create a functional specification of all vf-OS software components

O2.3 To provide a detailed technical specification of all vf-OS software components

O2.4 To define a holistic security and privacy concept which is to be followed by all vf-OS components

WP2 will thus define an overall architecture and the specifications which are needed in RTD work packages WP3-7, and therefore provides a foundation for the upcoming work from both a functional and technical point of view. It will ensure that the selected vf-OS technologies fit the requirements and that interfaces for all vf-OS software components are defined. Important security and privacy issues are promoted to their own focused task as they are cross-cutting concerns which largely need to be fulfilled by all vf-OS software components but of course they will be integrated with the overall specification stack. Within the functional deliverable, the users and RTD providers will work closely together to deliver mock-ups for each application which has been found to both better engage users and to facilitate more realistic and valid development priorities.

### Description of work and role of partners

**WP2 - Virtual Factory Operating System Architecture** [Months: 3-12]

ASC, ICE, IKERLAN, UNINOVA, UPV, CMS, LYON2, ALM, MASS, VS, CONSULGAL, KBZ, APR, Tardy

This work package will initiate the technical side of the project, starting with the architecture (T2.1) based on the work of WP1 and, in particular, the Requirements Specification (T1.5). The architecture will be developed based on the partner's knowledge, experience and competences. The architecture will naturally lead to a Functional Specification (T2.2), validated through user engagement, and from this to the Technical Specification (T2.3) covering each WP3-7 task component. In parallel to this, a cross-cutting security task (T2.4) will feed and interact with all three specifications. Together these will specify the direction for the remaining RTD tasks.

T2.1 Global Architecture Definition ICE M3-7

D2.1 Global Architecture Definition R CO 7 R1

The first step to transform the requirements identified within the course of WP1 into particular specifications for all vf-OS software components is to define a global architecture identifying vf-OS components and their interactions and any security relevance.

Roles: ICE will lead this task as an experience partner in the design of software architecture. All technological partners contribute in the definition and design of the vf-OS global architecture.

T2.2 Functional Specification & Mockups UPV M7-9

D2.2 Functional Specification and Mockups R CO 9 R1

This task will deliver a Functional Specification document to provide an in-depth definition of the functionalities and behaviours of all vf-OS components. It will also explain how related requirements will be fulfilled as an important means to measure the outcome of the individual tasks and the overall project. Furthermore, all possible interactions between the vf-OS components will be detailed and depicted so as to guide the overall flow of functionalities and data between components. Components will be split into subcomponents and defined following a unified approach. For components that feature a user interface a first mock-up of the GUI (created in Balsamiq) will be included through close RTD provider/user interaction.

Roles: The technical partners will contribute in the functional specification and mock-ups of vf-OS. UPV will lead this task bringing its experience in the definition of functionalities and behaviours of software components.

T2.3 Technical Specification ASC M10-12

D2.3 Technical Specification OTH (or R) CO 12 R2

This task will deliver a Technical Specification, which is the final outcome of the project-wide software engineering process and is based on the Functional Specification. Since this represents core partner IPR for exploitation this specification will remain confidential. It will define concrete interfaces between vf-OS software components, protocols and class/package structures, including definitions of methods, parameters, return values, and error handling for each

component and interface. It will define data models and concrete data schemas to be used on the source code level. It will also select the (software) technologies to be reused and applied within the project based on a study of possible technologies and in cooperation with the SOTA Wiki Task. Based on this, it will define the missing functionalities and implementation needs that are the foundation for the work to be performed in the RTD work packages WP3-7. For realising the technical specification, the project will examine the use an online approach such as Swagger or Slate to allow a practical and modern approach for documenting its component interfaces but if insufficient or incomplete to address all aspects may fall back to and/or a paper based document. This will be decided during this task and in conjunction with the Technical Manager, Project Manager and T11.4/5.

Roles: The technical partners will contribute in the technical specification of vf-OS. ASC will lead this task considering its experience in the elaboration of technical specification of computational systems.

#### T2.4 Holistic Security and Privacy Concept IKERLAN M7-10

##### D2.4 Holistic Security and Privacy Concept R CO 10 R2

This task will develop a concept for privacy and security handling, and will ensure that the concept is applicable to and followed by all vf-OS components. It will consider existing approaches (eg encryption), the specific requirements of the manufacturing domain, and the need for data security. This task will start at an early stage and provide an according deliverable at the end of the first project year, identifying suitable general approaches and standards to be applied – an early report will help tune the specification tasks. Due to the subject of this deliverable it has been decided to keep it provisionally confidential. Based on this, concrete guidelines will be generated which need to be taken into account throughout the vf-OS software development tasks. Since this area is cross-cutting the actual relevant security for each component will be applied within the individual tasks. On an on-going basis this task will continuously check the adherence to the security and privacy concept by those tasks and provide feedback to the individual RTD work packages.

Roles: As a recognised partner in the domain of security and privacy of computational systems, IKERLAN will lead this task. Technological partners CMS, ASC, and KBZ will also contribute to this task.

#### Participation per Partner

Partner number and short name	WP2 effort
1 - ICE	9.00
2 - IKERLAN	8.00
3 - UNINOVA	6.00
4 - UPV	10.00
5 - CMS	7.00
6 - LYON2	6.00
7 - ASC	12.50
8 - ALM	6.00
9 - MASS	1.50
10 - VS	1.50
11 - CONSULGAL	1.50
12 - KBZ	3.00
13 - APR	1.50
14 - Tardy	1.50
<b>Total</b>	<b>75.00</b>

List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D2.1	vfOS - ID2.1 - Global Architecture Definition(M7)	1 - ICE	Report	Public	7
D2.2	vfOS - ID2.2 - Functional Specification & Mockups(M9)	4 - UPV	Report	Public	9
D2.3	vfOS - ID2.3 - Technical Specification(M12)	7 - ASC	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D2.4	vfOS - ID2.4 - Holistic Security and Privacy Concept(M10)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	10

Description of deliverables

D2.1 : vfOS - ID2.1 - Global Architecture Definition(M7) [7]

The deliverable document will present the architecture based on the main components defined in this DOA but it will be performed in a greater level of detail and will also involve the specification of subcomponents and actors. As well as the internal architecture connected with the project it will cover the architecture of applications to be developed by third party software developers who will eventually use easy integration in the vf-OS platform.

D2.2 : vfOS - ID2.2 - Functional Specification & Mockups(M9) [9]

This task will deliver a Functional Specification document to provide an in-depth definition of the functionalities and behaviours of all vf-OS components. It will also explain how related requirements will be fulfilled as an important means to measure the outcome of the individual tasks and the overall project. Furthermore, all possible interactions between the vf-OS components will be detailed and depicted so as to guide the overall flow of functionalities and data between components. Components will be split into subcomponents and defined following a unified approach. For components that feature a user interface a first mock-up of the GUI (created in Balsamiq) will be included through close RTD provider/user interaction.

D2.3 : vfOS - ID2.3 - Technical Specification(M12) [12]

This task will deliver a Technical Specification, which is the final outcome of the project-wide software engineering process and is based on the Functional Specification. Since this represents core partner IPR for exploitation this specification will remain confidential. It will define concrete interfaces between vf-OS software components, protocols and class/package structures, including definitions of methods, parameters, return values, and error handling for each component and interface. It will define data models and concrete data schemas to be used on the source code level. It will also select the (software) technologies to be reused and applied within the project based on a study of possible technologies and in cooperation with the SOTA Wiki Task. Based on this, it will define the missing functionalities and implementation needs that are the foundation for the work to be performed in the RTD work packages WP3-7.

D2.4 : vfOS - ID2.4 - Holistic Security and Privacy Concept(M10) [10]

This deliverable will identify suitable general approaches and standards to be applied – an early report will help tune the specification tasks. Concrete guidelines will be generated which need to be taken into account throughout the vf-

OS software development tasks. Since this area is cross-cutting the actual relevant security for each component will be applied within the individual tasks.

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>
MS2	R2 - Prepared	7 - ASC	12	<ul style="list-style-type: none"> <li>• Global Architecture defined</li> <li>• Technical specifications including Mockups prepared</li> <li>• Security and Privacy Concept produced</li> <li>• Kernel/FI-Ware Framework defined and first Enablers Prototyped</li> <li>• I/O Tool Kit specified</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP3	<b>Lead beneficiary</b> <sup>10</sup>	3 - UNINOVA
<b>Work package title</b>	Virtual Factory System Kernel		
<b>Start month</b>	5	<b>End month</b>	24

### Objectives

O3 To design, develop, and deploy the “vf-OS kernel”

O3.1 To define a framework which will generically allow existing enablers, and new enablers, core to vf-OS to be used throughout the vf-OS environment

O3.2 To ‘wrap’ relevant FI-WARE Generic Enablers into vf-OS

O3.3 To ‘wrap’ relevant FI-WARE Manufacturing/Specific Enablers into vf-OS

O3.4 To create compatible Enablers relevant for the vf-OS Project/Requirements

O3.5 To utilise/adapt an existing commercial-grade open source Process Execution engine for to vf-OS

In computing, the “kernel” is a computer program that manages requests from software, and translates them into data processing instructions for the central processing unit and other electronic components of a system. At its deepest level it can be considered as the machine code or the BIOS. Its functionality is intrinsic to the start-up of the system and its operation thereafter with the service calls being common across all applications at even the deepest level such as interrupt handling, space allocation, and process management.

In this sense the aim of WP3 is in specifying, developing, and deploying the “vf-OS kernel”: A specific set of core functions and infrastructure for vf-OS applications to be built upon and interact with each other. The “vf-OS kernel” is also the core of the operating system, responsible for the processing and mediating the access to all vf-OS resources. The basic services to be offered by the “vf-OS kernel” are related to setup a specific core of services which will be used by the manufacturing Applications of the pilots. This work package will design and implement these services; these will be open, accessible, and comply with the requirements of the manufacturing Apps such as supporting easy integration in the vf-OS platform.

However, there is no point creating a kernel from scratch and vf-OS has several starting points with a strong one being the aforementioned FI-WARE initiative. Its Generic and Specific Enables can offer the basis for much of this Kernel. This WP allows this although for some enablers, specifically the process engine, due to its pervasive use throughout the vf-OS a specific task is envisioned although still taking use of existing open software but at a commercial grade. This task will shape it to be suitable for the project.

General Note: Broadly speaking all WP3-7 activity follow a 6 monthly development synchronisation phasing such that the different tasks/work packages are synchronised together. In addition, within each task, an agile process will be followed based on a monthly cycle. This is detailed in the management section along with milestones which represent these phases. The lower level WPs such as WP3 and 4 will start and finish early than the higher level WPs such as 6 and 7.

### Description of work and role of partners

**WP3 - Virtual Factory System Kernel** [Months: 5-24]

UNINOVA, ICE, LYON2, KBZ

This task is composed of a hierarchy of intrinsic enablers. The initial Kernel/Framework task (T3.1) starts off by defining a proposition which will generically fit existing enablers and enablers core to vf-OS into a framework which allows them to be used throughout the vf-OS environment. This framework is then used to ‘wrap’ both FI-WARE Generic (T3.2) and FI-WARE Manufacturing orientated Enablers (T3.3). This will not be for all FI-WARE enablers but for those that have most relevance to the scope of the project and in particular the manufacturing pilots. The vs-OS Enablers (T3.4) are in essence specific enablers which are needed for vf-OS but do not currently exist and will be created in the project based on the requirements. The final task, vf-OS Process Enabler (T3.5), is a process execution engine which will be responsible for managing all Application processes and is felt to be so intrinsic to vf-OS it will be based on existing commercial-grade but open source tools.

T3.1 vf-OS Kernel and FI-WARE Framework UNINOVA M5-10

D3.1 vf-OS Kernel and FI-WARE Framework OTHER PU 10 R2

The Kernel/Framework task is set in defining a proposition which will generically fit existing enablers and enablers’ core to vf-OS into a framework which allows them to be used throughout the vf-OS environment.

Roles: UNINOVA will lead this task considering its recognised experience developing for FI-WARE. LYON2 and KBZ will contribute to this task bringing their expertise in the implementation of FIWARE enablers applied for industrial environments.

### T3.2 FI-WARE Generic Enablers UNINOVA M7-24

D3.2abc FI-WARE Generic Enablers OTHER PU 12, 18, 24 R2 & R3 & R4

This task will take the framework and policies for T3.1 and apply them to the FI-WARE generic enablers which makes sense in the context of vf-OS, its manufacturing setting and in particular the pilot requirements. These will then form a basis for developed Applications to utilise knowing that the specific enablers have already been proven to work inside the vf-OS environment. Of particular interest, since they have no counterpart in vf-OS WPs, are IoT Enablers such as “IoT Discovery” and “IoT Broker” as well as security enablers such as “AuthZforce” and “Identity Management”.

Roles: UNINOVA will lead this task and together with KBZ will use their experience in using FI-WARE Generic Enablers to set them in the manufacturing setting for the particular vf-OS pilot requirements.

### T3.3 FI-WARE Manufacturing Enablers LYON2 M7-24

D3.3abc FI-WARE Manufacturing Enablers OTHER PU 12, 18, 24 R2 & R3 & R4

This task is similar to T3.2 but will focus on the FI-WARE specific enablers and those which come under the FI-WARE ‘Manufacturing category’ or could be slotted into it. In particular, enablers from the FITMAN project of which partner UNINOVA and LYON2 were members of will be re-purposed – FITMAN: “provides the FI-PPP Core Platform with 10 industry-led use cases which [...] FIWARE GEs and FITMAN SEs while contributing to the [...] sustainability of EU Manufacturing Industries.”

Roles: LYON2 will lead this task and together with UNINOVA will use their experience in developing FI-WARE Specific Enablers to respond to the particular manufacturing pilot requirements.

### T3.4 vf-OS Enablers KBZ M7-24

D3.4abc vf-OS Enablers OTHER PU 12, 18, 24 R2 & R3 & R4

Both T3.2 and T3.3 rely on existing FI-WARE enablers which are designed to be generic but equally were designed for “others”; they are also considered in many cases to be ‘large’ functional components such as “Kurento” which claims to create “complex media applications”. Thus this task will look more closely at vf-OS needs and develop (smaller) enablers from scratch based on the requirements and pilots but which are felt to be still intrinsic to the vf-OS system. The T3.1 framework will be used as the basis for this task.

Roles: KBZ will lead, assisted by LYON2, will use their large experience in development of enablers to implement the novel vf-OS enablers based on the requirements and pilots that will be intrinsic to the vf-OS system.

### T3.5 vf-OS Process Enabler ICE M7-24

D3.5abc vf-OS Process Enabler OTHER PU 12, 18, 24 R2 & R3 & R4

Process execution and interrupt handling will be responsible for managing manufacturing Applications and affect the processes which are currently running. When a manufacturing app makes requests to the kernel, the request is called as a system call. This task will define and implement the kernel processor and how it will manage system calls and resources. The process execution engine is felt to be so intrinsic to vf-OS it will be based on existing commercial-grade but open source tools and by default the Talend suite.

Roles: ICE will provide their insights in operating systems development to develop the vf-OS kernel processor. ICE will lead this task as an experienced middleware developer.

## Participation per Partner

Partner number and short name	WP3 effort
1 - ICE	16.00
3 - UNINOVA	30.00
6 - LYON2	16.00
12 - KBZ	24.00
<b>Total</b>	<b>86.00</b>



### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D3.1	vfOS - ID3.1 - vf-OS Kernel and FI-WARE Framework(M10)	3 - UNINOVA	Other	Public	10
D3.2	vfOS - ID3.2a - FI-WARE Generic Enablers(M12)	3 - UNINOVA	Other	Public	12
D3.3	vfOS - ID3.2b - FI-WARE Generic Enablers(M18)	3 - UNINOVA	Other	Public	18
D3.4	vfOS - ID3.2c - FI-WARE Generic Enablers(M24)	3 - UNINOVA	Other	Public	24
D3.5	vfOS - ID3.3a - FI-WARE Manufacturing Enablers(M12)	6 - LYON2	Other	Public	12
D3.6	vfOS - ID3.3b - FI-WARE Manufacturing Enablers(M18)	6 - LYON2	Other	Public	18
D3.7	vfOS - ID3.3c - FI-WARE Manufacturing Enablers(M24)	6 - LYON2	Other	Public	24
D3.8	vfOS - ID3.4a - vf-OS Enablers(M12)	12 - KBZ	Other	Public	12
D3.9	vfOS - ID3.4b - vf-OS Enablers(M18)	12 - KBZ	Other	Public	18
D3.10	vfOS - ID3.4c - vf-OS Enablers(M24)	12 - KBZ	Other	Public	24
D3.11	vfOS - ID3.5a - vf-OS Process Enabler(M12)	1 - ICE	Other	Public	12
D3.12	vfOS - ID3.5b - vf-OS Process Enabler(M18)	1 - ICE	Other	Public	18
D3.13	vfOS - ID3.5c - vf-OS Process Enabler(M24)	1 - ICE	Other	Public	24

### Description of deliverables

D3.1 : vfOS - ID3.1 - vf-OS Kernel and FI-WARE Framework(M10) [10]

The deliverable will be the creation of a framework, including code and policies, which facilitates the creation of enablers in the remainder of WP3.



D3.2 : vfOS - ID3.2a - FI-WARE Generic Enablers(M12) [12]

Delivery of code/package of re-purposed FI-Ware generic enablers according to the vf-OS Kernel framework will complete this task.

D3.3 : vfOS - ID3.2b - FI-WARE Generic Enablers(M18) [18]

Update of the previous deliverable

D3.4 : vfOS - ID3.2c - FI-WARE Generic Enablers(M24) [24]

Update of the previous deliverable

D3.5 : vfOS - ID3.3a - FI-WARE Manufacturing Enablers(M12) [12]

Delivery will be the code/package of Repurposed FI-Ware specific/manufacturing enablers according to the vf-OS Kernel framework.

D3.6 : vfOS - ID3.3b - FI-WARE Manufacturing Enablers(M18) [18]

Update of the previous deliverable

D3.7 : vfOS - ID3.3c - FI-WARE Manufacturing Enablers(M24) [24]

Update of the previous deliverable

D3.8 : vfOS - ID3.4a - vf-OS Enablers(M12) [12]

The delivery will be the Creation/Repackaging and delivery of code/package of vf-OS specific manufacturing enablers according to the vf-OS Kernel framework.

D3.9 : vfOS - ID3.4b - vf-OS Enablers(M18) [18]

Update of the previous deliverable

D3.10 : vfOS - ID3.4c - vf-OS Enablers(M24) [24]

Update of the previous deliverable

D3.11 : vfOS - ID3.5a - vf-OS Process Enabler(M12) [12]

Delivery will be the repackaging and production of the vf-OS Processing Engine.

D3.12 : vfOS - ID3.5b - vf-OS Process Enabler(M18) [18]

Update of the previous deliverable

D3.13 : vfOS - ID3.5c - vf-OS Process Enabler(M24) [24]

Update of the previous deliverable

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	R2 - Prepared	7 - ASC	12	<ul style="list-style-type: none"> <li>• Global Architecture defined</li> <li>• Technical specifications including Mockups prepared</li> <li>• Security and Privacy Concept produced</li> <li>• Kernel/FI-Ware Framework defined and first Enablers Prototyped</li> <li>• I/O Tool Kit specified</li> </ul>
MS3	R3 - Developed	3 - UNINOVA	18	<ul style="list-style-type: none"> <li>• Developed prototypes of initial background work packages</li> <li>• First OAK Developments accomplished</li> <li>• Use case definitions updated</li> <li>• All</li> </ul>

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				specifications defined • Second Exploitation Plans
MS4	R4 - Refined	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages • First prototypes of OAK and Platform components • First phase of use case demonstrators – Smart Apps Development (initial) focus • Research Workshop Successful</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP4	<b>Lead beneficiary</b> <sup>10</sup>	4 - UPV
<b>Work package title</b>	Virtual Factory I/O		
<b>Start month</b>	7	<b>End month</b>	33

### Objectives

O4 To provide vf-OS the means for Input/Output (I/O), and thus integrate with real factories and serve as interoperability mechanisms between the factory and vf-OS

O4.1 To define and develop a toolkit, the vf I/O, to further develop Drivers and APIs

O4.2 To create a set of functional “Device Drivers” based on the I/O toolkit

O4.3 To create a set of functional “APIs” based on the I/O toolkit

O4.4 To implement security policies and procedures that protect of factory assets, people and data

WP4 aims at providing vf-OS with the means to integrate with real factories through the definition of Open APIs, interconnection modules and drivers that serve as interoperability mechanisms between the factory and the vf-OS platform. In the vf-OS concept diagram it represents largely “Manufacturing Systems” which Manufacturing users may expose through vf-OS applications or other service/gateways. It will develop the Virtual Factory Plug-and-Play mechanisms and device drivers/APIs for seamless/open access and smart virtualisation of the factory resources. It will also provide a set of collaborative tools for the supporting factory business. The focus is the creation of modules that virtualise the factories real assets and connect them to their virtual images in the vf-OS platform. This integration between the factory and vf-OS will be seamless; hence transparency and openness are keys for the definition of APIs to interface factories and vf-OS. Security is also a strong asset to tackle in this WP and protect the 2nd party factor assets. Whilst not an exact split, the difference between drivers and APIs can be boiled down to:

- Drivers: Typically physical peripheral resources (machines, controllers, etc.)
- APIs: Typically virtual resources (cloud services, software, etc.)

### Description of work and role of partners

#### **WP4 - Virtual Factory I/O** [Months: 7-33]

UPV, IKERLAN, LYON2, ALM

This WP starts with task (T4.1) which builds and develops a Device Driver/API framework to provide core toolkit software for the subsequent tasks of the WP. This starts with Device Drivers (T4.2), which will take this toolkit and build specific connectors (drivers) for popular/relevant factory assets, such as PLC, Machines, ERPs with a priority taken from the requirements document D1.5 as well as the needs of the validation pilots. Similarly, the API Connectors (T4.3) takes this toolkit and does the same job for popular/relevant APIs. Finally, the security task (T4.4) is intended to protect these assets.

T4.1 Devices Drivers and Open API Toolkit UPV M7-M24

D4.1.1 Devices Drivers/API Toolkit - Specifications R PU 12 R2

D4.1.2ab Devices Drivers/API Toolkit - Software OTHER PU 18, 24 R3 & R4

This task will define and develop (based on the vf-OS architecture) a toolkit for the APIs that are required to integrate vf-OS with the factory. The Device Driver/API Toolkit Specification (D4.1.1) will further detail the specifications regarding the creation and development of the vf-OS devices drivers, Open APIs, and test cases, in order to enable very flexible and customisable elements that are able to connect the real factories’ resources to the virtualised elements and services of vf-OS.

This task will also produce the base software technology/library (D4.1.2) derived from the specifications, which can facilitate the interconnection and design of both the device drivers and APIs, in order to enable the seamless/open access to resources, and provide a base toolkit for the precise drivers/APIs of T4.2 and T4.3. This toolkit will be a flexible infrastructure adaptable to the applications and tools which are provided by vf-OS.

Roles: UPV (Leader), together with LYON2 and ALM, develop the device driver/API framework via D412ab and UOV will design it with assistance from the other WP4 partners (out of WP4 resources).

T4.2 Devices Drivers UPV M13-33

D4.2abc Devices Drivers OTHER PU 24, 30, 33 R2 & R3 & R4

Task 4.2 will analyse the requirements and use cases from WP1 and WP7 and according to the needs of each, develop and deliver the needed drivers for the vf-OS business pilots. The outcomes of this task are the software of the developed

drivers (D4.2). Device Drivers will typically create gateways to physical peripheral resources (eg machines, controllers, etc.).

Roles: UPV (task leader) and ALM will analyse the requirements for the business pilot device drivers, and develop them and integrate them in the vf-OS platform.

#### T4.3 API Connectors LYON2 M13-33

D4.3abc API Connectors OTHER PU 24, 30, 33 R2 & R3 & R4

This task will develop and deliver the core vf-OS software API Connectors (D4.3) of the toolkit on a similar basis to T4.2, based upon the outcome of T4.1 and T4.2. These will permit an open and seamless access to the vf-OS Functionalities/ Drivers. APIs will typically create gateways to virtual (vs. physical) peripheral resources (eg ERPs, CRMs, Cloud Services, etc.).

Roles: LYON2 (will analyse the requirements for the business pilots APIs, and develop them and integrate them in the vf-OS platform.

#### T4.4 Security & Data Access IKERLAN M13-24

D4.4ab Security & Data Access OTHER PU 18, 24 R3 & R4

A specific focus of vf-OS is on the integration of data from various (real-time) factory resources and data sources, which can be foreseen as “sensitive”, and will invariably need security considerations. Service developers need to be provided with tools to securely store data within the Cloud. This deliverable represents the core security structure and developed/ delivered artefact which will help protect 2nd party factory assets and can be quickly integrated in to applications.

Roles: IKERLAN has experience in security and data access in industrial setting and will lead this task and so provide the technological insights for the developments.

### Participation per Partner

Partner number and short name	WP4 effort
2 - IKERLAN	8.00
4 - UPV	27.00
6 - LYON2	27.00
8 - ALM	12.00
<b>Total</b>	<b>74.00</b>

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D4.1	vfOS - ID4.1.1 - Devices Driver/ API Toolkit - Specifications(M12)	4 - UPV	Report	Public	12
D4.2	vfOS - ID4.1.2a - Devices Driver/ API Toolkit - Software(M18)	4 - UPV	Other	Public	18
D4.3	vfOS - ID4.1.2b - Devices Driver/ API Toolkit - Software(M24)	4 - UPV	Other	Public	24
D4.4	vfOS - ID4.2a - Devices Drivers(M24)	4 - UPV	Other	Public	24

List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D4.5	vfOS - ID4.2b - Devices Drivers(M30)	4 - UPV	Other	Public	30
D4.6	vfOS - ID4.2c - Devices Drivers(M33)	4 - UPV	Other	Public	33
D4.7	vfOS - ID4.3a - APIs Connectors(M24)	6 - LYON2	Other	Public	24
D4.8	vfOS - ID4.3b - APIs Connectors(M30)	6 - LYON2	Other	Public	30
D4.9	vfOS - ID4.3c - APIs Connectors(M33)	6 - LYON2	Other	Public	33
D4.10	vfOS - ID4.4a - Security & Data Access(M18)	2 - IKERLAN	Other	Public	18
D4.11	vfOS - ID4.4b - Security & Data Access(M24)	2 - IKERLAN	Other	Public	24

Description of deliverables

D4.1 : vfOS - ID4.1.1 - Devices Driver/API Toolkit - Specifications(M12) [12]

The Device Driver/API Toolkit Specification (D4.1.1) will further detail the specifications regarding the creation and development of the vf-OS devices drivers, Open APIs, and test cases, in order to enable very flexible and customisable elements that are able to connect the real factories' resources to the virtualised elements and services of vf-OS.

D4.2 : vfOS - ID4.1.2a - Devices Driver/API Toolkit - Software(M18) [18]

This task will also produce the base software technology/library (D4.1.2) derived from the specifications, which can facilitate the interconnection and design of both the device drivers and APIs, in order to enable the seamless/open access to resources, and provide a base toolkit for the precise drivers/APIs of T4.2 and T4.3. This toolkit will be a flexible infrastructure adaptable to the applications and tools which are provided by vf-OS.

D4.3 : vfOS - ID4.1.2b - Devices Driver/API Toolkit - Software(M24) [24]

Update of the previous deliverable

D4.4 : vfOS - ID4.2a - Devices Drivers(M24) [24]

The outcomes of this task are the software of the developed drivers (D4.2). Device Drivers will typically create gateways to physical peripheral resources (eg machines, controllers, etc.).

D4.5 : vfOS - ID4.2b - Devices Drivers(M30) [30]

Update of the previous deliverable

D4.6 : vfOS - ID4.2c - Devices Drivers(M33) [33]

Update of the previous deliverable

D4.7 : vfOS - ID4.3a - APIs Connectors(M24) [24]

This task will develop and deliver the core vf-OS software API Connectors (D4.3) of the toolkit on a similar basis to T4.2, based upon the outcome of T4.1 and T4.2.

D4.8 : vfOS - ID4.3b - APIs Connectors(M30) [30]

Update of the previous deliverable

D4.9 : vfOS - ID4.3c - APIs Connectors(M33) [33]

Update of the previous deliverable

D4.10 : vfOS - ID4.4a - Security & Data Access(M18) [18]

This deliverable represents the core security structure and developed/delivered artefact which will help protect 2nd party factory assets and can be quickly integrated in to applications.

D4.11 : vfOS - ID4.4b - Security & Data Access(M24) [24]

Update of the previous deliverable

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	R2 - Prepared	7 - ASC	12	<ul style="list-style-type: none"> <li>• Global Architecture defined</li> <li>• Technical specifications including Mockups prepared</li> <li>• Security and Privacy Concept produced</li> <li>• Kernel/FI-Ware Framework defined and first Enablers Prototyped</li> <li>• I/O Tool Kit specified</li> </ul>
MS3	R3 - Developed	3 - UNINOVA	18	<ul style="list-style-type: none"> <li>• Developed prototypes of initial background work packages</li> <li>• First OAK Developments accomplished</li> <li>• Use case definitions updated</li> <li>• All specifications defined</li> <li>• Second Exploitation Plans</li> </ul>
MS4	R4 - Refined	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages</li> <li>• First prototypes of OAK and Platform components</li> <li>• First phase of use case demonstrators – Smart Apps Development (initial) focus</li> <li>• Research Workshop Successful</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP5	<b>Lead beneficiary</b> <sup>10</sup>	1 - ICE
<b>Work package title</b>	Virtual Factory Data and Connect		
<b>Start month</b>	13	<b>End month</b>	30

### Objectives

O5 To create the vf-OS data infrastructure including interoperability connectors, storage, transformation services, and analytics functionality

O5.1 To develop a middleware data infrastructure accounting for heterogeneity, volumes and speed

O5.2 To implement a scalable data storage capable of handling real-time sensor data and events

O5.3 To develop semantic-based mechanisms for harmonising sensor data

O5.4 To develop off-line analytic methods for enrichment, analysis, and interpretation of data

The applications foreseen in vf-OS will consume and/or produce tremendous amounts of data. Handling such amounts of data becomes challenging, according to orthogonal concerns; namely: Data must be connected – this not only includes using the WP4 toolkit, but also managing the movement of this data through middleware (Messaging) which is also linked to WP3 process execution; the storage capability must scale, ie the underlying infrastructure must transparently absorb very large amounts of eg machine and sensed data. Next, before applications consume this data, it must typically be mapped from input to output type – this will be facilitated via semantic harmonisation and transformation techniques; finally, for consumption analytics interfaces provided by the infrastructure must scale to extract relevant data subsets according to user's expectations in the simplest possible way. To access the data, it also includes all the elements required for data stream management, ie: reading, cleaning, storing, indexing, enrichment, search & retrieval, fusion, maintenance, and correspondence of open APIs. The data infrastructure will serve analytic and decision making services.

### Description of work and role of partners

#### **WP5 - Virtual Factory Data and Connect** [Months: 13-30]

ICE, IKERLAN, UNINOVA, MASS, VS, CONSULGAL, KBZ, APR, Tardy

This work package will provide a set of semi-independent but related services with the inputs of data in a variety of format, at large scale, at different speeds, and providing set of nontrivial analytic operators. The Data Infrastructure Middleware (T5.1) will provide the core access, which can utilise Data Storage (T5.2) for permanent and cross application access. Data Harmonisation (T5.3) will provide innovative transformation services, based on semantics, and is particularly connected to T5.1 for data connectivity. All three will be supported by the analytics engine T5.4. In all cases, existing technologies/open solutions or background IPR will be used where possible, since it is not the need, purpose, or feasibility to build such heavy duty functionality within the project itself.

T5.1 Data Infrastructure Middleware UNINOVA M13-30

D5.1abc Data Infrastructure OTHER PU 18, 24, 30 R3 & R4 & R5

This task will specify and implement a messaging/data bus that will support the other components of WP5 and of vf-OS application for data storage, transformation, and analytic operations. The data infrastructure will contain adapters which will be developed for necessary data sources including, sensor data, ERP, machines, etc. and take advantage of WP4 activity. Adapters will be developed for necessary enterprise information sources such as hardware sensors (which might include accelerometers, vibration, and temperature sensors), software sensors from ERP systems and external business context data. Since sensor data typically generates large amounts of micro measurements, the supporting data infrastructure needs to support a high throughput technology pipeline for acquisition, pre-processing, and aggregation of the collected data.

A "publish-subscribe" (pub-sub) middleware will help realise an Event Driven Architecture (EDA) and infrastructure for components and end user services. Pub-sub middleware will provide the data infrastructure and will be fully compatible with major industry standards (eg JBI, SCA, BPEL or WSDL). Most likely this functionality will be built on the top of existing open source products, such as the Talend suite (and as examined in the SOTA of WP1), since it is not the purpose (nor the possibility) of the project to build such complex infrastructures especially when these freely exist. The aim is to prepare the data into a form which allows higher level decision making services to perform their tasks. The result of T5.1 will be a software module (D5.1) implementing the pipeline for sensor data acquisition, cleaning, storing, simple enrichment, indexing and querying.



Roles: UNINOVA (leader) together with IKERLAN will design and develop the architecture and implement the services for the data infrastructure middleware. The industrial partners will provide their needs on data infrastructure access needs for their business scenarios.

#### T5.2 Data Storage IKERLAN M13-30

##### D5.2abc Data Storage OTHER PU 18, 24, 30 R3 & R4 & R5

This task will specify and implement vf-OS data storage module (D5.2), supporting three major dimensions of “Big Data” when dealing with intensive streaming data, namely: Volume (scale of data processed), Velocity (speed of moving data and optimised reaction time), and Variety (supporting heterogeneous types to data under consideration). The veracity dimension (fuzziness of data) will not be explored in this specific project. The data storage will be designed around modern NoSQL data storage infrastructure (minimising overheads when processing data and maximising flexibility in terms of data schemas being used), complemented with approaches developed specifically for handling sensor data.

Dedicated event storage is also foreseen, in order to provide event forwarding (in the form of RDF triples) received from pre-processing services, such as the transformation task. It will be realised as an event cloud - a scalable, semantic, P2P based repository that delivers RDF events to the requesting parties (subscribers). These will be pushed and are relevant to external services or project related components. At the same time, vf-OS should store the events for historical and statistical purposes, and supports synchronous and asynchronous queries expressed in a subset of the SPARQL language and accessible through corresponding APIs.

Roles: IKERLAN leads this task implementing the vf-OS data storage module. UNINOVA will support the technical developments. The industrial partners will provide their data storage needs for their business scenarios.

#### T5.3 Data Harmonisation ICE M13-30

##### D5.3abc Data Harmonisation OTHER PU 18, 24, 30 R3 & R4 & R5

Data Harmonisation aims to (a) extract information from incoming data and (b) prepare the data in a form/schema suitable for other tasks in the subsequent work packages. It will enable semantic enrichment with background knowledge and data mining of real-time streams, received through the data bus. The data enrichment objective is to generate from the observed data additional derived attributes/features, either using external background knowledge or internal relationships within data. This could include the use of external ontologies, statistically derived knowledge, (models) of data and/or temporal characteristics of data. The key aim is to encode functional transformations of data to help analytic techniques of T5.4 to detect non-linear and other nontrivial patterns within the data (otherwise non-detectable by traditional analytic techniques). This will be built using background technology from partner ICE, who is constructing a semantic enablement platform driving syntactical data transformation to the next level, such that transformation maps and element data maps can be quickly (even automatically) generated, thus speeding up interconnections between different sources and interactions. The deliverable represents the functionalities of the semantic-based data harmonisation services.

Roles: ICE will lead this task with the technical contribution of UNINOVA. All who have expertise regarding semantic interoperability, data transformations, and data harmonisation. The industrial partners will provide the data harmonisation needs for their business scenarios.

#### T5.4 Data Analytics ICE M13-30

##### D5.4abc Data Analytics OTHER PU 18, 24, 30 R3 & R4 & R5

This task covers the creation of building blocks for off-line analytical processing of sensor inputs. This will include machine learning algorithms supporting supervised and unsupervised scenarios. The core of the analytic algorithms will be based on the combination of the modern statistical-machine-learning linear-algebra based algorithms (eg SVM, CRF, LDA, Mixture-Models) and traditional data-mining algorithms (eg decision trees and rules, k-means, association rules). This will cover typical classification and segmentation scenarios for enriched representations coming from semantic based ontological descriptions to capture nonlinearities in data. The key research innovation will be provided by using “multi-level” analysis on the top of more traditional machine learning algorithms simultaneously observing the data on multiple aggregation levels. Once again, it is not the possibility nor need of the project to build a data analytics platform from scratch thus in the nature of the project it will take an existing platform or technology, derived from the SOTA of WP1, and then wrap and massage it to suit the challenge of the vf-OS project. The deliverable represents the functionalities of the data analytics.

Roles: ICE will lead this task, with the technical contribution of IKERLAN all with recognised expertise on data analytics. The industrial partners will provide the data harmonisation needs for their business scenarios.



Partner number and short name	WP5 effort
1 - ICE	35.00
2 - IKERLAN	22.00
3 - UNINOVA	25.00
9 - MASS	2.00
10 - VS	2.00
11 - CONSULGAL	2.00
12 - KBZ	2.00
13 - APR	2.00
14 - Tardy	2.00
<b>Total</b>	<b>94.00</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D5.1	vfOS - ID5.1a - Data Infrastructure Middleware(M18)	3 - UNINOVA	Other	Public	18
D5.2	vfOS - ID5.1b - Data Infrastructure Middleware(M24)	3 - UNINOVA	Other	Public	24
D5.3	vfOS - ID5.1c - Data Infrastructure Middleware(M30)	3 - UNINOVA	Other	Public	30
D5.4	vfOS - ID5.2a - Data Storage(M18)	2 - IKERLAN	Other	Public	18
D5.5	vfOS - ID5.2b - Data Storage(M24)	2 - IKERLAN	Other	Public	24
D5.6	vfOS - ID5.2c - Data Storage(M30)	2 - IKERLAN	Other	Public	30
D5.7	vfOS - ID5.3a - Data Harmonisation(M18)	1 - ICE	Other	Public	18
D5.8	vfOS - ID5.3b - Data Harmonisation(M24)	1 - ICE	Other	Public	24
D5.9	vfOS - ID5.3c - Data Harmonisation(M30)	1 - ICE	Other	Public	30
D5.10	vfOS - ID5.4a - Data Analytics(M18)	1 - ICE	Other	Public	18

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D5.11	vfOS - ID5.4b - Data Analytics(M24)	1 - ICE	Other	Public	24
D5.12	vfOS - ID5.4c - Data Analytics(M30)	1 - ICE	Other	Public	30

### Description of deliverables

D5.1 : vfOS - ID5.1a - Data Infrastructure Middleware(M18) [18]

The result of T5.1 will be a software module (D5.1) implementing the pipeline for sensor data acquisition, cleaning, storing, simple enrichment, indexing and querying.

D5.2 : vfOS - ID5.1b - Data Infrastructure Middleware(M24) [24]

Update of the previous deliverable

D5.3 : vfOS - ID5.1c - Data Infrastructure Middleware(M30) [30]

Update of the previous deliverable

D5.4 : vfOS - ID5.2a - Data Storage(M18) [18]

This task will specify and implement vf-OS data storage module (D5.2), supporting three major dimensions of “Big Data” when dealing with intensive streaming data, namely: Volume (scale of data processed), Velocity (speed of moving data and optimised reaction time), and Variety (supporting heterogeneous types to data under consideration).

D5.5 : vfOS - ID5.2b - Data Storage(M24) [24]

Update of the previous deliverable

D5.6 : vfOS - ID5.2c - Data Storage(M30) [30]

Update of the previous deliverable

D5.7 : vfOS - ID5.3a - Data Harmonisation(M18) [18]

The deliverable represents the functionalities of the semantic-based data harmonisation services.

D5.8 : vfOS - ID5.3b - Data Harmonisation(M24) [24]

Update of the previous deliverable

D5.9 : vfOS - ID5.3c - Data Harmonisation(M30) [30]

Update of the previous deliverable

D5.10 : vfOS - ID5.4a - Data Analytics(M18) [18]

The deliverable represents the functionalities of the data analytics.

D5.11 : vfOS - ID5.4b - Data Analytics(M24) [24]

Update of the previous deliverable

D5.12 : vfOS - ID5.4c - Data Analytics(M30) [30]

Update of the previous deliverable

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS3	R3 - Developed	3 - UNINOVA	18	• Developed prototypes of initial background

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				work packages • First OAK Developments accomplished • Use case definitions updated • All specifications defined • Second Exploitation Plans
MS4	R4 - Refined	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages • First prototypes of OAK and Platform components • First phase of use case demonstrators – Smart Apps Development (initial) focus • Research Workshop Successful</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP6	<b>Lead beneficiary</b> <sup>10</sup>	5 - CMS
<b>Work package title</b>	Open Applications Development Kit (OAK)		
<b>Start month</b>	16	<b>End month</b>	36

## Objectives

O6 To define the vf-OS Open Application Development framework including the SDK (OAK), a hub to engage developers, a system dashboard, and the OAK Studio for development

O6.1 OAK SDK: To define and develop the application development environment in which all vf-OS Applications can be developed. This includes SDK documentation

O6.2 OAK System Dashboard: To develop system applications similar to Windows control panel and task manager for monitoring and adapting system resources

O6.3 OAK FrontEnd Environment: To provide a framework which facilitates the composition of Application front ends

O6.4 OAK Studio: To allow the easy development and integration of the different applications

O6.5 OAK Developer Engagement Hub: To assist developers via a Centralised developer communications center

As part of the transformation of a manufacturing organisation to be part of the manufacturing vf-OS, it needs to make use of a set of applications to support this. To effectively develop these applications (eg as part of WP7 activity) a common development framework is applicable. This is the main objective of WP6: ie to propose and define a framework, called the vf-OS Open Applications Development Kit (OAK), for developing applications allowing this business transformation. Thus WP6 specifies the OAK Data Model, API conventions, and exchange formats to allow both basic development but also a future development paths. In particular OAK will be constructed to allow third parties to develop their own applications and facilitate their integration into the vf-OS Platform thus widening and opening this way the development of specific third parties and specialised applications. OAK will be proposed and defined following the vf-OS architecture specified in WP2 which includes supporting efficient software development and easy integration in the vf-OS platform by those third parties. WP6 will thus also form the corner stone for WP7 applications development platform within (and beyond) the project. OAK will be integrated into the vf-OS platform for its ultimate exploitation. OAK should be perceived as a typical software development kit (SDK or "devkit") which according to Wikipedia can be defined as "a set of software development tools that allows the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar development platform. To create applications you have to download [such a] software development kit." For example, if you want to create an Android app you require an SDK with java programming, for iOS apps you require an iOS SDK with swift language. For a vf-OS application a developer will need to know OAK and utilise the vf-OS Platform of WP7.

## Description of work and role of partners

### WP6 - Open Applications Development Kit (OAK) [Months: 16-36]

CMS, ASC, ALM

The OAK SDK and Documentation task (T6.1) is the core part of this WP and defines the core aspect of the vf-OS, in order to construct applications. The OAK System Dashboard (T6.2) represents the core software services, akin to a Microsoft Windows OS Control Panel or Task Manager, (which allow system monitoring and configuration), and are linked to the applications developed according to the SDK. Since many applications will need front-ends, the OAK FrontEnd environment (T6.3) provides a framework that facilitates a general 'look, feel, and composition' to vf-OS applications and will assist rapid development. It will be used in conjunction with the OAK Studio (T6.4) which is a desktop development environment that facilitates users (software developers) to compose their applications according to the aforementioned components. The Developer Engagement Hub (T6.5) will be based on existing open source environment and is a collaboration platform for developers that can be perceived to be similar to, but a focused subset of, GitHub, Jira, and Stackoverflow.

T6.1 OAK SDK and Documentation CMS M16-36

D6.1.1abc OAK SDK Software OTHER PU 24, 30, 36 R4 & R5 & R6

D6.1.2abc OAK SDK Documentation R PU 24, 30, 36 R4 & R5 & R6

Within Task T6.1, The vf-OS SDK (D6.1.1) supports service developers with the functionalities needed to define, design, develop, and orchestrate manufacturing-related services. The vf-OS Applications/Services SDK, templates and manifest will be developed. Based on the knowledge and technology from previous projects such as Simpli-city (in the mobility sector) and SOA4All (generic services), the project participants will develop an extensive fully documented

API framework that provides developers with the means to easily generate applications and services. The API contains the means to combine services in order to provide value-added service compositions. An important part of OAK will be the Application's Manifest, which will characterise the applications developed in the vf-OS Marketplace of WP7. The Service API offers methods to access functionalities of all technical components that service developers need, such as the easy integration of data from the Cloud-based Information Infrastructure, and the storage of service-specific data within the Cloud. After the applications/services have been developed, they can be registered in the WP7 marketplace. Within vf-OS, applications will be developed in WP8.

Role: The technology partners will design the OAK SDK. CMS is a recognised company in the development of open software and will lead this task. For the documentation part they will be assisted by all other partners in the Workpackage

#### T6.2 OAK System Dashboard - Control Panel and Task Manager ALM M16-36

D6.2abc OAK System Dashboard OTHER PU 24, 30, 36 R4 & R5 & R6

This task will provide a system dashboard, which can be perceived as being akin to Windows Control Panel, Task Manager, or other intrinsic functions for monitoring, warning, configuring, and adapting system resources. It can be used by both service providers, applications developers, and advanced users to test and monitor systems. As an example, it can report back on communication difficulties with connect services (from WP4), as well as service responsiveness or availability.

Role: ALM will lead this task, considering its expertise in the development of software system control interfaces. All technology partners will collaborate in the development of the OAK System Dashboard, Control Panel and Task Manager.

#### T6.3 OAK Front End Environment ASC M16-36

D6.3abc OAK Front End Environment OTHER PU 24, 30, 36 R4 & R5 & R6

This task will provide the vf-OS default end user interface. Based on the WP1 findings and technologies, a multimodal UI will be developed. The applications developed in WP8 can apply and further refine this UI. For example, menu and application structures will be revised according to the findings of user testing. To achieve multimodality, methods, and technologies need to be analysed, enhanced, and integrated with the necessary UI technologies. Invariably an HTML5 solution will be adopted to achieve this and create the flexibility needed.

Role: ASC will lead this task, considering its expertise in the development of computational front end environments. All technology partners will collaborate in the development of the OAK front end environment.

#### T6.4 OAK Studio CMS M16-36

D6.4ab OAK Studio OTHER PU 30, 36 R5 & R6

The vf-OS Application Design Studio is a holistic graphical user interface supporting application developers to easily implement vf-OS-related end user applications by integrating and orchestrating services, APIs, and connectors. The design studio provides application developers with the necessary tools and means to develop and deploy applications on end user devices. The application developer will be supported by a step-by-step procedure which covers the entire development process including the registration of new applications (or updates) at the vf-OS Marketplace.

Role: The technology partners will design the OAK Studio. CMS is a recognised company in the development of open software and will lead this task.

#### T6.5 OAK Developer Engagement Hub CMS M16-36

D6.5ab OAK Developer Engagement Hub OTHER PU 30, 36 R5 & R6

Key to getting application developers on board is for them to use a development environment which they are familiar with – for example GitHub/Stackoverflow/JIRA. These allow developers to interact with each other at both a personal and technical level – for example asking ‘does anyone know how to...’ or to store code for improvement, or track bugs. Certainly vf-OS will not develop this from scratch but base itself on existing system and enhance/restrict them for vf-OS. Importantly, this hub will be used in the actual engagement task of WP7 since as part of the platform vf-OS will encourage developers and train them.

Role: The technology partners will design and implement the OAK Developer Engagement Hub. CMS is a recognised company in the development of open software and integrator and will lead this task.

### Participation per Partner

Partner number and short name	WP6 effort
5 - CMS	62.00
7 - ASC	32.00

Partner number and short name	WP6 effort
8 - ALM	12.00
<b>Total</b>	<b>106.00</b>

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D6.1	vfOS - ID6.1.1a - OAK SDK - Software(M24)	5 - CMS	Other	Public	24
D6.2	vfOS - ID6.1.1b - OAK SDK - Software(M30)	5 - CMS	Other	Public	30
D6.3	vfOS - ID6.1.1c - OAK SDK - Software(M36)	5 - CMS	Other	Public	36
D6.4	vfOS - ID6.1.2a - OAK SDK - Documentation(M24)	5 - CMS	Report	Public	24
D6.5	vfOS - ID6.1.2b - OAK SDK - Documentation(M30)	5 - CMS	Report	Public	30
D6.6	vfOS - ID6.1.2c - OAK SDK - Documentation(M36)	5 - CMS	Report	Public	36
D6.7	vfOS - ID6.2a - OAK System Dashboard(M24)	8 - ALM	Other	Public	24
D6.8	vfOS - ID6.2b - OAK System Dashboard(M30)	8 - ALM	Other	Public	30
D6.9	vfOS - ID6.2c - OAK System Dashboard(M36)	8 - ALM	Other	Public	36
D6.10	vfOS - ID6.3a - OAK Front End(M24)	7 - ASC	Other	Public	24
D6.11	vfOS - ID6.3b - OAK Front End(M30)	7 - ASC	Other	Public	30
D6.12	vfOS - ID6.3c - OAK Front End(M36)	7 - ASC	Other	Public	36
D6.13	vfOS - ID6.4a - OAK Studio(M30)	5 - CMS	Other	Public	30

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D6.14	vfOS - ID6.4b - OAK Studio(M36)	5 - CMS	Other	Public	36
D6.15	vfOS - ID6.5a - OAK Developer Engagement Hub(M30)	5 - CMS	Other	Public	30
D6.16	vfOS - ID6.5b - OAK Developer Engagement Hub(M36)	5 - CMS	Other	Public	36

### Description of deliverables

D6.1 : vfOS - ID6.1.1a - OAK SDK - Software(M24) [24]

The vf-OS SDK (D6.1.1) supports service developers with the functionalities needed to define, design, develop, and orchestrate manufacturing-related services.

D6.2 : vfOS - ID6.1.1b - OAK SDK - Software(M30) [30]

Update of the previous deliverable

D6.3 : vfOS - ID6.1.1c - OAK SDK - Software(M36) [36]

Update of the previous deliverable

D6.4 : vfOS - ID6.1.2a - OAK SDK - Documentation(M24) [24]

The deliverable D6.1.2 documents the OAK SDK, enabling developers to efficiently develop applications.

D6.5 : vfOS - ID6.1.2b - OAK SDK - Documentation(M30) [30]

Update of the previous deliverable

D6.6 : vfOS - ID6.1.2c - OAK SDK - Documentation(M36) [36]

Update of the previous deliverable

D6.7 : vfOS - ID6.2a - OAK System Dashboard(M24) [24]

This deliverable represents the functionalities of the OAK System Dashboard.

D6.8 : vfOS - ID6.2b - OAK System Dashboard(M30) [30]

Update of the previous deliverable

D6.9 : vfOS - ID6.2c - OAK System Dashboard(M36) [36]

Update of the previous deliverable

D6.10 : vfOS - ID6.3a - OAK Front End(M24) [24]

The deliverable represents the functionalities of the OAK Front End Environment.

D6.11 : vfOS - ID6.3b - OAK Front End(M30) [30]

Update of the previous deliverable

D6.12 : vfOS - ID6.3c - OAK Front End(M36) [36]

Update of the previous deliverable

D6.13 : vfOS - ID6.4a - OAK Studio(M30) [30]

This deliverable represents the functionalities of the OAK Studio.

D6.14 : vfOS - ID6.4b - OAK Studio(M36) [36]

Update of the previous deliverable

D6.15 : vfOS - ID6.5a - OAK Developer Engagement Hub(M30) [30]

This deliverable represents the functionalities of the OAK Engagement Hub.

D6.16 : vfOS - ID6.5b - OAK Developer Engagement Hub(M36) [36]

Update of the previous deliverable

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS4	R4 - Refined	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages • First prototypes of OAK and Platform components • First phase of use case demonstrators – Smart Apps Development (initial) focus • Research Workshop Successful</li> </ul>
MS5	R5 - Established	5 - CMS	30	<ul style="list-style-type: none"> <li>• Established and final prototype for Data/Connect of OAK and Platform components • Second phase of use case demonstrators – Apps Validation (interim)</li> </ul>
MS6	R6 - Matured	9 - MASS	36	<ul style="list-style-type: none"> <li>• Use case pilots are full installed and deployed</li> <li>• Completion of all outstanding components including platform • User Evaluation and Validation finished • Industrial Workshop Successful • Final Exploitation Plans</li> </ul>



<b>Work package number</b> <sup>9</sup>	WP7	<b>Lead beneficiary</b> <sup>10</sup>	8 - ALM
<b>Work package title</b>	Platform and Integration		
<b>Start month</b>	4	<b>End month</b>	36

### Objectives

O7 To provide the user/developer a runtime platform including environment, marketplace, 1st/3rd party service framework, developer hub, and internal integration

O7.1 To establish the container vf-Platform, which encapsulates all other vf-OS components and outwards facing applications

O7.2 To implement the vf-mApp store (Manufacturing applications), where users can pay for and download applications or components that developers have uploaded

O7.3 To implement the vf-Service provision framework, which allows vf-OS partners and third parties to provide and market additional services

O7.4 To engage and train internal and external developers

O7.5 To provide capacity for software integration, issue tracking, and bug fixing

iPhone and Android Mobile Apps offer a wide range of new functionalities showcasing the ideas innovative power of thousands of developers. vf-OS brings this approach to the manufacturing sector. The vf-mApp Store (the Application Marketplace) takes this idea further, as not only applications will be provided, but also services that can be used by other application or service developers. The architecture of the vf-OS marketplace allows services integration from other platforms into the vf-OS marketplace. Furthermore, a possible integration of the vf-mApp Store into common App markets will be investigated.

This work package is the critical outwards facing facility that publishes vf-OS features for use, (both components and services), and allows interactions. Interaction will be with manufacturing users, who may wish to procure new applications from subscribed developers or by downloading/buying existing applications in the marketplace (vf-mApp store). Correspondingly, there will also be interactions with developers, who can both respond to user demands and self-innovate to design/build new applications, and offer them to others. Developers could be independent (ISVs) or from existing manufacturing organisations. Manufacturing users might provide (through vf-OS based applications) facilities which others can use – eg a connection to a specific set of machine services or to part of an ERP output – so that others can take advantage of these and so construct applications. Importantly, resources are allocated to foster application development through training, engagement, and utilisation of the Developer Engagement Hub (WP6). Finally, an integration and bugfixing task is provided to ensure the completion of periodic integration trials and testing between components.

### Description of work and role of partners

#### **WP7 - Platform and Integration** [Months: 4-36]

ALM, ICE, IKERLAN, UNINOVA, UPV, CMS, LYON2, ASC, CONSULGAL

The first three WP7 tasks run in parallel, with the vf-Platform Environment (T7.1) acting as a coherent portal and container for the vf-mApp Store, Service Provision Framework and components and applications from other WPs such as the OAK Studio. The mApp store task (T7.2) represents a marketplace in the portal where applications can be procured, selected, accessed, purchased, and used by developers and users. The Service Provision Framework (T7.3) will allow the vf-OS consortium and third parties (in and beyond project) to provide services, such as hosting and storage resources. Engagement and Training (T7.4) of developers will be critical for uptake and this task will be aimed initially at internal developers for the WP8 pilots but later for external parties who show early interest. The integration task (T7.5) is a container task across the project and allows time for both integration of components, bugfixing, and an allowance for feature of specific components which need extending and utilising the infrastructure of T11.5.

T7.1 vf-Platform Environment ALM M16-36

D7.1abc vf-OS Platform Environment OTHER PU 24, 30, 36 R4 & R5 & R6

T7.1 aims at providing a holistic service platform, which is the foundation for all services and end user applications vf-OS will facilitate. The service platform will be the central outwards facing component of the project, and will both encapsulate and act as the interface between the RTD Components, connectors, OAK functions of WP6, Marketplace, Service Framework, and the end user applications/developers. The platform will allow parties to easily develop, describe, discover, provide, consume, administrate, personalise and combine/compose applications, as well as monitor

their execution through the OAK System Dashboard. Furthermore, it will evaluate the usage of services from other platforms, and enrich them using the means provided. It will be rendered as a web portal, where not only these component applications can be accessed, but also components and applications from other WPs such as the OAK Studio.

Role: ALM will design and develop the vf-platform.

#### T7.2 vf-mApp Store & Marketplace ASC M16-36

D7.2abc vf-OS mApp Store and Marketplace OTHER PU 24, 30, 36 R4 & R5 & R6

vf-OS will take advantage of the great success of mobile apps business model that are currently being provided, such as Google Play or the Apple App Store, which have created new opportunities and business models, by enabling developers to create and distribute applications. vf-OS will thus engage this approach, and transfer it to the manufacturing sector based on the application framework and the information infrastructure created. Marketplace functionalities include different licensing models, user comments and ratings. Hence, this marketplace additionally allows the provision of detailed technical information about applications under WP7 and by third parties to drive sales. The marketplace will additionally go “beyond the Apple App Store”; it will also offer manufacturing users to request Applications, (which developers can then build either for those users or make generally available), and also to make available connections to manufacturing systems (primarily for developers).

Role: ASC has experience in the development and deployment of marketplace solutions and will design and develop the Store and Marketplace.

#### T7.3 vf-Service Provision Framework ALM M16-36

D7.3abc Vf-Service Provision Framework OTHER PU 24, 30, 36 R4 & R5 & R6

The developed applications may rely on on-cloud services or even run in the cloud, which can be especially pertinent for SMEs. Additionally, some applications or the underlying manufacturing services may only be available externally and not be embeddable. This task will provide a basic framework to facilitate these aspects both for vf-OS partners in/beyond the project and for third parties who wish to provide additional services, such as hosting or computation resources. Thus, the vf-OS Service Provision Framework (D7.3) is used to frame previously defined and registered services/applications/connectors and facilitate their use in applications. The environment will take into account fault tolerance and adherence to defined QoS requirements.

Role: ALM will lead the development and deployment of cloud services.

#### T7.4 Developer Engagement & Training CMS M25-36

D7.4 Developer Engagement and Training OTHER PU 36 Ongoing

WP6 and WP7 provide an environment for developers in terms of the entry platform, marketplace, service framework as well as the OAK studio and front end environment. Whilst this provides a ‘typical’ facility and environment for developers, it will be helpful to reach critical mass by further encouraging and educating them. This not only applies for internal developers (connected with the pilots) but also external developers who can later become the customers of vf-OS and who can help prove the system. This task will provide an engagement and training program orientated around the engagement hub (interaction) for all developers. Aspects such as hackathons, workshops, or similar dissemination activities will be evaluated and supported. A report will be produced at the end of the project that details provided training material, participants involved, details of workshops/hackathons, feedback from application developers, and any other relevant matters. This will both quantify the work and provide material for further development and training.

Role: CMS will lead this task with the direct support of UNINOVA; both with good experience in the development of engagement and training programmes. The other technology and academic partners contribute to this task with the contents material for training.

#### T7.5 Integration and Bug Fixing ASC M4-36

D7.5 Software Integration Report OTHER PU 36 Ongoing

This task will specifically allocate time to resolve integration issues regarding the results of the RTD and use cases of WP8, to mitigate the risk of tricky time-consuming issues in distributed projects. Next, integration and functionality tests (and bug fixing) will be conducted and results will be given as feedback to the individual development tasks of vf-OS. Third, this task will allocate buffer time to enhance the WP3-7 deliverables should the use cases need enhanced functionality for some components. Finally, after development has been finished, the task will generate a Software Integration Report (D7.5), a handbook for interested parties with information on how to deploy the vf-OS architecture, and will also give generic recommendations to other who may perform other similar projects

Role: ASC leads the integration and bug fixing of the vf-OS platform, with the collaboration of all the other technologic and academic partners.

Partner number and short name	WP7 effort
1 - ICE	4.00
2 - IKERLAN	4.00
3 - UNINOVA	4.00
4 - UPV	4.00
5 - CMS	5.00
6 - LYON2	4.00
7 - ASC	32.00
8 - ALM	44.00
11 - CONSULGAL	6.00
<b>Total</b>	<b>107.00</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D7.1	vfOS - ID7.1a - vf-Platform Environment(M24)	8 - ALM	Other	Public	24
D7.2	vfOS - ID7.1b - vf-Platform Environment(M30)	8 - ALM	Other	Public	30
D7.3	vfOS - ID7.1c - vf-Platform Environment(M36)	8 - ALM	Other	Public	36
D7.4	vfOS - ID7.2a - vf- mApp Store & Marketplace(M24)	7 - ASC	Other	Public	24
D7.5	vfOS - ID7.2b - vf- mApp Store & Marketplace(M30)	7 - ASC	Other	Public	30
D7.6	vfOS - ID7.2c - vf- mApp Store & Marketplace(M36)	7 - ASC	Other	Public	36
D7.7	vfOS - ID7.3a - vf- Service Provision Framework(M24)	8 - ALM	Other	Public	24
D7.8	vfOS - ID7.3b - vf- Service Provision Framework(M30)	8 - ALM	Other	Public	30
D7.9	vfOS - ID7.3c - vf- Service Provision Framework(M36)	8 - ALM	Other	Public	36
D7.10	vfOS - ID7.4 - Developer	5 - CMS	Other	Public	36

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
	Engagement & Training(M36)				
D7.11	vfOS - ID7.5 - Software Integration Report(M36)	7 - ASC	Other	Public	36

### Description of deliverables

D7.1 : vfOS - ID7.1a - vf-Platform Environment(M24) [24]  
The deliverable represents the functionalities of the vf-Platform.

D7.2 : vfOS - ID7.1b - vf-Platform Environment(M30) [30]  
Update of the previous deliverable

D7.3 : vfOS - ID7.1c - vf-Platform Environment(M36) [36]  
Update of the previous deliverable

D7.4 : vfOS - ID7.2a - vf- mApp Store & Marketplace(M24) [24]  
The deliverable represents the functionalities of the vf-mApp Store.

D7.5 : vfOS - ID7.2b - vf- mApp Store & Marketplace(M30) [30]  
Update of the previous deliverable

D7.6 : vfOS - ID7.2c - vf- mApp Store & Marketplace(M36) [36]  
Update of the previous deliverable

D7.7 : vfOS - ID7.3a - vf-Service Provision Framework(M24) [24]  
The vf-OS Service Provision Framework (D7.3) is used to frame previously defined and registered services/ applications/connectors and facilitate their use in applications. The environment will take into account fault tolerance and adherence to defined QoS requirements.

D7.8 : vfOS - ID7.3b - vf-Service Provision Framework(M30) [30]  
Update of the previous deliverable

D7.9 : vfOS - ID7.3c - vf-Service Provision Framework(M36) [36]  
Update of the previous deliverable

D7.10 : vfOS - ID7.4 - Developer Engagement & Training(M36) [36]  
The deliverable that will be produced at the end of the project details provided training material, participants involved, details of workshops/hackathons, feedback from application developers, and any other relevant matters. This will both quantify the work and provide material for further development and training.

D7.11 : vfOS - ID7.5 - Software Integration Report(M36) [36]  
After development has been finished, the task will generate a Software Integration Report (D7.5), a handbook for interested parties with information on how to deploy the vf-OS architecture, and will also give generic recommendations to other who may perform other similar projects.

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS4	R4 - Refined	4 - UPV	24	• Refined and final prototypes of initial

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				background work packages Kernel and I/O • Developed prototypes of Data/Connect work packages • First prototypes of OAK and Platform components • First phase of use case demonstrators – Smart Apps Development (initial) focus • Research Workshop Successful
MS5	R5 - Established	5 - CMS	30	• Established and final prototype for Data/Connect of OAK and Platform components • Second phase of use case demonstrators – Apps Validation (interim)
MS6	R6 - Matured	9 - MASS	36	• Use case pilots are full installed and deployed • Completion of all outstanding components including platform • User Evaluation and Validation finished • Industrial Workshop Successful • Final Exploitation Plans

<b>Work package number</b> <sup>9</sup>	WP8	<b>Lead beneficiary</b> <sup>10</sup>	9 - MASS
<b>Work package title</b>	vf-OS Smart Application Piloting and Validation		
<b>Start month</b>	3	<b>End month</b>	36

### Objectives

O8 To act as the experimental base of the vf-OS Platform, linking scenario definition, test and validation activities to research, innovation and development tasks

O8.1 To define, consolidate and share pilot management procedures, supporting the applications development and pilot running at users' sites and to assess and refine the vf-OS Platform

O8.2 To build and run vf-OS Smart Applications at users' pilot sites in differing domains and create a viable demonstration of real use case scenarios. The domains being:

Pilot 1: Manufacturing & Logistic – Automation

Pilot 2: Construction – Industrialisation

Pilot 3: Manufacturing Assembly: Collaboration

This work package defines and validates the set of tools developed by vf-OS consortium against specified and real-world scenarios and requirements as well as their exploitation potential. Thus, WP8 acts as the experimental base of the vf-OS Platform. It operates in strong connection with WPs 1-7 by collecting, connecting, processing, and organising their outputs. In the first phase, the validation scenarios will be defined for all the pilot cases with feedback into WP1 to influence the business and requirements aspects. In the second phase, Smart Applications will be developed to solve specific pilot needs based upon the progress of RTD technologies being delivered – particularly from WP3-6. In a third phase, pilots will start by validating developed Smart Applications in relevant scenarios. In the final phase, with the readiness of the vf-OS platform via WP7, the platform's use to develop applications will be demonstrated. At the end of WP8 the results of the pilots will be collected, assessed, and formalised in order to report the demonstrated effects of vf-OS Platform and tools in operational scenarios. The pilots will continuously feedback the knowledge gained into the RTD WPs, and will do this through the adoption of an incremental development model for the vf-OS Smart Applications developed for supporting the concrete needs of pilots. In this way, the consortium will be able to immediately address design/implementation needs coming from the users sites.

### Description of work and role of partners

#### **WP8 - vf-OS Smart Application Piloting and Validation** [Months: 3-36]

MASS, ICE, IKERLAN, UNINOVA, UPV, CMS, LYON2, ASC, ALM, VS, CONSULGAL, KBZ, APR, Tardy

The purpose of the Validation Scenarios Task (T8.1) is multifold: To define scenarios from the start to influence WP1, in particular the requirements, and also to provide the basis for all pilots (T8.2, T8.3, and T8.4). It will also define the metrics for the project and the end point expected in user (pilot) terms. Next, it will act as a common reporting (and adjustment) facility across the project's duration to fine tune the RTD tasks and development. Finally, it will act as the reporting mechanism for all 3 validation scenarios. The validation scenarios run in parallel after the definition and the delivery of the first batch of RTD software, and continue for the duration of the project.

#### T8.1 Validation Scenarios UPV M3-36

#### D8.1abcd Validation Scenarios R PU 6, 12, 24, 36 R1

This task will define a set of general specifications for each pilot in the project that will be used as validation scenarios of the vf-OS Platform and its Smart Applications for supporting collaboration in manufacturing and logistics processes. Specific problems, requirements, and processes associated with each pilot will be addressed obtaining a set of general specifications to build the Smart Applications needed by each one. These general specifications will serve as input to elaborate detailed specifications of each pilot to be implemented in WP7. Moreover, the implementation of the innovative set of Smart Applications will be evaluated and validated applying the methodology of this task. Measurements (performance indicators) will involve both implementation of software applications using the Open Applications Development Kit (OAK) implemented in WP6 and the use of such applications by the end users. According to the pilot requirements and specifications, a general structure of the pilot implementation will be established, including specific workflows, reporting, and evaluation procedures. Moreover different sets of Key Performance Indicators (both pilot specific and at project level) will be defined in order to measure and monitor the performance and the usefulness of the vf-OS Smart Applications, and to select the most appropriate way to support the test and validation phases. The deliverables consist of a report detailing the initial scenarios and implementation plan (D81a); then a yearly document/



report (D81bcd) detailing and further elaborating a plan as well as the results from the previous year. This will include a checklist of general specifications of each pilot to test the feasibility and functionality of vf-OS Platform and the Smart Applications developed for each pilot. The D81b report will also include the formal validation of the pilots against initial implementation requirements and metrics.

Role: UPV leads the definition of the industrial validation scenarios. UPV and MAS contribute to pilot 1; UNINOVA, CON and KBZ contribute to Pilot 2; LYON2, APR, TARDY contribute to pilot 3. The contribution of all other partners will bring their experience in the development tasks.

Pilot 1-3 Generic aspects

Each Pilot will take a common approach albeit in a different manufacturing subdomain:

- Pilot 1: Manufacturing & Logistic – Automation
- Pilot 2: Construction – Industrialisation
- Pilot 3: Manufacturing Assembly – Collaboration

Each pilot deliverable will combine the scenario and validation reports of all pilots vf-OS piloting and will include the scenarios, framework, activities performed, and the results.

• Pilots Smart Applications development: This subtask will define the development for vf-OS Smart Applications development using the OAK. The selected business cases (T7.1) regarding the pilots need for supporting collaborative manufacturing and logistics processes will originate the development of specific Smart Applications for each pilot. Therefore, this task will be in close contact with WP6 providing feedback from the use of the OAK for software development in real implementations.

• Pilots Smart Applications implementation: This task acts to identify a clear and shared development for vf-OS Smart Application implementations at industrial sites, in defined and subsequent steps. The work package will make sure that the methodology definition process is fully shared by all partners through a bottom-up approach which will then ease the active participation of partners in the implementation phase. The pilots' activity will be framed according to a specific matrix which will establish the relation between the problems to be solved through vf-OS, and the platform functionalities sorted by relevance.

• Scheduling: Each pilot will adopt a similar schedule as defined in the generic objective phases. However, since each pilot will be in different sectors, and have a different requirements basis, this will be adjusted throughout the project. Critically, the use of an agile methodology (opposed to a waterfall approach) will ensure implementations are to expectations

T8.2 Pilot 1: Manufacturing & Logistic - Automation - "Spare-parts advanced management in automation production equipment" MASS M16-36

D8.2abc Pilot 1: Manufacturing & Logistic – Automation DEM CO 24, 30, 36 R4 & R5 & R6

In this task the Use Case described in section 1.3.4.1 will be implemented.

Role: MASS leads the definition of the Pilot1, with the contribution of UPV.

T8.3 Pilot 2: Construction – Industrialisation: "Virtual Construction Factory" CON M16-36

D8.3abc Pilot 2: Construction – Industrialisation DEM CO 24, 30, 36 R4 & R5 & R6

In this task the Use Case described in section 1.3.4.2 will be implemented.

Role: CON leads the definition of the Pilot 2, with the contribution of UNINOVA and KBZ.

T8.4 Pilot 3: Manufacturing Assembly: Collaboration - "Towards new business collaboration channels in Virtual Factory" TARDY M16-36

D8.4abc Pilot 3: Manufacturing Assembly: Collaboration DEM CO 24, 30, 36 R4 & R5 & R6

In this task the Use Case described in section 1.3.4.3 will be implemented.

Role: TAR leads the definition of the Pilot 3. With the contribution of LYON2 and APR.

#### Participation per Partner

Partner number and short name	WP8 effort
1 - ICE	4.00
2 - IKERLAN	4.50
3 - UNINOVA	4.50
4 - UPV	8.00
5 - CMS	4.00

Partner number and short name	WP8 effort
6 - LYON2	4.00
7 - ASC	4.00
8 - ALM	4.00
9 - MASS	18.00
10 - VS	14.00
11 - CONSULGAL	17.00
12 - KBZ	18.00
13 - APR	14.00
14 - Tardy	14.00
<b>Total</b>	<b>132.00</b>

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D8.1	vfOS - ID8.1a - Validation Scenarios(M6)	4 - UPV	Report	Public	6
D8.2	vfOS - ID8.1b - Validation Scenarios(M12)	4 - UPV	Report	Public	12
D8.3	vfOS - ID8.1c - Validation Scenarios(M24)	4 - UPV	Report	Public	24
D8.4	vfOS - ID8.1d - Validation Scenarios(M36)	4 - UPV	Report	Public	36
D8.5	vfOS - ID8.2a - Pilot 1: Manufacturing & Logistic – Automation(M24)	9 - MASS	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	24
D8.6	vfOS - ID8.2b - Pilot 1: Manufacturing & Logistic – Automation(M30)	9 - MASS	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.7	vfOS - ID8.2c - Pilot 1: Manufacturing & Logistic – Automation(M36)	9 - MASS	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	36



List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D8.8	vfOS - ID8.3a - Pilot 2: Construction – Industrialisation(M24)	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	24
D8.9	vfOS - ID8.3b - Pilot 2: Construction – Industrialisation(M30)	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.10	vfOS - ID8.3c - Pilot 2: Construction – Industrialisation(M36)	11 - CONSULGAL	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	36
D8.11	vfOS - ID8.4a - Pilot 3: Manufacturing Assembly: Collaboration(M24)	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	24
D8.12	vfOS - ID8.4b - Pilot 3: Manufacturing Assembly: Collaboration(M30)	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	30
D8.13	vfOS - ID8.4c - Pilot 3: Manufacturing Assembly: Collaboration(M36)	14 - Tardy	Demonstrator	Confidential, only for members of the consortium (including the Commission Services)	36

Description of deliverables

D8.1 : vfOS - ID8.1a - Validation Scenarios(M6) [6]  
A report detailing the initial scenarios and implementation plan

D8.2 : vfOS - ID8.1b - Validation Scenarios(M12) [12]  
A yearly document/report detailing and further elaborating a plan as well as the results from the previous year

D8.3 : vfOS - ID8.1c - Validation Scenarios(M24) [24]  
Update of the previous deliverable

D8.4 : vfOS - ID8.1d - Validation Scenarios(M36) [36]  
Update of the previous deliverable

D8.5 : vfOS - ID8.2a - Pilot 1: Manufacturing & Logistic – Automation(M24) [24]  
Report on the implementation of Pilot 1: Manufacturing & Logistic – Automation

D8.6 : vfOS - ID8.2b - Pilot 1: Manufacturing & Logistic – Automation(M30) [30]  
Update of the previous deliverable

D8.7 : vfOS - ID8.2c - Pilot 1: Manufacturing & Logistic – Automation(M36) [36]  
Update of the previous deliverable

D8.8 : vfOS - ID8.3a - Pilot 2: Construction – Industrialisation(M24) [24]  
Report on the implementation of Pilot 2: Construction – Industrialisation

D8.9 : vfOS - ID8.3b - Pilot 2: Construction – Industrialisation(M30) [30]  
Update of the previous deliverable

D8.10 : vfOS - ID8.3c - Pilot 2: Construction – Industrialisation(M36) [36]  
Update of the previous deliverable

D8.11 : vfOS - ID8.4a - Pilot 3: Manufacturing Assembly: Collaboration(M24) [24]  
Report on the implementation of Pilot 3: Manufacturing Assembly: Collaboration

D8.12 : vfOS - ID8.4b - Pilot 3: Manufacturing Assembly: Collaboration(M30) [30]  
Update of the previous deliverable

D8.13 : vfOS - ID8.4c - Pilot 3: Manufacturing Assembly: Collaboration(M36) [36]  
Update of the previous deliverable

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>
MS4	R4 - Refined	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages</li> <li>• First prototypes of OAK and Platform components</li> </ul>

### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				First phase of use case demonstrators – Smart Apps Development (initial) focus • Research Workshop Successful
MS5	R5 - Established	5 - CMS	30	<ul style="list-style-type: none"> <li>Established and final prototype for Data/Connect of OAK and Platform components</li> <li>Second phase of use case demonstrators – Apps Validation (interim)</li> </ul>
MS6	R6 - Matured	9 - MASS	36	<ul style="list-style-type: none"> <li>Use case pilots are full installed and deployed</li> <li>Completion of all outstanding components including platform</li> <li>User Evaluation and Validation finished</li> <li>Industrial Workshop Successful</li> <li>Final Exploitation Plans</li> </ul>

<b>Work package number</b> <sup>9</sup>	WP9	<b>Lead beneficiary</b> <sup>10</sup>	2 - IKERLAN
<b>Work package title</b>	Business Model and Exploitation		
<b>Start month</b>	1	<b>End month</b>	36

### Objectives

O9 To ensure that the project results will be effectively exploited in the market

O9.1 To explore the different business case opportunities and market value mapping, including to identify technical and non-technical risks, barriers, and enablers for bringing vf-OS to market

O9.2 To identify realistic potential business models and basic business plans for exploiting opportunities

O9.3 To establish background and IPR baselines, the consortium's collaborative exploitation strategies, and foreground IPRs agreements in order to foster partners' exploitation initiatives

O9.4 To bring the project's exploitable results progressively closer to the impact objectives through market comparisons and produce a set of collaborative and individual exploitation plans as a living document

This WP will justify the project objectives and funding received – both via the EU and partner resources. It will act as a bridge between the RTD activities and the projects expected impact objectives. The primary long term goal of WP9 is to develop steps to deploy and exploit vf-OS outcomes as intensively as possible in each partner's interest. Thus this task will start by assessing such opportunities, selecting and refining them, and then producing solid exploitation plans. These plans will be the foundation for real-world exploitation of project outcomes. A parallel exploitation goal is to deal with the intellectual property rights' (IPRs) background and foreground issues during the project, in order to establish a fair and successful collaborative exploitation. WP9 exploitation activities will be supported by vf-OS Impact Support Group.

Note that all deliverables connected with this WP are confidential since they represent the exploitation potential of the project.

### Description of work and role of partners

#### **WP9 - Business Model and Exploitation** [Months: 1-36]

**IKERLAN, ICE, UNINOVA, UPV, CMS, LYON2, ASC, ALM, MASS, VS, CONSULGAL, KBZ, APR, Tardy**

This WP represents a cascading series of tasks connected with exploitation. First, the full range of Business Opportunities are explored (T9.1) using the original DOA commitments, the user/developer aspirations from WP1, and further ideas generated through this task. From this the most promising business models are selected and further refined (T9.2). The Exploitation Strategy (T9.3) will set up a series of guidelines concerning specific exploitation plans and IPR management. Then the Collaborative and Partner Value Propositions and Exploitation plans Task (T9.4) will further explore this in terms of the strategic value propositions' hypotheses, strategic businesses' growth hypotheses along with the collaborative (and individual) exploitation plans which will be developed as a living document.

T9.1 Business Cases Opportunities and Value Mapping IKERLAN M1-6

D9.1 Business Cases Opportunities and Value Mapping R CO 6 R1

A complete range of potential business cases will be explored, both from the users' and providers' points of view, (ie needs and solutions). This will use the outputs of Task 1.2 and Task 1.3 respectively and will build a mapping between the needs and solutions in order to identify potential success areas and gaps to be filled, composing the different business cases which will be the base of the business models for vf-OS exploitation.

In order to ensure that vf-OS RTD activities take the required market orientation, a road-mapping approach will be taken: An information baseline (regarding both the state-of-the-art main technologies addressed by vf-OS and the competitive and societal challenges context) will be identified. Then, specific value opportunities will be identified within the potential value streams prioritised in the project to target the impact objectives. Next the potential technical and market risks, barriers and enablers regarding each opportunity will be elicited. These activities are planned to be performed through template based information sharing and workshops. The physical meetings are an important vehicle for intensive interactions and discussions for the inclusion of a broad spectrum of expertise and reaching a consensus within the project consortium on the identified value opportunities and to achieve the impact objectives. These will be the primary input for T9.2. The deliverable will be a report specifying the process followed, the value opportunities, and their associated market technical benefits-risks.

Role: IKERLAN (leader) will identify the business cases opportunities and develop the vf-OS value mapping, with the support of KBZ. All other partners will contribute to this task with their insights in the scope of their activities in the Project developments.

#### T9.2 Exploitation Business Models KBZ M4-9

##### D9.2 Exploitation Business Models R CO 9 R1

This task involves the realistic definition of business concepts, business models, and business plans to be established for vf-OS exploitation. These will be based on the more expansive, but less detailed, full range from T9.1, and will in essence take the recommended options and further define and analyse. Regarding the business concepts, the focus is to outline a set of business concepts for the prioritised value opportunities selected. This activity is planned to be performed through template based information sharing (eg value proposition canvas and strategy canvas, see section 2.2.2) and full-day workshops for sketching the offers and solutions (service-product-application), the target demographic, and a unique selling proposition with a clear competitive advantage. There will be regular draft iterations of this report (D9.2), collecting the business concepts, models and baseline plans, outlined and prioritised to orientate exploitation approaches from the value opportunities.

Role: KBZ will lead this task as a partner with reputation in the development of business models. IKERLAN will contribute bringing its experience in exploitation in industrial setting. Users will contribute with their insights on the exploitation on their domains.

#### T9.3 Exploitation Strategy IKERLAN M4-9

##### D9.3 Exploitation Strategy R CO 9 R1

The collaborative exploitation strategy (D9.3) will prepare the guidelines for the exploitation of vf-OS project results, comprising the following dimensions:

- Exploitable results: Dimensions and rules for exploitable outcomes identification and characterisation
- Potential addressees: Who and What – ie identification of potentially interested groups of users identified with which aspects and outcomes of the project
- Suppliers: Definition of rules and dimensions for characterising partners or external entities potentially in charge of exploitation initiatives and respective training needs
- Means and tools for enabling exploitation actions: Supporting exploitation initiatives, definition of documents, files and other materials needed to performing exploitation actions
- Policies and Rules to be followed for IPR and in order to safeguard IPRs and avoiding conflicts

Role: IKERLAN will lead the development of the exploitation strategy with the contribution of all other partners.

#### Task 9.4abc Collaborative and Partner Value Propositions and Exploitation plans IKERLAN M1-36

##### D9.4abc Collaborative and Partner Value Propositions and Exploitation plans R CO 9, 18, 36 R1 & R3 & R6

These iterative plans will be the foundation for real-world exploitation of project outcomes and take the T9.2 (Exploitation Models) and T9.3 (Exploitation Strategy) as a basis for its content. In essence it is composed of two highly dependent elements – the value propositions and exploitation plans both of which should be ‘tested’ with users and others in the potential market.

Vs-OS will be thus following the lean start-up methodology, a key goal is to elicit the strategic value propositions’ hypotheses, (ie what will people find valuable and payable) and strategic businesses’ growth hypotheses (ie how will the sales volume/customer grow) embedded in the business models and business plans previously outlined, which are directly related to the impact objectives.

In terms of exploitation, this includes a detailed planning of the exploitation efforts and a collection and presentation of the exploitation results. The partners will closely collaborate to create exploitation strategies as well as a set of exploitation and marketing tactics.

The deliverable will be in 3 phases following the period reviews and essentially the first deliverables will focus more on the proposition and the last on the strategy:

- Phase I (D94a) of the task will be based on assessing market potential of the project result/products and on theoretical outcomes. The first edition will also focus on the precise IPR Plans and will provide the basic information for joint and individual results ownership according to a structured methodology used in previous projects. It will also contain early high-level exploitation plans.
- Phase II (D94b) will be able to reference more mature version of the vf-OS ideas and components and also design the initial minimum viable product and product-market contrast piloting. The second report will also address the exploitation in more depth and invariably adjust the IPR due to the findings and real developments.
- Phase III (D94c) will execute the product-market contrast through piloting the minimum viable product in order to test the marketability of the vf-OS solution and find the best pivoting options to increase the exploitation success. This phase will also be used to prepare the continuation of exploitation after the project end. The final report will focus on post-project exploitation, ie the Business Plan. It will cover collaborative, joint, and individual plans. The plans will

progressively ensure that it is completely clear from an IPR point of view which participant is linked to each exploitable result. The reports will be confidential due to their nature.

This approach has proven to shorten product development cycles by adopting a combination of business-hypothesis-driven experimentation with potential customers (early customers) and iterative product releases through validated learning in order to reduce the product-market risks and failure. This activity is also planned to be performed through template based information sharing and workshops. A delivered report (D9.4abc) is produced incrementally along the project timeline.

Role: IKERLAN will lead the strategic value proposition, business plan, IPR, and Exploitation activities for vf-OS. IKERLAN will contribute bringing its experience in product-market in industrial setting and since IKERLAN has performed structured IPR and exploitation activities for its members and similar projects. Users will contribute with their insights on the exploitation on their domains. However all partners will be involved.

#### Participation per Partner

Partner number and short name	WP9 effort
1 - ICE	2.50
2 - IKERLAN	13.00
3 - UNINOVA	1.25
4 - UPV	3.75
5 - CMS	1.25
6 - LYON2	1.25
7 - ASC	1.25
8 - ALM	1.25
9 - MASS	1.25
10 - VS	1.25
11 - CONSULGAL	2.50
12 - KBZ	8.00
13 - APR	1.25
14 - Tardy	1.25
<b>Total</b>	<b>41.00</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D9.1	vfOS - ID9.1 - Business Case Opportunities and Value Mapping(M6)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D9.2	vfOS - ID9.2 - Exploitation Business Models(M9)	12 - KBZ	Report	Confidential, only for members of the consortium (including the	9

List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
				Commission Services)	
D9.3	vfOS - ID9.3 - Exploitation Strategy(M9)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D9.4	vfOS - ID9.4a - Collaborative and Partner Value Propositions and Exploitation plans(M9)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D9.5	vfOS - ID9.4b - Collaborative and Partner Value Propositions and Exploitation plans(M18)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D9.6	vfOS - ID9.4c - Collaborative and Partner Value Propositions and Exploitation plans(M36)	2 - IKERLAN	Report	Confidential, only for members of the consortium (including the Commission Services)	36

Description of deliverables

D9.1 : vfOS - ID9.1 - Business Case Opportunities and Value Mapping(M6) [6]

The deliverable will be a report specifying the process followed, the value opportunities, and their associated market technical benefits-risks.

D9.2 : vfOS - ID9.2 - Exploitation Business Models(M9) [9]

Regular draft iterations of this report (D9.2), collecting the business concepts, models and baseline plans, outlined and prioritised to orientate exploitation approaches from the value opportunities

D9.3 : vfOS - ID9.3 - Exploitation Strategy(M9) [9]

The collaborative exploitation strategy (D9.3) will prepare the guidelines for the exploitation of vf-OS project results, comprising the following dimensions: Exploitable results, Potential addressees, Suppliers, Means and tools, and Policies and Rules

D9.4 : vfOS - ID9.4a - Collaborative and Partner Value Propositions and Exploitation plans(M9) [9]

Phase I of the task will be based on assessing market potential of the project result/products and on theoretical outcomes, The first edition will also focus on the precise IPR Plans and will provide the basic information for joint and individual results ownership according to a structured methodology used in previous projects. It will also contain early high-level exploitation plans

D9.5 : vfOS - ID9.4b - Collaborative and Partner Value Propositions and Exploitation plans(M18) [18]

Phase II will be able to reference more mature version of the vf-OS ideas and components and also design the initial minimum viable product and product-market contrast piloting. The second report will also address the exploitation in more depth and invariably adjust the IPR due to the findings and real developments



D9.6 : vfOS - ID9.4c - Collaborative and Partner Value Propositions and Exploitation plans(M36) [36]

Phase III will execute the product-market contrast through piloting the minimum viable product in order to test the marketability of the vf-OS solution and find the best pivoting options to increase the exploitation success. This phase will also be used to prepare the continuation of exploitation after the project end. The final report will focus on post-project exploitation, ie the Business Plan. It will cover collaborative, joint, and individual plans. The plans will progressively ensure that it is completely clear from an IPR point of view which participant is linked to each exploitable result. The reports will be confidential due to their nature

Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>
MS3	R3 - Developed	3 - UNINOVA	18	<ul style="list-style-type: none"> <li>• Developed prototypes of initial background work packages</li> <li>• First OAK Developments accomplished</li> <li>• Use case definitions updated</li> <li>• All specifications defined</li> <li>• Second Exploitation Plans</li> </ul>
MS5	R5 - Established	5 - CMS	30	<ul style="list-style-type: none"> <li>• Established and final prototype for Data/ Connect of OAK and Platform components</li> <li>• Second phase of use case demonstrators – Apps Validation (interim)</li> </ul>
MS6	R6 - Matured	9 - MASS	36	<ul style="list-style-type: none"> <li>• Use case pilots are full installed and deployed</li> <li>• Completion of all outstanding components including platform</li> <li>• User Evaluation and Validation finished</li> <li>• Industrial Workshop Successful</li> <li>• Final Exploitation Plans</li> </ul>



<b>Work package number</b> <sup>9</sup>	WP10	<b>Lead beneficiary</b> <sup>10</sup>	12 - KBZ
<b>Work package title</b>	Impact		
<b>Start month</b>	1	<b>End month</b>	36

### Objectives

O10 To impact the external community in terms of dissemination and outreach of the project activity and results in order to encourage the spread of the vf-OS results

O10.1 To define a common consortium strategy for the dissemination and outreach of the project results

O10.2 To provide internal and external communication materials including a platform (website)

O10.3 To implement impact activities to:

- Disseminate project results throughout Europe and beyond
- Make knowledge available in a suitable format to enterprises and SMEs in order to increase the adoption of the research results

O10.4 To run (and lead) scientific and business orientated workshops in conjunctions with other projects/activities

O10.5 To cooperate with others; notably:

- Present the project outcomes in relevant scientific and industrial conferences
- Cooperate with EC clusters, eg, FoF PPP or EFFRA
- Transfer concepts to the industrial, research and standardisation communities
- Cooperate with (FoF) projects related to similar topics and relevant Cooperation and Support Actions

The impact activities will establish awareness and commitment from the numerous different project partners as well as enterprise and SME Communities gravitating around the vf-OS project. This workpackage is based on the principle that access to information advances discovery, accelerates innovation, and improves education. For this reason vf-OS dissemination will be focused on Open Access. This means making publicly-funded scientific information available online, to European researchers, innovative industries and SMEs, software developers, ICT and service providers all while ensuring long-term preservation. Moreover, WP10 will be in-line with WP "Exploitation", in order to analyse that the open access publications do not interfere in exploitation and protection issues of the vf-OS results. vf-OS will cooperate with others relevant parties including FoF initiatives/projects, EFFRA, Standards bodies, and conferences as necessary. WP10 will be supported by the vf-OS Impact Support Group.

### Description of work and role of partners

#### **WP10 - Impact** [Months: 1-36]

**KBZ, ICE, IKERLAN, UNINOVA, UPV, CMS, LYON2, ASC, ALM, MASS, VS, CONSULGAL, APR, Tardy**

The first task, Impact Strategy/Plan (T10.1) will define the strategy/plan for the entire impact WP according to a templated action plan approach and considering the resources available and individual dependencies. The Dissemination Materials Task (T10.2) includes aspects such as internal portal and external website, press releases, brochures, etc., and in particular the website (in a basic form) will be up-and-running on day 1 of the project (through partners own resources) and will be developed more completely (largely) within the first 2 months. The Impact Activities Task (T10.3) covers all practical impact activities, ie exploitation material from T10.2, updating website content, writing papers, etc. A special case is the Scientific and Industrial workshops (T10.4) planed in Year 2/3, since these require significant dedicated effort. Another special case is engagement activities with standards, clusters and other projects (T10.5).

T10.1 Impact Strategy and Plan KBZ M1-3

D10.1 Impact Strategy and Plan R PU 3 R1

The vf-OS dissemination strategy will be elaborated based on the information available at events, interaction occasions, conferences, and the observation of upcoming dissemination opportunities that allow vf-OS partners to achieve the maximum interaction with the different stakeholders and target groups. Moreover, potential journals and other dissemination means will be identified to support vf-OS partners with the dissemination activities of the project. The Impact Strategy and Plan Task will take into account the open access aspect of H2020, identify, analyse and study the different dissemination alternatives ("green" and "gold") based on Sherpa/Romeo (Publisher copyright policies & self-archiving). Moreover the dissemination plans and strategy will also highlight the steps to use the Open Access Infrastructure for Research in Europe (OpenAIRE). This task will be aligned with the exploitation of WP9, in order to reach a consensus about whether to publish directly or to first seek protection of the vf-OS results. The vf-OS dissemination strategy and plan will define the basis and guidelines for creating a context where vf-OS research

dissemination can be maximised for the benefit of European industry and for society in general. A report will be delivered detailing the outline of planned strategic dissemination as well as the identification and organisation of the activities to be performed in order to promote the project's results and the widest dissemination of knowledge from the project in an open access manner. The dissemination strategy and plan, in collaboration with WP9 "Exploitation", will define:

- i) What vf-OS plans to disseminate: The message (this aspect will be studied carefully in order to not interfere with exploitation activities);
- ii) To whom: The audience;
- iii) Why: The purpose;
- iv) How: The method;
- v) When: the timing.

Role: KBZ (leader) will coordinate the impact and strategy plan for vf-OS bringing its experience on business models design. CON will contribute bringing its experience dissemination on market. All partners will contribute with their insights on the impact strategy.

#### T10.2 Dissemination Materials, Internet, and Intranet UPV M1-36

D10.2abcd Dissemination Materials, Internet, and Intranet DEC PU 3, 9, 18, 36 R1 & Ongoing

In this task, the dissemination materials will be designed/produced – for external and internal use. Most importantly, the vf-OS website and portal will be implemented and maintained, based on the analysis of the project's needs. The project (responsive) website will contain up to date information on the progress of the vf-OS project. Furthermore, it will be used to publish public deliverables and provide information on vf-OS events, publications and exploitable results. The project's portal will consist of a private area to encourage the sharing of documents, knowledge, and the collaboration among the members of the vf-OS project. It will also contain a web-based document repository, in which work in progress publications and deliverables will be shared. Furthermore, it will provide access to an underlying code version control repository used in the vf-OS development. The vf-OS Portal will also offer direct access to different social networks (eg Facebook, LinkedIn, etc.) and YouTube videos related to vf-OS Project. The website (in basic form) will be up and running on day 1 of the project (through partner's own resources) and be developed more completely, mostly within the first 2 months. The website will also consider the demands of the WP11 management work package, project management needs (eg a web-based document repository in the restricted area, list server) and also the RTD management needs for bug tracking. Finally the STOA wiki will be supported. Reports will be produced, showing the setup of the vf-OS Web Page and the different areas created to give visibility to the project and encourage the collaboration among the vf-OS members. It will also include the contents of other dissemination material.

Role: UPV (leader) will manage the design and production of dissemination materials and the vf-OS website. All partners will provide pertinent information during the project execution for supporting and advertising it.

#### T10.3 Impact activities KBZ M1-36

D10.3abcd Impact Activity Reports R PU 3, 9, 18, 36 Ongoing

This task gives visibility to the achievements and results from the vf-OS Project, utilising material from T10.2. This task will be based on the following activities (more information is provided in section 2.2.1):

- eNewsletter and mailing distribution list: A eNewsletter will be sent out every year to interested subscribed stakeholders on a mailing list related to vf-OS
- vf-OS Brochures: Brochures will be published to show the objectives, advances, benefits and the exploitable results generated of the research, adapted to different and various target groups. Banners for use by partners will also be created
- Publication of technical papers and specialised articles: Throughout the project, scientific and technical results will be presented at industrial and scientific conferences, in industrial specialised press and in academic and international scientific journals following the principle of open access
- Press releases: Press release related to vf-OS will be created and provided to partners to be potentially published in order to provide visibility to the vf-OS results and its benefits.
- Industrial Cluster: Workshops will be held as specified in T10.4

A periodic report will contain the main dissemination activities performed and the definition of a number of KPIs for measuring the impact and efficiency of the proposed vf-OS dissemination strategy and plan. These will be based on the already defined Quantification of vf-OS Dissemination Activities in of section 2.2.1.5. Moreover it will contain the information related to the yearly vf-OS eNewsletters, brochures, and other material as well as the highly specialised information about the significant progresses and results of the project addressed to a highly targeted audience. Finally, it will include reporting related to T10.5 Standards, Clustering and Inter-project Cooperation

#### T10.4 Scientific and Industrial Workshops UNINOVA M18-35

D10.4ab Workshops Reports R PU 26, 35 R4 & R6

The vf-OS project will organise and participate in workshops at industrial conferences or during some of their internal meetings. vf-OS will both identify the most relevant conferences in the area (T10.1: Dissemination strategy and plan) and propose 'minor' workshops to be held during these events. Importantly, vf-OS commits to organise and lead two major workshops and will coordinate with other related projects to achieve this. One workshop in the middle of the project will identify current achievements and be orientated towards scientific/research/technology outcomes. The

second workshop will be held to the end of the project to present the final achievements of vf-OS (and other projects), laying the foundations for post-project exploitation and to create further synergies for future collaborations.

Role: UNINOVA will lead this activity with specific dedicated budget. All partners will be involved in the workshops, RTD partners will mainly contribute to the scientific workshops and industrial partners to the ones addressed to industrial community.

T10.5 Standards, Clustering and Inter-Project Cooperation UNINOVA M1-36

D10.5 Standards, Clustering and Inter-project Cooperation See 10.3

Further important interaction efforts will be performed in this task. In particular, EC events/project will be considered as important events to disseminate/discuss vf-OS advances. vf-OS will engage, if applicable, with the European standardisation process, specifically CEN, along with other standardisation bodies. Standardisation activities will use the “Standardization guidelines for IST research projects interfacing with ICT standards organizations” by the Cooperation Platform for Research and Standards (COPRAS). The task output will be included in the D10.3 Impact Reports.

Also, this task will perform collaboration activities with EU events and clusters (eg, FoF cluster or EFFRA). The partners commit to provide contributions to the following activities of a cluster to be selected in accordance with the European Commission:

- Exploitation of synergies/technical concertation: Participation in workshops, contribution to working group activities, input to scientific and strategic activities, or active contribution to task forces
- Joint activities for exchange, dissemination (incl. production of dissemination materials), and training
- Coordination of standardisation efforts
- Contribution to repositories of reference implementations and dissemination portals (to be determined according to the project results and exploitation strategy)

Specifically vf-OS agree to the cluster collaboration activity as defined below and noting that regardless of who has man-months for the tasks, all Partners will be expected to facilitate this and contribute in a “fair-share” way based on partners man-months and budgets:

Address the liaison and co-operation activities with other projects that will contribute to the platform building in Digital automation. The cooperation aims at exploiting synergies between the projects and increasing the impact of the initiative. The task entails contributions to the following activities:

- Help to organise and participate to joint events (2 per year) for dissemination and eco-system building starting with a kick-off meeting organised by the CSA ConnectedFactories
- Exploit synergies between projects (e.g. standardisation, SoA Wiki, agreement on API and SDKs, legacy system integration, sharing of industrial requirements, interoperability approaches, definition of concepts used within the project, possible business models, how to open up the platform)
- Work with the CSA to develop scenarios for use of the platforms

The above only covers the specific activities for collaboration with other projects. Other tasks/workpackages cover the individual project activities in some of these areas (e.g. dissemination, standardisation).

Under the leadership of CSA ConnectedFactories, a common deliverable will be prepared, to which all RIAs will contribute, the first version at M3, updated twice a year after every common event. Each project will report on their contribution to the collaboration activities, either in the management progress report or the dissemination report – in vf-OS case this will be via D10.3

Role: UNINOVA will be responsible for the clustering, ICE will handle the inter-project cooperation, and UPV will be responsible of standardisation activities. All partners will contribute to this task.

#### Participation per Partner

Partner number and short name	WP10 effort
1 - ICE	7.00
2 - IKERLAN	5.50
3 - UNINOVA	9.25
4 - UPV	7.25
5 - CMS	1.75
6 - LYON2	1.75

Partner number and short name	WP10 effort
7 - ASC	1.75
8 - ALM	1.75
9 - MASS	1.75
10 - VS	1.75
11 - CONSULGAL	6.00
12 - KBZ	11.50
13 - APR	1.75
14 - Tardy	1.75
<b>Total</b>	<b>60.50</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D10.1	vfOS - ID10.1 - Impact Strategy and Plan(M3)	12 - KBZ	Report	Public	3
D10.2	vfOS - ID10.2a - Dissemination Report(M3)	4 - UPV	Websites, patents filling, etc.	Public	3
D10.3	vfOS - ID10.2b - Dissemination Report(M9)	4 - UPV	Websites, patents filling, etc.	Public	9
D10.4	vfOS - ID10.2c - Dissemination Report(M18)	4 - UPV	Websites, patents filling, etc.	Public	18
D10.5	vfOS - ID10.2d - Dissemination Report(M36)	4 - UPV	Websites, patents filling, etc.	Public	36
D10.6	vfOS - ID10.3a - Impact Activity Reports(M9)	12 - KBZ	Report	Public	9
D10.7	vfOS - ID10.3b - Impact Activity Reports(M18)	12 - KBZ	Report	Public	18
D10.8	vfOS - ID10.3c - Impact Activity Reports(M36)	12 - KBZ	Report	Public	36
D10.9	vfOS - ID10.4a - Workshops Reports(M26)	3 - UNINOVA	Report	Public	26
D10.10	vfOS - ID10.4b - Workshops Reports(M35)	3 - UNINOVA	Report	Public	35

## Description of deliverables

### D10.1 : vfOS - ID10.1 - Impact Strategy and Plan(M3) [3]

This deliverable will detail the outline of planned strategic dissemination as well as the identification and organisation of the activities to be performed in order to promote the project's results and the widest dissemination of knowledge from the project in an open access manner

### D10.2 : vfOS - ID10.2a - Dissemination Report(M3) [3]

This deliverable (and subsequent) will show the setup of the vf-OS Web Page and the different areas created to give visibility to the project and encourage the collaboration among the vf-OS members. It will also include the contents of other dissemination material

### D10.3 : vfOS - ID10.2b - Dissemination Report(M9) [9]

Update of the previous deliverable

### D10.4 : vfOS - ID10.2c - Dissemination Report(M18) [18]

Update of the previous deliverable

### D10.5 : vfOS - ID10.2d - Dissemination Report(M36) [36]

Update of the previous deliverable

### D10.6 : vfOS - ID10.3a - Impact Activity Reports(M9) [9]

A periodic report will contain the main dissemination activities performed and the definition of a number of KPIs for measuring the impact and efficiency of the proposed vf-OS dissemination strategy and plan. These will be based on the already defined Quantification of vf-OS Dissemination Activities in of section 2.2.1.5. Moreover it will contain the information related to the yearly vf-OS eNewsletters, brochures, and other material as well as well as the highly specialised information about the significant progresses and results of the project addressed to a highly targeted audience. Finally, it will include reporting related to T10.5 Standards, Clustering and Inter-project Cooperation

### D10.7 : vfOS - ID10.3b - Impact Activity Reports(M18) [18]

Update of the previous deliverable

### D10.8 : vfOS - ID10.3c - Impact Activity Reports(M36) [36]

Update of the previous deliverable

### D10.9 : vfOS - ID10.4a - Workshops Reports(M26) [26]

Workshop reports will be produced detailing the workshop plan, results and constituency feedback.

### D10.10 : vfOS - ID10.4b - Workshops Reports(M35) [35]

Workshop reports will be produced detailing the workshop plan, results and constituency feedback.

## Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website</li> </ul>

**Schedule of relevant Milestones**

<b>Milestone number <sup>18</sup></b>	<b>Milestone title</b>	<b>Lead beneficiary</b>	<b>Due Date (in months)</b>	<b>Means of verification</b>
				and Early Dissemination • First Exploitation Plan prepared • Management Handbooks/Plans established

<b>Work package number</b> <sup>9</sup>	WP11	<b>Lead beneficiary</b> <sup>10</sup>	1 - ICE
<b>Work package title</b>	Project and RTD Management		
<b>Start month</b>	1	<b>End month</b>	36

### Objectives

O11 To Guarantee the success of the project objectives, both management and RTD, by ensuring successful completion of the project, using the resources allocated, and on time

O11.1 To set up the management infrastructure (committees, boards, quality plan, procedures, risk registers, project management tools, direction of internal website, etc.) and publish a project handbook

O11.2 To provide strategic and operational project management of the consortium

O11.3 To liaise with the EU as necessary and provide contractual reporting

O11.4 To coordinate consortium level RTD activities of the project - technical and scientific

O11.5 To establish the technical RTD set-up and Software Quality toolset

It needs to be ensured that the project is managed efficiently, meets its objectives, and the terms of the Grant Agreement. Furthermore, it is necessary that the Consortium Agreement between the partners is fulfilled, and that high-quality standards are guaranteed at all levels. This requires a strong Project Management, Quality Assurance, and Reporting. Within vf-OS, a well-defined and practiced management structure is used, which allows the management team and the project team to operate efficiently. Further details are specified in Section 3.2. In addition, a similar approach needs to be invoked at the RTD level for both technical and scientific actions. This task provides also the RTD management, set-up and quality toolset. All deliverable outcomes of this WP are considered confidential since they represent the 'internals' of the project.

Note the overall WP represents 7%, which can appear high for a Project Management WP but it includes a) 12MM (20%) representing the technical coordination/set up tasks (T11.4/5) which under FP7 could not be included in the PM WP and b) an allocation of reporting for the partners of 1MM each considering all reports. Thus in reality PM is around 4.5% which is considered average for this type of project.

### Description of work and role of partners

#### **WP11 - Project and RTD Management** [Months: 1-36]

**ICE, IKERLAN, UNINOVA, UPV, CMS, LYON2, ASC, ALM, MASS, VS, CONSULGAL, KBZ, APR, Tardy**

This WP is composed of the general project management tasks as more fully defined in section 3.2. The Coordinator/Project Manager in conjunction with all beneficiaries will initialise in the Project Set-up (T11.1) and the 'infrastructure' of the project in terms of the plan, procedures, conflict routes etc. The Management Coordination (T11.2) will address the strategic and operational aspects of running the project utilising the results of T11.1 as indeed must all partners. The EU Task (T11.3) will handle the day to day interactions with the EU as well as all reporting aspects again based on T11.1. The Technical/Scientific Management (T11.4) will largely coordinate WP3-6 to ensure research/technical coherency and progress. At a practical level the technical set-up/software quality approach (T11.5) will provide a coherent development environment in terms of infrastructure and plan.

T11.1 Project Set Up, Metrics, and Quality Plan ICE M1-2

D11.1 Project Handbook & Quality Plan R CO 2 R1

This task is devoted to setting the vf-OS project in motion. ICE will carry out the following activities: (i) Setting up the Project Management Office; (ii) Organising the kick-off meeting, (iii) Definition of the rules of procedure/schedules of meetings for the Board of Partners (BOP); (iv) Definition of administrative and reporting procedures; (v) Definition of procedures for the auditing of financial statements from partners if necessary; (vi) Design and implementation of standard formats and forms for project documentation; (vii) Agreement of details and additional metrics viii) Risk Management including contingency planning; (ix) Conflict resolution procedures (See Table 10). The T10.2 web infrastructure will be used where applicable, including a web-based document repository and a list server. These aspects and the Quality Plan will be detailed in the "Project Handbook" taking into account the E-OCVM approach. The Project Handbook will be binding on all partners (once formally approved by BOP) and will supplement, but cannot contradict, the CA/GA.

The Quality Plan part of the handbook will define the tools, procedures and criteria for the evaluation process (goals, deadlines, production of results, compliance procedures, the use of human and financial resources, etc.) and for the



evaluation of project results (recruitment, learning effectiveness, user satisfaction rate, software performance/usability and quality of the deliverables).

Role: The plan, procedures, and metrics role will be led by ICE to ensure proper conduction of project. To ensure a counterpart, an experienced academic partner will act as a devils-advocate “foil” to the coordinator and also ensure the operational quality checking of deliverables and monitoring against the processes set.

#### T11.2 Strategic and Operational Coordination ICE M1-36

Delivs: N/A Covered in Management Reports of T11.3 Via 11.3

Strategic coordination and decision-making within the vf-OS project will be the task of the Board of Partners (BOP). The responsibilities of the BOP are described in Table 11. The BOP will not be involved in the day-to-day management of the project, except where major strategic decisions are required.

Operational coordination will be by the Project Manager and Technical Manager via T11.4 with both working in close cooperation via the Project Management board which also contains the projects administrative secretariat. The Science Manager will also be involved in the Research directions. More expansive details in in section 3.2.

This task will also assure that any changes to the Consortium/Grant Agreement are managed on time and it also administers the project resources and monitors project spending according to the planned budget and project schedule. Due to the operational nature of these tasks which is also connected with progress reporting there is no specific deliverable for this task.

Role: ICE will largely be involved here with UPV supporting.

#### T11.3 EU Liaison and Reporting ICE M1-36

D11.3.1a-l Quarterly Reports R CO Quarterly Ongoing

D11.3.2abc Period Reports R CO 9, 18, 24 A1 & A2 & A3

D11.3.3 Final Reports R CO 36 A3

This task will take care of all interactions between the project and the European Commission (EC) including periodic reporting and reviewing activities. This includes daily liaisons to the EC, review attendance, periodic reporting, and the preparation of any other material administratively needed by the EC. This task will be led by coordinator who has extensive experience of large scale EU and commercial projects. All partners will also have minor days for the reporting processes. The certification of financial statements (if necessary) from individual partners will be the responsibility of the partners who will follow the procedures defined in task T11.1. All reports will require approval by the Coordinating Partner. Quarterly reports on the progress and evolution of the project, work package statuses, main risks, extant issues, accomplished milestones and other relevant information will be delivered, along with period reports on the progress and evolution of the project similar to the quarterly reports, and a final report on the evolution of the project and the obtained results. Monthly tracking of time and activities will take place and all partners will need to input to this on strict deadlines.

Role: The coordinator and project manager will naturally manage this task with others supporting as necessary. All partners will receive a time allocation to facilitate report preparation.

#### T11.4 RTD Management UPV M1-36

Delivs: N/A Covered in Management Reports of T11.3 See 11.3

This task handles the two primary management aspects of vf-OS at the RTD level: scientific (research) and technical (specification, development, etc.).

- Science management will ensure both the efficacy of the research in and out of vf-OS and to enable influencing, knowledge exchange, and RTD dissemination to society. RTD management will thus ensure the uptake and application of scientific evidence, paper production, conference presentations etc, and relate to the Scientific/Research workshop. This will be coordinated by the Science Manager.

- On the technical side there is primarily a software development process that must be managed and is concerned primarily with the production aspect of software development, as opposed to the technical aspect, such as software tools which is encompassed in Task 11.5. These processes exist primarily for supporting the management of software development, and are generally skewed toward addressing business concerns. This will be coordinated by the Technical Manager.

Due to the operational nature of these tasks which is also connected with progress reporting there is no specific deliverable for this task. .

Role: UPV will be the technical manager defining the procedures to perform the research and development and monitoring the tasks execution from scientific and technical points of view. UNINOVA will be the science manager also will not have resources directly allocated in this task.

#### T11.5 Technical Set Up and Quality Toolset ASC M4-36

D11.5 Technical Set Up and Quality Toolset OTHER CO 12 & Ongoing R2



This task will provide the technical infrastructure across all WPs including development server, dynamic build system, quality tools, bug/issue reporting, webdav repository, and mailing list. Quality assurance involves the entire vf-OS development process, making sure that any agreed-upon standards and procedures are followed, and ensuring that problems are found and dealt with. It is oriented towards prevention. A software quality evaluation toolset (eg Sonar and Moose) will be deployed working in compliance to the operating version control system so as to extract software metrics and detect duplicated code, coding standards, unit tests, code coverage, complex code and potential bugs. Following, these software development principles and technological choices, the RTD performers will deliver robust and technically validated software to be used for application development in other workpackages. Software testing and evaluation will be based on a method such as STEP (Systematic Test and Evaluation Process), a well-established industry methodology for test and evaluation activities in software projects. It should be mentioned that within this task testing will be performed to verify the proper functioning and performance of the integrated vf-OS Kernel. If required, specific improvements will be made. This will provide a Cross Project Development environment and guidance including the technical infrastructure across all WPs including development server, dynamic build system, quality tools and bug/issue reporting and the software quality evaluation toolset, (eg Sonar and Moose).

Role: ASC have been involved in quality assurance activities for industry, and will lead this task with contributions from UPV and ICE. All other partners will provide insights regarding their developments in the project.

#### Participation per Partner

Partner number and short name	WP11 effort
1 - ICE	34.00
2 - IKERLAN	1.00
3 - UNINOVA	1.00
4 - UPV	9.50
5 - CMS	1.00
6 - LYON2	1.00
7 - ASC	5.00
8 - ALM	1.00
9 - MASS	1.00
10 - VS	1.00
11 - CONSULGAL	1.00
12 - KBZ	1.00
13 - APR	1.00
14 - Tardy	1.00
<b>Total</b>	<b>59.50</b>

#### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D11.1	vfOS - ID11.1 - Project Handbook & Quality Plan(M2)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	2

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D11.2	vfOS - ID11.3.1a - Quarterly Reports(M3)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	3
D11.3	vfOS - ID11.3.1b - Quarterly Reports(M6)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D11.4	vfOS - ID11.3.1c - Quarterly Reports(M9)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D11.5	vfOS - ID11.3.1d - Quarterly Reports(M12)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D11.6	vfOS - ID11.3.1e - Quarterly Reports(M15)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	15
D11.7	vfOS - ID11.3.1f - Quarterly Reports(M18)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D11.8	vfOS - ID11.3.1g - Quarterly Reports(M21)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	21
D11.9	vfOS - ID11.3.1h - Quarterly Reports(M24)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	24

**List of deliverables**

<b>Deliverable Number</b> <sup>14</sup>	<b>Deliverable Title</b>	<b>Lead beneficiary</b>	<b>Type</b> <sup>15</sup>	<b>Dissemination level</b> <sup>16</sup>	<b>Due Date (in months)</b> <sup>17</sup>
D11.10	vfOS - ID11.3.1i - Quarterly Reports(M27)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	27
D11.11	vfOS - ID11.3.1j - Quarterly Reports(M30)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D11.12	vfOS - ID11.3.1k - Quarterly Reports(M33)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	33
D11.13	vfOS - ID11.3.1l - Quarterly Reports(M36)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D11.14	vfOS - ID11.3.2a - Period Reports(M9)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	9
D11.15	vfOS - ID11.3.2b - Period Reports(M18)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D11.16	vfOS - ID11.3.2c - Period Reports(M36)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D11.17	vfOS - ID11.3.3 - Final Reports(M36)	1 - ICE	Report	Confidential, only for members of the consortium (including the Commission Services)	36

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D11.18	vfOS - ID11.5 - Technical Set Up and Quality Toolset (M12 & Ongoing)	7 - ASC	Other	Confidential, only for members of the consortium (including the Commission Services)	12

### Description of deliverables

D11.1 : vfOS - ID11.1 - Project Handbook & Quality Plan(M2) [2]

The Project Handbook will be binding on all partners (once formally approved by BOP) and will supplement, but cannot contradict, the CA/GA. The Quality Plan part of the handbook will define the tools, procedures and criteria for the evaluation process (goals, deadlines, production of results, compliance procedures, the use of human and financial resources, etc.) and for the evaluation of project results (recruitment, learning effectiveness, user satisfaction rate, software performance/usability and quality of the deliverables).

D11.2 : vfOS - ID11.3.1a - Quarterly Reports(M3) [3]

This (and subsequent deliverables) is a Quarterly report on the progress and evolution of the project, work package statuses, main risks, extant issues, accomplished milestones and other relevant information

D11.3 : vfOS - ID11.3.1b - Quarterly Reports(M6) [6]

Update of the previous deliverable

D11.4 : vfOS - ID11.3.1c - Quarterly Reports(M9) [9]

Update of the previous deliverable

D11.5 : vfOS - ID11.3.1d - Quarterly Reports(M12) [12]

Update of the previous deliverable

D11.6 : vfOS - ID11.3.1e - Quarterly Reports(M15) [15]

Update of the previous deliverable

D11.7 : vfOS - ID11.3.1f - Quarterly Reports(M18) [18]

Update of the previous deliverable

D11.8 : vfOS - ID11.3.1g - Quarterly Reports(M21) [21]

Update of the previous deliverable

D11.9 : vfOS - ID11.3.1h - Quarterly Reports(M24) [24]

Update of the previous deliverable

D11.10 : vfOS - ID11.3.1i - Quarterly Reports(M27) [27]

Update of the previous deliverable

D11.11 : vfOS - ID11.3.1j - Quarterly Reports(M30) [30]

Update of the previous deliverable

D11.12 : vfOS - ID11.3.1k - Quarterly Reports(M33) [33]

Update of the previous deliverable

D11.13 : vfOS - ID11.3.1l - Quarterly Reports(M36) [36]

Update of the previous deliverable

D11.14 : vfOS - ID11.3.2a - Period Reports(M9) [9]

This deliverable (and its subsequent) will report on the progress and evolution of the project similar to the quarterly reports

D11.15 : vfOS - ID11.3.2b - Period Reports(M18) [18] Update of the previous deliverable
D11.16 : vfOS - ID11.3.2c - Period Reports(M36) [36] Update of the previous deliverable
D11.17 : vfOS - ID11.3.3 - Final Reports(M36) [36] Report on the evolution of the project and the obtained results
D11.18 : vfOS - ID11.5 - Technical Set Up and Quality Toolset (M12 & Ongoing) [12] Technical infrastructure across all WPs including development server, dynamic build system, quality tools, bug/issue reporting, webdav repository, and mailing list.

#### Schedule of relevant Milestones

Milestone number <sup>18</sup>	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	R1 - Initiated	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>
MS7	A1 - Period 1 Success	1 - ICE	9	<ul style="list-style-type: none"> <li>• First period of the project accomplished and review successful</li> </ul>
MS8	A2 - Period 2 Success	1 - ICE	18	<ul style="list-style-type: none"> <li>• Second period of the project accomplished and review successful and second funding tranche release</li> </ul>
MS9	A3 - Period 3 Success	1 - ICE	36	<ul style="list-style-type: none"> <li>• Third period of the project accomplished and review successful and third funding tranche release</li> </ul>

### 1.3.4. WT4 List of milestones

Milestone number <sup>18</sup>	Milestone title	WP number <sup>9</sup>	Lead beneficiary	Due Date (in months) <sup>17</sup>	Means of verification
MS1	R1 - Initiated	WP1, WP10, WP11, WP2, WP8, WP9	4 - UPV	9	<ul style="list-style-type: none"> <li>• Vision and Baseline established</li> <li>• Target market described</li> <li>• Business Cases understood and Initial Strategies prepared</li> <li>• Methodologies and techniques defined/ underway</li> <li>• Scenarios defined</li> <li>• Requirements analysed</li> <li>• Functional specifications prepared</li> <li>• Impact Strategy, Website and Early Dissemination</li> <li>• First Exploitation Plan prepared</li> <li>• Management Handbooks/Plans established</li> </ul>
MS2	R2 - Prepared	WP2, WP3, WP4	7 - ASC	12	<ul style="list-style-type: none"> <li>• Global Architecture defined</li> <li>• Technical specifications including Mockups prepared</li> <li>• Security and Privacy Concept produced</li> <li>• Kernel/ FI-Ware Framework defined and first Enablers Prototyped</li> <li>• I/O Tool Kit specified</li> </ul>
MS3	R3 - Developed	WP3, WP4, WP5, WP9	3 - UNINOVA	18	<ul style="list-style-type: none"> <li>• Developed prototypes of initial background work packages</li> <li>• First OAK Developments accomplished</li> <li>• Use case definitions updated</li> <li>• All specifications defined</li> <li>• Second Exploitation Plans</li> </ul>
MS4	R4 - Refined	WP3, WP4, WP5, WP6, WP7, WP8	4 - UPV	24	<ul style="list-style-type: none"> <li>• Refined and final prototypes of initial background work packages</li> <li>• Kernel and I/O</li> <li>• Developed prototypes of Data/Connect work packages</li> <li>• First prototypes of OAK and Platform components</li> <li>• First phase of use case demonstrators – Smart Apps Development (initial) focus</li> <li>• Research Workshop Successful</li> </ul>
MS5	R5 - Established	WP6, WP7, WP8, WP9	5 - CMS	30	<ul style="list-style-type: none"> <li>• Established and final prototype for Data/Connect of OAK and Platform</li> </ul>

<b>Milestone number</b> <sup>18</sup>	<b>Milestone title</b>	<b>WP number</b> <sup>9</sup>	<b>Lead beneficiary</b>	<b>Due Date (in months)</b> <sup>17</sup>	<b>Means of verification</b>
					components • Second phase of use case demonstrators – Apps Validation (interim)
MS6	R6 - Matured	WP6, WP7, WP8, WP9	9 - MASS	36	<ul style="list-style-type: none"> <li>• Use case pilots are full installed and deployed</li> <li>• Completion of all outstanding components including platform</li> <li>• User Evaluation and Validation finished</li> <li>• Industrial Workshop Successful</li> <li>• Final Exploitation Plans</li> </ul>
MS7	A1 - Period 1 Success	WP11	1 - ICE	9	<ul style="list-style-type: none"> <li>• First period of the project accomplished and review successful</li> </ul>
MS8	A2 - Period 2 Success	WP11	1 - ICE	18	<ul style="list-style-type: none"> <li>• Second period of the project accomplished and review successful and second funding tranche release</li> </ul>
MS9	A3 - Period 3 Success	WP11	1 - ICE	36	<ul style="list-style-type: none"> <li>• Third period of the project accomplished and review successful and third funding tranche release</li> </ul>

### 1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	Failure to meet milestones (Likely=H, Impact=M)	WP11	The project management methodology used for vf-OS includes high visibility of progress, early identification of problems and risks, and allow for quick response to changes or deviations that may affect the plan of the project. The PMB is a key figure in the process of collaboration with WP leaders in the early detection and resolution of problems
2	Loss of Beneficiary (Likely=L, Impact=H)	WP11	vf-OS consortium will by default see if the activity can be handled internally and if not look for another organisation with similar competences and characteristics
3	Under/overestimation of effort (Likely=H, Impact=L)	WP1, WP10, WP11, WP2, WP3, WP4, WP5, WP6, WP7, WP8, WP9	This risk will be handled by monitoring the planned versus the actual effort required by each task. Indicators and statistics will be included in the periodic progress reports. However, even if under-planned parties subscribed to a task must deliver results according to specifications, agreements, and expectations
4	Resource phase-in difficulties (Likely=H, Impact=L)	WP1, WP10, WP11, WP2, WP3, WP4, WP5, WP6, WP7, WP8, WP9	A familiarisation plan will be set up to allow easy integration of new people in the project. The amount of time needed to train new resources to work on the project will be defined and considered as part of the staffing plan
5	Lack of coordination (Likely=L, Impact=H)	WP11	This risk will be managed through meetings and fluent communication in order to promote the collaboration and organisation among partners
6	Integration issues (Likely=M, Impact=M)	WP8	Integration issues may occur when installing and implementing vf-OS results at users' sites. A specific task in WP7 addresses this
7	Delay of the evaluation results (Likely=M, Impact=H)	WP1, WP10, WP11, WP2, WP3, WP4, WP5, WP6, WP7, WP8, WP9	This risk depends on validation activities required to the pilot test environments and it can be mitigated through a tight co-operation with the support of the development teams
8	Poor outreach of knowledge (Likely=L, Impact=M)	WP10	This risk is handled by the development of the Impact Plan, which will detail and schedule the dissemination activities that should be performed in order to achieve the expected project results. Dissemination will be continuously monitored by Performance Indicators
9	Difficulties in exploitation (Likely=L, Impact=H)	WP9	This risk is handled by the development of a detailed Exploitation Plan, which will include a classification of the potential exploitable results, the project partners that will invest time and effort in each result, intentions of each partner with regard to the dissemination and use of all results and conflicts of interest and weaknesses related to exploitation issues



### 1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	Total Person/Months per Participant
1 - ICE	5.50	9	16	0	35	0	4	4	2.50	7	34	117
2 - IKERLAN	3.50	8	0	8	22	0	4	4.50	13	5.50	1	69.50
3 - UNINOVA	6	6	30	0	25	0	4	4.50	1.25	9.25	1	87
4 - UPV	8	10	0	27	0	0	4	8	3.75	7.25	9.50	77.50
5 - CMS	5.50	7	0	0	0	62	5	4	1.25	1.75	1	87.50
6 - LYON2	2	6	16	27	0	0	4	4	1.25	1.75	1	63
7 - ASC	3	12.50	0	0	0	32	32	4	1.25	1.75	5	91.50
8 - ALM	4.50	6	0	12	0	12	44	4	1.25	1.75	1	86.50
9 - MASS	7.50	1.50	0	0	2	0	0	18	1.25	1.75	1	33
10 - VS	4.50	1.50	0	0	2	0	0	14	1.25	1.75	1	26
11 - CONSULGAL	3.50	1.50	0	0	2	0	6	17	2.50	6	1	39.50
12 - KBZ	4.50	3	24	0	2	0	0	18	8	11.50	1	72
13 - APR	4.50	1.50	0	0	2	0	0	14	1.25	1.75	1	26
14 - Tardy	4.50	1.50	0	0	2	0	0	14	1.25	1.75	1	26
<b>Total Person/Months</b>	67	75	86	74	94	106	107	132	41	60.50	59.50	902

### *1.3.7. WT7 Tentative schedule of project reviews*

<b>Review number <sup>19</sup></b>	<b>Tentative timing</b>	<b>Planned venue of review</b>	<b>Comments, if any</b>
RV1	9	Brussels	technical review
RV2	20	Brussels	
RV3	36	Brussels	

### 1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

### 2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

### 3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

### 4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a written justification.

### 5. Duration

Insert the duration of the project in full months.

### 6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

### 7. Abstract

### 8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

### 9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

### 10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

### 11. Person-months per work package

The total number of person-months allocated to each work package.

### 12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

### 13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

### 14. Deliverable number

Deliverable numbers: D1 - Dn

### 15. Type

Please indicate the type of the deliverable using one of the following codes:

- R Document, report
- DEM Demonstrator, pilot, prototype
- DEC Websites, patent fillings, videos, etc.
- OTHER
- ETHICS Ethics requirement

### 16. Dissemination level

Please indicate the dissemination level using one of the following codes:

PU Public  
CO Confidential, only for members of the consortium (including the Commission Services)  
EU-RES Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)  
EU-CON Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)  
EU-SEC Classified Information: SECRET UE (Commission Decision 2005/444/EC)

**17. Delivery date for Deliverable**

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

**18. Milestone number**

Milestone number: MS1, MS2, ..., MSn

**19. Review number**

Review number: RV1, RV2, ..., RVn

**20. Installation Number**

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

**21. Installation country**

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

**22. Type of access**

VA if virtual access,  
TA-uc if trans-national access with access costs declared on the basis of unit cost,  
TA-ac if trans-national access with access costs declared as actual costs, and  
TA-cb if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

**23. Access costs**

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.



## Virtual Factory Open Operating System

**Call:** H2020-FoF-2016  
**Sub call:** ICT for the Factories of the Future  
**Topic:** FoF-11-2016: Digital Automation  
**Sub topic:** Collaborative manufacturing and logistics  
**Type of Action:** Research and Innovation Action (RIA)

### List of participants:

Participant no.	Participant organisation name	Country	Nature
1 (CO)	INFORMATION CATALYST FOR ENTERPRISE LTD (ICE)	UK	SME
2	IKERLAN SCL (IKERLAN)	Spain	Technological Center
3	UNINOVA - INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS (UNINOVA)	Portugal	Research Organisation
4	UNIVERSITAT POLITÈCNICA DE VALÈNCIA (UPV)	Spain	University
5	CAIXA MÁGICA SOFTWARE, S.A. (CMS)	Portugal	SME
6	UNIVERSITÉ LUMIÈRE LYON 2 (LYON2)	France	University
7	ASCORA GMBH (ASC)	Germany	SME
8	ALMENDE B.V. (ALM)	The Netherlands	SME
9	MONDRAGÓN ASSEMBLY (MASS)	Spain	SME
10	VIA SOLIS UAB (VS)	Lithuania	SME
11	CONSULGAL - ENGENHARIA E GESTAO SA. (CON)	Portugal	Large Enterprise
12	KNOWLEDGEBIZ, LDA (KBZ)	Portugal	SME
13	APPLICATIONS PLASTIQUES DU RHONE SAS (APR)	France	SME
14	TARDY SAS (TARDY)	France	SME

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## History of changes

The main changes from the submitted vf-OS Proposal are identified below noting that the Project Officer has been presented with redline/comment mode versions of the DOA documenting and explaining in detail the changes outside of the final SyGMA clean submission. The changes are categorised into EU orientated, General, and Specific.

Only the more specific changes are described below noting that even then only the core changes are mentioned – for example changing a deliverable date will not only update the deliverable date but can lengthen the tasks, cause an update of the Gantt, the deliverable table etc and these latter changes are not explicitly mentioned since they are obvious

- **EU Related (Rationale of all: Request of EU):**

- Movement of periods from 12/24/36 to 9/18/36 meaning multiple changes to the timing of many deliverables, administrative milestone one (M6 to M9) and movement of deliverables to fit the new periods (e.g. T2.2 from M10 to M9, T9.5/T10.2/T10.3/T11.4 timed to new periods etc)
- Fixing, where clear, issues in the ESR reports which resulted in changes to Impact section text, T1.1/T1.2/T1.4 (minor), T1.5, T9.5, WP11 and PM part of section 3
- Adding EU clustering text to T10.5 and adding related deliverable iteration via D10.3a at M3)

- **General:**

- Numerous typo, grammar, wording, style, format, misalignment, error and consistency fixes (e.g. partner acronyms, differing timing in different parts of proposal) and removal of wording referring to proposal. Rationale: Consistency and increasing quality considering will form part of contract and text will be also used in other context.
- Adjustment/Consistency to reflect change/language in CA – e.g. monthly time tracking. Rationale: To ensure now contract inconsistencies
- Already applying the project style sheet to the text: Rationale: For future use in project
- Removal of the explicit mentioning of names in various committees and roles. These are now subject to consortium management processes. Rationale: Since if they changed it would break GA and would need a GA change.
- RTD tasks involvement (WP3-7) has been consolidated without change in overall MM per partner. This has been quite a significant exercise although is largely hidden since the proposal/DOA works at WP level. Broadly this has meant that all RTD role texts have been updated to reflect final task partners. Rationale: This limits the complexities due to joint exploitation and provides more focus for partners

- **Specific:**

- WPs/Task Grids:
  - Changes of several deliverables to be confidential (e.g. T1.1 and all T2.1, T2.2 specification deliverables). Rationale: To help exploitation
  - T1.2 and T1.3 extended by 1M. Rationale: To spread deliverables during start-up/xmas
  - WP2: Allowance that technical specification can be online – e.g. use of Swagger. Rational: Reduce paperwork and use tools that developers really use
  - T34 change in lead from LYON to KBZ. Rationale: Due to consolidation exercise above.
  - Tasks T6.1/2/3, T7.1/2/3 move to start at M13 vs M16. Rationale: a)allows better smoothing of resources between the technical tasks WP1/2, b)have something to show at M18 review
  - Tasks T6.4/T6.5/T8.2/T8.3/T8.4 moved to start from M16 vs M19. Rationale: So more activity can be made in period 1
  - ALM to take over leadership of WP7 from ASC and be vice lead. Rationale: Was inconsistent in original proposal and meant to be ALM as ASC already lead one WP
  - MASS to take over leadership of WP8 and related task T1.2 with CON remaining vice-lead for WP. Corresponding move of 6MM of days and some incidental costs balancing on the equipment budget. Rationale: CON was a provisional lead and after full discussion was found perhaps better MASS with their deeper EU project experience
  - Consolidation of T93 and T95 into new task rebranded as T94 and corresponding reassigning of old T94 to T93. No change to overall scope. Rationale: Tasks were too overlapping and on examination found better to condense/simplify
- Project Management and other:



- Redrawing project management graphic. Rationale: To better represent bodies and ensuring DOA and CA text matches and is workable;
- Addition of science manager. Rationale: To boost science focus
- Clarity that handbook is binding and must be approved by BOP. Rationale: To make status of deliverable clear
- Section specifying the approximate length of deliverables and precision on what is necessary for software deliverables. Rationale: To limit paperwork and achieve focus and real outcome.
- Providing more precision on the costs of meetings and equipment. Rationale: For better project/contract management
- Since UPV were over 15% mark for direct costs and additional explanation table and related narratives have been added. Rationale: EU Requirement
- Line added on ICE and partner funding of integration servers from equipment budgets. Rationale: To clarify this funding
- Addition of informative annex on breakdown at Task, vs WP, level. Rationale: Better visibility and contract management
- Revising profiles of part 2: Rationale: To ensure still current

## 1. EXCELLENCE

### 1.1 Objectives

#### 1.1.1 Preamble

The World is facing the fourth industrial revolution based on ICT, specifically architectures and services, as key innovation drivers for manufacturing companies. Traditional factories will increasingly be transformed into smart digital manufacturing environments. Currently, the full potential for ICT in manufacturing is far from being fully exploited (Road4FAME, 2015). Factories are complex systems of systems and there is a need to develop a platform on which future manufacturing applications can be built. Europe should achieve leadership in digital platforms for industry on which value is created (e.g. embedded operating systems, autonomous systems building blocks, cloud platforms, data, security, openness, interoperability, etc.).

Examples of platforms exist in some industrial sectors: AUTOSAR (automotive), ISOBUS (agricultural machinery), Smart Agrifood (agri-food), but there is a lack of cross cutting platforms based on open standards for creating an ecosystem for cooperative innovation. Innovative open platforms to attract talent from solution developers and to provide accessible manufacturing smart applications to European SMEs are examples of the kind of solutions being sought.

European SME needs around ICT solutions are far from being satisfied in an affordable way in terms of cost and time; needs include: to reduce integration overheads for ICT, to provide mobile devices that are intuitive, to provide traceability from cradle to grave through the supply chain, and to facilitate monitoring, optimisation and predictive maintenance to enhance availability and productivity. Currently ICT solution providers are pushing technology at industry rather than there being user-pull for new technologies. Within factories the current situation is a “wild garden” of many diverse and unconnected disjoint systems that are not interoperable.

Over the last decades, manufacturing companies have been implementing point-solutions: each bringing a specific feature or fixing a specific issue. Resulting from this approach is a highly heterogeneous manufacturing IT landscape. These IT landscapes are already costly to administer and further addition of capabilities become even more costly because they have to be fitted into this existing heterogeneous IT landscape. There is thus a need for a homogeneous manufacturing IT landscape offering manufacturing IT solutions, to support manufacturing companies, especially SMEs, to successfully respond to the challenges to be flexible and offer highly customised products, without daunting implementation costs, and thereby maintaining and boosting their competitiveness locally in the increasingly globalised markets SMEs participate in.

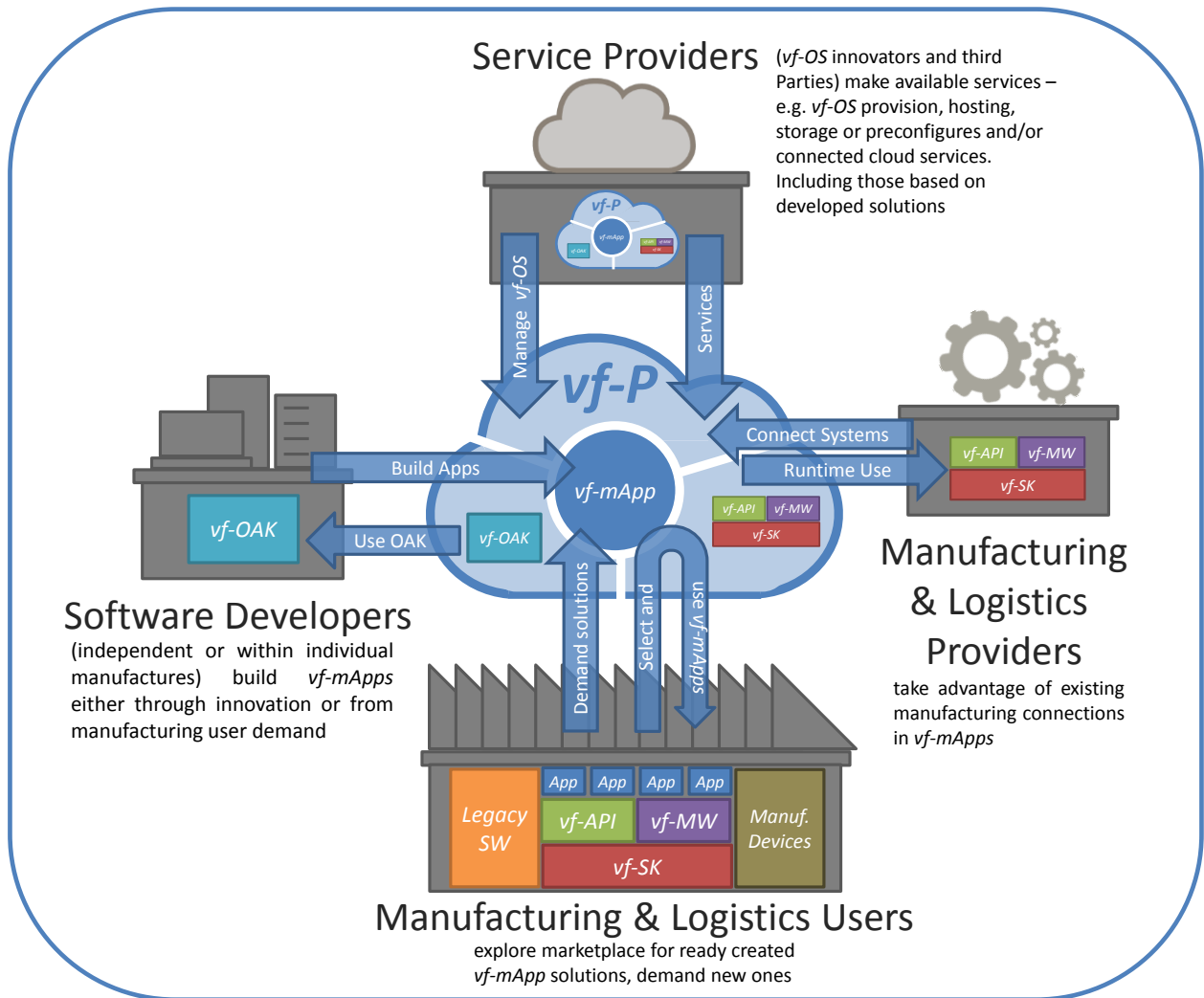
#### 1.1.2 Objectives

The goal of the *vf-OS* Project is to develop an **Open Operating System for Virtual Factories (*vf-OS*)** (Figure 1), composed by a Virtual Factory System Kernel (*vf-SK*), a Virtual Factory Application Programming Interface (*vf-API*) and a Virtual Factory Middleware (*vf-MW*) specifically designed for the factory of the future. An Open Applications Development Kit (*vf-OAK*) will be provided to software developers for deploying Manufacturing Smart Applications for industrial users, using the Manufacturing Applications Store (*vf-mApp*) at the Virtual Factory Platform (*vf-P*).

The Virtual Factory Platform (*vf-P*) will be an **economical multi-sided market platform** with the aim of creating value by enabling interactions between four customer groups: **a) Software Developers** (independent or within individual manufacturers) which will build Manufacturing Apps either through innovation or from manufacturing user demand; **b) Manufacturing Users** which will explore the marketplace for already created solutions, ready to be run on the *vf-OS*; **c) ICT Providers** which will provide ICT interfaces and manufacturing connections; and **d) Service Providers** (*vf-OS* innovators and third parties) will make available services (hosting, storage, connected cloud services, etc.) including those based on developed solutions.

The Virtual Factory Platform will provide a range of services to the connected factory of the future to integrate better manufacturing and logistics processes. Manufacturing Applications Store (*vf-mApp*) will be open to software developers who, using the free Open Applications Development Kit provided, will be able to quickly develop and deploy smart applications to enable and optimise communication and collaboration among supply networks of all manufacturing sectors in all the stages manufacturing and logistic processes: demand forecast, planning, supply, manufacturing, distribution, storage, and replacement / recycling.

*vf-OS* aims to become the reference system software for managing factory related computer hardware and software resources and providing common services for factory computational programs. This operating system will be the component of the system software in a real factory system where all factory application programs will run. This includes full management through virtualisation of the whole factory and related supply networks, including time-sharing schedule tasks for efficient use of the system. The Service Providers, as managers of the Virtual Factory Platform (*vf-P*) and the Manufacturing Applications Store (*vf-mApp*), will guarantee the quality of the Manufacturing Smart Applications and will define a clear revenue business model for the *complementors*.



**Figure 1:** The vf-OS approach.

vf-OS will be an **Open Framework** able to manage the overall network of a collaborative manufacturing and logistics environment that enables humans, applications, and devices to seamlessly communicate and interoperate in the interconnected operative environment. vf-OS will provide a set of **Open Services**, rooted in the cloud and instantiated at the vf-OS Platform that moves from the device-centric to the user-centric paradigm. It will implement a multi-sided market exploitation strategy, with a clear value proposition to manufacturers, machine and device providers, logistic operators and end users.

vf-OS proposes an **Open Platform**, linked by strong network externalities and exploiting advanced ICT (ie, CPS, IoT, Cloud-models, M2M, security by design, etc.), fulfilling the actual need on the market for open services for interoperability based on data exchange.

For hardware functions such as factory's input and output and resources allocation, the operating system will act as an intermediary between the application behaviour of the factory and the factory hardware itself. This will enable the application factory functionalities and services to be virtualised or executed directly by the hardware, allowing system calls to the OS function to appropriately manage the manufacturing requirements.

The key aspect of vf-OS regarding innovation, research, exploitation and management are the following:

- **Innovation:** To develop an Open Operating System for Virtual Factories with the following salient features:
  - **Virtual Factory System Kernel:** Specific set of libraries and infrastructure for vf-OS applications to be built upon and interact with each other
  - **Virtual Factory I/O:** Flexible infrastructure adaptable to the applications and tools which are provided by vf-OS including the establishment of adapters to integrate with real factories and thus serve as interoperability mechanisms between the factory and the vf-OS

*If you want to create an Android application you require an SDK with java programming and an Android Marketplace to exploit it.*

*If you want to create an iOS application you require an iOS SDK with the swift language and the Apple App Store to exploit.*

*If you want to create a vf-OS application you require the vf-OAK and utilise the vf-OS Platform to exploit it.*

- **Virtual Factory Data and Connect:** Set of semi-independent but related services taking a variety of input data at large scale, at different speeds and providing a set of nontrivial analytic operators
- **Open Applications Development Kit:** Composed of a SDK to develop applications, a Hub to engage developers, a System Dashboard and the OAK Studio for development itself
- **Research:** To research into system software for managing factory related computer hardware and software resources and providing common services for factory computational programs:
  - **vf-P:** Holistic service platform, which is the foundation for all services and end user applications that *vf-OS* will facilitate, encapsulating and acting as the interface between the components, connectors, OAK functions, marketplace, service framework and the end user applications/developers
  - **vf-mApp:** Live Manufacturing Smart Applications container for connecting manufacturing users' needs with software developers solutions **vf-Service:** Basic framework for facilitating third parties who may wish to provide additional services such as hosting or computation resources
- **Exploitation and Sustainability:** To derive a sustainable business model based on the use of the *vf-P*, *vf-mApp*, and the *vf-Service* provision framework with the ability to:
  - **Open Access:** *vf-OS* and all its components will be by default open source enabling *complementors* (software developers, services providers, etc.) to permanently improve the *vf-OS* components and interact with the Virtual Factory Platform (*vf-P*) and develop Manufacturing Smart Applications using the free Open Applications Development Kit (*vf-OAK*) provided
  - **Sustainable Marketplace and Store:** *vf-OS* will take advantage of the great success of the mobile apps business model that are currently being provided for systems such as Google Play or the Apple Store; transferring this approach to the manufacturing sector based on the application framework and the information infrastructure created
  - **Joint Exploitation:** Establish the RTD of *vf-OS* as a cloud platform and services what will represent the joint exploitation of all partners formalised through either a joint exploitation agreement
  - **Start-up Company:** Provide exploitation plans and a sustainability model for the furtherance of the project results including the establishment of a start-up company to exploit data and data services
- **Users:** To demonstrate and validate the *vf-OS* components and business models:
  - **3 Use cases:** Do so in 3 challenging diverse use cases acting as demonstrators: automation equipment, construction, and plastic/metal components
  - **Public-access:** Provide a continuous open, public-access demonstrator during the project for other parties, especially SMEs, web-entrepreneurs and students, including the availability of prizes to stimulate take-up
  - **Validation:** Instantiate and validate the business models and technicalities and verify and quantify the gains of using *vf-OS*
  - **Agile Approach:** Impact users current business scenarios during and beyond the project through an agile, sprint based approach to ensure maximum impact throughout the project and conformance with most-current and evolving user requirements approaches
- **Management:** To guarantee successful project management activities and ensure on-time and on-definition project delivery

## 1.2 Relation to the work programme

The *vf-OS* project is submitted to the call, H2020-IND-CE-2016-17 topic FoF-11-2016: Digital automation, subtopic "Collaborative manufacturing and logistics". The relation to the work programme is as follows:

*EU Challenge: "...new approaches....both on process and product lifecycle level, from design [to] recycling."*

*vf-OS* will comprehensively cover all stages of manufacturing process and product life cycles of factories: from the product / process design and engineering, to maintenance and recycling. The Virtual Factory Open Operating System will collect and characterise the requirements of the *vf-OS* final users (industry) by providing a framework enabling the creation of Manufacturing Smart Applications for supporting collaboration and interoperability in the different stages of manufacturing and logistics processes – e.g. demand forecast, planning, supply, manufacturing, distribution, storage, replacement and recycling. *vf-OS* will be supported by a framework and efficient software to create the necessary APIs to easily integrate industry with the *vf-OS* platform. Where possible it will not reinvent the wheel and add necessary value to existing solutions to provide rapid prototyping and solutions. To pilot it, several *vf-OS* Smart Applications will be implemented at the industrial sites of the 3 Pilots firmly taking into account the industry's requirements and specifications. Key Performance Indicators will be defined in order to measure and monitor the performance and the usefulness of the *vf-OS* Smart Applications for supporting a products lifecycle and the design and engineering of the production system.

*EU Challenge: “RIAs shall develop reference implementations of platforms in a multi-sided market ecosystem... Proposals should contain an outline business case and industrial exploitation strategy”*

The Virtual Factory Platform will be a multi-sided market ecosystem in with four interrelated and interacting groups representing the four sides: a) Manufacturing Users; b) Software Developers; c) Manufacturing Providers; and d) Service Providers. The Manufacturing Applications Store (vf-mApp) (WP7) is a market place that will be the focus of this. It will allow Manufacturing Users to “demand” new applications, Developers to respond to these demands (or self-innovate) and upload Applications, Manufacturers to expose and provide functions to the market place ( e.g. connections to machines), Cloud and other providers to provision services (e.g. storage) and then finally for the User to use the Smart Applications either in-cloud or on-premise. All built in the vf-OS platform and running over the vf-OS. The platform is the hub which will provide the stated services and then charge via various models similar to the classical mobile store examples – for example a % of Application purchase, a % of service purchase. The will be put together as a business cases with work package WP9 dedicated to achieve this – an initial case is presented in section 2.2.2. From the start, the vf-OS mentality, and the project mentality, will be focused to achieve ‘vf-OS Limited’ which will be the vehicle to exploit vf-OS post-project and will influence all decisions. This approach is on-going in project FoF Project CREMA and has been extremely well received during evaluations. Also of note is partner Ascora which released the results of an EU projecting into the Kickstarter funding market place and has experience of this process.

*EU Challenge: “...validated through pilots on business and system level to establish...economic collaboration models.”*

Users scenarios developed in vf-OS project will report on several main industrial scenarios that will be covered by the vf-OS Platform and its Smart Applications. In the validation scenarios of WP8 a technical report including a checklist of general specifications of each pilot, will be carried out, in order to test the feasibility and functionality of vf-OS Platform and the Smart Applications developed for each pilot. vf-OS validations will emphasise on ICT security, knowledge protection, and trust in collaborative infrastructures. Pilots have the purpose to act as the experimental base of the vf-OS Platform.

*EU Challenge: “proof-of-concept demonstrations and validation in several different scenarios.”*

vf-OS will include the participation of a powerful industrial consortium fully involved in validating the results of the project in several sectors to ensure both applicability and genericness. A set of general business specifications (WP1) and pilot definitions (WP8) belonging to different industrial sectors and ICT stakeholders will be used as validation scenarios of the vf-OS components. A set of specific Smart Applications will be developed for each pilot for supporting collaboration in manufacturing and logistics processes. Measurements (performance indicators) will involve both implementation of Smart Applications using the Open Applications Development Kit (vf-OAK) and use of such applications by the end users. These will form part of the formal validation which is also in WP8. In addition external parties will be invited to use vf-OS platform and OAK during the later stages and mini-hackathons implemented. Business concepts, business models, and business plans to be established for vf-OS exploitation is included in the project.

*EU Challenge: “...share information. Advances are needed in communication and collaboration schemes”*

vf-OS will be designed and developed as a generic infrastructure with the main aim of sharing real-time information (events, data) from different sensors and legacy systems. Such sharing will allow European industry competitiveness to be enhanced by increasing the understanding of situations that occur during manufacturing processes execution. vf-OS will ensure automated collaboration through providing semantic interoperability of the events and real-time processing of Volume/Velocity orientated sensorial data. The definition of communication adapters (vf-OS device drivers, APIs) will enable enterprises to communicate/interoperate vf-OS with the factory in order to offer the desired services from vf-OS platform. These will allow the resolution of complex situations and to respond in real-time (zero delay, or even ahead of time). Communication among industrial partners and developers will be achieved with vf-OS Platform, Marketplace, and studio. The platform will allow users to place demands on the marketplace for developers to react and to help them. Also a developer ‘engagement hub will assist developers to communicate and interact. The final developed Smart Applications will increase their agility and responsiveness of events occurring in the production process.

*EU Challenge: “Develop the ‘operating system’ of the connected factory of the future and to integrate better manufacturing and logistics processes through platforms that enable and optimise.”*

vf-OS will provide the complete means to integrate with the real factory-definition of Open APIs, interconnection modules, and drivers that serve as interoperability mechanisms between the factory and the vf-OS components and applications. It will provide a set of collaborative tools the support a factories business including a Studio and Front-end environment to implement them (WP6). These include communication, workflows, operation, management, and security. The vf-OS Kernel is proposed, in order to comply with the requirements of the manufacturing Apps and supporting the easy integration in the vf-OS platform by industry. These will also be framed in an SDK called OAK for the developers.

*EU Challenge: “...architectures need to be more responsive to dynamic market demands...”*



The Virtual Factory I/O will provide a flexible infrastructure and adapters for rapid integration with factories resources and thus serve as interoperability mechanisms between the factory assets/services and the *vf-OS* allowing fast re-configurability of production. The Virtual Factory Data and Connect task will be able to handle the variety of input data at a large scale, at different speeds, and by providing set of analytic operators. In addition, *vf-OS* will be constructed to allow re-configurability, scalability, and resource optimisation in different industries in which *vf-OS* is going to be applied thus ensuring a practical approach to data concerning production system changes.

*EU Challenge: “Research issues...: architectures for interoperability; management of the data deluge ... fusion with other information sources within the factory and supply chain.”*

*vf-OS* has connection management tools (WP3 & WP4) and an embedded a data infrastructure (WP5) to perform the operations to access data from the virtual factory. Data stream management of *vf-OS* will include reading, cleaning, storing, indexing, enrichment, search & retrieval, fusion, maintenance, and correspondence of open APIs. The data infrastructure will support analytic and decision making services, and will enable the generation of real-time, data-driven predictions, as well as the discovery of unusual situations, based on events delivered real-time data streams.

*EU Challenge: “exploit digital models of processes/products & synchronise digital/physical world [including] security*

*vf-OS* connectivity will include APIs, Drivers, Services, and the inclusion of Enablers (FI-WARE and others) to connect the *vf-OS* virtual system to other manufacturing assets both virtual (software) and physical (Machines, Sensors). “Manufacturing Providers” are one of the four sides of the marketplace and they will expose services to use which can be developed in the platform externally. If exposed the developed *vf-OS* applications can take advantage of them in a win-win scenario since if assets are available in the Marketplace then customers/suppliers can gain visibility and insight – of course all within a holistic security concept. These are fused with the needs of the Manufacturing users who want specific application functionality built by the developers. As mentioned, components will be built based on a holistic and pervasive security and privacy concept applicable to all *vf-OS* components. The definition of security policies and procedures will ensure the privacy and protection of the factory assets, people, and all related data. Suitable general approaches and standards to be applied will be identified (e.g. encryption) and will focus on the specific requirements of the manufacturing domain, to ensure data security

*EU Challenge: “M2M communication...human-machine-interaction, data analytics, as well as security by design.*

*vf-OS* will cover machine-to-machine (M2M) communication, advanced human-machine-interaction, and data analytics through the device management, providing plug-and-play connections (*vf-OS* Device Drivers and APIs based on a standardised toolkit) among the different Virtual Factory I/O devices (sensors and actuators). The device manager is responsible for establishing an efficient integration between factory devices and *vf-OS* apps, enabling an efficient response to changing designs at the virtual factory level, and allowing a scalable platform through plug-and-play capabilities. The *vf-OS* Virtual Factory Data and Connect will provide off-line analytical processing of sensory inputs supporting supervised and unsupervised scenarios. Security is addressed in a topic above.

### 1.3 Concept and approach

#### 1.3.1 Overall Concept and Positioning of *vf-OS*

The *vf-OS* Project will develop an **Open Operating System for Virtual Factories**, deployed in a cloud platform, supporting a multi-sided market ecosystem for providing a range of services to the connected factory of the future to integrate better manufacturing and logistics processes. It captures the notion of a manufacturing “operating system” and makes full use of the “concepts” of a classical software operating system such as that on a desktop computer and provides the necessary tools to realise it either in-cloud or on-premise. This manufacturing approach can enable a whole new level of flexibility and scalability in the manufacturing domain and, like any good concept, tries not the re-invent the wheel but to take advantage of, replicate, and adapt such concepts and tools. An analogy between Software OS and Manufacturing OS is pictured bellow. At a practical level *vf-OS* will re-use existing tools (especially Open Source ones) and technologies (especially standardised ones):

**Table 1:** Analogy between Software OS and Manufacturing OS.

Software OS Environment	Virtual Factory OS ( <i>vf-OS</i> )
<b>Kernel</b> Processor, Memory, Internal Bus	<b>Virtual Factory System Kernel (<i>vf-SK</i>)</b> Framework, Generic Enablers, Manufacturing Enablers
<b>I/O</b> Interfaces, Peripherals, Device Drivers, APIs	<b>Virtual Factory Application Programming Interface (<i>vf-API</i>)</b> Devices Drivers, APIs Connectors, Security & Data Access

<b>File and Data handling</b> Interfaces	<b>Virtual Factory Middleware (vf-MW)</b> Data Infrastructure Middleware, Data Storage, Data Harmonisation, Data Analytics
<b>SDK</b> SDK, Application Development portal, System Monitor	<b>Open Applications Development Kit (vf-OAK)</b> System Dashboard, Front End Environment, Studio, Developer Engagement Hub
<b>Applications</b> ERPs, CRMs, MES	<b>Manufacturing Smart Applications</b> Equipment real-time data collection, Monitoring and alerting, ...
<b>Developer Environment</b>	<b>vf-OS Engagement hub, vf-OS studio</b>
<b>App Store</b>	<b>Manufacturing Applications Store (vf-mApp)</b>
<b>Internet and Service Provision</b>	<b>Virtual Factory Platform (vf-P)</b>
<b>User</b>	<b>Manufacturing Users / Software Developers</b>

In order to foster the wide application of the Virtual Factory Operating system concepts a framework is needed to support the complete manufacturing process lifecycle. This will be from setting up the process to process execution, monitoring, and adaptation), data integration from technologically heterogeneous data sources, and end-to-end integration to give the potential users (eg, manufacturing engineers, process owners, production managers, shop floor workers) all the information and interoperability that is needed. This is independent from if a manufacturing process runs centrally in a particular location or spans different factories and organisations in a supply chain. This allows collaborative manufacturing based on cross-organisational manufacturing support, and mobile manufacturing.

**vf-OS** will profit from existing technologies to quickly provide value to enterprises (final users) and developers. At present, a widely used reference implementation of platforms supporting market ecosystems for developing applications for the virtual factory does not exist. Some valuable initiatives (e.g. FIWARE) have provided the basic elements for developing enterprise applications and **vf-OS** will build on this and other existing work to ensure the building from scratch is kept to the minimum. Toolkits such as the open source Talend suite (Big Data, Integration...) can be used to facilitate connectors although taking into consideration the solid commercial supported and industrially realised open source will be the target since **vf-OS** aims not to just provide 'never used research software' but outcomes which augment existing tools and only add/research where necessary.

The **vf-OS** aim is to become the neutral reference system software for managing factory related computer hardware and software resources and providing common services for factory computational programs. This operating system will be the component of the system software in a real factory system where all factory application programs will run. Such operating system will include real-time architectures for interoperability, management of the data deluge, ICT security, knowledge protection, and trust in collaborative infrastructures. **vf-OS** will have the following main features: Single- and multi-user, distributed, embedded, real-time, and library-based.

**vf-OS** will thus enable the Manufacturing Operating system by providing the following functionalities:

- **vf-OS provides a Virtual Factory System Kernel.** A specific set of libraries and infrastructure for **vf-OS** applications to be built upon and interact with each other. The **vf-OS** Kernel is the core of the operating system, responsible for providing key system wide **vf-OS** resources and providing a set of specific services, which will be open and accessible.
- **vf-OS provides a Virtual Factory Devices Drivers and Open APIs.** A set of modules that virtualise a factory's real assets and connect them to their virtual images in the **vf-OS**. Plug-and-Play mechanisms and device drivers for seamless/open access and smart virtualisation of the factory resources. Open APIs, interconnection modules and drivers will serve as interoperability mechanisms between the factory and the **vf-OS** applications. The integration between factory and **vf-OS** will be seamless and secure - hence transparency / openness but also protection/authentication are keys for the definition of APIs to interface factories and **vf-OS**.
- **vf-OS provides a Virtual Factory Middleware, System Services and Data Bus.** A set of modules for integrating data from arbitrary sources, including, but not limited to CPS, smart objects, RFID, and wireless sensor networks. Cloud-based data storage (but also on-premise) will be utilised in order to avoid vendor lock-in issues and that the whole system fails. Also consideration will also be given if a particular Cloud-based data store is not available anymore. Accessibility of data will be facilitated through connectors and wrappers.
- **vf-OS provides an Open Applications Development Kit.** A complete and fully open Applications Development Kit addressed to the community with the aim of guarantee the growth of the specific applications running in **vf-OS** for covering all industrial sectors and concrete industrial scenarios including for those beyond the project,. It will allow third parties to develop their own applications and facilitate their integration into the **vf-OS** Platform thus widening and opening this way the development of specific third parties and specialised applications.

- **vf-OS provides the Cloud Manufacturing Collaboration, Knowledge and Stakeholder Interaction Framework.** A Cloud Platform allocating the core business functionalities of **vf-OS**, including the marketplace (**vf-mApp Store**) and monetisation means as well as the ability to demand, advertise and lease/purchase manufacturing Applications and third party services. Users will use this to request functionality, software developers will introduce new applications running in **vf-OS** based on these requirements (or self-innovate), servicers providers will provide services (e.g. hosting), and users will download/purchase and run the built applications either in-cloud or on-premise. The manufacturers will download/buy existing applications via the marketplace. In addition a developer engagement hub (akin to Stackoverflow) will facilitate the interaction between developers.
- **vf-OS provides Applications.** The extensive 3 Industrial Pilots have the purpose to act as the experimental base of the **vf-OS** Platform, linking test and validation activities to research, innovation, and development tasks as well as produced requirements. The Manufacturing Smart Applications developed in the three Pilots will also continuously feed the process of knowledge creation through the adoption of an incremental development model.
- **vf-OS Components.** The individual technical components to build the functionalities of **vf-OS** will be modular and provide open interfaces. Therefore they can be easily integrated into other systems as well as incorporate future components, can integrate other technologies developed within current and future factories of the future projects, and can be used together with existing software systems within companies. In addition the Open Applications Development Kit will then provide methodologies and interfaces to develop the individual applications needed by industry which will be kick-started in WP3 from existing enablers such as those in FI-WARE.

**vf-OS** is thus a Research and Innovation Action which will contribute to the state of the art in Factories of the Future by providing new research results, concrete applications, and demonstrations of the technological advancements in concrete use cases and environments. The project is not limited to providing theory-driven concepts, but will deliver the technological means to realise these concepts in software and as already stated the focus will be on the concept and realisation of “**vf-OS** Limited”.

**vf-OS** TRL: With regard to the Technology Readiness Levels (TRL) formulated for the H2020 Work Programme, all of the RTD tasks will provide results which are at least “breadboard/lab validation (includes at users test labs)” (TRL 4). However, particular results will reach higher levels, especially these that are in the focus of the use case work packages. The technologies which are in the immediate focus of the use case work packages will be first tested in a lab environment at the SmartFactoryKL demonstration factory and later on in live environments in the production facilities of industrial partner and therefore reach TRL 5 (“breadboard validated in relevant environment”) and even TRL 6 (“prototype demonstrated in relevant environment”). It should be noted that the concept of Cloud manufacturing is currently still at the TRL 1 & 2 level (“Basic principles” and “Technology Concept”) although certain supporting technologies have already received more attention (eg, Sensor Abstraction is today available, however offering either proprietary or generic ways). Therefore, **vf-OS** will provide a clear increase in the maturity of these technologies. Certainly individual components, for example WP5s Semantic Harmonisation, will be exploitable in their own right. However, the thrust of **vf-OS** is for the joint system and thus project-wide exploitation operating the entire platform, with all the included components, as a service provider – **vf-OS** Limited.

### **1.3.2 National or international research and innovation activities linked with vf-OS**

In order to realise **vf-OS**, the consortium will bring in outputs from national and international research and innovation activities. These are either well-founded project results as well as existing solutions that the partners have been connected to and thus own or can re-utilise the Intellectual Property Rights (IPRs). The following table identifies these relationships and are broadly listed in most/current + priority order. In addition, **vf-OS** will collaborate with other upcoming H2020 Factories of the Future projects e.g. and the European Factories of the Future Research Association (EFFRA). With WP9 a clustering and collaboration task is envisioned to allocate the resources to achieve this. It is also noted the partner ICE has stimulated several clustering activities called “mini-clusters” which facilitate complementary lighter, but practical, cooperation thus with greater outcomes – for example between Adventure, ARUM and Premanus FoF projects.



**Table 2:** EU FP and H2020 Projects related with *vf-OS*

Project <sup>1</sup> /Status/ Partners	Related WPs
<b>Title/Value to <i>vf-OS</i></b>	
<a href="#">C2NET (H2020 636909)</a> / Active / IKERLAN, UNINOVA, UPV, CMS	WP5, WP7
<b>Cloud Collaborative Manufacturing Networks (C2NET)</b>	
<i>vf-OS</i> will study: (i) the Data Collection Framework (C2NET DCF) that provides software components and hardware devices for IoT-based continuous data collection since it presents synergies with <i>vf-OS</i> WP5 and (ii) the Cloud Platform (C2NET CPL) (which is still on development since C2NET finishes in 2018) with the <i>vf-OS</i> Platform and Integration developed in WP7.	
<a href="#">CREMA (H2020 637066)</a> / Active / ICE, IKERLAN, ASCORA	WP5
<b>Cloud-based Rapid Elastic Manufacturing</b>	
Reuse of Cloud Storage and Data Harmonisation components within WP5.	
<a href="#">MANTIS (H2020 662189)</a> / Active / IKERLAN	WP2, WP5
<b>Cyber Physical System based Proactive Collaborative Maintenance</b>	
<i>vf-OS</i> will benefit from the knowledge and results of proactive maintenance service platform architecture based on Cyber Physical Systems to be developed in MANTIS. A broad and diverse range of intelligent sensors, resulting in massive amounts of data are considered providing inputs for <i>vf-OS</i> Global platform architecture (WP2) and Data Storage, Data Harmonisation and Data Analytics (WP5)	
<a href="#">ADVENTURE (FP7 100733)</a> / Complete / ASC / ICE	WP5, WP6
<b>Adaptive Virtual ENTERprise ManufacTURING Environment</b>	
Especially the project's results regarding process design and runtime support will provide valuable input for <i>vf-OS</i> .	
<a href="#">ARUM (FP7 314056)</a> / Complete / ALM / ICE	WP6
<b>Adaptive Production Management</b>	
<i>vf-OS</i> will benefit from the knowledge acquired on active shopfloor operations monitoring, decision, re-planning and rescheduling support needed during not only the ramp-up product development phase, but also normal daily operational settings. In particular, coupling ASIMOV and MIDAS platforms to real-world business networks will help realise the Virtual Factory paradigm.	
<a href="#">ATHENA (FP6 507849)</a> / Complete / UNINOVA	WP2, WP7
<b>Advanced technologies for interoperability of heterogeneous enterprise networks and their applications</b>	
The operational ability to collaborate is a key success factor for networked enterprises, and interoperability is the target result of the enterprises involved in long established as well as ad-hoc or occasional forms of collaborations. <i>vf-OS</i> will examine the ATHENA Interoperability Framework (AIF) as a compound framework and associated reference architecture for capturing the research elements and solutions to interoperability issues that address the problem in a holistic way by inter-relating relevant information from different perspectives of the enterprise.	
<a href="#">CuteLoop (FP7 216420)</a> / Complete / UNINOVA	WP4, WP5
<b>Customer in the Loop: Using Networked Devices enabled Intelligence for Proactive Customers Integration as Drivers of Integrated Enterprise</b>	
The CUTELOOP framework provides to <i>vf-OS</i> a new dimension of networked applications and services capable of interoperation across a wide variety of business domains and organisations of all sizes, as a key enabler are Intelligent Networked Devices for distributed and asynchronous control of business processes. <i>vf-OS</i> will improve the interaction of diverse actors in the integrated enterprise, targeting at an approach which will facilitate the inclusion of customers as an integral part of complex relationships in business networks.	
<a href="#">EASY-IMP (FP7 609078)</a> / Active / LYON2	WP2, WP3
<b>Collaborative Development of Intelligent Wearable Meta-Products in the Cloud (FoF – NMP)</b>	
Reuse of methodologies, tools and platforms for the design and production of personalised meta-products (product/services). This project can provide knowledge about meta-descriptions of products/services from the functional viewpoint and the evolution of interoperability issues between several enablers.	
<a href="#">ECOSELL (PF5 00753)</a> / Complete / UPV	WP1
<b>Extended Collaborative Selling Chain</b>	
<i>vf-OS</i> will benefit from the knowledge and background acquired related to the innovative concept of meta-enterprises that support the collaboration in manufacturing and logistics processes in order to provide more value to their customers.	
<a href="#">ENSEMBLE (FP7 257548)</a> / Complete / UNINOVA	WP1

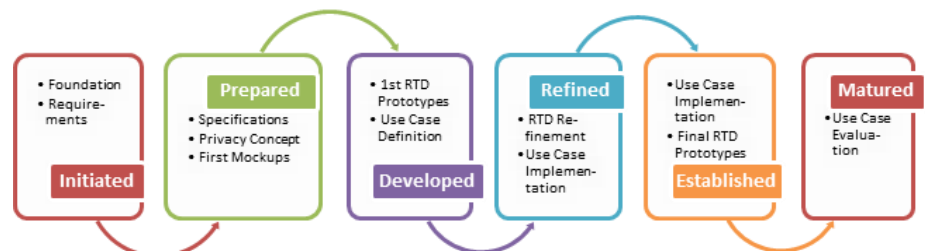
<sup>1</sup> The acronym of the project is a link to the project web page and its reference number is a link to the project description in CORDIS EU

<b>Envisioning, Supporting and Promoting Future Internet Enterprise Systems Research through Scientific Collaboration</b> Future Internet Enterprise Systems play an important role in the quest of <i>vf-OS</i> allowing European enterprises (typically SME's) to become more competitive, to enlarge their markets and overall potential, whilst transforming towards new business models and developing innovative products and services. The ENSEMBLE project combined systemic approaches, scientific multi-disciplinarity, innovative Web 2.0 and collaboration tools with a community-driven mentality, and thus to significantly increase the impact of the Future Internet Enterprise Systems (FIeS) domain, and its roadmap can steer the implementation of <i>vf-OS</i> concept aligned with the H2020 vision for the FoF.	
<a href="#">FITMAN (FP7 604674)</a> / Complete / UNINOVA, UPV, LYON2, CON, APR	WP3
<b>Future Internet Technologies for MANufacturing</b> FITMAN has created the FITMANnovation Lab (FML) as an exploitation instrument beyond the project. Through the FML, <i>vf-OS</i> will study the FITMAN experience with regard to the development of Specific Enablers (SE), based on the Generic Enablers (GE) selected from the FI-WARE Core Platform, which will be analysed in detail by <i>vf-OS</i> WP3. FITMAN has contributed to the Smart Factory and Virtual Factory use cases, e.g. for monitoring and visualising the state of production facilities which directly relates to <i>vf-OS</i> application scenarios.	
<a href="#">IMAGINE (FP7 285132)</a> / Complete / UNINOVA	WP2, WP4
<b>Innovative End-to-end Management of Dynamic Manufacturing Networks</b> The novel comprehensive methodology and the respective platform for effective end-to-end management of dynamic manufacturing networks in an innovative plug and produce approach provided by IMAGINE, will support <i>vf-OS</i> in the development of the services for the new networked production and logistics model, based on community, collaboration, self-organisation and openness rather than on hierarchy and centralised control.	
<a href="#">INTEROP (FP6 508011)</a> / Complete / UNINOVA, UPV	WP4 WP5
<b>Interoperability research for networked enterprises applications and software</b> <i>vf-OS</i> will take advantage from the knowledge generated in INTEROP NoE on enterprise interoperability to define interoperability mechanisms between the factory and the <i>vf-OS</i> (WP4) and to prepare the interoperability connectors to get access and analyse the data infrastructure (WP5).	
<a href="#">iSURF (FP7 213031)</a> / Complete / UNINOVA	WP2, WP3
<b>An interoperability service utility for collaborative supply chain planning across multiple domains supported by RFID devices</b> iSurf provides a knowledge-oriented inter-enterprise collaboration environment to SMEs to share information on the supply chain visibility, individual sales and order forecast of companies, current status of the products in the manufacturing and distribution process, and the exceptional events that may affect the forecasts in a secure and controlled way. <i>vf-OS</i> will investigate the iSurf's Semantic Interoperability Service Utility framework to develop the architecture for its services mechanism.	
<a href="#">MSEE (FP7 284860)</a> / Complete / UNINOVA	WP4, WP6
<b>Manufacturing Service Ecosystem</b> The MSEE's service-oriented management methodology and its Future Internet universal business infrastructure can enable <i>vf-OS</i> to implement the concept of virtual factories and enterprises to self-organise in distributed, autonomous, interoperable, non-hierarchical innovation ecosystems of tangible and intangible manufacturing assets, composed and dynamically delivered as a Service, end-to-end along the globalised value chain of the factory and logistics.	
<a href="#">NET-CHALLENGE (FP7 229287)</a> / Complete / ASCORA	WP7
<b>Innovative networks of SMEs for complex products manufacturing</b> Communication and data exchange functionalities, especially within the app store environment of WP7, will be investigated.	
<a href="#">OSMOSE (FP7 610905)</a> / Complete / UNINOVA	WP2, WP3
<b>OSMOsis applications for the Sensing Enterprise</b> <i>vf-OS</i> will investigate the OSMOSIS reference architecture and its middleware for the implementation of the Sensing-Liquid Enterprise concept to steer <i>vf-OS</i> on how to interconnect the Real/Digital/Virtual factory worlds in a seamless environment to be managed by the <i>vf-OS</i> services.	
<a href="#">ProaSense (FP7 612329)</a> / Complete / UNINOVA	WP2, WP5
<b>The Proactive Sensing Enterprise</b> The Proasense approach to proactive intelligence, information management, problem solving and decision support will be considered by <i>vf-OS</i> with the aim to address the issues in the application of proactive intelligent information technologies and monitoring of the contextual factors of decision making procedures within enterprise organisational structures, socially-aware collaboration environments, and networks within enterprise environments.	

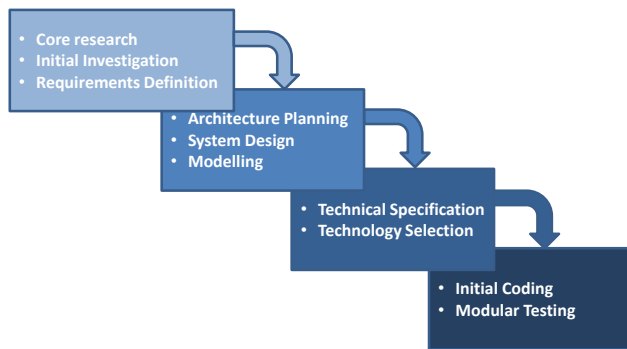
<b>Probe-IT (FP7 288315)</b> / Complete / UNINOVA	WP1, WP4
<b>Pursuing ROadmaps and BEnchmarks for the Internet of Things</b> <i>vf-OS</i> will use the results of the studies and roadmap provided by PROBE-IT on the worldwide deployments in different perspectives filling the needs of policy makers, deployments drivers, technology providers and users. The aim is to ensure interoperability and acceptance of validated IoT solutions in a global context to avoid unnecessary competitions and overlaps. This includes benchmarking of IoT deployments to provide stakeholders with decision tools aimed at identifying the best options when deploying or using IoT	
<b>PROSE (FP7 318218)</b> / Complete / CMS	WP6, WP7, WP9, WP10
<b>Promoting Open Source in European Projects</b> The adoption of open source in <i>vf-OS</i> can be enriched by the use/reuse of the <a href="https://opensourceprojects.eu">opensourceprojects.eu</a> platform that hosts the open source code of numerous EU-funded projects. This will allow <i>vf-OS</i> to reuse existing projects' code and to make its own code available, allowing the research community to contribute and reuse it during and after the project closure.	
<b>REMLANET (FP7 229333)</b> / Complete / IKERLAN, UPV	WP1
<b>Resilient Multi-Plant Networks</b> REMPLANET will serve as the foundation to support the review of existing architectures, technologies and solutions for supporting collaboration in manufacturing and logistics processes.	
<b>SOA4ALL (FP7 215219)</b> / Complete / ICE, ASCORA	WP6
<b>Service Oriented Architectures for All</b> Especially the functionalities to easily create and consume services and data can be of use to <i>vf-OS</i> .	
<b>STASIS (FP6 034980)</b> / Complete / ICE, ASCORA	WP5
<b>Software for ambient semantic interoperable services.</b> Data Harmonisation components developed within the STASIS semantic mapping platform will be investigated	
<b>V-CHAIN (FP5 00281)</b> / Complete / UPV	WP8
<b>Virtual Enterprise for Supply Chain Management</b> <i>vf-OS</i> developments will utilise the experience gained in V-CHAIN through the shift from extended enterprises to virtual ones since <i>vf-OS</i> enables the shift from the current factory to the connected factory of the future.	

### 1.3.3 Methodology

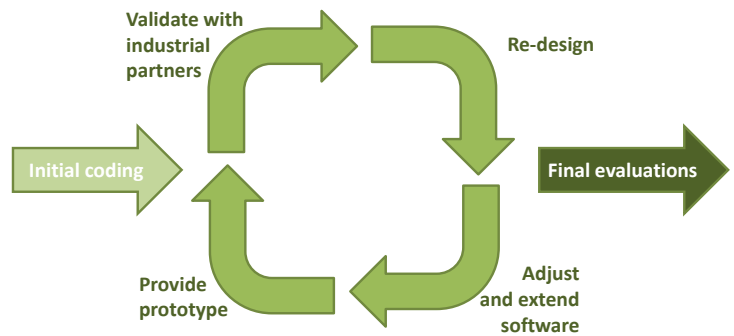
The described methodology adopted is a combination of waterfall during the first project phases and agile in the development orientated ones – i.e. hybrid. These are also coupled to the milestone phases as detailed in section 3.2.4. During the agile phases a sprint and scrum based approach will be taken which maximises both the engagement of, and delivery to, the users and thus the delivery of 'needed' vs. 'nice to have'. This is in the consortiums opinion and experience the most adequate, for research projects because of the reasons below:



- Research projects include an important and usually difficult elaboration of concepts and ideas during the analysis phase. This means that this phase, where the initial research is being done, cannot be accompanied by implementations and prototypes, because the landscape is still dim. A waterfall approach helps not only to separate the conceptual elaboration from technical development and prototype issues, but also to ensure that the core research will precede other tasks where innovation is asked, such as, the modelling phase, where the project aims at developing new solutions for data representations. Of course, even after the most successful linear development process, the results have a long way to go until they are understood from and useful to the end user. A prototyping part with an intensive involvement of industrial user partners is necessary in order to refine all the developed artefacts and serves as the first and most important part of this long way of transition from RTD to the industry.
- Pure linear methodologies are preferable in projects where the initial design and analysis is not expected to leave any open issues and the desired output can be defined in all detail from the beginning. Such an exact and binding outcome of the initial phases in research projects is difficult not desired.
- Pure iterative methodologies are preferable in projects where first results must be quickly shown to or examined by potential customers and where the initial analysis does not involve great challenges, which should be faced before starting with any implementations. None of these two features is valid for *vf-OS*.



**Figure 2.** Development methodology for the 1st part of *vf-OS* (Waterfall approach)



**Figure 3.** Development methodology for the 2nd part of *vf-OS* (Prototyping approach)

### 1.3.4 Motivating Applications – *vf-OS* Use Cases

This section identifies three major scenarios, in disparate sectors, for *vf-OS* to addresses coupled with a high-level user expectation of impact across these domains. These high-level generic scenarios will be explored in Task T1.2 (User Scenarios Characterisation) and fully defined as implementable cases in Task T8.1 (Validation Scenarios). The use cases introduced below will be implemented as part of *vf-OS* within WP8 to demonstrate the applicability and the impact of the project and its results into the market environment under real-world conditions. However, it should be noted that *vf-OS* will be designed for any industrial sector in highly complex inter- or intra-organisation scenarios, and not limited to the challenges of the use cases of the project.

**Manufacturing & Logistics/Automation:** Manufacturing and logistics are directly interconnected integrating the value chain. However, to improve the efficiency of logistics operations which have to operate at incredibly tight margins is very difficult. Success in the ultra-competitive logistics business is all about continually improving the efficiency of operations and ICT remains central to both operations and strategy. It is recognised that logistics can receive added value by access to applications and improving user experience, including sharing information across globally distributed teams to collaborate without regard to organisational, geographic, or systems boundaries. This requires to seamlessly collect, store, analyse, and transmit Big Data reliably and securely so as to ensure real-time visibility.

**Construction/Industrialisation:** Major construction projects are an exploitable area for Industry Cloud platforms; they involve large budgets, many players on any one project (architects, engineers, owners, GCs, subcontractors, materials providers), voluminous documents, certifications, licenses, permits, complex services, etc. They also have a continuing need to have an industry software platform that can help on its industrialisation. Moreover, the construction industry is very characteristic and unique in the industrial context, because each construction project is one of a kind, and requires that each construction project has mostly its own construction site, i.e. each project requires its own customised factory. This is an industry that has adopted technology such CAD and Building Information Management (BIM) on an internal basis for small teams or even large enterprises, but has lagged in use of inter-enterprise tools. The combination of an industry that has many different types of players but severe economic issues just as the cloud craze has full steam, thus delaying the adoption of industry platforms.

**Manufacturing Assembly/Collaboration:** Manufacturing Collaborative Project Management providers put buyers and suppliers in an industry on the same page in some, or all, of the “design-to-source-to-pay” process. Most of these players focus on the product design and sourcing processes and leave purchasing and supply chain execution to others. An example of that is TraceOne which joins retailers and their suppliers in designing in private label consumer products. However, collaborative project managers must decide how much of the transactional process to automate beyond the design phase. Although the entire process can be automatised, many providers cover just part of it. In addition, if they are not sufficiently diversified across clients, geographies, and industries, it can be hard for them to build consistent, recurring revenue streams. Fundamentally, the most advanced businesses are platforms that bring together one buyer or project owner with its supply chain, but not across multiple supply chains. Efficient communication has also become vital to the smooth functioning of the increasingly complex manufacturing environment and the extent of a manufacturer’s competitive edge is determined by the efficiency with which it collaborates. Thus, there is the need of networks to enable, secure, and manage vital information flows. This provides real-time visibility of global manufacturing operations and enables the employees and partners access to the manufacturing management systems. It also improves the efficiency with which they seamlessly communicate, interoperate and collaborate, and provisions connectivity to cloud-based services.



### 1.3.4.1 Use Case/Domain Demonstrator: Manufacturing & Logistic/Automation

**Mondragon Assembly S.C.** ([www.mondragon-assembly.com](http://www.mondragon-assembly.com)) is a Spanish SME located in Aretxabaleta (Gipuzkoa, Spain) reference in the development and manufacture of automation production equipment. Mondragon Assembly are specialised in the design, manufacture and installation of a wide range of systems and equipment to automate assembly processes, offering configurations of multiple high-speed machines, optimised for the automated and semi-automated manufacture of diverse components.



**Via Solis UAB** ([www.viasolis.eu](http://www.viasolis.eu)) is a Lithuanian company located in Vilnius (Lithuania) which is an international manufacturer of PhotoVoltaic (PV) glass and provider of solar energy solutions. Via Solis merge and utilise advancement of PV glass processing & lamination as well as insulated glass manufacturing industries. Via Solis is able to supply entirely customised PV safety glass components representing a wide range of shapes, sizes, glass features and colours, as well as transparency; therefore, manufacturing flexibility characterises Via Solis.

#### Use Case description

The goal of this use case is to build a set of Smart Applications, integrated into the Virtual Factory Open Operating System, for the advanced management of spare-parts in the automation production equipment sector. The Smart Apps will support the collaborative management of a range of stages of the spare parts supply chain: demand forecast, planning, supply, manufacturing, distribution, storage, and replacement. The current spare part manufacturing delay is 3 weeks. Depending on the complexity of the part (thermal treatments or coatings), it can be even 5 weeks to receive it at Mondragon Assembly facilities. Shipping and logistic of the part can take another week which makes actual delivery times between 4 and 6 weeks. Spare parts are usually machined parts, where the mechanical design is at Mondragon Assembly's database, but the tooling itself is made by subcontractors with high precision machine-tools. In cases where spare parts are commercial products (springs, pneumatic elements...etc.), Mondragon Assembly knows the product reference and supplier although Mondragon Assembly is not "manufacturing" it. In both cases, machined parts and commercial parts, spare parts management is more related to logistic activity rather than design or manufacturing activity. This could be hugely reduced/facilitated with smart Apps set, which are able to forecast a failure, generate an alert at Mondragon Assembly and Viasolis, and even generate purchasing suggestion to Viasolis and provide delivery time and cost estimations. If purchasing is accepted by Viasolis, a Smart-App could directly generate for Mondragon Assembly all the required documents for launching the purchasing of the spare part.

#### Problems to solve

- Lack of the appropriate technology for establishing efficient policies on predictive, preventive, and corrective maintenance in terms of spare parts demand forecast and supply chain stakeholders coordination
- Slow reaction to spare-parts failure due to non-visibility of equipment operation indicators and status
- Production downtime and lost profits due to spare-parts failure in industrial high-value capital assets

#### Potential Smart Apps to develop

- Spare-parts failure manual register: Client application for the manual registration of spare-part failures in automation production equipment
- Spare-parts failure automatic register: IoT application for the automatic registration of spare-part failures in automation production equipment
- Spare-parts failure analytics: Quality control of spare-parts past failures and forecasts from known historic behaviours using advanced statistics.
- Spare-parts stocks levels policies: Decision support system for deciding which spare parts to stock, at which location, and in what quantities
- Spare-parts maintenance calendar manager: Scheduled maintenance alerts for equipment owners to perform preventive maintenance and receiving a budget proposal for spare-parts maintenance or replacement.
- Spare-parts procurement tracking: Time and space status of the spare-parts from manufacturing, logistics, and assembly for the final user
- Spare-parts traceability: Manufacturing and logistics traceability of spare-parts and historical use in equipment to conduct a root-cause analysis when failure occurs
- Equipment real-time data collection: IoT application for the automatic and real-time collection of several equipment indicators for predictive maintenance
- Equipment data analytics: Real-time advanced analytics application for predicting the failure of mission-critical equipment or assets
- Monitoring and alerting: Mobile application for easy monitoring of spare-parts status and for receiving alerts from predictive and corrective maintenance

### 1.3.4.2 Use Case/Domain Demonstrator: Construction/Industrialisation

CONSULGAL ([www.consulgal.pt](http://www.consulgal.pt)) is one of the major Portuguese consultancy companies, providing a wide range of multi-disciplinary services to its Clients in engineering fields particularly those related to Project Management and Construction Works Supervision. In its activity as Construction Works Supervisor, CONSULGAL acts on behalf of its Clients to ensure the works are implemented according to the contract agreement, following the relevant and up to date construction methods to deliver a product that meets the Client's technical, usability, durability, and/or maintainability expectations.



#### Use Case description

In the construction industry, a factory can be defined as an industrial site, usually consisting of site buildings and machinery, where workers manufacture and assembly goods or operate machines (trucks, cranes, compactors, excavators, etc.), and carry out tasks processing products (steel, iron, concrete, bricks, electrical and electronic hardware, etc.). These result in a final product such as a building, a road, an airport, a dam, etc., when processing one product into another similar to a classical manufacturing factory site. A construction project may be set in a specific location or in various locations.

When **vf-OS** is applied to a virtual construction factory, it will tackle the six design principles that are generally recognised for Industry 4.0:

- **Interoperability:** Pilot will explore the possibility of having objects at the construction site seamlessly communicating with operators and which may be also supported by the FIWARE platform
- **Virtualisation:** Data collected from the construction site can be analysed and used to simulate structural behaviour of the product (the built structure) or even to understand how subsequent construction steps will be influenced
- **Decentralisation:** Systems can open the possibility for informed decisions to be taken remotely, based on the information collected from objects on the construction site, which would allow for better resource management and cost reduction
- **Real time capability:** Assess how the system can provide useful information in real time that the stakeholders can use for rapid decision making
- **Service orientation:** Construction projects involve a large amount of technical and managerial advice, circulation of information, comments and approvals, legislation assessment and fulfilment
- **Modularity:** Activity groups that are typical of a construction project are arranged in modules that can be cloned and/or adapted between projects

The project concept and the **vf-OS** operating system will be validated using a real construction project, ie, the Alto Tâmega dam, in Northern Portugal.

#### Problems to solve

- The high complexity and long lead-times needed for the establishment of each construction project requires the identification of resources, definition of the intra/inter-site information flows, setting up control methods, defining requirements for resources and archives, and agreeing on approval procedures even if in normally these are similar from project to project.
- Missed understanding of the quality characteristics of a constructed product due to the dispersion and heterogeneity of the resources, processes, and data. Control processes in construction are detailed and often very bureaucratic. Moreover the cross reference between quality control data of materials used in the same construction process is often not performed mainly because control processes are addressed individually.
- High need of human resources presence for processes control. In a sector where cost reduction is of paramount importance, it would be of great relevance to be able to have decisions taken remotely so as to be able to manage more efficiently the allocation of human resources to those controls that absolutely require their presence.
- High complexity in the interaction between sites in large multi-site construction projects with severe interoperability problems in the networked environment. Construction resources need to be managed, including assignment, switch and discard, and with the need to decide which resources are needed for each process in each phase of the construction project.

#### Potential Smart Apps to develop

- **Automatic material checker:** Automatic identification of material when arriving at construction site and alert triggers to inform the relevant stakeholders
- **Real time monitor:** Informing in real time the actual status of all construction tasks
- **Construction plan manager:** Real time analysis of the impact of deviations - e.g. related to the delay in the delivery of materials, corrections needed on site
- **Customised data analyser:** Customised data access and adaptive data analysis
- **Construction factory journal:** Continuous log of the construction factory activities including workplan deviations and adjustments

- Real time tracker: Management of in site construction machinery and resources
- Resources traceability: Construction and logistics traceability of human and material resources and machinery, including historical use in equipment, to conduct a root-cause analysis when failure occurs
- Construction data integrator: Access in an integrated view of all project data, viewed according to different profiles, and according the profile of the user

#### 1.3.4.3 Use Case/Domain Demonstrator: Manufacturing Assembly/Collaboration

**APPLICATIONS PLASTIQUES DU RHONE - APR** ([www.apr.eu](http://www.apr.eu)) is a French SME located in Saint Symphorien d'Ozon (Rhones, France) and specialised in plastic manufacturing and transformation. APR has advanced technical solutions to transform and compose plastics for several application domains: automotive, aeronautic, water, etc.

**TARDY SA - TARDY** ([www.tardy.fr](http://www.tardy.fr)) is a French SME located in La Grand-Croix (La Loire, France) has significant expertise in engineering and transforming metal parts using several technologies. The proposed resources and competences enable tardy to be a strategic partner for aeronautic and railway industries.



#### Use Case description

The proposed use case targets to accelerate and maintain collaboration channels between a network of collaborative SMEs in two complementary business domains: plastic and metal. The joint partners aim to provide their customers with a common decision system able to analyse, evaluate, monitor and optimise the achievability of their customer projects. Each partner can thus ensure a global commitment with competitive pricing and delays. The SMEs expect to use the IT development environment to implement the targeted system using solutions building blocks such as those experimented in the FITMAN virtual factory platform as well as other concepts from Big Data and CPS architectures.

#### Problems to solve

- Difficulty to detect the most appropriate business collaboration opportunities among common customer projects
- Absence of a common commitment system for collaborative customer projects
- Lack of reactive tools and mechanisms helping to track and estimate the convergence of manufacturing order operations compared with customer commitments among the collaborative shop-floors

#### Potential Smart Apps to develop

- Opportunity analysis: Analysis and the ranking of customer projects regarding the network technical capabilities and availabilities
- Collaborative production planner: Generation of collaborative manufacturing sequences and the validation of each to be realised
- Supply chain event manager: Integration of CPS concepts to identify unexpected manufacturing events, the estimation of their impacts (in terms of quality, time and quantity) and the decision of next operation
- Production operation optimiser: Optimisation of manufacturing order sequence in case of challenging situations such as change of raw material/ resource, rescheduling, etc

#### 1.3.5 Gender analysis in vf-OS Project

vf-OS will pay special attention to the gender inclusion. The main objectives to promote gender equality within the project are as follows:

- To enhance women's participation at all levels within vf-OS and in society as a consequence
- To enhance the consciousness-raising of the importance of the creation of gender equality with vf-OS's
- To ensure that the project addresses both user's needs of both sexes
- To address the gender research associated with the research focus of the project

The proposed Gender Actions for the consortium are as follows:

**Action 1: Promoting women's participation in the management process:** Promoting the participation and equality of women in vf-OS management positions is an objective of the vf-OS Consortium. Women will be selected on the basis of technical knowledge and management skills using no special criteria besides competence

**Action 2: Enhancing the consciousness-raising of gender equality issues:** This action will be addressed to diffuse consciousness among all vf-OS's members of the importance of the gender equality issue by:

- Disseminating among vf-OS's members, deliverables and other gender related documents
- Creating the vf-OS women's e-mail list. Women members of vf-OS will be invited to become part of this mailing list which will allow dissemination of information such as mentoring programs, conferences and events, and other European activities for women in Science, Engineering and Environment

**Action 3: Gender Research Areas for vf-OS:** Gender issues in Virtual Factory Open Operating System are still under-researched. *vf-OS* will contribute to this field by examining the gender impact of the project's research and contributing to the EU surveys and initiatives in this area

**Action 4: Promoting the execution of dissertation research among female PhD students of the different universities involved in the project:** Informing undergraduate students about the possibilities of making their dissertation research related to *vf-OS* issues, helping and encouraging individual women to apply for PhD programs, and giving feedback to female students to guide their tasks

## 1.4 Ambition

To achieve its goals *vf-OS* will advance the state of the art of R&D in the areas covered in the following subsections. These briefly cover the different aspects related to *vf-OS* and highlight the innovative contributions *vf-OS* will develop to support a multi-sided market ecosystem for providing a range of services to the connected factory of the future and with the aim of integrating better manufacturing and logistics processes. The subsections summarise recent and representative works as state of the art in those areas, identify limitations, and identify how *vf-OS* aims to cope and advance with them.

### Manufacturing OS

The Internet of Things created a vision for a future-oriented manufacturing, logistics, and quality systems where intelligent devices learn to think and goods could organise how to get to their destination all by themselves (Fraunhofer IML, 2016). Since its creation, interest in IoT has increased in importance (European Commission, 2015) and in parallel IoT platforms are exponentially appearing typically specified towards managing enterprises sensor data. Some examples are IBMs Bluemix which is offering a platform as a service (PaaS) based on an open-source Cloud Foundry. Its aim is to deliver functions and services at enterprise-level which are easy to integrate with cloud applications. Another is IBMs IoT service that allows Apps to consume data collected by an enterprises connected devices, sensors, and gateways. Microsoft Azure IoT Suite is a cloud-based solution offering preconfigured solutions to address common Internet of Things scenarios so that enterprises can capture and analyse untapped data. IoT is a new opportunity and at the same time a new challenge for managing the data that enterprises acquire from their embedded systems and controlling their outputs. The future wave of IoT leads to Industry 4.0.

*vf-OS* will offer an open platform going beyond the scope of the enterprises level and going towards the scope of the network level. The *vf-OS* platform will involve the network partners into the manufacturing process both offering collaboration and decision support at the network level. This will increase the competitive advantages and the business opportunities. *vf-OS* prioritizes the development of open source technologies and unlike the current commercial software offering IoT platforms, *vf-OS* will release an Open Source IoT platform, providing an advanced base for developing tools for collaborative decision-making.

### Multi-sided platforms

Multisided platforms (MSPs) are technologies, products, or services that create value primarily by enabling direct interactions between two or more customer or participant groups and in a commercial setting where parties(s) or communities in the middle get benefit, often financial, to subsidize the development and operation of such market places – win-win-win. Prominent examples of MSPs and the participants they connect include, for example, eBay (buyers and sellers), Google's Android operating system (handset manufacturers, application developers and users) (Hagiu & Wright, 2015), and Apples App Store (Developers and Users). Multisided platforms have recently risen to economic and business prominence in many industries and there is significant research on multi-sided markets (Seamans & Zhu, 2013 and Vermesan et al., 2011). As different sides of a platform's market are often interdependent with each other. Changes on one side of the market tend to propagate to other sides (Balamuralidhara et al., 2013). As a result, platforms need to be cognizant of the multisided-ness of their markets and consider all sides together when designing optimal strategies (Pérez et al., 2014). Cloud-based services are appropriate to deliver multisided platforms and the platform owner can benefit from mediating between different types of customers and/or charging for (additional) services or for services/goods/applications sold whilst serving as matchmakers between supply and demand side customers.

*Vf-OS* delivers a cloud-based open platform that provides services that facilitates interactions and transactions among the collaborative manufacturing and logistics constituents that it serves, ie, both users (industry) and solution providers (software and services developers). This ecosystem will develop a symbiotic business and operative environment that will bring a global value proposition to *vf-OS* users such that members of one side are more likely to be on board and get profit from the MSP when more members of another side do so.



## Cloud Computing

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (Mell and Grance, 2011). Cloud computing allows consumers and businesses to use applications without installation and access files at any computer with internet access. This technology allows for more efficient computing by centralising data storage, processing and bandwidth (Wikinvest, 2013; Hamdaqa et al., 2012 and Folch, 2011). The concept also allows for faster, lower-risk deployment, automatic upgrades, support for customisations, high scalability and reduction of maintenance costs (Salesforce, 2014; Cisco, 2014a and Saleem, 2011). In addition data recovery and business continuity is often guaranteed, as services are externalised (Cisco, 2014b). On the downside, switching costs and legacy software integration must be taken into account (Haff, 2009) as well as the need for monitoring of capacity and performance in order to ensure the continuity of service (McKendrick, 2014).

*The vf-OS Platform will be a cloud platform providing the Virtual Factory System Kernel, the Virtual Factory Application Programming Interface and the Virtual Factory Middleware, offering the Open Applications Development Kit to software developers and allocating the Manufacturing Applications Store as a multi-sided market ecosystem. Manufacturer users could also decide to run the Virtual Operating System on their own hardware or run it into the vf-OS Virtual Factory Platform which is an option especially relevant to SMEs.*

## Cloud Manufacturing Systems

Manufacturing is the largest industry market segment for enterprise IT and offers the largest potential market for cloud computing and software as a service (Brant, 2012). Currently cloud has not been fully developed or incorporated to the manufacturing market due to its requirements regarding security, availability, and integrity. Recent studies show increasing interest from such companies to use cloud computing and virtualisation (Davidson, 2013 and Morley, 2011). This is mainly due to the benefits and advantages to be reaped with the move from traditional, on-premise applications to cloud computing (NetSuite, 2013 and Littlefield, 2012). Cloud computing technology transfers the responsibility for running on-premises hardware and software out to the Internet. Cloud computing providers handle software releases, hardware maintenance, upgrades and incident-solving, thus reducing the initial capital investment, the costs of setup and maintenance, improving scalability of resources and eliminating resource limitations (TechTarget, 2013 and Zhou et al., 2014).

The multi-directional integration of vf-OS cloud-enabled tools offers both users (industry) and solution providers (software and services developers) a closed-loop solution to accelerate smart applications design and development, reduce risk of delays, and streamline supply network collaboration. Although there are platforms for connectivity between users/providers, none support connection between needs and solutions.

## Enterprise Apps

Apps on mobile devices such as smartphones have become the core of the digital life of consumers. Apps are used for everything from e.g. shopping to communicating in social networks. Recently, “smart” Apps are gaining more and more attention in enterprises as an enabler for agile process optimisation (Gröger et al., 2013). Smart Manufacturing is the dramatically intensified and pervasive application of networked information based technologies throughout the manufacturing and supply chain enterprise (Davis et al., 2012). The defining technical threads are time, synchronisation, integrated performance metrics, and cyber-physical-workforce requirements. Smart Manufacturing responds and leads to a dramatic and fundamental business transformation: to demand-dynamic economics keyed on customers, partners and the public; enterprise performance and variability management; real-time integrated computational materials engineering and rapid qualification, demand-driven supply chain services; and broad-based workforce involvement. IT-enabled Smart factories and supply networks can better respond to national interests and strategic imperatives and can revitalise the industrial sector by facilitating global competitiveness and exports, providing sustainable jobs, radically improving performance, and facilitating manufacturing innovation.

*vf-OS will take this approach and apply it for systems within the virtual factory by realizing an App driven concept (although –not- to be confused with Apps on a mobile phone!). In this approach, the project will allow software solutions to be distributed and installed via a marketplace. This makes discovering and installing solutions much easier. In addition to this, the approach has two other advantages: Software solutions are encapsulated meaning that they are running within their own application runtime environment – just like apps on an iPhone do. This makes it easier to secure and isolate apps. Furthermore, the updating of software solutions is much simpler allowing more up-to-date solutions with less maintenance and installation costs.*

## Operating System Virtualisation

Virtualisation (Barham et al., 2003) has enabled the abstraction of computing resources such that a single physical machine is able to function as a set of multiple logical virtual machines. A key benefit of virtual machines is the ability to host multiple operating system environments which are completely isolated from one another on the same physical machine (Buyya et al., 2009). Hypervisors, popularised by Xen and VMware are appropriate for many usage scenarios but there are scenarios that require system virtualisation with high degrees of both isolation and efficiency (Soltesz et al., 2009). An alternative to hypervisors that is better suited to such scenarios is Docker (Docker, 2016) which is an open source technology that allows the virtualisation at the Operating System level similar to virtual machines but with significantly reduced overhead. It allows the same application to be deployed on different environments, thus decoupling the infrastructure requirements from the application environment. Its portability allows a user to integrate it in all available IaaS/PaaS public solutions, as well as in private infrastructures.

*vf-OS* will mainly take the App approach. However, some solutions can obviously not be fully App driven as they require the use of backend services from other providers (SaaS-approach). For those solutions, *vf-OS* provides upscaling solutions for services based on distributed and synchronised containers following the Docker concept which has gained tremendous popularity in the software domain. *vf-OS* will transfer this approach to the virtual factory domain including a smart bridge between a Docker container and a virtual factory app for secure and fast communication between them.

## Virtual Factory Middleware

A virtual factory platform must address interoperability with digital factory tools. To deal with interoperability common and standard data models should be used. Among the available technical standard, ANSI/ISA-95 (International Society of Automation, 1995) is an international standard for developing an automated interface between enterprise and control systems. Moreover, shared data storage should be available by digital factory tools in order to collect input data and generate output data. According to Tolio et al. (2013) middleware software is required to enable the access of shared data and to address the transfer, interpretation and conversion of the factory data, for its use within the virtual factory operating system. The transfer of data is made from the internal data structures of the digital factory tool to the shared data storage embedded in the virtual factory platform, by developing a proper middleware according to the language required by the application programming interface (API). Works proposing a data model for Virtual Factory I/O, which can be taken as a baseline of the future work, include: Terkaj and Urgo (2012); Kadar et al. (2013); Tolio et al. (2013); Debevec et al. (2014); Terkaj and Urgo (2015).

*vf-OS* will be based on the proposition of a toolkit for APIs in order to provide enterprise the integration with the *vf-OS* Platform as well as performance management mechanisms for controlling and monitoring the integration and supported by security policies. Collaboration tools will be provided within the *vf-OS* project in order to connect the different factories through the *vf-OS* Platform. The platform will use solid, and industrially used, open source technologies and solutions for rapidity such as Talend tools.

## Virtual Factory Data and Connect

Traditional solutions for data integration are based on tightly or loosely coupled and object-oriented approaches (Wache, 2003 and Cali et al., 2003). These approaches provide good mechanisms for avoiding integration conflicts but lack in their canonical data models the expected Industry 4.0 reliability, flexibility, scalability, and extensibility features. However, novel data integration concepts have been proposed based on syntactic and semantic data mediators (Ullman, 1997) to extract knowledge regarding the data structures of the underlying data sources and subsequently transform, decompose and recompose data requests according to that knowledge. They rely on multiple ontologies and corresponding query language and systems for the logistics and production environment. In this context, a semantic mediator (Hribernik et al., 2010) has been further developed and demonstrated for Digital Factories in CREMA, STASIS and FITMAN. The semantic mediator SEMed, a Specific Enabler in the FITMAN catalogue, comes at a higher computational expense than simple data integration approaches but at least already provides the necessary interoperability for flexible and changing environments.

*vf-OS* will advance state-of-the-art data integration: a smart Virtual Factory Data Broker/Adaptor will ensure dynamic critical smart data storage, processing and exchange across virtual factory networks. *vf-OS* will extend existing catalogue enablers for data integration with services for adaptation of the semantic models to ensure i) middleware handling data heterogeneity, volumes and speed, ii) the data storage and processing scalability, iii) the semantic data harmonisation, and iv) smart data analytics.

## Data Analytics

Sensor stream analytics is a research area which deals with the processing continuous streams of on-line sensor data. The result of the processing is provided in a form that is useful results for decision makers and the

corresponding software systems which have the ability to act on the provided analytics. The tasks required for processing streaming data usually include: Detecting anomalies from the stream such as outliers (Chandola, et al., 2009); Prediction of the future evolution of the data, including predictive maintenance of machinery and other types of prediction in systems control (Li, et al., 2009); Interpretation of data with techniques such as decision trees and rules from data as well as various forms of visualisations (Javed, et al., 2010). The detection of complex events from heterogeneous data streams (for example, sensorial data used for a factory-wide monitoring systems) is becoming a promising area to support applications for monitoring, detection, and online responses (Etzion & Niblett, 2010). Real time Big Data processing has become important for various application scenarios which are data-intensive by their nature, as in systems control scenarios, where the volume, veracity, velocity, and variety of the data introduces additional dynamics in processing architectures. For example, sensorial data can be gathered in different ways and with different precision, depending on the current context and business goals. In the control systems domain the efficient integration of heterogeneous real-time data in order to achieve complex situational awareness is especially challenging as is taking into account the privacy concerns.

Classical methods of data processing and mining are centralised; this means that in order to apply them data must be available immediately available. Contrary to this, Big Data is constantly updated and collected in physically distributed storages, and data centralisation is not possible. Using the centralised approach, the system cannot adapt quickly to situations in real time, and it is very difficult or simply impossible to transmit Big Data over a network and to store, manage, and process large data sets in one location (Fiosins, et al., 2011). In addition, some nodes of the distributed system prefer to relay mostly of their own experience in the prediction process. Therefore, there is an inherent need to develop effective Big Data distributed processing algorithms.

**vf-OS** aim at providing a novel approach/architecture for real-time Big Data processing (possibly based on Storm) that senses ad-hoc dynamicity/changes in real-time data and if needed it changes the processing architecture. Such dynamicity in processing represents an important innovation, especially because some of the changes (in the processing architecture) can be learnt automatically enabling the system to continually improve its real-time processing capacity.

### Internet of Everything (IoE)

The Internet has changed the way enterprise businesses is performed due to the provision of open platforms, web services, and multiple tools to collaboratively perform their processes regardless of an enterprises' geographic location. The Internet of Everything (IoE), which has evolved from the concept of Internet of Things (IoT), is leading to a new era of computing (Steenman, 2013). IoE brings together people, processes, data, and things to make networked connections more relevant and valuable than ever before; turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunities for businesses, individuals, and countries (Cisco, 2013 and Chui et al., 2010). This results in significant improvements of products, services and processes, customer and constituent experiences at the host organisation and in the relationships with partners (van der Meulen, 2013). As of today, few companies have deployed more than their own Intranet focused on local, isolated and closed-loop scenarios. The true value in the IoE is realised when these intelligent devices, software and processes communicate and share data with each other and the cloud. Communication will lead to uncovering information and actionable insight that can transform business (Steenman, 2013 and Shetty, 2014). This can be achieved by the convergence of M2M, Big Data and Cloud, key capabilities for the building of next-generation systems (North, 2014 and Davidson, 2014).

**vf-OS** will integrate relevant technologies, including cloud computing, IoT, embedded systems, sensors and CPS components, data analytics, Big Data sources and mobile data sources for building Manufacturing Apps which allow a seamless and efficient communication of all relevant information, integration with the organisations' applications and devices, and ultimately realizing the IoE.

### Enterprise Interoperability

Today Enterprises face many challenges related to the lack of interoperability. Enterprises need to adapt more quickly to changes in the business and economic market and are required to become more responsive to customers' needs. Although enterprises are heavily dependent on Information and Communication Technology (ICT) solutions in their day-to-day business operations, the solutions are often inflexible and difficult to adapt to meet the requirements of those changing enterprises (Truex et al., 1999). Interoperability is essentially a problem of sharing information and exchanging services. It goes far beyond the simple technical problems of computer hardware and software and encompasses the broad but precise identification of barriers which not only concern data and service but also process and business as well (INTEROP- DI.1b, 2006). Definitions for interoperability have been intensively reviewed (Chen and Vernadat, 2003; 2004). From a computer technology point of view, it provides a facility for two heterogeneous computer systems to function jointly and to give access to their resources in a reciprocal way. In the context of networked enterprises, it refers to the ability of interactions (exchange of information and services) between the enterprise's systems. Several European project have provided important results on the Enterprise Interoperability field: ATHENA FP6- IST 507849, 2004-2007;

INTEROP-NoE FP6-IST 508011, 2003-2007; ABILITIES - FP6 IST-027306, 2006-2008; FUSION - FP6 IST-027385, 2006-2008; GENESIS FP6-IST- 027867, 2006-2008; SYNERGY FP7-ICT- 216089, 2008-201; COIN FP7-ICT-216256, 2008-2010, among others).

*vf-OS* will incorporate advanced interoperability functionalities at business, processes, services, and data levels to ensure the interoperability of all the *vf-OS* cloud-enabled tools with the enterprise legacy systems and devices to promote seamless integration with the objective of working in a harmonised way at all the levels of the enterprise. New enterprise ontologies adapted to cloud processes will be proposed.

### Open Innovation

The term “open innovation” defines a strategy in innovation management, which is put to practice frequently in many companies today. Instead of a company relying solely on internal resources such as its researchers and developers other parties such as external problem solvers are integrated into the innovation process as well. A large, undefined network of actors is called upon to solve a problem as opposed to traditional alliances in research and development or a commissioned engineering service company (Hauschildt and Salmo, 2007). The open innovation phenomenon has developed from a small club of innovation practitioners, mostly active in high-tech industries, to a widely discussed and implemented innovation practice. Open innovation has been defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively’ (Chesbrough et al., 2006).

The *vf-OS* project will test whether open innovation could be a successful strategy for innovation on Manufacturing Smart Applications for supporting collaborative manufacturing and logistics processes in value chains. External “complementors” play a very central role in open innovation building applications with *vf-OAK*. For many companies, a tight-knit integration of users and solution providers has proved to be an essential factor in successful innovation. The *vf-OS* project will provide efficient and innovative cloud-enabled tools to collaborate and optimize manufacturing and logistics assets, involving the whole supply chain.

## 2. IMPACT

### 2.1 Expected impacts

This section describes the expected impacts that *vf-OS* will have on the FoF domain and more specifically on the Digital Automation research challenge taking as a basis three different impact sets: i) The expected impacts listed in the work programme for the FoF-11-2016, ii) The objectives of *vf-OS* itself with clear measurement indicators and iii) The expected impacts of *vf-OS* in the three Pilots of WP8.

#### 2.1.1 Expected Impacts from the Work programme

Implementing the different work programme objectives, *vf-OS* will provide a wide number of benefits. The following ones cover the expected impacts described in FoF-11-2016 call.

**Table 3:** Expected Impacts from the Work Programme

<i><b>"Innovative services, models and practices optimising manufacturing and logistics processes"</b></i>
<p>The <i>vf-OS</i> project provides novel reference system software for managing factory related computer hardware and software resources and providing common services for factory environments. This will be the basis for developing advanced Manufacturing Applications for the optimisation of manufacturing and logistics processes, involving supply networks, enterprises, machines, and objects. It will do this via:</p> <ul style="list-style-type: none"> <li>• WP3: Innovative services will be included in <i>vf-OS</i> Kernel and used by the Manufacturing Apps. These services will be characterised as being open and accessible as well as supporting easy interaction with enterprise applications and devices</li> <li>• WP5: Transformation services will be included in <i>vf-OS</i> for covering data interoperability between enterprises and with <i>vf-OS</i>. Moreover data storage, harmonisation, and connectivity are services incorporated in <i>vf-OS</i>, will allow the use of the enterprises input data in the optimisation of manufacturing and logistics processes</li> <li>• WP6: The Open Applications Development Kit (<i>vf-OAK</i>) will allow parties to be able to quickly develop and deploy smart applications to enable and optimise communication and collaboration among supply networks of all manufacturing sectors in all the stages manufacturing and logistic processes: Demand forecast, planning, supply, manufacturing, distribution, storage, replacement, and recycling</li> <li>• WP7: The Service Provision Framework will allow the <i>vf-OS</i> consortium and third parties to provide services such as hosting and storage resources. <i>vf-OS</i> will take advantage of mobile app business models giving an innovative service to the enterprises willing to use it.</li> <li>• WP8: Smart Apps will be developed within the <i>vf-OS</i> context and deployed in industrial sites with the aim of optimising manufacturing and logistics processes</li> </ul>
<i><b>"Quantified drastic reductions in the effort for integration or reconfiguration of today's hierarchical automation systems through advanced de-centralised or hybrid architectures"</b></i>
<p><i>vf-OS</i> will be constructed in a way to allow re-configurability, scalability and resources optimisation in different industries in which <i>vf-OS</i> is applied through decentralised and modularity principles. Decentralised systems open the possibility of taking into account different decision-makers, allowing better resource management and cost reduction. Modular systems allow the featuring of specific components which need extending and utilising the infrastructure. Each module may be even rearranged in sub-modules which could make it easier to be cloned. Summarising: <i>vf-OS</i> will provide the means to integrate with the real factory-definition of Open APIs, interconnection modules, and drivers that serve as interoperability mechanisms between the factory and the <i>vf-OS</i> components and applications. It will do this via:</p> <ul style="list-style-type: none"> <li>• WP2: Holistic and solid architecture covering both <i>vf-OS</i> and the developed applications</li> <li>• WP3: Re-packaged enablers (e.g. from FI-WARE) and creation of new enablers</li> <li>• WP4: A toolkit for API/Drivers and necessary/popular drivers/API gateways for general use and pilots</li> <li>• WP6/7: A platform of components for easier development: a Developer Studio, Engagement hub, Front end framework and system dashboard</li> </ul>
<i><b>"Better and faster reaction to market changes by being able to use holistic global and local optimisation algorithms in a collaborative sustainable value chain"</b></i>
<p>The <i>vf-OS</i> Virtual Factory Data and Connect will provide off-line analytical processing of sensory inputs, including machine learning algorithms supporting supervised and unsupervised scenarios. <i>vf-OS</i> will provide useful information in real time so that the stakeholders can use for quicker decisions. Moreover, Big Data processing algorithms will be used for making optimised decisions both from a global and local perspective, in a collaborative sustainable value chain. Specifically:</p> <ul style="list-style-type: none"> <li>• WP5: Off-line analytical processing of sensor inputs and machine learning algorithms will support supervised and unsupervised scenarios when market changes occur</li> <li>• WP6/7: <i>vf-OS</i> will support agile methodologies for application production to enhance interactions between individuals, processes, tools, collaboration over contracts negotiation, and responsiveness to plan changes</li> </ul>



### 2.1.2 Expected Impacts from the *vf-OS* Objectives

*vf-OS*' RDI objectives will be materialised in the implementation of the Virtual Factory Open Operation System composed by several components including the multi-sided market platform. The following table summarises the assessment criteria and measurable performance indicators for each *vf-OS* objective which will be further described in the Requirements Specification (T1.5):

**Table 4:** Expected Impacts from the *vf-OS* Objectives

Objective	Assessment Criteria and Further Information	KPI
To provide a Virtual Factory System Kernel	This is delivered by WP3. This objective will be reached through the implementation of the <i>vf-OS</i> Kernel which will be the core of the Virtual Factory Open Operating System, responsible for the processing and mediating the access to all <i>vf-OS</i> resources. The <i>vf-OS</i> Kernel will setup a specific core of services which will be used by the Manufacturing Apps deployed in <i>vf-OS</i> . These services will be open and accessible and comply with the requirements of the Manufacturing Apps such as supporting easy integration in the <i>vf-OS</i> Platform. The <i>vf-OS</i> Kernel will utilise some FI-WARE Generic and Specific Enablers and will also develop new <i>vf-OS</i> Enablers. In addition the process engine, due to its pervasive use throughout the <i>vf-OS</i> , has a specific task is envisioned although taking use of existing open software but at a commercial grade.	<ul style="list-style-type: none"> <li>• &gt; 5 connected generic enablers</li> <li>• &gt; 5 connected specific enablers</li> <li>• &gt; 5 created enablers</li> </ul>
To provide a Virtual Factory Application Programming Interface and Devices Drivers	This is delivered by WP4. This objective will be reached through the implementation of the <i>vf-OS</i> Input/Output with the means to integrate with real factories through Open APIs, interconnection modules, and drivers that serve as interoperability mechanisms between the factory and the <i>vf-OS</i> . These Virtual Factory Plug-and-Play mechanisms will be developed for seamless/open access and smart virtualisation of the factory resources. The focus is on the creation of modules that virtualise the factories real assets and connect them to their virtual images in the <i>vf-OS</i> platform.	<ul style="list-style-type: none"> <li>• 5 functionalities: Possibility to propose, subscribe, rank and promote asset profile in the virtual factory portal</li> <li>• 2 functionalities: Possibility to monitor and assess asset properties</li> <li>• 3 functionalities : Possibility to compose, or change assets through the virtual factories</li> <li>• Support of, at least, 20 of the most popular interconnection protocols to access data</li> </ul>
To provide Virtual Factory Middleware for Data and Connectivity	This is delivered by WP5. This objective will be reached through the implementation of <i>vf-OS</i> data infrastructure including interoperability connectors, storage, transformation services, and analytics functionality. This workpackage will provide a set of semi-independent but related services taking the inputs of a variety data at large scale, at different speeds, and providing a set of analytic operators. The Data Infrastructure middleware will provide the core data access, which can utilise the Data Storage for permanent and cross application access and Data Harmonisation will provide innovative transformation services, based on semantics.	<ul style="list-style-type: none"> <li>• Possibility to exchange &gt;100 messages/minute via the middleware</li> <li>• Possibility to store &gt;1Tb of assets in the data storage</li> <li>• Up to 50% reduction of data integration efforts regarding manual for new kinds of data sources</li> <li>• Statistical linear-algebra based algorithms for Machine Learning and data-mining will be developed leading to 25% reduction of intervention costs</li> </ul>
To provide an Open Applications Development Kit	This is delivered by WP6. This objective will be reached through the implementation of the <i>vf-OAK</i> SDK which defines the core aspect of the <i>vf-OS</i> to fast-construct manufacturing applications: OAK System Dashboard which represents the core software services for allowing system monitoring and configuration; OAK FrontEnd environment for providing a framework that facilitates a general 'look, feel, and composition' to <i>vf-OS</i> applications and will assist rapid development; OAK Studio which is a desktop development environment that facilitates software	<ul style="list-style-type: none"> <li>• To develop an Applications on top of the <i>vf-OAK</i> SDK within &lt;5 days</li> <li>• 15 Apps created within the project runtime – 5 from each pilot</li> </ul>

	developers to compose their applications for running at <i>vf-OS</i> . Additionally, the Developer Engagement Hub will be based on existing open source environment and is a collaboration platform for developers.	
To provide a Virtual Factory Platform	This is delivered by WP7. This objective will be reached through the implementation of the <i>vf-Platform</i> acting as a coherent portal and container for the <i>vf-mApp</i> . This represents a marketplace in the portal where applications can be procured, selected, accessed, purchased, and used by developers / users. The Service Provision Framework will allow the <i>vf-OS</i> consortium and third parties to provide services, such as hosting and storage resources.	<ul style="list-style-type: none"> <li>• Possibility to upload and describe a <i>vf-mApp</i> within &lt;1 hour (approval process)</li> <li>• &gt;15 Internal Apps listed in the marketplace during project runtime</li> <li>• &gt;10 External Apps listed in the marketplace during project runtime</li> </ul>
To provide a set of Manufacturing Smarts Apps for each Pilot	This is delivered by WP8. This objective will be reached through the implementation of a set of Smart Applications specified according to real-world scenarios and requirements provided by the three Pilots. This will be the real experimental base of the <i>vf-OS</i> Platform. Pilots will validate the developed Smart Applications in relevant scenarios demonstrating the <i>vf-OS</i> Platform's use to develop applications. The <i>vf-OS</i> project will be able to immediately address design/implementation needs coming from the users sites in an agile process.	<ul style="list-style-type: none"> <li>• Deploy at least 20 <i>vf-mApps</i> in the Pilots sites</li> </ul>

### 2.1.3 Expected Impacts from the *vf-OS* Pilots

To demonstrate the Virtual Factory Open Operation System, several *vf-OS* Smart Applications will be implemented at industrial sites of the 3 Pilots, taking into account the industry's requirements and specifications. The following table summarises the expected impacts produced in the industrial partners by using the *vf-OS* Apps which will be further described in the User/Provider Scenario Characterisation (T1.2):

**Table 5:** Expected Impacts from the *vf-OS* pilots

Pilot	Expected impacts
<b>Pilot 1: Manufacturing &amp; Logistic/Automation</b>	
	<ul style="list-style-type: none"> <li>• 20% reduction of spare-parts replacement time when failure occurs</li> <li>• 10% decrease of lost profits for production downtime due to spare-parts failure</li> <li>• 30% reduction of spare-parts stocks</li> <li>• 15% increase of sales of spare-parts due to enhanced services to customers</li> <li>• 5% reduction of cost in the replenishment process (shipping and logistic)</li> <li>• 5% reduction of cost for production overtime due to spare-parts failure</li> </ul>
<b>Pilot 2: Construction/Industrialisation</b>	
	<ul style="list-style-type: none"> <li>• 25% reduction of a construction project development</li> <li>• 30% faster and accurate access to construction project data</li> <li>• 20% improvement in the adaptation with minimum modifications to various construction projects</li> <li>• 30% faster adaptation of construction project changes, rescheduling and readjustment of one-site and multi-site construction project 35% of assessment of construction process through remote and distributed access to global project data 20% reduction of rescheduling time when delays or failure occurs</li> <li>• 15% reduction of material replacement time and components relocation when adjustments and failure occurs</li> </ul>
<b>Pilot 3: Manufacturing Assembly/Collaboration</b>	
	<ul style="list-style-type: none"> <li>• 10% improve the engineering capabilities of the network: Identify the typology of rejected projects to improve the joint engineering capabilities</li> <li>• 7% decrease of delivery additional delays for complex products: improve the respect of customer commitments contracted in collaborative schema</li> <li>• 35% reduction of time to confirm project acceptance for treatment: improve the network capacity to answer quickly to the most achievable customer projects with more shortest delays</li> <li>• 25% reduction of inter-sites bottlenecks in manufacturing: improve the reliability and the agility of the supply chain by integrating new technologies (such a CPS) in order to ensure a dynamic optimisation of manufacturing orders</li> <li>• 10% decrease in the global cost (manufacturing + logistic) of multisite products</li> </ul>

## 2.1.4 Project's benefits

### 2.1.4.1 For *vf-OS* Customers groups

The Virtual Factory Platform will be a multi-sided market ecosystem in which four customer groups will interact and benefit from the *vf-OS* Project results:

**Table 6:** Project's benefits for *vf-OS* customers

Customers	Benefits
<b>Platform operators</b>	Various multi-sided marketplace Business models at the juncture of Manufacturing - e.g. Application Purchasers and Third Party Service Providers (i.e. sales or lease commission), <i>vf-OS</i> 'owners' Application/Service Providers (ROI in developed applications, services)
<b>Software Developers</b>	New and huge-growth potential market for Manufacturing Apps, using a free Open Applications Development Kit for quickly building applications running over a Virtual Factory System Kernel specifically designed for allocating Manufacturing functionality by providing high interoperability with factory devices and IT systems and advanced data handlers.
<b>Manufacturing Users</b>	A myriad of Manufacturing Apps accessible, in term of cost and implementation time, at the Manufacturing Applications Store of the Virtual Factory Platform, and providing requirements to the community of software developers.
<b>Manufacturing Providers</b>	Exposing their ICT interfaces and manufacturing connections to the Manufacturing Apps. They will also be able to contribute to the development of Manufacturing Apps themselves that may be added and commercialised in the <i>vf-OS</i> Apps marketplace ( <i>vf-mApps</i> ).
<b>Service Providers</b>	Offering services (hosting, storages, connected cloud services, etc.) including those based developed solutions. These can be provided by <i>vf-OS</i> partners or third parties

### 2.1.4.2 For European Industrial SMEs

SMEs depend on a whole range of software applications to manage their operations and to support initiatives for growing and increasing competitiveness. Many of these systems have taken years and cost many millions of euros to install and use (SCM World, 2013). Changes in the way enterprise applications are developed and delivered can thus have disruptive impact. In particular cloud-enabled tools will have an important impact in the next decade. In addition to on-boarding suppliers faster and more cost-effectively, cloud-enabled tools can accelerate the benefits and decrease costs or at least move them from CAP-EX to OP-EX increasing flexibility which is especially important to SMEs. SMEs are in general more flexible and open to new ideas if they save money. SME also are caught by a trap of not being able to influence built applications. The *vf-OS* platform and marketplace is constructed with this in mind such that SME can put forward their demands (i.e. "I need a...") and they can be answered by software providers (i.e. "I can offer this..." "would you like to have this..." etc.) and so engage in a community the same way as more classical App communities exist. Thus SMEs will be part of the community also and influence the direction to suit their needs rather than be dependent on others.

### 2.1.4.3 For European ICT Companies

*vf-OS* will generate a Cloud Platform and several open-source cloud-enabled tools for efficient Manufacturing Apps development and commercialisation, opening new business for ICT companies interested in providing manufacturing software to industrial companies. The *vf-OS* infrastructure will be supported by open-source technologies. In this way European industry will obtain the highest benefit from the interoperability technology developed within the *vf-OS* project as follows:

- **Community adoption:** Providing easy access to the source code produced in the project lowers the entry barriers for adoption and impact of *vf-OS* solutions
- **Synergies:** An open-source approach fosters the collaboration with other parties from both national and international scale. Providing unencumbered access to project results is also a widely accepted strategy for achieving a higher impact into research community
- **Business development:** Using *vf-OS* solutions across members of the supply chain and enhancing interoperability with other pre-existing software applications increases the business value of new products
- **Reuse:** *vf-OS* will use existing open source tools to the maximum provided they are commercial grade and already implemented except in some specific research instance needs. This will increase both the rapidity and relevance of the results

## 2.2 Measures to maximise impact

### A) Dissemination and Exploitation of Results

The impact plan (WP10) has been constructed to ensure that interest and awareness of the *vf-OS* ideas, methods and tools are widespread. The main objective of the plan is to provide active, professional and open dissemination and outreach of the project results to key European stakeholders especially those in European Industry and R&D. The Business and Exploitation plans (WP9) ensure that the project results will adopt an effective and realistic strategy, accompanied by competitive business models, that unleashes the innovation potential of *vf-OS*. The plan not only involves industrial practitioners, but also academic peers and software



developers, to ensure a strong understanding of market needs. Both dissemination and exploitation strategies have been clearly distinguished, and the portfolio of activities has been defined while considering the different stakeholder groups in order to ensure that the results reach both the industrial and academic communities. Of particular note is the concept of ‘company by design’ which should be perceived as similar to ‘security by design’. *vf-OS* will aim to create a concept company, *vf-OS* Limited, from day 1 of the project with all its members as conceptual stakeholders – from project managers to developers. This will focus the requirements and need on real-world demand and overall focus the project to achieve real results which will not simply sit of the shelf for the next project to arrive. This approach is being used in projects such as CREMA and has been well rated by reviewers.

### 2.2.1 *vf-OS* Dissemination

The dissemination plan consists of a set of added value activities to ensure the efficient dissemination of project results to the various target groups. Dissemination activities include promoting the objectives and innovations of *vf-OS* to a broad audience, making the target audience aware of the project's potential, and to guarantee an efficient stakeholder engagement. In addition, it will ensure an effective transfer of produced knowledge to the industrial community (manufacturing, software developers and ICT and service providers), research and academic practitioners, as well as next generations for future advancement. The planned dissemination activities build on the consortium partners' expertise and well established track record in dissemination. Finally, *vf-OS* consortium will guarantee the open access principle of its dissemination activities through “green” and “gold” ways of open access publications. For example, UPV will do this through its own institutional repository: <https://riunet.upv.es>. Moreover, the *vf-OS* consortium will ensure that dissemination activities do not interfere with potential commercial exploitation of research results.

#### 2.2.1.1 Dissemination for Maximising Industrial Practitioners Impact and Market Awareness

This type of dissemination will be focused on manufacturing users, software developers, and ICT service providers. To create awareness and ensure impact, the following actions have been planned:

- **Industrial Cluster:** Two workshops will be organised around the *vf-OS* Industrial Cluster; most probably in the pilot countries to maximise the capability of *vf-OS* deployment. These workshops will be organised in year 2 and 3 with the first focusing more on RTD impact and the second focusing on user/developer impact. The aim will be to increase the exposure of more developers and to *vf-OS*.
- **Publications in Industrial Specialised Press:** The *vf-OS* consortium partners will publish reports on successful case studies in industry press/forums and in science literature where possible and as appropriate. This way, the project will reach out to the wider community and will raise awareness among the general public about the issues that Europe's industry is facing, the solutions being developed within *vf-OS*, and how these solutions can increase the competitiveness and market share of European industry.
- **Presentations at Industrial Conferences:** Presentations about the project will be offered to national special interested groups and European industrial conferences. *vf-OS* will participate in technical events organised by the European Commission, by other H2020 EU projects, or by the Technological Platforms and PPPs (such as EFFRA), making the project results available to the different sectors in Europe.

#### 2.2.1.2 Generic Dissemination Activities for the Community of Researchers

In order to ensure maximum impact, the *vf-OS* partners will undertake a number of important outreach activities, designed to raise awareness of the results that the project will develop, and to gain feedback about the *vf-OS* results from the wider European research community.

- **Workshops:** As mentioned the two *vf-OS* workshops will be held in Europe in conjunction with international conferences related with *vf-OS* knowledge domains and with industrial booths for project results demonstrators. This will ensure that the European research and practitioners community is able to fully exploit the project and will also help to attract the international research effort in creation of a novel open operating system for virtual factory, placing Europe front and centre for developments in this research area.
- **Website:** It will be set up at the start of the project and will be kept up-to-date with the latest news regarding the project, focusing, in particular, on the dissemination activities and the final commercialisation of the product. **Project news, public deliverables, scientific publications and the material** used in the events where the project is presented (such as slides, videos, etc.) will be promoted through the *vf-OS* website. This will also be used as an internal intranet.
- **Publication of technical papers and specialised articles:** *vf-OS* will publish its findings through academic and international scientific journals following the principle of open access and as detailed in section 2.2.1.3.
- **Dedicated Pages in Relevant Social Networks:** Together, with the official website, additional pages/channels will be created in the appropriate social networks (Facebook, LinkedIn, YouTube and Twitter) to increase the viral promotion of the project.
- **eNewsletters:** A virtual newsletter will be sent every year to interested stakeholders on a subscription basis, managed through the *vf-OS* website. This newsletter will summarise and report on new trends, significant

research results, conferences, and thematically related projects. A email distribution list will be create to distribute this information and to increase the availability and visibility of **vf-OS** findings

- **Brochures:** Brochures and banners will be created to show the objectives of the project, the advances and benefits of the **vf-OS** research, and the exploitable results generated within the project. This dissemination material will be adapted to different and various target groups in different languages where appropriate.
- **Press Release:** News related to the **vf-OS** project will be pushed to digital newspapers and repositories in order to raise visibility of **vf-OS** results and benefits.

### 2.2.1.3 Dissemination for Maximising Impact on the Academic Community

The **vf-OS** project will strive to publish in leading journals and conferences on collaborative manufacturing and logistics, virtual factories and ITC operating system. Article publication will be encouraged as way of knowledge sharing. Throughout the project, scientific and technical results will be published at workshops and conferences and in academic and international scientific journals in accordance with the principle of open access.

### 2.2.1.4 Ensuring Lasting Impact into the Next Generation

A project prize will be offered annually by the **vf-OS** project to the best PhD paper in RTD aspects related to open operating systems for virtual Factories. The presence of this prize will serve to stimulate interest in the topic, reward the effort of top quality PhD students, and to support the growing field of research by building a strong base of trained and qualified post-doctoral researchers. The prize will be 1000€, which will be sponsored by the industrial partners (RTD and Users) who will form the Board of Adjudication of the award prize. This will not come from EU funding. For graduate students, UPV will use the Polimedia infrastructure to make learning objects that will be available on Politube.

### 2.2.1.5 Dissemination metrics

While the individual dissemination plans can be found in next section, a tentative schedule for the most significant tools and channels is presented below; this listing is not a “must-do” list of activities but an identification of interesting activities that the Consortium considers worthwhile in moving forward.

**Table 7:** Quantification of General **vf-OS** Dissemination Activities.

How	Why	Action	Target KPI
<b>Clustering</b>	Joint engagement	Meeting attendance and common publications	<ul style="list-style-type: none"> <li>• 2 participants in every cluster event</li> <li>• 10 bilateral with other projects</li> </ul>
<b>Industrial publications</b>	Publication of the solutions being developed in <b>vf-OS</b>	Publication to industrial press and magazines	<ul style="list-style-type: none"> <li>• &gt; 3 publications accepted</li> </ul>
<b>Industrial and scientific Conferences and exhibitions</b>	Promotion & Networking	Attendance and Speaking slots	<ul style="list-style-type: none"> <li>• 20 speaker slots</li> <li>• 5 Conferences</li> <li>• 4 Exhibitions</li> </ul>
<b>Workshops</b>	Information broadcasting and networking	<b>vf-OS</b> hosted scientific and Industrial Workshop	<ul style="list-style-type: none"> <li>• 2 workshops / 30-50 participants each</li> </ul>
<b>vf-OS Website</b>	General information	100 updates and Search Engine Optimisation (SEO)	<ul style="list-style-type: none"> <li>• 25% yearly growth in website traffic yearly</li> </ul>
<b>Scientific Open Access publications</b>	Dissemination of innovation	Publication to journals and magazines	<ul style="list-style-type: none"> <li>• &gt; 10 publications accepted</li> <li>• &gt; 3 Papers per each academic partner</li> <li>• &gt; 6 Paper for the Scientific Manager</li> </ul>
<b>Social Media</b>	General information	Sharing and liking	<ul style="list-style-type: none"> <li>• 400 likes / shares</li> <li>• &gt; 5 comments / share</li> </ul>
<b>Press release (Project news, public deliverables...)</b>	Generic dissemination	Impacting the external community	<ul style="list-style-type: none"> <li>• &gt; 500 views / publications / year</li> <li>• &gt; 8 publications</li> <li>• &gt; 4 blog post per year</li> <li>• Initial and Final press release distributable and tailorable by each partner</li> </ul>
<b>Dissemination materials (brochures)</b>	Regional dissemination	Publication of on-line brochures at in major languages of the consortium	<ul style="list-style-type: none"> <li>• 2 brochures (at the beginning and end of the project)</li> </ul>

<b>Newsletters</b>	Wide Awareness	Yearly Newsletter	<ul style="list-style-type: none"> <li>3 newsletters &gt;100 subscribers on average</li> </ul>
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### 2.2.1.6 Individual Dissemination Plans

This section provides with the individual dissemination plans for *vf-OS*:










**Table 8:** Individual Dissemination Plan for *vf-OS*.

Individual Dissemination Plan	
ICE	ICE is very active in this field and has lead initiatives ranging from the BDVA Summit which was built from scratch in just 7 weeks, engaging 450 participants and 60 sessions with a 'come again' rating of 99%. It has also organised a 5 days 200 person conference called semantic week, as well as multiple project workshops and similar dissemination events. It was awarded 2nd place exhibition stand at ICT 2010 and 2nd place at ICT 2013. Thus, ICE is proven to achieve dissemination results. In addition, it will publish news and information about <i>vf-OS</i> through social media and its dissemination channels such as ETPs NESSI (as board member) and the BDV PPP (as Member). Finally, ICE will raise awareness about <i>vf-OS</i> through cluster and collaboration meetings.
IKERLAN	IKERLAN, as a Technology Research Centre, will actively participate in all <i>vf-OS</i> dissemination activities that will take place during and after the project. <i>vf-OS</i> findings will be disseminated through IKERLANs membership to several European initiatives (MANUFUTURE-EU, EFFRA, ECSEL, INTEROP-VLab) as well as national ones (MANU-KET, LOGISTOP). Also it will take advantage of its membership of the Mondragon Corporation (the tenth largest business group in Spain) with specific events to promote <i>vf-OS</i> aims and outcomes among potential and current industrial partners.
UNINOVA	UNINOVA will disseminate <i>vf-OS</i> results through close connections with several international organisations (e.g. NIST, etc). The dissemination of <i>vf-OS</i> results will be through European and international conferences/workshops, scientific newsletters, magazines, websites, etc. Links and synergies with other regions and regional actors will also be sought. At the national level (Portugal), UNINOVA will organise several dissemination activities with the objective to create awareness and promote knowledge transfer to industry, by organising national workshops, publications at national conferences and organising several peer-to-peer meetings with major national companies. UNINOVA aims to raise awareness and promote project results, and to mobilise the industry. Papers will be submitted to international conferences, namely, ICE, CE, I-ESA and scientific journals such as IEEE.
UPV	UPV will disseminate, based on the open access strategy, the <i>vf-OS</i> project results in international research publications and conferences from the domains of manufacturing, virtual factory, operating systems, and others. The Research Centre on Production Management and Engineering (CIGIP), Research Centre of UPV, have published over 1000 papers in scientific journals and conferences and have organised several seminars to show the results of its research and development activities to companies. News about research results are regularly published at the CIGIP website, the UPV video channel, newsletters of associations, and in the press. <i>vf-OS</i> results will be also disseminated in master student level courses and thesis.
CMS	CMS has high expertise in disseminating results from its research projects. This is usually achieved by showcasing its products in numerous events (either as participant or host), both in the academic and industrial fields, with particularly high impact in the open source, Linux and Android communities, where the company is a model. CMS is responsible for the OpenSourceProjects.eu platform, which was developed within the scope of the EU-funded project PROSE, which aims to become a base for the hosting of EU-project development codebases. This allows for contribution from the open source community and also promotes future reuse.
LYON2	The LYON2 university will support the dissemination of <i>vf-OS</i> project in several channels: At the academic level, LYON2 supports several international journals (IJPLM, IJPDm, etc.), conferences (PLM, SKIMA, ICLT, etc.) and national working groups (GDR MACS). At the industrial level, the LYON2 team drives national working groups on sustainable products, digital manufacturing, and preservation, etc. Within these networks, LYON2 can organise workshops, special sessions, working days, knowledge transfer sessions, etc.
ASC	ASC is actively contributing to the OISV (Organisation of Independent Software Vendors), the biggest ISV association in the world. Moreover, ASC is member of the NESSI ETP (Networked European Software and Services Initiative) and the Net!Works ETP (European Technology Platform for Communications Networks and Services). This allows ASC to actively promote <i>vf-OS</i> and its results in those initiatives. Additionally, ASC will raise awareness about <i>vf-OS</i> on its website and within cluster and collaboration meetings.
ALM	ALM will publish the project results on the OAK System Dashboard - Control Panel and Task Manager in international conferences and journals on Distributed Artificial Intelligence, such as HoloMAS and IEEE Transactions on Industrial Informatics.
MASS	MASS will support the dissemination actions through participating in trade fairs, where the latest developments are made public and transmitted to customers. MASS is also member of Solar Power Europe Association), which contributes to the dissemination of PV industry developments. Smart-Applications, which will be made available to industry, will be disseminated through this channel.

<b>VS</b>	VS will support dissemination by revealing the difficulties in manufacturing line processes, exploitation and maintenance. The will contribute to understand an efficient work of a manufacturing line thus allowing parties to understand the influence in case of urgent maintenance and errors. It will organise meetings with suppliers/customers to evangelise the promise of <b>vf-OS</b> .
<b>CON</b>	CONSULGAL Group has subsidiaries in 9 countries and is active in many others. The <b>vf-OS</b> results will be applied in our on-going projects in many countries and will be publicised to our clients and partners, as an important advantage of our service, and a reassurance of a successfully implemented and cost effective project. Its use may be exported to our subsidiaries, contributing to develop their know-how and work methods, and giving them a cutting edge advantage over their local competitors. Additionally, Consulgal regularly participates in international fairs, providing opportunities to publicise the <b>vf-OS</b> achievements.
<b>KBZ</b>	The dissemination activities of KBZ are focused on commercial market by means of attending fairs and organising workshops for industrial business customers. Commonly, KBZ organises workshops near to commercial fairs to guarantee a broader audience. The commercial fairs which could be attended by KBZ are to be coordinated with the other partners of the consortium, and it will be defined in which fairs are the most suitable. At the same time, KBZ will actively contribute to the publication of articles in specialised magazines for the construction sector.
<b>APR</b>	APR will support the dissemination of <b>vf-OS</b> project within the plastic industry with the regional economic cluster in France (Plastipolis) and other partners (metal, chemical, etc.) in order to set up new collaboration channels. APR will present also the results of its experiments to the academic partners, where APR engineers hold sessions about manufacturing techniques, applications and lessons learned.
<b>TARDY</b>	The dissemination action proposed by TARDY for <b>vf-OS</b> results targets their partners in the ferrous (metal) industry in order to prove the impact of future technologies in the creation of new collaborations issues and the improvement of existing ones. This transfer can be performed through on-premise demos.

### 2.2.2 **vf-OS** Exploitation

This section outlines the **vf-OS** business case and industrial exploitation strategy. The outlined business model is based on the Business Canvas approach (Osterwalder & Pigneur, 2010) shown in the figure below. The section defines the exploitation team, the exploitable results and areas of application, a market and SWOT analysis and financial projections. The consortium has planned the IPR Handling and established the joint and individual exploitation plans as well as the communication activities for promoting the project. This canvas is illustrative only and will be adapted and enhanced in the exploitation workpackage.

 <b>Key Partnership</b>  - Factories of supply networks - Software developers - Services providers - Manufacturing providers -- Research Institutions - Universities	 <b>Key Activities</b>  - To develop and progress toward the advance of the Open Operating System (vf-OS) and the Open vf-OS Platform - To provide service and support to the customers	 <b>Value Proposition</b>  - Virtual Factory System Kernel - Virtual Factory Devices Drivers and Open APIs - Virtual Factory Middleware, System Services and Data Bus - Open Applications Development Kit - Cloud Manufacturing Collaboration, Knowledge and Stakeholder Interaction Framework, including the marketplace (vf-mApp Store) - vf-OS Applications.	 <b>Customer Relationship</b>  - Manufacturing users : have a complete and interoperable solutions; - Software developers to design and build new manufacturing apps - ICT and services providers to offer ICT interfaces demands.	 <b>Customers Segment</b>  - Manufacturing users that belong to factories of supply networks; - Software developers to use vf-OS results to build further applications, Manufacturing Providers who will provide ICT interfaces and manufacturing connections - Service providers to make available services related to vf-OS.
	 <b>Key Resources</b>  - Cloud platform hosting - Online marketing - High industrialized consortium - Open operating technology	 <b>Channels</b>  - Cloud infrastructure - Online open operating system		
 <b>Cost structure</b>  <b>During vf-OS project:</b> Project Budget <b>After vf-OS Project:</b> - Open operating system maintenance - Dissemination activities (dissemination material, workshops...)			 <b>Revenue Streams</b>  - Consulting services - Technology transfer - Training and - Increase in sales due to user satisfaction	

**Figure 4: **vf-OS** Preliminary Canvas Business Model.**



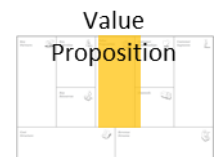
### 2.2.2.1 Exploitation Team

The partners required for the successful exploitation of **vf-OS** come from different areas. Manufacturing factories of the different industrial areas must be understood in detail, as well as the technology required to implement the **vf-OS** developments. ICT professionals related to the research area of **vf-OS** are required and for this reason the consortium includes ICE, CMS, AML and ASC. Experts in collaborative manufacturing and logistics are vital for the project development and from this perspective the consortium has the background of IKERLAN, UNINOVA, UPV and LYON2. Finally, end users (MASS, VS, CON, KBZ, APR and TARDY) play an important role in exploiting the **vf-OS** results as it can be seen in section 2.2.2.6



Throughout the **vf-OS** project, alliances and agreements between consortium members will be established. Synergistic exploitation tasks will form the so-called Exploitation Business Constellations, which will vary depending on geographical focus of the commercial task, selected exploitation model depending on strategic interests, and final customer approach. The definition of the previous variables will answer the following basic exploitation questions: (i) Where to perform the service? (ii) How to invoice the services? (iii) Type of services performed (iv) Why perform these services? and (v) Target audience of the services.

During the project lifetime key partners will be contacted and involved in **vf-OS** to ask for their advice, the Impact Support Group (ISG) will also support the exploitation activities of **vf-OS**, and assess their interest in acquiring the final outcomes such as other local ICT developers, customer associations, etc.



### 2.2.2.2 Exploitable Results and Areas of Application

**vf-OS** will provide the following value propositions: (i) Virtual Factory System Kernel, (ii) Virtual Factory Devices Drivers and Open APIs, (iii) Virtual Factory Middleware, System Services and Data Bus, (iv) Open Applications Development Kit, (v) Cloud Manufacturing Collaboration, Knowledge and Stakeholder Interaction Framework, including the marketplace (**vf-mApp Store**) and (vi) **vf-OS** Applications.



- **Customer segments:** The **vf-OS** project aims at an Open Operating System for Virtual Factories, deployed in a cloud platform, supporting a multi-sided market ecosystem for providing a range of services to the connected factory of the future. Its application potential is vast. Therefore, **vf-OS** has identified the following initial, focused, customers segments: (i) Manufacturing users that belong to factories of supply networks; (ii) Software developers to use **vf-OS** results to build further applications, (iii) Manufacturing Providers who will provide ICT interfaces and manufacturing connections and (iv) Service Providers to make available services related to **vf-OS**.
- **Customer relationships:** Each customer segment will be approached in a different and specific way to optimise the expected outcome. As such manufacturing users will have a complete and interoperable solution to provide supply chain stakeholders in all manufacturing and logistics processes; software developers will profit from **vf-OS**, to design and build new manufacturing applications; ICT and services providers will take advantage of the **vf-OS** solutions to offer ICT interfaces and different services to respond to user demands.
- **Channels:** When the time comes to exploit the results of **vf-OS**, the selected channel can be decisive. One of the major added value assets of **vf-OS** is its communication channel. At present a widely used reference implementations of a platform supporting a market ecosystem for developing virtual factory applications does not exist. Some valuable initiatives (e.g. FI-WARE) will provide the basic elements for developing **vf-OS** kernel system and **vf-OS** will profit from this to quickly provide value to factories (manufacturing users), software developers and ICT and service providers. Furthermore, current channels of communication will be able to use **vf-OS** to offer an improved service to customers.



### 2.2.2.3 Market Analysis and SWOT Analysis

A close look at the market dynamics will be undertaken by assessing the market in terms of technologies, key players, recent actions, market barriers and drivers. The market analysis, executed under Task T9.4, will comprise of an analysis focused on **vf-OS**'s target markets. On a preliminary basis, the markets targeted are focused on the three pilots are automation equipment, construction and plastic/metal manufacturing. These areas have been selected as realistic and diverse scenarios of the target users in **vf-OS**. However, **vf-OS** itself is generic. The SWOT analysis included below touches several different aspects in order to evaluate strengths, weaknesses, opportunities, and threats to the exploitation of **vf-OS**. This should also be considered along with the Section on Risks (Section 3.2.5):

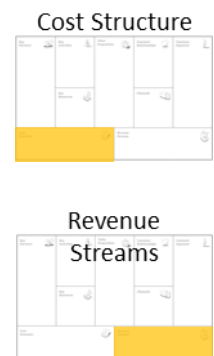
- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Platform/Components: <b>vf-SK</b>, <b>vf-API</b>, <b>vf-MW</b>, <b>vf-OAK</b>, <b>vf-mApp</b> and <b>vf-P</b></li> <li>• IKERLAN-UPV, UNINOVA and LYON2: Research</li> </ul> | <ul style="list-style-type: none"> <li>• Constant change in ICT technologies and methodologies</li> <li>• Data analytics have a slow adoption in the</li> </ul> |
|---|---|

and knowledge transfer players for Spain, Portugal and France respectively. • ICE, CMS, ASC and ALM: Leading ICT developers for real-time architectures for interoperability, management of the data deluge and ICT security, knowledge protection, and trust in collaborative infrastructures • Open access & cross domain demonstrators • SOTA players in cloud computing, manufacturing systems, operating systems, virtual factory.			manufacturing sector • Difficulty of integration regarding legacy systems • Data connectors cannot be used by the End User • Marketplace concept is not accepted
<b>Strengths</b>	<b>S</b>	<b>W</b>	<b>Weaknesses</b>
<b>Opportunities</b>	<b>O</b>	<b>T</b>	<b>Threats</b>
• Strategic alliances and partnerships with Relevant Clusters • New markets for RTD partners • Create new business relationships among Industrial and RTD partners • Clear relevance to open operating systems for virtual factories.			• Concept too far from reality • General technical lethargy of the manufacturing industry • Breach of data security across the difference supply chain (confidentiality and privacy) • Unexpected developments of the market requirements • Time for development is underestimated.

Figure 5: *vf-OS* Preliminary SWOT Analysis.

#### 2.2.2.4 Financial Projections

- **Cost structure:** *vf-OS*'s cost structure needs to be differentiated between the required investment during the project lifetime (further detailed in section 3.4) and the expected costs after the funding period. To guarantee *vf-OS*'s sustainability, the consortium will have to find the initial balance to commercialise and maintain the platform hosting service and consider the possibility of having a user support service. Moreover, costs for further marketing activities will be required.
- **Revenue Streams:** *vf-OS* will develop exploitable results at a significant Technology Readiness Level as identified in section 1.3.1. This will imply the potential for earning for consortium members after the project's end with several revenues coming from i) Consulting services, ii) Technology transfer, iii) Training and iv) Increase in sales due to user satisfaction.



#### 2.2.2.5 IPR Handling

There is no doubt that the *vf-OS* project will create new important knowledge. It is evident from the list of products and journal publications performed by the partners of the *vf-OS* Consortium that new knowledge is generally made available to the industrial, academic, research and ICT community, as peer-review is essential for scientific quality and progress. The university partners in the *vf-OS* Consortium are involved with the organisation of relevant conferences. They also collaborate in research projects with universities and research centres worldwide. As the ICT companies in *vf-OS* recognise the potential impact of this project and its relevance through market development and service sales, they will also strive to participate in generating and publishing knowledge. Therefore, the following factors and elements will be taken into consideration:

- **Consortium Agreement (CA):** The purpose of the CA is to establish a legal framework for the project in order to provide clear regulations for issues within the consortium related to IP ownership, confidential information, open source issues, standard contributions, and access rights to background and foreground for the duration of the project and any other matters of the consortium's interest.
- **IPR Management during the Project:** For the success of the project, it is essential that all project partners agree before the project starts on explicit rules concerning IPR ownership, access rights to any Background and Foreground for the execution of the project, and the protection of IPRs and confidential information. Therefore, such issues will be addressed in detail within the CA between all project partners as well as contractual obligations in the grant agreement
- **Access Rights to Background and Foreground:** In order to ensure a smooth execution of the project, the project partners agree to grant each other royalty-free access rights to their Background and Foreground for the execution of the project. Any details concerning the access rights to Background and Foreground after the duration of the project will be defined in the CA.

- **IP Ownership:** Foreground shall be owned by the project partner carrying out the work leading to such Foreground. If any Foreground is created jointly by at least two project partners and it is not possible to distinguish between the contributions of each of the project partners, such work will be jointly owned by the contributing project partners. The same shall apply if, in the course of carrying out work on the project, an invention is made having two or more contributing parties contributing to it, and it is not possible to separate the individual contributions. Any such joint inventions and all related patent applications and patents shall be jointly owned by the contributing parties. Any details concerning the exposure to jointly owned Foreground, joint inventions and joint patent applications will be addressed in the CA. All IPR created in the non-RTD workpackages (WP1, 2, 9, 10, and 11 and tasks 7.4, 7.5 and 8.1) shall be considered as joint IP without royalty unless otherwise agreed unanimously by BOP once the results have been generated subject to the provisions set out in Article 26.2 of the GA.
- **Open Source and Standards:** A central aim of this consortium is to provide benefit to the European community. As such, the project partners may be either using Open Source code in their deliverables or contributing their deliverables to the Open Source communities. In addition some of the partners may be contributing to standards, being they open standards or other. Details concerning Open Source code use and standard contributions will be addressed in the CA. Industrial/Commercial grade open-source tools will be preferred and will kick start the project.

### 2.2.2.6 Joint and Individual Exploitation Plans

This section provides the Individual Exploitation Thoughts of the individual partners.

**Table 9:** Joint and Individual Exploitation Plans.

	Exploitation Plan
Joint	<p>The <b>vf-OS</b> consortium will place a strong emphasis on turning the research outcomes and technological developments of the project into value-creating products and services. Due to the diverse nature of the partners that shapes the <b>vf-OS</b> project, there is potential to perform the exploitation activities of the <b>vf-OS</b> team as a whole, jointly carried out by the partners of the project, such as:</p> <ul style="list-style-type: none"> <li>• Formation of the company "vf-OS" Limited to jointly commercialise the work (outside the action)</li> <li>• Using the results in further research activities (outside the action)</li> <li>• Using the results for further ICT developments to ensure follow up</li> <li>• Developing, creating or marketing a global <b>vf-OS</b> product</li> <li>• Creating and providing a service</li> <li>• Using them in standardisation activities</li> <li>• Using them in training activities</li> </ul>
ICE	<p>ICE, as commercial SME focused on IT products and services development, will focus on a) Acting as the leader along with the impact lead in establishing the concept company "<b>vf-OS</b> Limited" which will focus the output of the project into practical impact; b) Improving its products with new features coming from the execution of <b>vf-OS</b> and in particular the Data Harmonisation product; c) Interacting with the technical <b>vf-OS</b> community to make impact and market value. ICE has been working in the field of integration for nearly 2 decades and <b>vf-OS</b> is well suited to its potential and expertise.</p>
IKERLAN	<p>The participation of IKERLAN offers it a great opportunity to continue developing its research line on virtual factories where operating systems are playing a central role to support a multisided market ecosystem providing a range of services to the connected factory of the future with the objective to integrate better manufacturing and logistics processes. The aim of <b>vf-OS</b> is fully aligned with this strategy and benefits from other ongoing projects both in research and industry transfer. During the project, IKERLAN will be able to exchange its experience in the field as well as broadening and strengthening its contact base and collaboration with a huge number of different industries.</p>
UNINOVA	<p>UNINOVA, as an RTD institute, has a close cooperation with Academia, namely the Universidade Nova de Lisboa, where several UNINOVA researchers are teaching. UNINOVA has several mechanisms to exploit knowledge in academia. Furthermore, it is foreseen that <b>vf-OS</b> will provide both support and a test-bed for advanced research programmes (MSc and PhD) to be conducted in service related domains, associated established and new sciences. UNINOVA, as member of the ISO TC184/SC4, is committed to establish links standards bodies such as ISO and contribute and outreach the project results within the standards community.</p>
UPV	<p>UPV intends to spread the project results among Spanish companies. CIGIP has great experience in enterprise consultancies in different sectors (automotive, ceramics, metal-mechanic, capital goods, textile, furniture, agro-food, etc.) with over 100 contracts and 2,000,000 Euro income from technology transfer to companies.</p>

CMS	The participation of CMS as an SME provider of commercial Open Source products and services will focus on enhancing its portfolio with the solutions and strategies developed in the project. CMS's current customers already include manufacturing companies, in the fields of plastic moulds and pharmaceuticals, which do not participate directly in the project, but are interested in the integration of its outcomes. Moreover, CMS expects to increase its consulting and product range in the market, as well as expanding its range of customers in the manufacturing business. The <b>vf-OS</b> project will also provide CMS increased expertise in state-of-the-art technologies.
LYON2	The exploitation roadmap for LYON2 starts from a pilot to be developed within the <b>vf-OS</b> project. In fact, LYON2 expects to use the APR-TARDY showcase as an illustration for the impact of business collaboration. As an R&D institution working in IT for industry, it is actively participating in industrial working groups (i.e. Micado in France) and working in connection with economic clusters (i.e. Edit, Plastipolis, etc.) in order to develop joint industrial actions, R&D projects, and more specific innovation actions. Therefore, the APR-TARDY pilot will be used as new concrete illustration of the collaboration benefits in virtual factories.
ASC	The main exploitation of ASC will be to integrate the vf-mApp Store & Marketplace into its FIPS eCommerce system, which is the main license system for Ascora's apps, including shopping, payment and licensing. FIPS will highly benefit from the vf-mApp Store & Marketplace, as this allows for more flexible communication with external app data providers, which is not possible within the current FIPS system. Ascora estimates a 4-6% lift in App income from this feature within the first 2 years. Additionally, Ascora aims in reusing the Security & Data Access component to extend its existing solutions for user management and security (Ascora SPC) with enterprise authorisation facilities. Most importantly, Ascora is interested in LDAP integration and better 2-factor authentication support which should be delivered within the <b>vf-OS</b> Security & Data Access component.
ALM	ALM's business model is built on transferring and transforming research into basic technology to build different products or services for different application domains. In this context, ALM's commercial activities take concrete form within its spin-off companies. In relationship with <b>vf-OS</b> , ALM plans after the end of the project to further develop and commercialise the results and experiences gained regarding the OAK System Dashboard - Control Panel and Task Manager. It will do so through its spin-off company DOBots and its business contacts within the Consumer Lifestyle industry (eg, Philips CL).
MASS	As a system integrator, the main interest for Mondragon Assembly is to learn how to integrate into actual real production lines the developed smart-apps and operating system. The project will also serve as demonstrator of the potential of machines to "auto-manage" in their productive process. This technology will enable a significant improvement in service to the customers, taking care of their production line 24/7, reducing their stops and profit losses. At the same time, it will permit starting with the idea of "production machine as-a-service". This is very interesting for a machine manufacturer because it makes "recurrent" incomes.
VS	vf-OS pilot in particular will let VS assess new operations, store data, and analyse the whole value for the system's operations in order to keep the working manufacturing line in full efficiency and without unexpected interruptions. Thus the exploitation of VS will primarily be internal to help its engineers build and design applications in conjunction with others and make its processes, plans, and procedures more efficient.
CON	The <b>vf-OS</b> platform will allow for the establishment and management of a real time interaction between clients and suppliers. Thus <b>vf-OS</b> will allow the establishment of a new relationship between the parties usually involved in a construction project (client, contractor, consultant/engineer, supplier), as the information is expected to be available in a straightforward, real-time way, allowing for a more rapid assessment of costs and options and making better informed decisions. The system's ultimate use will be in building construction; nevertheless its characteristics and expected advantages, on better cost effectiveness and reduced decision time will certainly allow its use to be extended to other types of projects, such as utility networks or even transport infrastructures.
KBZ	<b>vf-OS</b> will be a major milestone for the company's development and reach a higher level of competitiveness on the market of cloud services and data-intensive offering services. KBZ aims to increase its revenue through new projects enabled by the competencies developed during the project and by providing a European-wide dimension on the services that have been mainly focused on national level projects. The ability to apply the know-how on designing complex cloud-based and data-intensive services will considerably increase. Thus it is expected that KBZ may sustain a stronger competitive positioning at a European level and also other geographical areas such as Brazil and Angola.
APR	The new collaborative system will be used to support APR customers' projects with several perspectives: The first regarding quality assurance that can facilitate APR in producing multi-sites complex parts with reduced delays. The second concerns the collaboration level that APR targets to reach with its strategic customers by integrating their collaborative design teams and providing strong recommendations about the industrialisation constraints and the product quality specifications for their parts.



TARDY	The targeted collaborative system will be used to support the manufacturing of complex and specific parts as well as prototypes. TARDY aims to push this new capability for other partners. In collaborative schema, TARDY can replicate the developed applications to be integrated with other partners from the plastic industry and then open new business domains. In a cooperative way, TARDY would like to explore a flexible service of renting its assets with maintaining in real time a minimal impact on its manufacturing capabilities.
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## B) Communication activities

The communication measures for promoting the project and its findings during the period of the project within industry, academics, researchers, and the ICT community are included in the *vf-OS* Dissemination strategy. As is shown in the business model, the communication and dissemination are key activities for the fulfilment of the exploitation goals. Communication activities will be performed from the beginning of the project, rather than waiting until the final outcome of the project has been implemented and ready for public presentation. The involvement of all the consortium partners, the awareness that communication is a continuous process, the support of professional communicators and graphic designers if necessary, and asking for support to the European Commission to amplify the message that *vf-OS* wishes to transmit are key elements of the *vf-OS* communication activities. Therefore, the communication will be focused to target the desired customer segments and objectives. To do this, several different elements will be taken into consideration:

### 1. What do we want to achieve through our communication activities?

The different Communication Goals (CG) are the following: CG1: Capture attention (Governments, authorities, public & private funding sources), CG2: Highlight & enhance (International research cooperation benefits + EU visibility), CG3: Attract (businesses + potential partners + top students + scientists), CG4: Create (market demand) and CG5. Exploit & disseminate (Research results).

### 2. Which is the target audience for *vf-OS* message?

The above described goals will be met by reaching different Target Audiences (TA): TA1: Manufacturing users and systems, TA2: Service Providers and TA3: ICT developers. Then for each audience the communication activities will work on a distinct strategy using targeted messages, means, and language.

### 3. What is the message we want to communicate or release?

The different Messages (MS) addressed to the previous audiences are the following: MS1: “*vf-OS* as a way to integrate better manufacturing and logistics processes”; MS2: “Enhancement of the connected factory of the future” and MS3: “Cloud platform as a way to optimise the communication and collaboration among supply networks, enterprises, machines and objects”.

### 4. What means do we need to perform such communication activities?

In order to deliver the described messages to the identified audiences different Dissemination Means (DM) have been considered as described in section 2.2.1. DM1: Industrial Cluster, DM2: Publications in industrial specialised press, DM3: Presentations at industrial conferences, DM4: Workshops, DM5: Website, DM6. Social networks, DM7: eNewsletters, DM8: Brochures, DM9: Press Releases. Moreover, *vf-OS* will also use the means available through the support of the European Commission such as: Publications: Horizon Magazine [horizon-magazine.eu](http://horizon-magazine.eu); Project stories <https://ec.europa.eu/programmes/horizon2020/en/newsroom/551/>; research\*eu results; magazine [www.cordis.europa.eu/researcheu/magazine\\_en.html](http://www.cordis.europa.eu/researcheu/magazine_en.html); Audiovisual: Futuris Magazine <http://www.euronews.net/sci-tech/futuris/>; Events: Events on the Commission's Research & Innovation website [www.ec.europa.eu/research/index.cfm?pg=conferences&filter=all](http://www.ec.europa.eu/research/index.cfm?pg=conferences&filter=all); Events on the CORDIS website [www.cordis.europa.eu/news/home\\_en.html](http://www.cordis.europa.eu/news/home_en.html) and Open access scientific publishing: Openaire [www.openaire.eu](http://www.openaire.eu)

### 3. IMPLEMENTATION

#### 3.1 Work plan — Work packages, deliverables

##### 3.1.1 Overall structure of the work plan

###### 3.1.1.1 Project Architecture, Work Allocation and Access

As depicted in Figure 6, the *vf-OS* project implementation is arranged in 11 work packages and will operate over 36 months. The precise plan is broken down into the work packages listed in Sections 3.1.3.1-0.

WP1 (Vision, Scenario & Requirements) provides the foundation for the core Research, Development, and Innovation (RDI) work packages of *vf-OS*. Hence, the work conducted in this work package will be the core of the first year of the project. The RDI Work packages WP2-7 provide the open operating system for virtual factories. Based on their results, a range of representative Use Case of WP8 will focus on piloting/demonstration and validation by providing real-world use cases in the target domains of the project (automation equipment, construction and plastic/metal components). Exploitation (WP9) and Dissemination (WP10) activities will irrigate the project community for proper sharing of information, concepts, and techniques by all the actors, and expose the projects results and statements to the outside world. Moreover, these activities will identify and quantify exploitation opportunities and related stakeholders characteristics and methods of approach in order to steer and guide project partners to correctly and consistently exploit project outcomes. Management activities (WP11) will be focused on the coordination of the Project actors from a project and RTD point of view in order to guarantee that the project fulfils the planned quality, time and costs engagements.

In terms of work allocation the project takes a very logical approach rather than a 'free-for-all' or an 'I only want to be in there' attitude. For example all partners are involved in the vision, and in fact all of WP1 since it influences entire project. All partners have effort for workshops since they will need to contribute, however only those with communication experience have effort in T10.2 etc. Importantly the RDI tasks primarily focus on the principle of one primary expert lead and one supporting expert partner to ensure there is clear responsibility, ownership, a credible body of days for real work without lots of minor involvements. This also reduces the joint IPR issues and facilitates better RDI activity since it is not split into multiple small roles.



Figure 6: Work Package Structure – See also Section 3.1.4

###### 3.1.1.2 Agile Methodology

During the development and pilot phases *vf-OS* will adopt a completely agile, sprint-based, development methodology. The benefits of agile development in the ICT domain are well known. The Agile manifesto (Agile Manifesto, 2001) highlights: Individuals and interactions over Processes and tools; Working software over Comprehensive documentation; Customer collaboration over Contract negotiation; Responding to change over following a plan. Typical EU projects are waterfall based even during development whereas *vf-OS*s approach will be 3 months cross-project sprints which is depicted in the figure below and is also coupled with 6 monthly major milestones detailed later. In addition within each major sprint the task leads will conduct roughly 2-4 weekly-tasks-based sprints. In practice 2 weekly is not suitable for

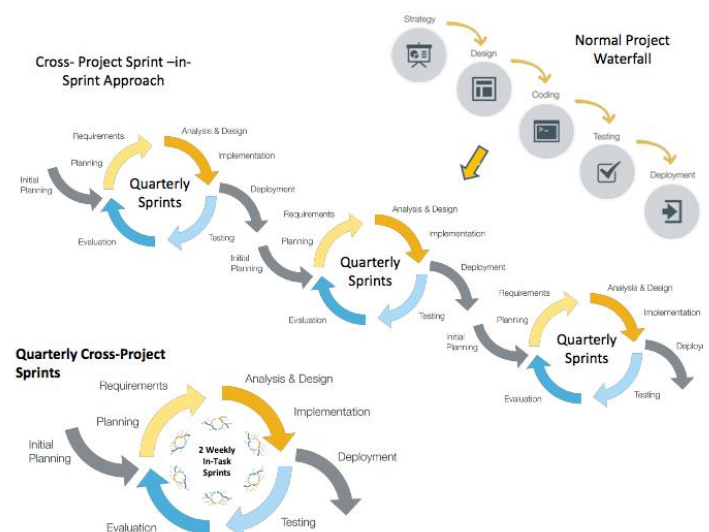


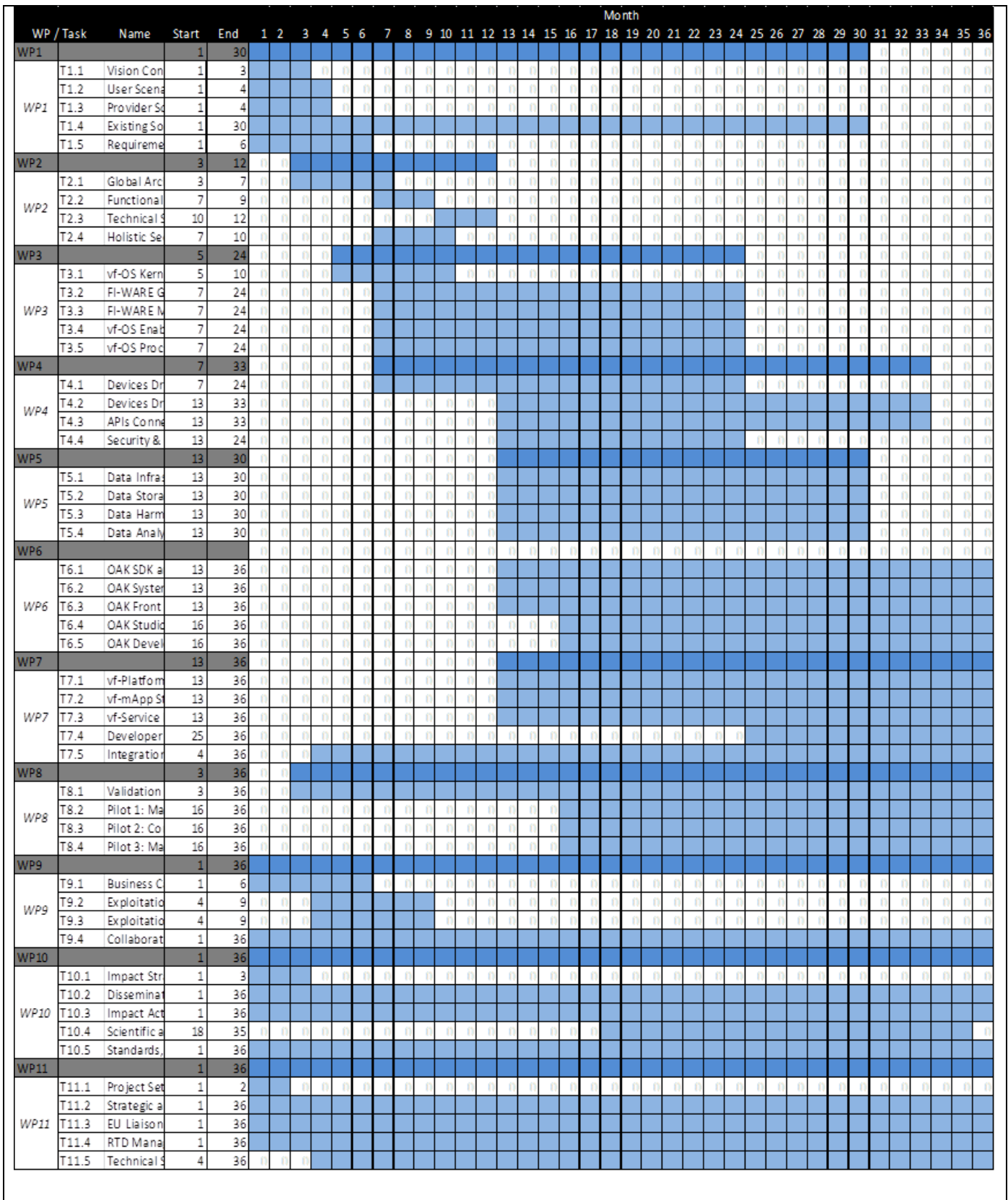
Figure 7: Agile Sprint-based Methodology.

cross-project sprints because of the overhead involved when the teams are so dispersed and there are so many dependencies. The technical coordinator will take the Product Owner role typical in such methodologies and the Project Manager will act as Cross-Project sprint/scrumb master. To control this process a development support tool, such as Jira, will be selected but this will be finalised in the project handbook (WP11).

Complex tasks will have several phases (typically 6 months and represent 2 sprints) which result in tangible delivery typically timed also to reviews and major milestones. The delivery dates will be different for each task since there is an integration progression from the more fundamental tasks of WP3 to the higher level, user facing, tasks of for example WP6. Importantly WP7 contains an integration tasks which provisions for the often-not-anticipated difficulties of integration and allows for bug fixing.

### **3.1.2 Gantt Chart Overview**

The following Gantt chart shows all tasks and their defined running periods:

Figure 8: *vf-OS* Gantt Chart

### 3.1.3 Detailed work description

#### 3.1.3.1 WP1 Vision, Scenarios and Requirements

WP Title	WP1: Vision, Scenarios and Requirements														
Start/End	Start: 1 / End: 30														
Participant	VICE			LEAD											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total
Person Days	6	4	6	8	6	2	3	5	8	5	4	5	5	5	67
%	8%	5%	9%	12%	8%	3%	4%	7%	11%	7%	5%	7%	7%	7%	100%

#### Objectives

**O1 To reassert the project vision, defining the reference framework, and the overall requirements depicting the envisioned Virtual Factory Operating System**

The following specific objectives are targeted:

- O1.1** To synchronise the project vision, including to overview the target audience and the target market sector
- O1.2** To collect and characterise the requirements of the *vf-OS* final users (industry) for supporting collaboration in the different stages of manufacturing and logistics processes in an efficient manner
- O1.3** To collect and characterise the requirements of the *vf-OS* app builders (software developers) for supporting efficient software development and easy integration in the *vf-OS* platform
- O1.4** To obtain an exhaustive map of existing architectures, technologies and solutions, and to support collaboration in manufacturing and logistics processes
- O1.5** To define the requirements of the project based on the pilot scenarios

Although the Description of Action (DOA) gives a clear narrative of what the project will achieve and how the achievements will happen), there are naturally questions that need to be clarified when it comes to details for the different tasks, and thus these will be finalised in this work package through a “vision consensus document”. In addition, the stakeholders of *vf-OS* and their participation in the multisided market ecosystem around the *vf-OS* platform will be identified: Manufacturing users (industry), providers (software developers), manufacturing systems (connections) and service providers. Cases will be explored and defined to guarantee the success of the *vf-OS* exploitation based on the fulfilment of the need of all sides and in conjunction with WP9. Within this WP, existing solutions and technologies are assessed to highlight to what extent they can be integrated with *vf-OS*. Thanks to the close interaction of the RTD partners, IT developers, and end users, the detailed definition and requirements of the Virtual Factory Smart Applications and validation scenarios from WP8 will also be developed in this WP.

*Note in the WP grids the task, deliverable, and milestones properties are defined in the following format. Summaries of these are available elsewhere in the document.*

[Task Number]	[Task Name]	[Lead]		[Start]-[End]	
[Deliverable Number]	[Deliverable Name]	[Report/Other / Dem/Dec]	[PU/CO]	[Delivery]	[Milestones – R=Research, A=Admin]

#### Description of Work and Role of Participant

The WP kicks-off the project through the Vision Consensus (T1.1), which confirms and provides additional detail on the DOA. In parallel, the User and Developer Characterisation Scenarios (T1.2 and T1.3) will both feed and extend this, as will the solutions/technology identification (T1.4). The WP concludes with the requirements that stem from these documents (T1.5) and most importantly from the pilot scenario of WP8, which will also be running simultaneously.

<b>Task 1.1</b>	<b>Vision Consensus</b>	<b>ICE</b>	<b>M1-3</b>
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D1/D1.1	vfOS - ID1.1 - Vision Consensus(M3)	R	CO	3	R1
<p>The task will provide a balanced guide document as a deliverable, which acts as a reference for the project and will be used by all partners to stay focused on the main ideas and goals of the project, even in complex and technical phases. The document will also be used internally to keep the single RTD tasks (and personnel) in synchronisation with the overall idea of the project. It may also be used by the partners as a source for documents, deliverables and presentations to third parties, e.g. during the dissemination activities, and by interested third parties to get an early overview of the project. In addition this document will include an initial risk table, upgraded from the DOA, which itemises RTD risks in particular and including integration.</p> <p><b>Roles:</b> All partners will be involved in this task to provide their business and technical insights and to ensure a holistic buy-in to the project vision. ICE will lead this task as project visionary.</p>					
<b>Task 1.2</b>	<b>Users Scenarios Characterisation</b>	<b>MASS</b>		<b>M1-4</b>	
D2/D1.2	vfOS - ID1.2 - Users scenarios characterization(M4)	R	PU	4	R1
<p>This task will deal with data and information collection, taking into account criteria such as targeted industrial sectors, industry types, supply chain processes, and management strategies. A comparative analysis of the current status of the main manufacturing and logistics environments will be performed, with particular attention to the needs for supporting collaboration in the supply chain and to classify the different industrial scenarios that will address the <i>vf-OS</i> Platform and its Smart Applications. The characterisation of the pilot Industrial Scenarios will represent the starting point for the setting-up of the innovative solutions that the <i>vf-OS</i> project aims to develop. The deliverable document is thus a report that includes the characterisation of the main industrial scenarios. The deliverable will also detail and explain the aims identified and expected in 2.1.3</p> <p><b>Roles:</b> MASS leads this task as an industrial company with significant experience in industrial projects and due to leadership of WP8. All the other industrial partners will contribute in the characterisation of their user scenarios.</p>					
<b>Task 1.3</b>	<b>Providers Scenarios Characterisation</b>	<b>ALM</b>		<b>M1-4</b>	
D3/D1.3	vfOS - ID1.3 - Providers scenarios characterization(M4)	R	PU	4	R1
<p>This task will deal with the identification of the potential software application developers, the understanding of their needs and expected business models. This will guarantee their participation in expanding the <i>vf-OS</i> Platform with Smart Applications. The classification performed in Task 1.2 will be complemented with the main features of <i>vf-OS</i> Platform and its Smart Applications in order to identify market opportunities for future <i>vf-OS</i> results exploitation by the solutions providers. The deliverable document is thus a report that includes the characterisation of the main of main software developer scenarios that will use the <i>vf-OS</i> Platform for developing Smart Applications.</p> <p><b>Roles:</b> ALM leads this task as an industrial provider with recognised experience in supervising industrial projects. All the other industrial partners will contribute in the characterisation of their providers’ scenarios.</p>					
<b>Task 1.4</b>	<b>Existing Solutions and Technology Identification/Analysis</b>	<b>UPV</b>		<b>M1-30</b>	
D4/D1.4	vfOS - ID1.4a - Existing SOTA Analysis(M6)	OTHER	PU	6, 18, 30	Ongoing
D5/D1.5	vfOS - ID1.4b - Existing SOTA Analysis(M18)				
D6/D1.6	vfOS - ID1.4c - Existing SOTA Analysis(M30)				
<p>This task deals with a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain. It will also study the current state of relevant technologies, including cloud computing, IOT, embedded systems, sensors and CPS components, data analytics, Big Data sources, Security, and mobile data sources. The investigation of the data sources will be carried out in close cooperation with the end users and the solutions providers. Another important aspect to be considered for analysis is “public enablers” such as the generic enables of the FI-WARE and FI-PPP initiative and existing industry solutions such as the up-and-coming IBM Bluemix. The execution of this task will be through a Wiki, with access provided to other projects and contributors in a moderated way.</p> <p><b>Roles:</b> All partners contribute to this task, providing their knowledge about existing solutions and technology. UPV will lead this task as an expert in the state of the art in the collaboration in manufacturing and logistics domain.</p>					
<b>Task 1.5</b>	<b>Requirements Specification</b>	<b>CMS</b>		<b>M1-6</b>	
D7/D1.7	vfOS - ID1.5 - Requirements Specification(M6)	R	PU	6	R1
<p>The requirements analysis is the borderline between the business/requirements aspects mentioned in tasks T1.2, T4 and in WP8, and the software engineering process of the project detailed in WP2. The specification will take into account the DOA, the functional requirements from the targetuser and provider scenarios, requirements arising from the preliminary scenarios defined within WP8, the state of the art analysis, the</p>					

partners' further knowledge and expertise and particularly in the case of WP4 drivers/API "popular" systems which manufacturers might wish to connect to – e.g. ERPs such as SAP ERP, SME Cloud Resources (e.g. Toggl), Sensor types, etc. The deliverable will be a joint document for the requirements of all project components, divided into strategic, high level functional and technical requirements. It will also further detail, where applicable, the KPIs of Section 2.1.2

**Roles:** CMS will lead this user-orientated task but all partners will be in it – user partners will have the main role to specify their requirements, and technical partners to start the "translation" of these requirements into more 'exactly phrased' requirements. Researchers will also have a role to ensure the technology is at least state of the art and moving forward in many areas.

### 3.1.3.2 WP2 Virtual Factory Operating System Architecture

WP Title	WP2 :Virtual Factory Operating System Architecture															
Start/End	Start: 3 / End: 12															
Participant				VICE			LEAD									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	9	8	6	10	7	6	13	6	2	2	2	3	2	2	75	8%
%	12%	11%	8%	13%	9%	8%	17%	8%	2%	2%	2%	4%	2%	2%	100%	

#### Objectives

#### O2 To detail the software engineering aspects including all major specifications

- O2.1** To define a global architecture for *vf-OS*
- O2.2** To create a functional specification of all *vf-OS* software components
- O2.3** To provide a detailed technical specification of all *vf-OS* software components
- O2.4** To define a holistic security and privacy concept which is to be followed by all *vf-OS* components

WP2 will thus define an overall architecture and the specifications which are needed in RTD work packages WP3-7, and therefore provides a foundation for the upcoming work from both a functional and technical point of view. It will ensure that the selected *vf-OS* technologies fit the requirements and that interfaces for all *vf-OS* software components are defined. Important security and privacy issues are promoted to their own focused task as they are cross-cutting concerns which largely need to be fulfilled by all *vf-OS* software components but of course they will be integrated with the overall specification stack. Within the functional deliverable, the users and RTD providers will work closely together to deliver mock-ups for each application which has been found to both better engage users and to facilitate more realistic and valid development priorities.

#### Description of Work and Role of Participant

This work package will initiate the technical side of the project, starting with the architecture (T2.1) based on the work of WP1 and, in particular, the Requirements Specification (T1.5). The architecture will be developed based on the partner's knowledge, experience and competences. The architecture will naturally lead to a Functional Specification (T2.2), validated through user engagement, and from this to the Technical Specification (T2.3) covering each WP3-7 task component. In parallel to this, a cross-cutting security task (T2.4) will feed and interact with all three specifications. Together these will specify the direction for the remaining RTD tasks.

Task 2.1	Global Architecture Definition	ICE		M3-7	
D8/D2.1	vfOS - ID2.1 - Global Architecture Definition(M7)	R	CO	7	R1

The first step to transform the requirements identified within the course of WP1 into particular specifications for all *vf-OS* software components is to define a global architecture identifying *vf-OS* components and their interactions and any security relevance. The deliverable document will present the architecture based on the main components defined in this DOA but it will be performed in a greater level of detail and will also involve the specification of subcomponents and actors. As well as the internal architecture connected with the project it will cover the architecture of applications to be developed by third party software developers who will eventually use easy integration in the *vf-OS* platform.

**Roles:** ICE will lead this task as an experience partner in the design of software architecture. All technological partners contribute in the definition and design of the *vf-OS* global architecture.

Task 2.2	Functional Specification & Mockups	UPV		M7-9	
D9/D2.2	vfOS - ID2.2 - Functional Specification & Mockups(M9)	R	CO	9	R1

This task will deliver a Functional Specification document to provide an in-depth definition of the functionalities and behaviours of all *vf-OS* components. It will also explain how related requirements will be fulfilled as an important means to measure the outcome of the individual tasks and the overall project. Furthermore, all possible interactions between the *vf-OS* components will be detailed and depicted so as to guide the overall flow



of functionalities and data between components. Components will be split into subcomponents and defined following a unified approach. For components that feature a user interface a first mock-up of the GUI (created in Balsamiq) will be included through close RTD provider/user interaction.

**Roles:** The technical partners will contribute in the functional specification and mock-ups of *vf-OS*. UPV will lead this task bringing its experience in the definition of functionalities and behaviours of software components.

Task 2.3	Technical Specification	ASC		M10-12	
D10/D2.3	vfOS - ID2.3 - Technical Specification(M12)	OTH (or R)	CO	12	R2

This task will deliver a Technical Specification, which is the final outcome of the project-wide software engineering process and is based on the Functional Specification. Since this represents core partner IPR for exploitation this specification will remain confidential. It will define concrete interfaces between *vf-OS* software components, protocols and class/package structures, including definitions of methods, parameters, return values, and error handling for each component and interface. It will define data models and concrete data schemas to be used on the source code level. It will also select the (software) technologies to be reused and applied within the project based on a study of possible technologies and in cooperation with the SOTA Wiki Task. Based on this, it will define the missing functionalities and implementation needs that are the foundation for the work to be performed in the RTD work packages WP3-7. For realising the technical specification, the project will examine the use an online approach such as Swagger or Slate to allow a practical and modern approach for documenting its component interfaces but if insufficient or incomplete to address all aspects may fall back to and/or a paper based document. This will be decided during this task and in conjunction with the Technical Manager, Project Manager and T11.4/5.

**Roles:** The technical partners will contribute in the technical specification of *vf-OS*. ASC will lead this task considering its experience in the elaboration of technical specification of computational systems.

Task 2.4	Holistic Security and Privacy Concept	IKERLAN		M7-10	
D11/D2.4	vfOS - ID2.4 - Holistic Security and Privacy Concept(M10)	R	CO	10	R2

This task will develop a concept for privacy and security handling, and will ensure that the concept is applicable to and followed by all *vf-OS* components. It will consider existing approaches (e.g. encryption), the specific requirements of the manufacturing domain, and the need for data security. This task will start at an early stage and provide an according deliverable at the end of the first project year, identifying suitable general approaches and standards to be applied – an early report will help tune the specification tasks. Due to the subject of this deliverable it has been decided to keep it provisionally confidential. Based on this, concrete guidelines will be generated which need to be taken into account throughout the *vf-OS* software development tasks. Since this area is cross-cutting the actual relevant security for each component will be applied within the individual tasks. On an on-going basis this task will continuously check the adherence to the security and privacy concept by those tasks and provide feedback to the individual RTD work packages.

**Roles:** As a recognised partner in the domain of security and privacy of computational systems, IKERLAN will lead this task. Technological partners CMS, ASC, and KBZ will also contribute to this task.

### 3.1.3.3 WP3 Virtual Factory System Kernel

Objectives																
WP Title	WP3: Virtual Factory System Kernel															
Start/End	Start: 5 / End: 24															
Participant			LEAD			VICE										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	16	0	30	0	0	16	0	0	0	0	0	24	0	0	86	10%
%	19%	0%	35%	0%	0%	19%	0%	0%	0%	0%	0%	28%	0%	0%	100%	

#### Software “OS”

**vf-OS**

**Kernel:** Processor, Memory, Internal Bus, Core services

**vf –System Kernel:** Virtual Factory System Kernel

### O3 To design, develop, and deploy the “vf-OS kernel”

**O3.1** To define a framework which will generically allow existing enablers, and new enablers, core to **vf-OS** to be used throughout the **vf-OS** environment

**O3.2** To ‘wrap’ relevant FI-WARE Generic Enablers into **vf-OS**

**O3.3** To ‘wrap’ relevant FI-WARE Manufacturing/Specific Enablers into **vf-OS**

**O3.4** To create compatible Enablers relevant for the **vf-OS** Project/Requirements

**O3.5** To utilise/adapt an existing commercial-grade open source Process Execution engine for to **vf-OS**

In computing, the “kernel” is a computer program that manages requests from software, and translates them into data processing instructions for the central processing unit and other electronic components of a system. At its deepest level it can be considered as the machine code or the BIOS. Its functionality is intrinsic to the start-up of the system and its operation thereafter with the service calls being common across all applications at even the deepest level such as interrupt handling, space allocation, and process management.

In this sense the aim of WP3 is in specifying, developing, and deploying the “**vf-OS** kernel”: A specific set of core functions and infrastructure for **vf-OS** applications to be built upon and interact with each other. The “**vf-OS** kernel” is also the core of the operating system, responsible for the processing and mediating the access to all **vf-OS** resources. The basic services to be offered by the “**vf-OS** kernel” are related to setup a specific core of services which will be used by the manufacturing Applications of the pilots. This work package will design and implement these services; these will be open, accessible, and comply with the requirements of the manufacturing Apps such as supporting easy integration in the **vf-OS** platform.

However, there is no point creating a kernel from scratch and **vf-OS** has several starting points with a strong one being the aforementioned FI-WARE initiative. Its Generic and Specific Enables can offer the basis for much of this Kernel. This WP allows this although for some enablers, specifically the process engine, due to its pervasive use throughout the **vf-OS** a specific task is envisioned although still taking use of existing open software but at a commercial grade. This task will shape it to be suitable for the project.

General Note: Broadly speaking all WP3-7 activity follow a 6 monthly development synchronisation phasing such that the different tasks/work packages are synchronised together. In addition, within each task, an agile process will be followed based on a monthly cycle. This is detailed in the management section along with milestones which represent these phases. The lower level WPs such as WP3 and 4 will start and finish early than the higher level WPs such as 6 and 7.

#### Description of Work and Role of Participant

This task is composed of a hierarchy of intrinsic enablers. The initial Kernel/Framework task (T3.1) starts off by defining a proposition which will generically fit existing enablers and enablers core to **vf-OS** into a framework which allows them to be used throughout the **vf-OS** environment. This framework is then used to ‘wrap’ both FI-WARE Generic (T3.2) and FI-WARE Manufacturing orientated Enablers (T3.3). This will not be for all FI-WARE enablers but for those that have most relevance to the scope of the project and in particular the manufacturing pilots. The vs-OS Enablers (T3.4) are in essence specific enablers which are needed for **vf-OS** but do not currently

exist and will be created in the project based on the requirements. The final task, *vf-OS* Process Enabler (T3.5), is a process execution engine which will be responsible for managing all Application processes and is felt to be so intrinsic to *vf-OS* it will be based on existing commercial-grade but open source tools.

Task 3.1	<i>vf-OS</i> Kernel and FI-WARE Framework	UNINOVA		M5-10	
D12/D3.1	vfOS - ID3.1 - vf-OS Kernel and FI-WARE Framework(M10)	OTHER	PU	10	R2

The Kernel/Framework task is set in defining a proposition which will generically fit existing enablers and enablers' core to *vf-OS* into a framework which allows them to be used throughout the *vf-OS* environment. The deliverable will be the creation of a framework, including code and policies, which facilitates the creation of enablers in the remainder of WP3

**Roles:** UNINOVA will lead this task considering its recognised experience developing for FI-WARE. LYON2 and KBZ will contribute to this task bringing their expertise in the implementation of FIWARE enablers applied for industrial environments.

Task 3.2	FI-WARE Generic Enablers	UNINOVA		M7-24	
D13/D3.2	vfOS - ID3.2a - FI-WARE Generic Enablers(M12)	OTHER	PU	12, 18, 24	R2 & R3 & R4
D14/D3.3	vfOS - ID3.2b - FI-WARE Generic Enablers(M18)				
D15/D3.4	vfOS - ID3.2c - FI-WARE Generic Enablers(M24)				

This task will take the framework and policies for T3.1 and apply them to the FI-WARE generic enablers which makes sense in the context of *vf-OS*, its manufacturing setting and in particular the pilot requirements. These will then form a basis for developed Applications to utilise knowing that the specific enablers have already been proven to work inside the *vf-OS* environment. Of particular interest, since they have no counterpart in *vf-OS* WPs, are IoT Enablers such as "IoT Discovery" and "IoT Broker" as well as security enablers such as "AuthZforce" and "Identity Management". Delivery of code/package of re-purposed FI-Ware generic enablers according to the *vf-OS* Kernel framework will complete this task.

**Roles:** UNINOVA will lead this task and together with KBZ will use their experience in using FI-WARE Generic Enablers to set them in the manufacturing setting for the particular *vf-OS* pilot requirements.

Task 3.3	FI-WARE Manufacturing Enablers	LYON2		M7-24	
D16/D3.5	vfOS - ID3.3a - FI-WARE Manufacturing Enablers(M12)	OTHER	PU	12, 18, 24	R2 & R3 & R4
D17/D3.6	vfOS - ID3.3b - FI-WARE Manufacturing Enablers(M18)				
D18/D3.7	vfOS - ID3.3c - FI-WARE Manufacturing Enablers(M24)				

This task is similar to T3.2 but will focus on the FI-WARE specific enablers and those which come under the FI-WARE 'Manufacturing category' or could be slotted into it. In particular, enablers from the FITMAN project of which partner UNINOVA and LYON2 were members of will be re-purposed – FITMAN: "provides the FI-PPP Core Platform with 10 industry-led use cases which [...] FIWARE GEs and FITMAN SEs while contributing to the [...] sustainability of EU Manufacturing Industries." Delivery will be the code/package of Repurposed FI-Ware specific/manufacturing enablers according to the *vf-OS* Kernel framework

**Roles:** LYON2 will lead this task and together with UNINOVA will use their experience in developing FI-WARE Specific Enablers to respond to the particular manufacturing pilot requirements.

Task 3.4	<i>vf-OS</i> Enablers	KBZ		M7-24	
D19/D3.8	vfOS - ID3.4a - vf-OS Enablers(M12)	OTHER	PU	12, 18, 24	R2 & R3 & R4
D20/D3.9	vfOS - ID3.4b - vf-OS Enablers(M18)				
D21/D3.10	vfOS - ID3.4c - vf-OS Enablers(M24)				

Both T3.2 and T3.3 rely on existing FI-WARE enablers which are designed to be generic but equally were designed for "others"; they are also considered in many cases to be 'large' functional components such as "Kurento" which claims to create "complex media applications". Thus this task will look more closely at *vf-OS* needs and develop (smaller) enablers from scratch based on the requirements and pilots but which are felt to be still intrinsic to the *vf-OS* system. The T3.1 framework will be used as the basis for this task. The delivery will be the Creation/Repackaging and delivery of code/package of *vf-OS* specific manufacturing enablers according to the *vf-OS* Kernel framework

**Roles:** KBZ will lead, assisted by LYON2, will use their large experience in development of enablers to implement the novel *vf-OS* enablers based on the requirements and pilots that will be intrinsic to the *vf-OS* system.

Task 3.5	<i>vf-OS</i> Process Enabler	ICE		M7-24	
D22/D3.11	vfOS - ID3.5a - vf-OS Process Enabler(M12)	OTHER	PU	12, 18, 24	R2 & R3 & R4
D23/D3.12	vfOS - ID3.5b - vf-OS Process Enabler(M18)				
D24/D3.13	vfOS - ID3.5c - vf-OS Process Enabler(M24)				

Process execution and interrupt handling will be responsible for managing manufacturing Applications and affect the processes which are currently running. When a manufacturing app makes requests to the kernel, the request is called as a system call. This task will define and implement the kernel processor and how it will manage system calls and resources. The process execution engine is felt to be **so** intrinsic to **vf-OS** it will be based on existing commercial-grade but open source tools and by default the Talend suite. Delivery will be the repackaging and production of the **vf-OS** Processing Engine.

**Roles:** ICE will provide their insights in operating systems development to develop the **vf-OS** kernel processor. ICE will lead this task as an experienced middleware developer.

### 3.1.3.4 WP4 Virtual Factory I/O

WP Title	WP4: Virtual Factory I/O															
Start/End	Start: 7 / End: 33															
Participant				LEAD		VICE										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	0	8	0	27	0	27	0	12	0	0	0	0	0	0	74	8%
%	0%	11%	0%	36%	0%	36%	0%	16%	0%	0%	0%	0%	0%	0%	100%	

#### Objectives

Software "OS"	<b>vf-OS</b>
I/O: Interfaces, Peripherals, Device Drivers, APIs	<b>vf-I/O: Devices Drivers and Open APIs</b>

**O4 To provide **vf-OS** the means for Input/Output (I/O), and thus integrate with real factories and serve as interoperability mechanisms between the factory and **vf-OS****

- O4.1** To define and develop a toolkit, the **vf I/O**, to further develop Drivers and APIs
- O4.2** To create a set of functional "Device Drivers" based on the I/O toolkit
- O4.3** To create a set of functional "APIs" based on the I/O toolkit
- O4.4** To implement security policies and procedures that protect of factory assets, people and data

WP4 aims at providing **vf-OS** with the means to integrate with real factories through the definition of Open APIs, interconnection modules and drivers that serve as interoperability mechanisms between the factory and the **vf-OS** platform. In the **vf-OS** concept diagram it represents largely "Manufacturing Systems" which Manufacturing users may expose through **vf-OS** applications or other service/gateways. It will develop the Virtual Factory Plug-and-Play mechanisms and device drivers/APIs for seamless/open access and smart virtualisation of the factory resources. It will also provide a set of collaborative tools for the supporting factory business. The focus is the creation of modules that virtualise the factories real assets and connect them to their virtual images in the **vf-OS** platform. This integration between the factory and **vf-OS** will be seamless; hence transparency and openness are keys for the definition of APIs to interface factories and **vf-OS**. Security is also a strong asset to tackle in this WP and protect the 2<sup>nd</sup> party factor assets. Whilst not an exact split, the difference between drivers and APIs can be boiled down to:

- Drivers: Typically physical peripheral resources (machines, controllers, etc.)
- APIs: Typically virtual resources (cloud services, software, etc.)

#### Description of work and role of participant

This WP starts with task (T4.1) which builds and develops a Device Driver/API framework to provide core toolkit software for the subsequent tasks of the WP. This starts with Device Drivers (T4.2), which will take this toolkit and build specific connectors (drivers) for popular/relevant factory assets, such as PLC, Machines, ERPs with a priority taken from the requirements document D1.5 as well as the needs of the validation pilots. Similarly, the API Connectors (T4.3) takes this toolkit and does the same job for popular/relevant APIs. Finally, the security task (T4.4) is intended to protect these assets.

Task 4.1	Devices Drivers and Open API Toolkit	UPV	M7-M24
D25/D4.1	vfOS - ID4.1.1 - Devices Driver/API Toolkit -	R	PU
			12
			R2

	Specifications(M12)				
D26/D4.2 D27/D4.3	vfOS - ID4.1.2a - Devices Driver/API Toolkit - Software(M18) vfOS - ID4.1.2b - Devices Driver/API Toolkit - Software(M24)	OTHER	PU	18, 24	R3 & R4

This task will define and develop (based on the **vf-OS** architecture) a toolkit for the APIs that are required to integrate **vf-OS** with the factory. The Device Driver/API Toolkit Specification (D4.1.1) will further detail the specifications regarding the creation and development of the **vf-OS** devices drivers, Open APIs, and test cases, in order to enable very flexible and customisable elements that are able to connect the real factories' resources to the virtualised elements and services of **vf-OS**.

This task will also produce the base software technology/library (D4.1.2) derived from the specifications, which can facilitate the interconnection and design of both the device drivers and APIs, in order to enable the seamless/open access to resources, and provide a base toolkit for the precise drivers/APIs of T4.2 and T4.3. This toolkit will be a flexible infrastructure adaptable to the applications and tools which are provided by **vf-OS**.

**Roles:** UPV (Leader), together with LYON2 and ALM, develop the device driver/API framework via D412ab and UOV will design it with assistance from the other WP4 partners (out of WPp4 resources).

Task 4.2	Devices Drivers	UPV		M13-33	
D28/D4.4 D29/D4.5 D30/D4.6	vfOS - ID4.2a - Devices Drivers(M24) vfOS - ID4.2b - Devices Drivers(M30) vfOS - ID4.2c - Devices Drivers(M33)	OTHER	PU	24, 30, 33	R2 & R3 & R4

Task 4.2 will analyse the requirements and use cases from WP1 and WP7 and according to the needs of each, develop and deliver the needed drivers for the **vf-OS** business pilots. The outcomes of this task are the software of the developed drivers (D4.2). Device Drivers will typically create gateways to *physical* peripheral resources (e.g. machines, controllers, etc.).

**Roles:** UPV (task leader) and ALM will analyse the requirements for the business pilot device drivers, and develop them and integrate them in the **vf-OS** platform.

Task 4.3	API Connectors	LYON2		M13-33	
D31/D4.7 D32/D4.8 D33/D4.9	vfOS - ID4.3a - APIs Connectors(M24) vfOS - ID4.3b - APIs Connectors(M30) vfOS - ID4.3c - APIs Connectors(M33)	OTHER	PU	24, 30, 33	R2 & R3 & R4

This task will develop and deliver the core **vf-OS** software API Connectors (D4.3) of the toolkit on a similar basis to T4.2, based upon the outcome of T4.1 and T4.2. These will permit an open and seamless access to the **vf-OS** Functionalities/Drivers. APIs will typically create gateways to *virtual* (vs. physical) peripheral resources (e.g. ERPs, CRMs, Cloud Services, etc.).

**Roles:** LYON2 (will analyse the requirements for the business pilots APIs, and develop them and integrate them in the **vf-OS** platform).

Task 4.4	Security & Data Access	IKERLAN		M13-24	
D34/D4.10 D35/D4.11	vfOS - ID4.4a - Security & Data Access(M18) vfOS - ID4.4b - Security & Data Access(M24)	OTHER	PU	18,24	R3 & R4

A specific focus of **vf-OS** is on the integration of data from various (real-time) factory resources and data sources, which can be foreseen as "sensitive", and will invariably need security considerations. Service developers need to be provided with tools to securely store data within the Cloud. This deliverable represents the core security structure and developed/delivered artefact which will help protect 2<sup>nd</sup> party factory assets and can be quickly integrated in to applications.

**Roles:** IKERLAN has experience in security and data access in industrial setting and will lead this task and so provide the technological insights for the developments.



### 3.1.3.5 WP5 Virtual Factory Data and Connect

Objectives																
WP Title	WP5: Virtual Factory Data and Connect															
Start/End	Start: 13 / End: 30															
Participant	LEAD	VICE														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	35	22	25	0	0	0	0	0	2	2	2	2	2	2	94	10%
%	37%	23%	27%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%	100%	

#### Software "OS"

*vf-OS*

File and Data handling: Interfaces

**vf-Data and Connect** : Virtual Factory Middleware, System Services and Data Bus

**O5 To create the *vf-OS* data infrastructure including interoperability connectors, storage, transformation services, and analytics functionality**

**O5.1** To develop a middleware data infrastructure accounting for heterogeneity, volumes and speed

**O5.2** To implement a scalable data storage capable of handling real-time sensor data and events

**O5.3** To develop semantic-based mechanisms for harmonising sensor data

**O5.4** To develop off-line analytic methods for enrichment, analysis, and interpretation of data

The applications foreseen in *vf-OS* will consume and/or produce tremendous amounts of data. Handling such amounts of data becomes challenging, according to orthogonal concerns; namely: Data must be connected – this not only includes using the WP4 toolkit, but also managing the movement of this data through middleware (Messaging) which is also linked to WP3 process execution; the storage capability must scale, i.e. the underlying infrastructure must transparently absorb very large amounts of e.g. machine and sensed data. Next, before applications consume this data, it must typically be mapped from input to output type – this will be facilitated via semantic harmonisation and transformation techniques; finally, for consumption analytics interfaces provided by the infrastructure must scale to extract relevant data subsets according to user's expectations in the simplest possible way. To access the data, it also includes all the elements required for data stream management, ie: reading, cleaning, storing, indexing, enrichment, search & retrieval, fusion, maintenance, and correspondence of open APIs. The data infrastructure will serve analytic and decision making services.

#### Description of work and role of participant

This work package will provide a set of semi-independent but related services with the inputs of data in a variety of format, at large scale, at different speeds, and providing set of nontrivial analytic operators. The Data Infrastructure Middleware (T5.1) will provide the core access, which can utilise Data Storage (T5.2) for permanent and cross application access. Data Harmonisation (T5.3) will provide innovative transformation services, based on semantics, and is particularly connected to T5.1 for data connectivity. All three will be supported by the analytics engine T5.4. In all cases, existing technologies/open solutions or background IPR will be used where possible, since it is not the need, purpose, or feasibility to build such heavy duty functionality within the project itself.

Task 5.1	Data Infrastructure Middleware	UNINOVA		M13-30	
D36/D5.1	vfOS - ID5.1a - Data Infrastructure Middleware(M18)	OTHER	PU	18, 24, 30	R3 & R4 & R5
D37/D5.2	vfOS - ID5.1b - Data Infrastructure Middleware(M24)				
D38/D5.3	vfOS - ID5.1c - Data Infrastructure Middleware(M30)				

This task will specify and implement a messaging/data bus that will support the other components of WP5 and of *vf-OS* application for data storage, transformation, and analytic operations. The data infrastructure will contain adapters which will be developed for necessary data sources including, sensor data, ERP, machines, etc. and take advantage of WP4 activity. Adapters will be developed for necessary enterprise information sources such as hardware sensors (which might include accelerometers, vibration, and temperature sensors), software

sensors from ERP systems and external business context data. Since sensor data typically generates large amounts of micro measurements, the supporting data infrastructure needs to support a high throughput technology pipeline for acquisition, pre-processing, and aggregation of the collected data.

A "publish-subscribe" (pub-sub) middleware will help realise an Event Driven Architecture (EDA) and infrastructure for components and end user services. Pub-sub middleware will provide the data infrastructure and will be fully compatible with major industry standards (e.g. JBI, SCA, BPEL or WSDL). Most likely this functionality will be built on the top of existing open source products, such as the Talend suite (and as examined in the SOTA of WP1), since it is not the purpose (nor the possibility) of the project to build such complex infrastructures especially when these freely exist. The aim is to prepare the data into a form which allows higher level decision making services to perform their tasks. The result of T5.1 will be a software module (D5.1) implementing the pipeline for sensor data acquisition, cleaning, storing, simple enrichment, indexing and querying.

**Roles:** UNINOVA (leader) together with IKERLAN will design and develop the architecture and implement the services for the data infrastructure middleware. The industrial partners will provide their needs on data infrastructure access needs for their business scenarios.

Task 5.2	Data Storage	IKERLAN		M13-30	
D39/D5.4	vfOS - ID5.2a - Data Storage(M18)	OTHER	PU	18, 24, 30	R3 & R4 & R5
D40/D5.5	vfOS - ID5.2b - Data Storage(M24)				
D41/D5.6	vfOS - ID5.2c - Data Storage(M30)				

This task will specify and implement **vf-OS** data storage module (D5.2), supporting three major dimensions of "Big Data" when dealing with intensive streaming data, namely: Volume (scale of data processed), Velocity (speed of moving data and optimised reaction time), and Variety (supporting heterogeneous types to data under consideration). The veracity dimension (fuzziness of data) will not be explored in this specific project. The data storage will be designed around modern NoSQL data storage infrastructure (minimising overheads when processing data and maximising flexibility in terms of data schemas being used), complemented with approaches developed specifically for handling sensor data.

Dedicated event storage is also foreseen, in order to provide event forwarding (in the form of RDF triples) received from pre-processing services, such as the transformation task. It will be realised as an event cloud - a scalable, semantic, P2P based repository that delivers RDF events to the requesting parties (subscribers). These will be pushed and are relevant to external services or project related components. At the same time, **vf-OS** should store the events for historical and statistical purposes, and supports synchronous and asynchronous queries expressed in a subset of the SPARQL language and accessible through corresponding APIs.

**Roles:** IKERLAN leads this task implementing the **vf-OS** data storage module. UNINOVA will support the technical developments. The industrial partners will provide their data storage needs for their business scenarios.

Task 5.3	Data Harmonisation	ICE		M13-30	
D42/D5.7	vfOS - ID5.3a - Data Harmonisation(M18)	OTHER	PU	18, 24, 30	R3 & R4 & R5
D43/D5.8	vfOS - ID5.3b - Data Harmonisation(M24)				
D44/D5.9	vfOS - ID5.3c - Data Harmonisation(M30)				

Data Harmonisation aims to (a) extract information from incoming data and (b) prepare the data in a form/schema suitable for other tasks in the subsequent work packages. It will enable semantic enrichment with background knowledge and data mining of real-time streams, received through the data bus. The data enrichment objective is to generate from the observed data additional derived attributes/features, either using external background knowledge or internal relationships within data. This could include the use of external ontologies, statistically derived knowledge, (models) of data and/or temporal characteristics of data. The key aim is to encode functional transformations of data to help analytic techniques of T5.4 to detect non-linear and other nontrivial patterns within the data (otherwise non-detectable by traditional analytic techniques). This will be built using background technology from partner ICE, who is constructing a semantic enablement platform driving syntactical data transformation to the next level, such that transformation maps and element data maps can be quickly (even automatically) generated, thus speeding up interconnections between different sources and interactions. The deliverable represents the functionalities of the semantic-based data harmonisation services.

**Roles:** ICE will lead this task with the technical contribution of UNINOVA. All who have expertise regarding semantic interoperability, data transformations, and data harmonisation. The industrial partners will provide the data harmonisation needs for their business scenarios.



Task 5.4	Data Analytics	ICE		M13-30	
D45/D5.10	vfOS - ID5.4a - Data Analytics(M18)	OTHER	PU	18, 24, 30	R3 & R4 & R5
D46/D5.11	vfOS - ID5.4b - Data Analytics(M24)				
D47/D5.12	vfOS - ID5.4c - Data Analytics(M30)				

This task covers the creation of building blocks for off-line analytical processing of sensor inputs. This will include machine learning algorithms supporting supervised and unsupervised scenarios. The core of the analytic algorithms will be based on the combination of the modern statistical-machine-learning linear-algebra based algorithms (e.g. SVM, CRF, LDA, Mixture-Models) and traditional data-mining algorithms (e.g. decision trees and rules, k-means, association rules). This will cover typical classification and segmentation scenarios for enriched representations coming from semantic based ontological descriptions to capture nonlinearities in data. The key research innovation will be provided by using “multi-level” analysis on the top of more traditional machine learning algorithms simultaneously observing the data on multiple aggregation levels. Once again, it is not the possibility nor need of the project to build a data analytics platform from scratch thus in the nature of the project it will take an existing platform or technology, derived from the SOTA of WP1, and then wrap and massage it to suit the challenge of the *vf-OS* project. The deliverable represents the functionalities of the data analytics.

**Roles:** ICE will lead this task, with the technical contribution of IKERLAN all with recognised expertise on data analytics. The industrial partners will provide the data harmonisation needs for their business scenarios.

### 3.1.3.6 WP6 Open Applications Development Kit (OAK)

Objectives																
WP Title	WP6: Open Applications Development Kit (OAK)															
Start/End	Start: 16 / End: 36															
Participant					LEAD		VICE									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	0	0	0	0	62	0	32	12	0	0	0	0	0	0	106	12%
%	0%	0%	0%	0%	58%	0%	30%	11%	0%	0%	0%	0%	0%	0%	100%	

Software "OS"	vf-OS
SDK: SDK, Application Development portal, System Monitor	Open Applications Development Kit including Studio, SDK, Hub, and Dashboard

#### O6 To define the **vf-OS** Open Application Development framework including the SDK (OAK), a hub to engage developers, a system dashboard, and the OAK Studio for development

- O6.1** OAK SDK: To define and develop the application development environment in which all **vf-OS** Applications can be developed. This includes SDK documentation
- O6.2** OAK System Dashboard: To develop system applications similar to Windows control panel and task manager for monitoring and adapting system resources
- O6.3** OAK FrontEnd Environment: To provide a framework which facilitates the composition of Application front ends
- O6.4** OAK Studio: To allow the easy development and integration of the different applications
- O6.5** OAK Developer Engagement Hub: To assist developers via a Centralised developer communications center

As part of the transformation of a manufacturing organisation to be part of the manufacturing **vf-OS**, it needs to make use of a set of applications to support this. To effectively develop these applications (e.g. as part of WP7 activity) a common development framework is applicable. This is the main objective of WP6: i.e. to propose and define a framework, called the **vf-OS** Open Applications Development Kit (OAK), for developing applications allowing this business transformation. Thus WP6 specifies the OAK Data Model, API conventions, and exchange formats to allow both basic development but also a future development paths. In particular OAK will be constructed to allow third parties to develop their own applications and facilitate their integration into the **vf-OS** Platform thus widening and opening this way the development of specific third parties and specialised applications. OAK will be proposed and defined following the **vf-OS** architecture specified in WP2 which includes supporting efficient software development and easy integration in the **vf-OS** platform by those third parties. WP6 will thus also form the corner stone for WP7 applications development platform within (and beyond) the project. OAK will be integrated into the **vf-OS** platform for its ultimate exploitation.

OAK should be perceived as a typical software development kit (SDK or "devkit") which according to Wikipedia can be defined as "a set of software development tools that allows the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar development platform. To create applications you have to download [such a] software development kit." For example, if you want to create an Android app you require an SDK with java programming, for iOS apps you require an iOS SDK with swift language. For a **vf-OS** application a developer will need to know OAK and utilise the **vf-OS** Platform of WP7.

#### Description of Work and Role of Participant

The OAK SDK and Documentation task (T6.1) is the core part of this WP and defines the core aspect of the **vf-OS**, in order to construct applications. The OAK System Dashboard (T6.2) represents the core software services, akin to a Microsoft Windows OS Control Panel or Task Manager, (which allow system monitoring and configuration), and are linked to the applications developed according to the SDK. Since many applications will need front-ends, the OAK FrontEnd environment (T6.3) provides a framework that facilitates a general 'look, feel, and composition' to **vf-OS** applications and will assist rapid development. It will be used in conjunction with the OAK

Studio (T6.4) which is a desktop development environment that facilitates users (software developers) to compose their applications according to the aforementioned components. The Developer Engagement Hub (T6.5) will be based on existing open source environment and is a collaboration platform for developers that can be perceived to be similar to, but a focused subset of, GitHub, Jira, and Stackoverflow.

Task 6.1	OAK SDK and Documentation	CMS		M16-36	
D48/D6.1	vfOS - ID6.1.1a - OAK SDK - Software(M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D49/D6.2	vfOS - ID6.1.1b - OAK SDK - Software(M30)				
D50/D6.3	vfOS - ID6.1.1c - OAK SDK - Software(M36)				
D51/D6.4	vfOS - ID6.1.2a - OAK SDK - Documentation(M24)	R	PU	24, 30, 36	R4 & R5 & R6
D52/D6.5	vfOS - ID6.1.2b - OAK SDK - Documentation(M30)				
D53/D6.6	vfOS - ID6.1.2c - OAK SDK - Documentation(M36)				

Within Task T6.1, The *vf-OS* SDK (D6.1.1) supports service developers with the functionalities needed to define, design, develop, and orchestrate manufacturing-related services. The *vf-OS* Applications/Services SDK, templates and manifest will be developed. Based on the knowledge and technology from previous projects such as Simpli-city (in the mobility sector) and SOA4All (generic services), the project participants will develop an extensive fully documented API framework that provides developers with the means to easily generate applications and services. The API contains the means to combine services in order to provide value-added service compositions. An important part of OAK will be the Application's Manifest, which will characterise the applications developed in the *vf-OS* Marketplace of WP7. The Service API offers methods to access functionalities of all technical components that service developers need, such as the easy integration of data from the Cloud-based Information Infrastructure, and the storage of service-specific data within the Cloud. After the applications/services have been developed, they can be registered in the WP7 marketplace. Within *vf-OS*, applications will be developed in WP8. The deliverable D6.1.2 documents the OAK SDK, enabling developers to efficiently develop applications.

**Role:** The technology partners will design the OAK SDK. CMS is a recognised company in the development of open software and will lead this task. For the documentation part they will be assisted by all other partners in the Workpackage

Task 6.2	OAK System Dashboard - Control Panel and Task Manager	ALM		M16-36	
D54/D6.7	vfOS - ID6.2a - OAK System Dashboard(M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D55/D6.8	vfOS - ID6.2b - OAK System Dashboard(M30)				
D56/D6.9	vfOS - ID6.2c - OAK System Dashboard(M36)				

This task will provide a system dashboard, which can be perceived as being akin to Windows Control Panel, Task Manager, or other intrinsic functions for monitoring, warning, configuring, and adapting system resources. It can be used by both service providers, applications developers, and advanced users to test and monitor systems. As an example, it can report back on communication difficulties with connect services (from WP4), as well as service responsiveness or availability. This deliverable represents the functionalities of the OAK System Dashboard.

**Role:** ALM will lead this task, considering its expertise in the development of software system control interfaces. All technology partners will collaborate in the development of the OAK System Dashboard, Control Panel and Task Manager.

Task 6.3	OAK Front End Environment	ASC		M16-36	
D57/D6.10	vfOS - ID6.3a - OAK Front End (M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D58/D6.11	vfOS - ID6.3b - OAK Front End (M30)				
D59/D6.12	vfOS - ID6.3c - OAK Front End (M36)				

This task will provide the *vf-OS* default end user interface. Based on the WP1 findings and technologies, a multimodal UI will be developed. The applications developed in WP8 can apply and further refine this UI. For example, menu and application structures will be revised according to the findings of user testing. To achieve multimodality, methods, and technologies need to be analysed, enhanced, and integrated with the necessary UI technologies. Invariably an HTML5 solution will be adopted to achieve this and create the flexibility needed. The deliverable represents the functionalities of the OAK Front End Environment.

**Role:** ASC will lead this task, considering its expertise in the development of computational front end environments. All technology partners will collaborate in the development of the OAK front end environment.

Task 6.4	OAK Studio	CMS		M16-36	
D60/D6.13	vfOS - ID6.4a - OAK Studio(M30)	OTHER	PU	30, 36	R5 & R6
D61/D6.14	vfOS - ID6.4b - OAK Studio(M36)				

The *vf-OS* Application Design Studio is a holistic graphical user interface supporting application developers to easily implement *vf-OS*-related end user applications by integrating and orchestrating services, APIs, and connectors. The design studio provides application developers with the necessary tools and means to develop and deploy applications on end user devices. The application developer will be supported by a step-by-step procedure which covers the entire development process including the registration of new applications (or updates) at the *vf-OS* Marketplace. This deliverable represents the functionalities of the OAK Studio.

**Role:** The technology partners will design the OAK Studio. CMS is a recognised company in the development of open software and will lead this task.

Task 6.5	OAK Developer Engagement Hub	CMS		M16-36	
D62/D6.15	vfOS - ID6.5a - OAK Developer Engagement Hub(M30)	OTHER	PU	30, 36	R5 & R6
D63/D6.16	vfOS - ID6.5b - OAK Developer Engagement Hub(M36)				

Key to getting application developers on board is for them to use a development environment which they are familiar with – for example GitHub/Stackoverflow/JIRA. These allow developers to interact with each other at both a personal and technical level – for example asking ‘does anyone know how to...’ or to store code for improvement, or track bugs. Certainly *vf-OS* will not develop this from scratch but base itself on existing system and enhance/restrict them for *vf-OS*. Importantly, this hub will be used in the actual engagement task of WP7 since as part of the platform *vf-OS* will encourage developers and train them. This deliverable represents the functionalities of the OAK Engagement Hub.

**Role:** The technology partners will design and implement the OAK Developer Engagement Hub. CMS is a recognised company in the development of open software and integrator and will lead this task.

### 3.1.3.7 WP7 Platform and Integration

Objectives																
WP Title	WP7: Platform and Integration															
Start/End	Start: 4 / End: 36															
Participant	1	2	3	4	5	6	VICE	LEAD	9	10	11	12	13	14	Total	Total % by Days
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALIM	MASS	VS	CON	KBZ	APR	TARDY		
Person Days	4	4	4	4	5	4	32	44	0	0	6	0	0	0	107	12%
%	4%	4%	4%	4%	5%	4%	30%	41%	0%	0%	6%	0%	0%	0%	100%	

Software "OS"	vf-OS
Apps Store & Internet and Service Provision	vf-OS Platform including vf-mApp and demand/supply functionality & vf-OS Service Provision Framework – including hosting, and storage

#### 07 To provide the user/developer a runtime platform including environment, marketplace, 1<sup>st</sup>/3rd party service framework, developer hub, and internal integration

- 07.1** To establish the container *vf-Platform*, which encapsulates all other *vf-OS* components and outwards facing applications
- 07.2** To implement the *vf-mApp* store (Manufacturing applications), where users can pay for and download applications or components that developers have uploaded
- 07.3** To implement the *vf-Service* provision framework, which allows *vf-OS* partners and third parties to provide and market additional services
- 07.4** To engage and train internal and external developers
- 07.5** To provide capacity for software integration, issue tracking, and bug fixing

iPhone and Android Mobile Apps offer a wide range of new functionalities showcasing the ideas innovative power of thousands of developers. *vf-OS* brings this approach to the manufacturing sector. The *vf-mApp* Store (the Application Marketplace) takes this idea further, as not only applications will be provided, but also services that can be used by other application or service developers. The architecture of the *vf-OS* marketplace allows services integration from other platforms into the *vf-OS* marketplace. Furthermore, a possible integration of the *vf-mApp* Store into common App markets will be investigated.

This work package is the critical outwards facing facility that publishes *vf-OS* features for use, (both components and services), and allows interactions. Interaction will be with manufacturing users, who may wish to procure new applications from subscribed developers or by downloading/buying existing applications in the marketplace (*vf-mApp* store). Correspondingly, there will also be interactions with developers, who can both respond to user demands and self-innovate to design/build new applications, and offer them to others. Developers could be independent (ISVs) or from existing manufacturing organisations. Manufacturing users might provide (through *vf-OS* based applications) facilities which others can use – e.g. a connection to a specific set of machine services or to part of an ERP output – so that others can take advantage of these and so construct applications. Importantly, resources are allocated to foster application development through training, engagement, and utilisation of the Developer Engagement Hub (WP6). Finally, an integration and bugfixing task is provided to ensure the completion of periodic integration trials and testing between components.

#### Description of work and role of participant

The first three WP7 tasks run in parallel, with the *vf-Platform* Environment (T7.1) acting as a coherent portal and container for the *vf-mApp* Store, Service Provision Framework and components and applications from other WPs such as the OAK Studio. The *mApp* store task (T7.2) represents a marketplace in the portal where applications can be procured, selected, accessed, purchased, and used by developers and users. The Service Provision Framework (T7.3) will allow the *vf-OS* consortium and third parties (in and beyond project) to provide services, such as hosting and storage resources. Engagement and Training (T7.4) of developers will be critical for uptake and this task will be aimed initially at internal developers for the WP8 pilots but later for external parties who

show early interest. The integration task (T7.5) is a container task across the project and allows time for both integration of components, bugfixing, and an allowance for feature of specific components which need extending and utilising the infrastructure of T11.5.

Task 7.1	vf-Platform Environment	ALM		M16-36	
D64/D7.1	vfOS - ID7.1a - vf-Platform Environment(M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D65/D7.2	vfOS - ID7.1b - vf-Platform Environment(M30)				
D66/D7.3	vfOS - ID7.1c - vf-Platform Environment(M36)				

T7.1 aims at providing a holistic service platform, which is the foundation for all services and end user applications *vf-OS* will facilitate. The service platform will be the central outwards facing component of the project, and will both encapsulate and act as the interface between the RTD Components, connectors, OAK functions of WP6, Marketplace, Service Framework, and the end user applications/developers. The platform will allow parties to easily develop, describe, discover, provide, consume, administrate, personalise and combine/compose applications, as well as monitor their execution through the OAK System Dashboard. Furthermore, it will evaluate the usage of services from other platforms, and enrich them using the means provided. It will be rendered as a web portal, where not only these component applications can be accessed, but also components and applications from other WPs such as the OAK Studio. The deliverable represents the functionalities of the *vf-Platform*.

**Role:** ALM will design and develop the *vf-platform*.

Task 7.2	vf-mApp Store & Marketplace	ASC		M16-36	
D67/D7.4	vfOS - ID7.2a - vf- mApp Store & Marketplace(M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D68/D7.5	vfOS - ID7.2b - vf- mApp Store & Marketplace(M30)				
D69/D7.6	vfOS - ID7.2c - vf- mApp Store & Marketplace(M36)				

*vf-OS* will take advantage of the great success of mobile apps business model that are currently being provided, such as Google Play or the Apple App Store, which have created new opportunities and business models, by enabling developers to create and distribute applications. *vf-OS* will thus engage this approach, and transfer it to the manufacturing sector based on the application framework and the information infrastructure created. Marketplace functionalities include different licensing models, user comments and ratings. Hence, this marketplace additionally allows the provision of detailed technical information about applications under WP7 and by third parties to drive sales. The marketplace will additionally go “beyond the Apple App Store”; it will also offer manufacturing users to request Applications, (which developers can then build either for those users or make generally available), and also to make available connections to manufacturing systems (primarily for developers). The deliverable represents the functionalities of the *vf-mApp Store*.

**Role:** ASC has experience in the development and deployment of marketplace solutions and will design and develop the Store and Marketplace.

Task 7.3	vf-Service Provision Framework	ALM		M16-36	
D70/D7.7	vfOS - ID7.3a - vf-Service Provision Framework(M24)	OTHER	PU	24, 30, 36	R4 & R5 & R6
D71/D7.8	vfOS - ID7.3b - vf-Service Provision Framework(M30)				
D72/D7.9	vfOS - ID7.3c - vf-Service Provision Framework(M36)				

The developed applications may rely on on-cloud services or even run in the cloud, which can be especially pertinent for SMEs. Additionally, some applications or the underlying manufacturing services may only be available externally and not be embeddable. This task will provide a basic framework to facilitate these aspects both for *vf-OS* partners in/beyond the project and for third parties who wish to provide additional services, such as hosting or computation resources. Thus, the *vf-OS* Service Provision Framework (D7.3) is used to frame previously defined and registered services/applications/connectors and facilitate their use in applications. The environment will take into account fault tolerance and adherence to defined QoS requirements.

**Role:** ALM will lead the development and deployment of cloud services,

Task 7.4	Developer Engagement & Training	CMS		M25-36	
D73/D7.10	vfOS - ID7.4 - Developer Engagement & Training(M36)	OTHER	PU	36	Ongoing

WP6 and WP7 provide an environment for developers in terms of the entry platform, marketplace, service framework as well as the OAK studio and front end environment. Whilst this provides a ‘typical’ facility and environment for developers, it will be helpful to reach critical mass by further encouraging and educating them. This not only applies for internal developers (connected with the pilots) but also external developers who can later become the customers of *vf-OS* and who can help prove the system. This task will provide an engagement and training program orientated around the engagement hub (interaction) for all developers. Aspects such as



hackathons, workshops, or similar dissemination activities will be evaluated and supported. A report will be produced at the end of the project that details provided training material, participants involved, details of workshops/hackathons, feedback from application developers, and any other relevant matters. This will both quantify the work and provide material for further development and training.

**Role:** CMS will lead this task with the direct support of UNINOVA; both with good experience in the development of engagement and training programmes. The other technology and academic partners contribute to this task with the contents material for training.

Task 7.5	Integration and Bug Fixing	ASC		M4-36	
D74/D7.11	vfOS - ID7.5 - Software Integration Report(M36)	OTHER	PU	36	Ongoing

This task will specifically allocate time to resolve integration issues regarding the results of the RTD and use cases of WP8, to mitigate the risk of tricky time-consuming issues in distributed projects. Next, integration and functionality tests (and bug fixing) will be conducted and results will be given as feedback to the individual development tasks of *vf-OS*. Third, this task will allocate buffer time to enhance the WP3-7 deliverables should the use cases need enhanced functionality for some components. Finally, after development has been finished, the task will generate a Software Integration Report (D7.5), a handbook for interested parties with information on how to deploy the *vf-OS* architecture, and will also give generic recommendations to other who may perform other similar projects

**Role:** ASC leads the integration and bug fixing of the *vf-OS* platform, with the collaboration of all the other technologic and academic partners.



### 3.1.3.8 WP8 vf-OS Smart Application Piloting and Validation

#### Objectives

WP Title	WP8: vf Smart Application Piloting and Validation														
Start/End	Start: 3 / End: 36														
Participant									LEAD		VICE				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total
Person Days	4	5	5	8	4	4	4	4	18	14	17	18	14	14	132
%	3%	3%	3%	6%	3%	3%	3%	3%	14%	11%	13%	14%	11%	11%	100%

**O8 To act as the experimental base of the vf-OS Platform, linking scenario definition, test and validation activities to research, innovation and development tasks**

**O8.1** To define, consolidate and share pilot management procedures, supporting the applications development and pilot running at users' sites and to assess and refine the vf-OS Platform

**O8.2** To build and run vf-OS Smart Applications at users' pilot sites in differing domains and create a viable demonstration of real use case scenarios. The domains being:

Pilot 1: Manufacturing & Logistic – Automation

Pilot 2: Construction – Industrialisation

Pilot 3: Manufacturing Assembly: Collaboration

This work package defines and validates the set of tools developed by vf-OS consortium against specified and real-world scenarios and requirements as well as their exploitation potential. Thus, WP8 acts as the experimental base of the vf-OS Platform. It operates in strong connection with WPs 1-7 by collecting, connecting, processing, and organising their outputs. In the first phase, the validation scenarios will be defined for all the pilot cases with feedback into WP1 to influence the business and requirements aspects. In the second phase, Smart Applications will be developed to solve specific pilot needs based upon the progress of RTD technologies being delivered – particularly from WP3-6. In a third phase, pilots will start by validating developed Smart Applications in relevant scenarios. In the final phase, with the readiness of the vf-OS platform via WP7, the platform's use to develop applications will be demonstrated. At the end of WP8 the results of the pilots will be collected, assessed, and formalised in order to report the demonstrated effects of vf-OS Platform and tools in operational scenarios. The pilots will continuously feedback the knowledge gained into the RTD WPs, and will do this through the adoption of an incremental development model for the vf-OS Smart Applications developed for supporting the concrete needs of pilots. In this way, the consortium will be able to immediately address design/implementation needs coming from the users sites.

#### Description of Work and Role of Participant

The purpose of the Validation Scenarios Task (T8.1) is multifold: To define scenarios from the start to influence WP1, in particular the requirements, and also to provide the basis for all pilots (T8.2, T8.3, and T8.4). It will also define the metrics for the project and the end point expected in user (pilot) terms. Next, it will act as a common reporting (and adjustment) facility across the project's duration to fine tune the RTD tasks and development. Finally, it will act as the reporting mechanism for all 3 validation scenarios. The validation scenarios run in parallel after the definition and the delivery of the first batch of RTD software, and continue for the duration of the project.

Task 8.1	Validation Scenarios	UPV		M3-36	
D75/D8.1	vfOS - ID8.1a - Validation Scenarios(M6)	R	PU	6, 12, 24, 36	R1
D76/D8.2	vfOS - ID8.1b - Validation Scenarios(M12)				
D77/D8.3	vfOS - ID8.1c - Validation Scenarios(M24)				
D78/D8.4	vfOS - ID8.1d - Validation Scenarios(M36)				

This task will define a set of general specifications for each pilot in the project that will be used as validation scenarios of the vf-OS Platform and its Smart Applications for supporting collaboration in manufacturing and logistics processes. Specific problems, requirements, and processes associated with each pilot will be addressed

obtaining a set of general specifications to build the Smart Applications needed by each one. These general specifications will serve as input to elaborate detailed specifications of each pilot to be implemented in WP7. Moreover, the implementation of the innovative set of Smart Applications will be evaluated and validated applying the methodology of this task. Measurements (performance indicators) will involve both implementation of software applications using the Open Applications Development Kit (OAK) implemented in WP6 and the use of such applications by the end users. According to the pilot requirements and specifications, a general structure of the pilot implementation will be established, including specific workflows, reporting, and evaluation procedures. Moreover different sets of Key Performance Indicators (both pilot specific and at project level) will be defined in order to measure and monitor the performance and the usefulness of the **vf-OS** Smart Applications, and to select the most appropriate way to support the test and validation phases. The deliverables consist of a report detailing the initial scenarios and implementation plan (D81a); then a yearly document/report (D81bcd) detailing and further elaborating a plan as well as the results from the previous year. This will include a checklist of general specifications of each pilot to test the feasibility and functionality of **vf-OS** Platform and the Smart Applications developed for each pilot. The D81b report will also include the formal validation of the pilots against initial implementation requirements and metrics.

**Role:** UPV leads the definition of the industrial validation scenarios. UPV and MAS contribute to pilot 1; UNINOVA, CON and KBZ contribute to Pilot 2; LYON2, APR, TARDY contribute to pilot 3. The contribution of all other partners will bring their experience in the development tasks.

### Pilot 1-3 Generic aspects

Each Pilot will take a common approach albeit in a different manufacturing subdomain:

- Pilot 1: Manufacturing & Logistic – Automation
- Pilot 2: Construction – Industrialisation
- Pilot 3: Manufacturing Assembly – Collaboration

Each pilot deliverable will combine the scenario and validation reports of all pilots **vf-OS** piloting and will include the scenarios, framework, activities performed, and the results.

- **Pilots Smart Applications development:** This subtask will define the development for **vf-OS** Smart Applications development using the OAK. The selected business cases (T7.1) regarding the pilots need for supporting collaborative manufacturing and logistics processes will originate the development of specific Smart Applications for each pilot. Therefore, this task will be in close contact with WP6 providing feedback from the use of the OAK for software development in real implementations.
- **Pilots Smart Applications implementation:** This task acts to identify a clear and shared development for **vf-OS** Smart Application implementations at industrial sites, in defined and subsequent steps. The work package will make sure that the methodology definition process is fully shared by all partners through a bottom-up approach which will then ease the active participation of partners in the implementation phase. The pilots' activity will be framed according to a specific matrix which will establish the relation between the problems to be solved through **vf-OS**, and the platform functionalities sorted by relevance.
- **Scheduling:** Each pilot will adopt a similar schedule as defined in the generic objective phases. However, since each pilot will be in different sectors, and have a different requirements basis, this will be adjusted throughout the project. Critically, the use of an agile methodology (opposed to a waterfall approach) will ensure implementations are to expectations

Task 8.2	Pilot 1: Manufacturing & Logistic - Automation - "Spare-parts advanced management in automation production equipment"	MASS		M16-36	
D79/D8.5	vfOS - ID8.2a - Pilot 1: Manufacturing & Logistic - Automation(M24)	DEM	CO	24, 30, 36	R4 & R5 & R6
D80/D8.6	vfOS - ID8.2b - Pilot 1: Manufacturing & Logistic - Automation(M30)				
D81/D8.7	vfOS - ID8.2c - Pilot 1: Manufacturing & Logistic - Automation(M36)				

In this task the Use Case described in section 1.3.4.1 will be implemented.

**Role:** **MASS** leads the definition of the Pilot1, with the contribution of UPV.

Task 8.3	Pilot 2: Construction – Industrialisation: "Virtual Construction Factory"	CON		M16-36	
D82/D8.8	vfOS - ID8.3a - Pilot 2: Construction – Industrialisation(M24)	DEM	CO	24, 30, 36	R4 & R5 & R6
D83/D8.9	vfOS - ID8.3b - Pilot 2: Construction – Industrialisation(M30)				
D84/D8.10	vfOS - ID8.3c - Pilot 2: Construction – Industrialisation(M36)				

In this task the Use Case described in section 1.3.4.2 will be implemented.

**Role:** CON leads the definition of the Pilot 2, with the contribution of UNINOVA and KBZ.

Task 8.4	Pilot 3: Manufacturing Assembly: Collaboration - "Towards new business collaboration channels in Virtual Factory"	TARDY		M16-36	
D85/D8.11	vfOS - ID8.4a - Pilot 3: Manufacturing Assembly: Collaboration(M24)	DEM	CO	24, 30, 36	R4 & R5 & R6
D86/D8.12	vfOS - ID8.4b - Pilot 3: Manufacturing Assembly: Collaboration(M30)				
D87/D8.13	vfOS - ID8.4c - Pilot 3: Manufacturing Assembly: Collaboration(M36)				

In this task the Use Case described in section 1.3.4.3 will be implemented.

**Role:** TAR leads the definition of the Pilot 3. With the contribution of LYON2 and APR.

### 3.1.3.9 WP9 Business Model and Exploitation

Objectives																
WP Title	WP9: Business Model and Exploitation															
Start/End	Start: 1 / End: 36															
Participant	LEAD											VICE				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	3	13	1	4	1	1	1	1	1	1	3	8	1	1	41	5%
%	6%	32%	3%	9%	3%	3%	3%	3%	3%	3%	6%	20%	3%	3%	100%	

#### 09 To ensure that the project results will be effectively exploited in the market

**09.1** To explore the different business case opportunities and market value mapping, including to identify technical and non-technical risks, barriers, and enablers for bringing **vf-OS** to market

**09.2** To identify realistic potential business models and basic business plans for exploiting opportunities

**09.3** To establish background and IPR baselines, the consortium's collaborative exploitation strategies, and foreground IPRs agreements in order to foster partners' exploitation initiatives

**09.4** To bring the project's exploitable results progressively closer to the impact objectives through market comparisons and produce a set of collaborative and individual exploitation plans as a living document

This WP will justify the project objectives and funding received – both via the EU and partner resources. It will act as a bridge between the RTD activities and the projects expected impact objectives. The primary long term goal of WP9 is to develop steps to deploy and exploit **vf-OS** outcomes as intensively as possible in each partner's interest. Thus this task will start by assessing such opportunities, selecting and refining them, and then producing solid exploitation plans. These plans will be the foundation for real-world exploitation of project outcomes. A parallel exploitation goal is to deal with the intellectual property rights' (IPRs) background and foreground issues during the project, in order to establish a fair and successful collaborative exploitation. WP9 exploitation activities will be supported by **vf-OS** Impact Support Group.

Note that all deliverables connected with this WP are confidential since they represent the exploitation potential of the project.

#### Description of work and role of participant

This WP represents a cascading series of tasks connected with exploitation. First, the full range of Business Opportunities are explored (T9.1) using the original DOA commitments, the user/developer aspirations from WP1, and further ideas generated through this task. From this the most promising business models are selected and further refined (T9.2). The Exploitation Strategy (T9.3) will set up a series of guidelines concerning specific exploitation plans and IPR management. Then the Collaborative and Partner Value Propositions and Exploitation plans Task (T9.4) will further explore this in terms of the strategic value propositions' hypotheses, strategic businesses' growth hypotheses along with the collaborative (and individual) exploitation plans which will be developed as a living document.

Task 9.1	Business Cases Opportunities and Value Mapping	IKERLAN		M1-6	
D88/D9.1	vfOS - ID9.1 - Business Case Opportunities and Value Mapping(M6)	R	CO	6	R1

A complete range of potential business cases will be explored, both from the users' and providers' points of view, (i.e. needs and solutions). This will use the outputs of Task 1.2 and Task 1.3 respectively and will build a mapping between the needs and solutions in order to identify potential success areas and gaps to be filled, composing the different business cases which will be the base of the business models for **vf-OS** exploitation.

In order to ensure that **vf-OS** RTD activities take the required market orientation, a road-mapping approach will be taken: An information baseline (regarding both the state-of-the-art main technologies addressed by **vf-OS** and the competitive and societal challenges context) will be identified. Then, specific value opportunities will be identified within the potential value streams prioritised in the project to target the impact objectives. Next the potential technical and market risks, barriers and enablers regarding each opportunity will be elicited. These activities are planned to be performed through template based information sharing and workshops. The physical meetings are an important vehicle for intensive interactions and discussions for the inclusion of a broad

spectrum of expertise and reaching a consensus within the project consortium on the identified value opportunities and to achieve the impact objectives. These will be the primary input for T9.2. The deliverable will be a report specifying the process followed, the value opportunities, and their associated market technical benefits-risks.

**Role:** IKERLAN (leader) will identify the business cases opportunities and develop the **vf-OS** value mapping, with the support of KBZ. All other partners will contribute to this task with their insights in the scope of their activities in the Project developments.

Task 9.2	Exploitation Business Models	KBZ		M4-9	
D89/D9.2	vfOS - ID9.2 - Exploitation Business Models(M9)	R	CO	9	R1

This task involves the realistic definition of business concepts, business models, and business plans to be established for **vf-OS** exploitation. These will be based on the more expansive, but less detailed, full range from T9.1, and will in essence take the recommended options and further define and analyse. Regarding the business concepts, the focus is to outline a set of business concepts for the prioritised value opportunities selected. This activity is planned to be performed through template based information sharing (e.g. value proposition canvas and strategy canvas, see section 2.2.2) and full-day workshops for sketching the offers and solutions (service-product-application), the target demographic, and a unique selling proposition with a clear competitive advantage. There will be regular draft iterations of this report (D9.2), collecting the business concepts, models and baseline plans, outlined and prioritised to orientate exploitation approaches from the value opportunities.

**Role:** KBZ will lead this task as a partner with reputation in the development of business models. IKERLAN will contribute bringing its experience in exploitation in industrial setting. Users will contribute with their insights on the exploitation on their domains.

Task 9.3	Exploitation Strategy	IKERLAN		M4-9	
D90/D9.3	vfOS - ID9.3 - Exploitation Strategy(M9)	R	CO	9	R1

The collaborative exploitation strategy (D9.3) will prepare the guidelines for the exploitation of **vf-OS** project results, comprising the following dimensions:

- Exploitable results: Dimensions and rules for exploitable outcomes identification and characterisation
- Potential addressees: Who and What – i.e. identification of potentially interested groups of users identified with which aspects and outcomes of the project
- Suppliers: Definition of rules and dimensions for characterising partners or external entities potentially in charge of exploitation initiatives and respective training needs
- Means and tools for enabling exploitation actions: Supporting exploitation initiatives, definition of documents, files and other materials needed to performing exploitation actions
- Policies and Rules to be followed for IPR and in order to safeguard IPRs and avoiding conflicts

**Role:** IKERLAN will lead the development of the exploitation strategy with the contribution of all other partners.

Task 9.4	Collaborative and Partner Value Propositions and Exploitation plans	IKERLAN		M1-36	
D91/D9.4	vfOS - ID9.4a - Collaborative and Partner Value Propositions and Exploitation plans(M9)	R	CO	9, 18, 36	R1 & R3 & R6
D92/D9.5	vfOS - ID9.4b - Collaborative and Partner Value Propositions and Exploitation plans(M18)				
D93/D9.6	vfOS - ID9.4c - Collaborative and Partner Value Propositions and Exploitation plans(M36)				

These iterative plans will be the foundation for real-world exploitation of project outcomes and take the T9.2 (Exploitation Models) and T9.3 (Exploitation Strategy) as a basis for its content. In essence it is composed of two highly dependent elements – the value propositions and exploitation plans both of which should be ‘tested’ with users and others in the potential market.

Vs-OS will be thus following the lean start-up methodology, a key goal is to elicit the strategic value propositions’ hypotheses, (i.e. what will people find valuable and payable) and strategic businesses’ growth hypotheses (i.e. how will the sales volume/customer grow) embedded in the business models and business plans previously outlined, which are directly related to the impact objectives.

In terms of exploitation, this includes a detailed planning of the exploitation efforts and a collection and presentation of the exploitation results. The partners will closely collaborate to create exploitation strategies as well as a set of exploitation and marketing tactics.

The deliverable will be in 3 phases following the period reviews and essentially the first deliverables will focus more on the proposition and the last on the strategy.

- Phase I (D94a) of the task will be based on assessing market potential of the project result/products and on theoretical outcomes, The first edition will also focus on the precise IPR Plans and will provide the basic information for joint and individual results ownership according to a structured methodology used in previous projects. It will also contain early high-level exploitation plans.
- Phase II (D94b) will be able to reference more mature version of the vf-OS ideas and components and also design the initial minimum viable product and product-market contrast piloting. The second report will also address the exploitation in more depth and invariably adjust the IPR due to the findings and real developments.
- Phase III (D94c) will execute the product-market contrast through piloting the minimum viable product in order to test the marketability of the vf-OS solution and find the best pivoting options to increase the exploitation success. This phase will also be used to prepare the continuation of exploitation after the project end. The final report will focus on post-project exploitation, i.e. the Business Plan. It will cover collaborative, joint, and individual plans. The plans will progressively ensure that it is completely clear from an IPR point of view which participant is linked to each exploitable result. The reports will be confidential due to their nature.

This approach has proven to shorten product development cycles by adopting a combination of business-hypothesis-driven experimentation with potential customers (early customers) and iterative product releases through validated learning in order to reduce the product-market risks and failure. This activity is also planned to be performed through template based information sharing and workshops. A delivered report (D9.4abc) is produced incrementally along the project timeline.

**Role:** IKERLAN will lead the strategic value proposition, business plan, IPR, and Exploitation activities for *vf-OS*. IKERLAN will contribute bringing its experience in product-market in industrial setting and since IKERLAN has performed structured IPR and exploitation activities for its members and similar projects. Users will contribute with their insights on the exploitation on their domains. However all partners will be involved.



### 3.1.3.10 WP10 Impact

Objectives																
WP Title	WP10: Impact															
Start/End	Start: 1 / End: 36															
Participant	VICE											LEAD				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	7	6	9	7	2	2	2	2	2	2	6	12	2	2	61	7%
%	12%	9%	15%	12%	3%	3%	3%	3%	3%	3%	10%	19%	3%	3%	100%	

**O10 To impact the external community in terms of dissemination and outreach of the project activity and results in order to encourage the spread of the **vf-OS** results**

**O10.1** To define a common consortium strategy for the dissemination and outreach of the project results

**O10.2** To provide internal and external communication materials including a platform (website)

**O10.3** To implement impact activities to:

- Disseminate project results throughout Europe and beyond
- Make knowledge available in a suitable format to enterprises and SMEs in order to increase the adoption of the research results

**O10.4** To run (and lead) scientific and business orientated workshops in conjunctions with other projects/activities

**O10.5** To cooperate with others; notably:

- Present the project outcomes in relevant scientific and industrial conferences
- Cooperate with EC clusters, eg, FoF PPP or EFFRA
- Transfer concepts to the industrial, research and standardisation communities
- Cooperate with (FoF) projects related to similar topics and relevant Cooperation and Support Actions

The impact activities will establish awareness and commitment from the numerous different project partners as well as enterprise and SME Communities gravitating around the **vf-OS** project. This workpackage is based on the principle that access to information advances discovery, accelerates innovation, and improves education. For this reason **vf-OS** dissemination will be focused on Open Access. This means making publicly-funded scientific information available online, to European researchers, innovative industries and SMEs, software developers, ICT and service providers all while ensuring long-term preservation. Moreover, WP10 will be in-line with WP "Exploitation", in order to analyse that the open access publications do not interfere in exploitation and protection issues of the **vf-OS** results. **vf-OS** will cooperate with others relevant parties including FoF initiatives/projects, EFFRA, Standards bodies, and conferences as necessary. WP10 will be supported by the **vf-OS** Impact Support Group.

#### Description of work and role of participant

The first task, Impact Strategy/Plan (T10.1) will define the strategy/plan for the entire impact WP according to a templated action plan approach and considering the resources available and individual dependencies. The Dissemination Materials Task (T10.2) includes aspects such as internal portal and external website, press releases, brochures, etc., and in particular the website (in a basic form) will be up-and-running on day 1 of the project (through partners own resources) and will be developed more completely (largely) within the first 2 months. The Impact Activities Task (T10.3) covers all practical impact activities, i.e. exploitation material from T10.2, updating website content, writing papers, etc. A special case is the Scientific and Industrial workshops (T10.4) planed in Year 2/3, since these require significant dedicated effort. Another special case is engagement activities with standards, clusters and other projects (T10.5).

Task 10.1	Impact Strategy and Plan	KBZ		M1-3	
D94/D10.1	vfOS - ID10.1 - Impact Strategy and Plan(M3)	R	PU	3	R1

The **vf-OS** dissemination strategy will be elaborated based on the information available at events, interaction occasions, conferences, and the observation of upcoming dissemination opportunities that allow **vf-OS** partners to achieve the maximum interaction with the different stakeholders and target groups. Moreover, potential journals and other dissemination means will be identified to support **vf-OS** partners with the dissemination



activities of the project. The Impact Strategy and Plan Task will take into account the open access aspect of H2020, identify, analyse and study the different dissemination alternatives (“green” and “gold”) based on Sherpa/Romeo (Publisher copyright policies & self-archiving). Moreover the dissemination plans and strategy will also highlight the steps to use the Open Access Infrastructure for Research in Europe (OpenAIRE). This task will be aligned with the exploitation of WP9, in order to reach a consensus about whether to publish directly or to first seek protection of the *vf-OS* results. The *vf-OS* dissemination strategy and plan will define the basis and guidelines for creating a context where *vf-OS* research dissemination can be maximised for the benefit of European industry and for society in general. A report will be delivered detailing the outline of planned strategic dissemination as well as the identification and organisation of the activities to be performed in order to promote the project’s results and the widest dissemination of knowledge from the project in an open access manner. The dissemination strategy and plan, in collaboration with WP9 “Exploitation”, will define: i) What *vf-OS* plans to disseminate: The message (this aspect will be studied carefully in order to not interfere with exploitation activities); ii) To whom: The audience; iii) Why: The purpose; iv) How: The method; v) When: the timing.

**Role:** KBZ (leader) will coordinate the impact and strategy plan for *vf-OS* bringing its experience on business models design. CON will contribute bringing its experience dissemination on market. All partners will contribute with their insights on the impact strategy.

Task 10.2	Dissemination Materials, Internet, and Intranet	UPV		M1-36	
D95/D10.2	vfOS - ID10.2a - Dissemination Report(M3)	DEC	PU	3, 9, 18, 36	R1 & Ongoing
D96/D10.3	vfOS - ID10.2b - Dissemination Report(M9)				
D97/D10.4	vfOS - ID10.2c - Dissemination Report(M18)				
D98/D10.5	vfOS - ID10.2d - Dissemination Report(M36)				

In this task, the dissemination materials will be designed/produced – for external and internal use. Most importantly, the *vf-OS* website and portal will be implemented and maintained, based on the analysis of the project’s needs. The project (responsive) website will contain up to date information on the progress of the *vf-OS* project. Furthermore, it will be used to publish public deliverables and provide information on *vf-OS* events, publications and exploitable results. The project’s portal will consist of a private area to encourage the sharing of documents, knowledge, and the collaboration among the members of the *vf-OS* project. It will also contain a web-based document repository, in which work in progress publications and deliverables will be shared. Furthermore, it will provide access to an underlying code version control repository used in the *vf-OS* development. The *vf-OS* Portal will also offer direct access to different social networks (e.g. Facebook, LinkedIn, etc.) and YouTube videos related to *vf-OS* Project. The website (in basic form) will be up and running on day 1 of the project (through partner’s own resources) and be developed more completely, mostly within the first 2 months. The website will also consider the demands of the WP11 management work package, project management needs (e.g. a web-based document repository in the restricted area, list server) and also the RTD management needs for bug tracking. Finally the STOA wiki will be supported. Reports will be produced, showing the setup of the *vf-OS* Web Page and the different areas created to give visibility to the project and encourage the collaboration among the *vf-OS* members. It will also include the contents of other dissemination material.

**Role:** UPV (leader) will manage the design and production of dissemination materials and the *vf-OS* website. All partners will provide pertinent information during the project execution for supporting and advertising it.

Task 10.3	Impact activities	KBZ		M1-36	
D99/D10.7	vfOS - ID10.3a - Impact Activity Reports(M9)	R	PU	9, 18, 36	Ongoing
D100/D10.8	vfOS - ID10.3b - Impact Activity Reports(M18)				
D101/D10.9	vfOS - ID10.3c - Impact Activity Reports(M36)				

This task gives visibility to the achievements and results from the *vf-OS* Project, utilising material from T10.2. This task will be based on the following activities (more information is provided in section 2.2.1):

- eNewsletter and mailing distribution list: A eNewsletter will be sent out every year to interested subscribed stakeholders on a mailing list related to *vf-OS*
- *vf-OS* Brochures: Brochures will be published to show the objectives, advances, benefits and the exploitable results generated of the research, adapted to different and various target groups. Banners for use by partners will also be created
- Publication of technical papers and specialised articles: Throughout the project, scientific and technical results will be presented at industrial and scientific conferences, in industrial specialised press and in academic and international scientific journals following the principle of open access
- Press releases: Press release related to *vf-OS* will be created and provided to partners to be potentially published in order to provide visibility to the *vf-OS* results and its benefits.
- Industrial Cluster: Workshops will be held as specified in T10.4

A periodic report will contain the main dissemination activities performed and the definition of a number of KPIs for measuring the impact and efficiency of the proposed *vf-OS* dissemination strategy and plan. These will be based on the already defined Quantification of *vf-OS* Dissemination Activities in of section 2.2.1.5. Moreover it will contain the information related to the yearly *vf-OS* eNewsletters, brochures, and other material as well as the highly specialised information about the significant progresses and results of the project addressed to a highly targeted audience. Finally, it will include reporting related to T10.5 Standards, Clustering and Inter-project Cooperation

Task 10.4	Scientific and Industrial Workshops	UNINOVA		M18-35	
D102/D10.10	vfOS - ID10.4a - Workshops Reports(M26)	R	PU	26, 35	R4 & R6
D103/D10.11	vfOS - ID10.4b - Workshops Reports(M35)				

The *vf-OS* project will organise and participate in workshops at industrial conferences or during some of their internal meetings. *vf-OS* will both identify the most relevant conferences in the area (T10.1: Dissemination strategy and plan) and propose ‘minor’ workshops to be held during these events. Importantly, *vf-OS* commits to organise and lead two major workshops and will coordinate with other related projects to achieve this. One workshop in the middle of the project will identify current achievements and be orientated towards scientific/research/technology outcomes. The second workshop will be held to the end of the project to present the final achievements of *vf-OS* (and other projects), laying the foundations for post-project exploitation and to create further synergies for future collaborations. Workshop reports will be produced detailing the workshop plan, results and constituency feedback.

**Role:** UNINOVA will lead this activity with specific dedicated budget. All partners will be involved in the workshops, RTD partners will mainly contribute to the scientific workshops and industrial partners to the ones addressed to industrial community.

Task 10.5	Standards, Clustering and Inter-Project Cooperation	UNINOVA	M1-36
Deliverable: N/A	Covered in Impact Reports of T10.3	See 10.3	

Further important interaction efforts will be performed in this task. In particular, EC events/project will be considered as important events to disseminate/discuss *vf-OS* advances. *vf-OS* will engage, if applicable, with the European standardisation process, specifically CEN, along with other standardisation bodies. Standardisation activities will use the “Standardization guidelines for IST research projects interfacing with ICT standards organizations” by the Cooperation Platform for Research and Standards (COPRAS). The task output will be included in the D10.3 Impact Reports.

Also, this task will perform collaboration activities with EU events and clusters (eg, FoF cluster or EFFRA). The partners commit to provide contributions to the following activities of a cluster to be selected in accordance with the European Commission:

- Exploitation of synergies/technical concertation: Participation in workshops, contribution to working group activities, input to scientific and strategic activities, or active contribution to task forces
- Joint activities for exchange, dissemination (incl. production of dissemination materials), and training
- Coordination of standardisation efforts
- Contribution to repositories of reference implementations and dissemination portals (to be determined according to the project results and exploitation strategy)

Specifically *vf-OS* agree to the cluster collaboration activity as defined below and noting that regardless of who has man-months for the tasks, all Partners will be expected to facilitate this and contribute in a “fair-share” way based on partners man-months and budgets:

- Address the liaison and co-operation activities with other projects that will contribute to the platform building in Digital automation. The cooperation aims at exploiting synergies between the projects and increasing the impact of the initiative. The task entails contributions to the following activities:
  - Help to organise and participate to joint events (2 per year) for dissemination and eco-system building starting with a kick-off meeting organised by the CSA ConnectedFactories
  - Exploit synergies between projects (e.g. standardisation, SoA Wiki, agreement on API and SDKs, legacy system integration, sharing of industrial requirements, interoperability approaches, definition of concepts used within the project, possible business models, how to open up the platform)
  - Work with the CSA to develop scenarios for use of the platforms
- The above only covers the specific activities for collaboration with other projects. Other tasks/workpackages cover the individual project activities in some of these areas (e.g. dissemination, standardisation).

- Under the leadership of CSA ConnectedFactories, a common deliverable will be prepared, to which all RIAs will contribute, the first version at M3, updated twice a year after every common event. Each project will report on their contribution to the collaboration activities, either in the management progress report or the dissemination report – in vf-OS case this will be via D10.3

**Role:** UNINOVA will be responsible for the clustering, ICE will handle the inter-project cooperation, and UPV will be responsible of standardisation activities. All partners will contribute to this task.

### 3.1.3.11 WP11 Project and RTD Management

Objectives																
WP Title	WP11: Project and RTD Management															
Start/End	Start: 1 / End: 36															
Participant	LEAD			VICE												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY	Total	Total % by Days
Person Days	34	1	1	10	1	1	5	1	1	1	1	1	1	1	60	7%
%	57%	2%	2%	16%	2%	2%	8%	2%	2%	2%	2%	2%	2%	2%	100%	

**O11 To Guarantee the success of the project objectives, both management and RTD, by ensuring successful completion of the project, using the resources allocated, and on time**

**O11.1** To set up the management infrastructure (committees, boards, quality plan, procedures, risk registers, project management tools, direction of internal website, etc.) and publish a project handbook

**O11.2** To provide strategic and operational project management of the consortium

**O11.3** To liaise with the EU as necessary and provide contractual reporting

**O11.4** To coordinate consortium level RTD activities of the project - technical and scientific

**O11.5** To establish the technical RTD set-up and Software Quality toolset

It needs to be ensured that the project is managed efficiently, meets its objectives, and the terms of the Grant Agreement. Furthermore, it is necessary that the Consortium Agreement between the partners is fulfilled, and that high-quality standards are guaranteed at all levels. This requires a strong Project Management, Quality Assurance, and Reporting. Within *vf-OS*, a well-defined and practiced management structure is used, which allows the management team and the project team to operate efficiently. Further details are specified in Section 3.2. In addition, a similar approach needs to be invoked at the RTD level for both technical and scientific actions. This task provides also the RTD management, set-up and quality toolset. All deliverable outcomes of this WP are considered confidential since they represent the 'internals' of the project.

Note the overall WP represents 7%, which can appear high for a Project Management WP but it includes a) 12MM (20%) representing the technical coordination/set up tasks (T11.4/5) which under FP7 could not be included in the PM WP and b) an allocation of reporting for the partners of 1MM each considering all reports. Thus in reality PM is around 4.5% which is considered average for this type of project.

#### Description of work and role of participant

This WP is composed of the general project management tasks as more fully defined in section 3.2. The Coordinator/Project Manager in conjunction with all beneficiaries will initialise in the Project Set-up (T11.1) and the 'infrastructure' of the project in terms of the plan, procedures, conflict routes etc. The Management Coordination (T11.2) will address the strategic and operational aspects of running the project utilising the results of T11.1 as indeed must all partners. The EU Task (T11.3) will handle the day to day interactions with the EU as well as all reporting aspects again based on T11.1. The Technical/Scientific Management (T11.4) will largely coordinate WP3-6 to ensure research/technical coherency and progress. At a practical level the technical set-up/software quality approach (T11.5) will provide a coherent development environment in terms of infrastructure and plan.

Task 11.1	Project Set Up, Metrics, and Quality Plan	ICE		M1-2		
D104/D11.1	vfOS - ID11.1 - Project Handbook & Quality Plan(M2)	R	CO	2		R1

This task is devoted to setting the *vf-OS* project in motion. ICE will carry out the following activities: (i) Setting up the Project Management Office; (ii) Organising the kick-off meeting, (iii) Definition of the rules of procedure/schedules of meetings for the Board of Partners (BOP); (iv) Definition of administrative and reporting procedures; (v) Definition of procedures for the auditing of financial statements from partners if necessary; (vi) Design and implementation of standard formats and forms for project documentation; (vii) Agreement of details

and additional metrics viii) Risk Management including contingency planning; (ix) Conflict resolution procedures (See Table 10). The T10.2 web infrastructure will be used where applicable, including a web-based document repository and a list server. These aspects and the Quality Plan will be detailed in the “Project Handbook” taking into account the E-OCVM approach. The Project Handbook will be binding on all partners (once formally approved by BOP) and will supplement, but cannot contradict, the CA/GA.

The Quality Plan part of the handbook will define the tools, procedures and criteria for the evaluation process (goals, deadlines, production of results, compliance procedures, the use of human and financial resources, etc.) and for the evaluation of project results (recruitment, learning effectiveness, user satisfaction rate, software performance/usability and quality of the deliverables).

**Role:** The plan, procedures, and metrics role will be led by ICE to ensure proper conduction of project. To ensure a counterpart, an experienced academic partner will act as a devils-advocate “foil” to the coordinator and also ensure the operational quality checking of deliverables and monitoring against the processes set.

Task 11.2	Strategic and Operational Coordination	ICE	M1-36
Deliverable: N/A	Covered in Management Reports of T11.3	Via 11.3	

Strategic coordination and decision-making within the *vf-OS* project will be the task of the Board of Partners (BOP). The responsibilities of the BOP are described in Table 11. The BOP will not be involved in the day-to-day management of the project, except where major strategic decisions are required.

Operational coordination will be by the Project Manager and Technical Manager via T11.4 with both working in close cooperation via the Project Management board which also contains the projects administrative secretariat. The Science Manager will also be involved in the Research directions. More expansive details in in section 3.2.

This task will also assure that any changes to the Consortium/Grant Agreement are managed on time and it also administers the project resources and monitors project spending according to the planned budget and project schedule. Due to the operational nature of these tasks which is also connected with progress reporting there is no specific deliverable for this task.

**Role:** ICE will largely be involved here with UPV supporting.

Task 11.3	EU Liaison and Reporting	ICE		M1-36	
D105 to D116 D11.2 to D11.13	vfOS - ID11.3.1a - Quarterly Reports(M3) to vfOS - ID11.3.1l - Quarterly Reports(M36)	R	CO	Quarterly	Ongoing
D117/D11.14 D118/D11.15 D119/D11.16	vfOS - ID11.3.2a - Period Reports(M9) vfOS - ID11.3.2b - Period Reports(M18) vfOS - ID11.3.2c - Period Reports(M36)	R	CO	9, 18, 24	A1 & A2 & A3
D120/D11.17	vfOS - ID11.3.3 - Final Reports(M36)	R	CO	36	A3

This task will take care of all interactions between the project and the European Commission (EC) including periodic reporting and reviewing activities. This includes daily liaisons to the EC, review attendance, periodic reporting, and the preparation of any other material administratively needed by the EC. This task will be led by coordinator who has extensive experience of large scale EU and commercial projects. All partners will also have minor days for the reporting processes. The certification of financial statements (if necessary) from individual partners will be the responsibility of the partners who will follow the procedures defined in task T11.1. All reports will require approval by the Coordinating Partner. Quarterly reports on the progress and evolution of the project, work package statuses, main risks, extant issues, accomplished milestones and other relevant information will be delivered, along with period reports on the progress and evolution of the project similar to the quarterly reports, and a final report on the evolution of the project and the obtained results. Monthly tracking of time and activities will take place and all partners will need to input to this on strict deadlines.

**Role:** The coordinator and project manager will naturally manage this task with others supporting as necessary. All partners will receive a time allocation to facilitate report preparation.

Task 11.4	RTD Management	UPV	M1-36
Deliverable: N/A	Covered in Management Reports of T11.3	See 11.3	

This task handles the two primary management aspects of *vf-OS* at the RTD level: scientific (research) and technical (specification, development, etc.).

- Science management will ensure both the efficacy of the research in and out of *vf-OS* and to enable influencing, knowledge exchange, and RTD dissemination to society. RTD management will thus ensure the uptake and application of scientific evidence, paper production, conference presentations etc, and relate to

the Scientific/Research workshop. This will be coordinated by the Science Manager.

- On the technical side there is primarily a software development process that must be managed and is concerned primarily with the production aspect of software development, as opposed to the technical aspect, such as software tools which is encompassed in Task 11.5. These processes exist primarily for supporting the management of software development, and are generally skewed toward addressing business concerns. This will be coordinated by the Technical Manager.

Due to the operational nature of these tasks which is also connected with progress reporting there is no specific deliverable for this task. .

**Role:** UPV will be the technical manager defining the procedures to perform the research and development and monitoring the tasks execution from scientific and technical points of view. UNINOVA will be the science manager also will not have resources directly allocated in this task.

Task 11.5	Technical Set Up and Quality Toolset	ASC		M4-36	
D121/D11.18	vfOS - ID11.5 - Technical Set Up and Quality Toolset (M12 & Ongoing)	OTHER	CO	12 & Ongoing	R2

This task will provide the technical infrastructure across all WPs including development server, dynamic build system, quality tools, bug/issue reporting, webdav repository, and mailing list. Quality assurance involves the entire **vf-OS** development process, making sure that any agreed-upon standards and procedures are followed, and ensuring that problems are found and dealt with. It is oriented towards prevention. A software quality evaluation toolset (e.g. Sonar and Moose) will be deployed working in compliance to the operating version control system so as to extract software metrics and detect duplicated code, coding standards, unit tests, code coverage, complex code and potential bugs. Following, these software development principles and technological choices, the RTD performers will deliver robust and technically validated software to be used for application development in other workpackages. Software testing and evaluation will be based on a method such as STEP (Systematic Test and Evaluation Process), a well-established industry methodology for test and evaluation activities in software projects. It should be mentioned that within this task testing will be performed to verify the proper functioning and performance of the integrated **vf-OS** Kernel. If required, specific improvements will be made. This will provide a Cross Project Development environment and guidance including the technical infrastructure across all WPs including development server, dynamic build system, quality tools and bug/issue reporting and the software quality evaluation toolset, (e.g. Sonar and Moose).

**Role:** ASC have been involved in quality assurance activities for industry, and will lead this task with contributions from UPV and ICE. All other partners will provide insights regarding their developments in the project.

### 3.1.3.12 List of work packages

WP	Work package title	#	Lead	Vice	Person-months	%	Start month	End month
WP1	Vision, Scenario & Requirements	4	UPV	ICE	67	7%	1	30
WP2	Virtual Factory Operating System Architecture	7	ASC	UPV	73	8%	3	12
WP3	Virtual Factory System Kernel	3	UNINOVA	LYON2	86	10%	5	24
WP4	Virtual Factory I/O	4	UPV	LYON2	76	8%	7	33
WP5	Virtual Factory Data and Connect	1	ICE	IKERLAN	90	10%	13	30
WP6	Open Applications Development Kit (OAK)	5	CMS	ASC	105	12%	13	36
WP7	Platform and Integration	7	ALM	ASC	111	12%	4	36
WP8	vf Smart Application Piloting and Validation	11	MASS	CON	131	15%	3	36
WP9	Business Model and Exploitation	2	IKERLAN	KBZ	41	5%	1	36
WP10	Impact	12	KBZ	ICE	60,5	7%	1	36
WP11	Project and RTD Management	1	ICE	UPV	60,5	7%	1	36
Total					901	100%		

### 3.1.3.13 List of major deliverables

#	Deliverable name	WP	Lead	Type	Level	Date
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<b>D1.1</b>	Vision Consensus	WP1	ICE	R	PU	3
<b>D1.2</b>	Users Scenarios Characterisation	WP1	MASS	R	PU	3
<b>D1.3</b>	Providers Scenarios Characterisation	WP1	ALM	R	PU	3
<b>D1.4abc</b>	Existing SOTA Analysis	WP1	UPV	OTHER	PU	6, 18, 30
<b>D1.5</b>	Requirements Specification	WP1	CMS	R	PU	6
<b>D2.1</b>	Global Architecture Definition	WP2	ICE	R	PU	7
<b>D2.2</b>	Functional Specification and Mockups	WP2	UPV	R	PU	9
<b>D2.3</b>	Technical Specification	WP2	ASC	OTHER or R	CO	12
<b>D2.4</b>	Holistic Security and Privacy Concept	WP2	IKERLAN	R	CO	10
<b>D3.1</b>	<i>vf-OS</i> Kernel and FI-WARE Framework	WP3	UNINOVA	OTHER	PU	10
<b>D3.2abc</b>	FI-WARE Generic Enablers	WP3	UNINOVA	OTHER	PU	12, 18, 24
<b>D3.3abc</b>	FI-WARE Manufacturing Enablers	WP3	LYON2	OTHER	PU	12, 18, 24
<b>D3.4abc</b>	<i>vf-OS</i> Enablers	WP3	KBZ	OTHER	PU	12, 18, 24
<b>D3.5abc</b>	<i>vf-OS</i> Process Enabler	WP3	ICE	OTHER	PU	12, 18, 24
<b>D4.1.1</b>	Devices Drivers/API Toolkit - Specifications	WP4	UPV	R	PU	12
<b>D4.1.2ab</b>	Devices Drivers/API Toolkit - Software	WP4	UPV	OTHER	PU	18, 24
<b>D4.2abc</b>	Devices Drivers	WP4	UPV	OTHER	PU	24, 30, 33
<b>D4.3abc</b>	API Connectors	WP4	LYON2	OTHER	PU	24, 30, 33
<b>D4.4ab</b>	Security & Data Access	WP4	IKERLAN	OTHER	PU	18, 24
<b>D5.1abc</b>	Data Infrastructure	WP5	UNINOVA	OTHER	PU	18, 24, 30
<b>D5.2abc</b>	Data Storage	WP5	IKERLAN	OTHER	PU	18, 24, 30
<b>D5.3abc</b>	Data Harmonisation	WP5	ICE	OTHER	PU	18, 24, 30
<b>D5.4abc</b>	Data Analytic	WP5	ICE	OTHER	PU	18, 24, 30
<b>D6.1.1abc</b>	OAK SDK Software	WP6	CMS	OTHER	PU	24, 30, 36
<b>D6.1.2abc</b>	OAK SDK Documentation	WP6	CMS	R	PU	24, 30, 36
<b>D6.2abc</b>	OAK System Dashboard	WP6	ALM	OTHER	PU	24, 30, 36
<b>D6.3abc</b>	OAK Front End Environment	WP6	ASC	OTHER	PU	24, 30, 36
<b>D6.4ab</b>	OAK Studio	WP6	CMS	OTHER	PU	30,36
<b>D6.5ab</b>	OAK Developer Engagement Hub	WP6	CMS	OTHER	PU	30,36
<b>D7.1abc</b>	<i>vf-OS</i> Platform Environment	WP7	ALM	OTHER	PU	24, 30, 36
<b>D7.2abc</b>	<i>vf-OS</i> mApp Store and Marketplace	WP7	ASC	OTHER	PU	24, 30, 36
<b>D7.3abc</b>	<i>vf-Service</i> Provision Framework	WP7	ALM	OTHER	PU	24, 30, 36
<b>D7.4</b>	Developer Engagement and Training	WP7	CMS	OTHER	PU	36
<b>D7.5</b>	Software Integration Report	WP7	ASC	OTHER	PU	36
<b>D8.1abcd</b>	Validation Scenarios	WP8	UPV	R	PU	6, 12, 24, 36
<b>D8.2abc</b>	Pilot 1: Manufacturing & Logistic – Automation	WP8	MASS	DEM	CO	24. 30, 36
<b>D8.3abc</b>	Pilot 2: Construction – Industrialisation	WP8	CON	DEM	CO	24. 30, 36
<b>D8.4abc</b>	Pilot 3: Manufacturing Assembly: Collaboration	WP8	TARDY	DEM	CO	24. 30, 36
<b>D9.1</b>	Business Cases Opportunities and Value Mapping	WP9	IKERLAN	R	CO	6
<b>D9.2</b>	Exploitation Business Models	WP9	KBZ	R	CO	9
<b>D9.3</b>	Product-Market Contrast	WP9	IKERLAN	R	CO	9
<b>D9.4</b>	Exploitation Strategy	WP9	IKERLAN	R	CO	9



<b>D9.5abc</b>	Collaborative and Individual Exploitation Plans	WP9	IKERLAN	R	CO	9, 18, 36
<b>D10.1</b>	Impact Strategy and Plan	WP10	KBZ	R	PU	3
<b>D10.2abcd</b>	Dissemination Materials, Internet, and Intranet	WP10	UPV	DEC	PU	3, 9, 18, 36
<b>D10.3abc</b>	Impact Activity Reports	WP10	KBZ	R	PU	9, 18, 36
<b>D10.4ab</b>	Workshops Reports	WP10	UNINOVA	R	PU	26, 35
<b>D11.1</b>	Project Handbook including Quality Plan	WP11	ICE	R	CO	2
<b>D11.3.1a-l</b>	Quarterly Reports	WP11	ICE	R	CO	Quarterly
<b>D11.3.2abc</b>	Period Reports	WP11	ICE	R	CO	Periodically
<b>D11.3.3</b>	Final Report	WP11	UPV	R	CO	36
<b>D11.5</b>	Technical Set Up and Quality Toolset	WP11	ASC	OTHER	CO	12 & Ongoing

### 3.1.4 Graphical presentation of the components showing how they inter-relate

Figure 9 shows the interdependencies among the different *vf-OS* WPs:

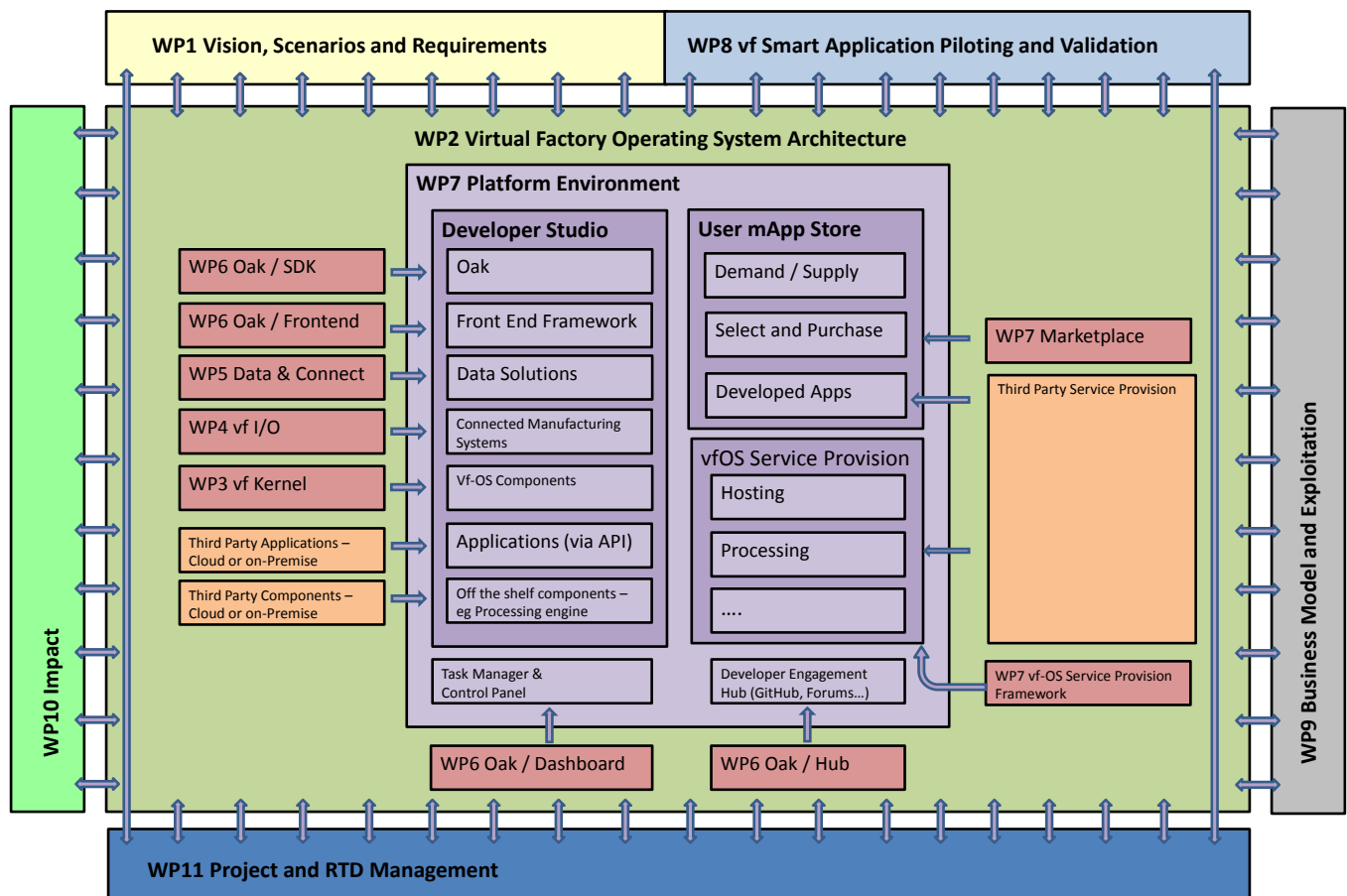


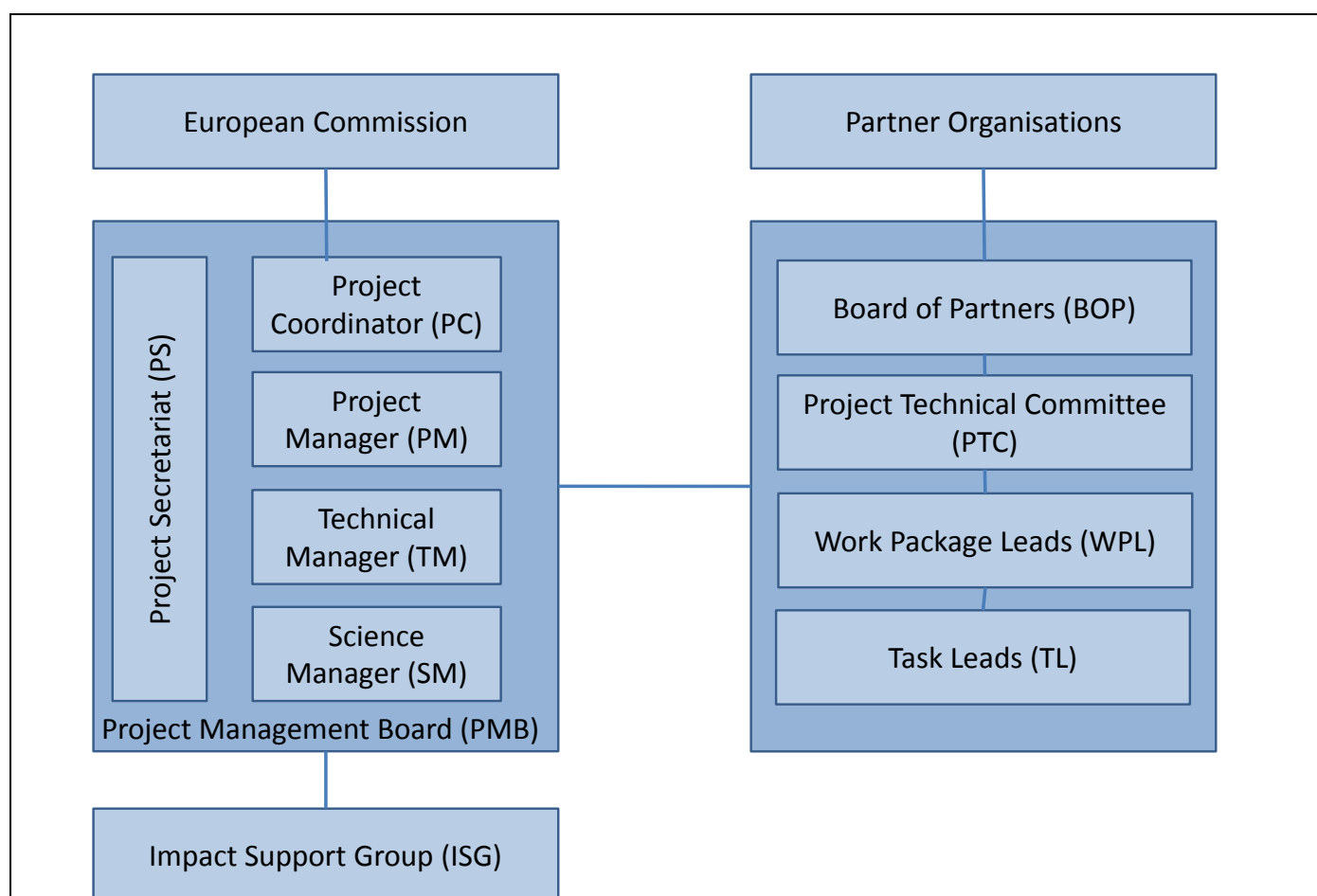
Figure 9: General *vf-OS* components inter-relationship

## 3.2 Management structure and procedures

The success of *vf-OS* project relies on the ability of the Consortium to implement an efficient management structure and adequate procedures capable of addressing the challenges normally encountered in such collaborative initiatives. Every project needs its own management structure depending on the consortium, the objectives, and the Technology Readiness Level (TRL) expected when the project is finished.

### 3.2.1 Organisational structure and the decision-making

The proposed management structure has been designed as a comprehensive framework for making coordinated and structural decisions. It will foster co-operation between all partners involved in the project. Figure 10 outlines in an informative way the project management structure which will be further specified in the consortium agreement and project handbook.



**Figure 10:** *vf-OS* Management Structure.

**Table 10:** Roles, responsibilities and partner of the Project Management Board (PMB)

Role	Responsibilities	#
<b>Project Coordinator [PC]</b>	The PC is a managerial role responsible for the project's overall coordination, acting as focal point for all administrative content while ensuring that all guidelines established by the different decision bodies are observed. They will work closely with the Project Manager which may be the same or another beneficiary. The PC, or PM, will also chair the Board of Partners (BOP) and will lead the Project Management Board (PMB).	ICE
<b>Project Manager [PM]</b>	They have the role to manage all day-to-day administrative aspects of the project, providing advice regarding financial and procedural issues and keeping track of all important administrative procedures. The PM will also undertake assistance duties such as facilitating meetings, providing logistics, compiling reports, disseminating documentation, etc. They may be assisted by a Project Secretariat.	ICE
<b>Technical Manager [TM]</b>	The TM is a managerial role that has the overall RTD responsibility in the project. They will provide support to the PC regarding technical management and will be responsible for the long-term technical strategy and the technical quality of results. They will supervise, together with the PC, the integration and harmonisation of the technical deliverable documents before submission to the Commission. The TM will co-chair the Project Technical Committee (PTC).	UPV
<b>Science Manager [SM]</b>	The SM has the role to providing strategic scientific advice and inputs to the project and to European Commission in the research domains of <i>vf-OS</i> . The SM will work closely with the TM and the PC to assure a long-term scientific strategy and best scientific results and outreach in the scientific community of the project results, establishing and promoting standards of practice and quality across the whole project research developments. The SM will co-chair the Project Technical Committee (PTC).	UNINOVA
<b>Project Secretariat</b>	The PS, headed by the Project Manager, has the role to manage all day-to-day administrative aspects of the project, providing advice regarding financial and	ICE

<b>[PS]</b>	procedural issues and keeping track of all important administrative procedures. The PS will also undertake assistance duties such as facilitating meetings, providing logistics, compiling reports, disseminating documentation, etc.	
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**Table 11:** Description of the *vf-OS* Management bodies

Name	Role	Main Responsibilities
<b>Project Management Board [PMB]</b>	<p>The PMB is a permanent body with the overall responsibility of keeping the project permanently focused guaranteeing high-standard results in every task. It is formally composed of the PC, PM (Chair), TM, SM supported by the PS. It will enact day-day management addressing several issues regarding (1) Quality and Risk opportunities management and (2) Financial and Administrative management and provide advice on them where an aspect is under the control of the BOP.</p> <p>At the start of the project, the PC will define and issue, in accordance with the European Operational Concept Validation Methodology (E-OCVM v3 framework) the Quality Plan, in the format of a handbook, containing the formats, tools, administrative issues and all quality assurance procedures that all team members will have to apply to facilitate communication, execution, control and risk management tasks.</p>	<ul style="list-style-type: none"> <li>• Uphold the EC Grant Agreement contract and Consortium Agreement</li> <li>• Coordinate and supervise the activities</li> <li>• Organise meetings of the BOP and the PTC (logistics, agenda, presentations, minutes)</li> <li>• Ensure overall project coordination with the aim to meet the project schedule and objectives</li> </ul>
<b>Board of Partners [BOP]</b>	<p>The Board of Partners, previously referred to with the synonym Strategic Management Committee, will provide strategic management as the higher decision-making and arbitration authority in the project. Each of the partners in the Consortium will appoint one representative that will act as focal point within the Consortium taking part in the BOP (and in other management bodies, depending on the responsibilities entrusted to them). The BOP will be chaired by the Coordinator/Project Manager</p>	<ul style="list-style-type: none"> <li>• Making policy, strategic or economic decisions</li> <li>• Ensuring co-operation and co-ordination among the Consortium members</li> <li>• Supervising technical and cost reports transmitted to the EC</li> </ul>
<b>Project Technical Committee [PTC]</b>	<p>The PTC will be in charge of supervising the RTD parts of the work plan implementation and is responsible for scientific and technical parts of the project. It will be co-chaired by the TM/SM and composed of the WP Leaders and PC, PM, TM and SM.</p>	<ul style="list-style-type: none"> <li>• Ensure that the scientific/technical content of project deliverables and publications produced by the Project meet the necessary requirements</li> <li>• Ensure scientific/technical coordination with the aim that the project maintains relevance against the program objectives and progress made by international research</li> </ul>
<b>Work package Leaders [WPL]</b>  <b>Task leaders [TL]</b>	<p>The PC, PM and PMB will be assisted by WP Leaders who will be responsible for the day-to-day management of the work undertaken within their work package, coordinating the contributions from all subordinate work packages or tasks and ensuring that they comply with the work package description. They will</p>	<ul style="list-style-type: none"> <li>• Planning the execution of their work packages.</li> <li>• Arranging meetings and technical exchanges between work package participants</li> <li>• Monitoring progress of each WP under their control</li> <li>• Identifying current/ future divergence from the plan</li> <li>• Identifying &amp; maintaining a register of all</li> </ul>

	periodically report to the PC/PM/PMB.  Task leaders will server a similar role but at Task level and will report to relevant WPLs	significant risks <ul style="list-style-type: none"> <li>• Ensuring coherence between WPs and/or tasks</li> <li>• Ensuring that all project deliverables are produced on time and with a high technical standard</li> <li>• Providing progress reports for their work package</li> </ul>
<b>Impact Support Group [ISG]</b>	This contributes to the control and monitoring of impacts achieved by project activities. It will be chaired by the WP10 Leader and supported by WP9 Leader and other members of the consortium with deep expertise in dissemination and exploitation issues and a strong role in WP9 and 10. Thus KPZ/UPV/IKERLAN/ICE will at least be involved	<ul style="list-style-type: none"> <li>• Send reports to the BOP regarding the impact of the project re the stimulation of the creation, delivery and use of the virtual factory open operating system.</li> <li>• Propose and take care of the dissemination activities of the project.</li> </ul>

**Table 12:** Management Structure Members.

### 3.2.2 Management Procedures

- **General project management:** The overall Management Methodology is based on best practices and international standards such as PRINCE2, PMBOK, ITIL and COBIT and will be documented in the project handbook. However, any Project Management methodology adopted needs to be adapted and tailored to **vf-OS's** needs, that is, adapting the method to external and the project's factors, applying a level of project management that will never compromise the efficiency and efficacy of the management. Additionally, the tailoring of **vf-OS's** methodology does provide an adequate level of control to guarantee the achievement of successful project results. For the Consortium, structured Project Management following defined steps means managing the project must be in a logical and organised way and will be further specified in the project handbook. Additionally the Consortium's assignments are led by qualified personnel from ICE who have been trained to and have experience with Project Management best practices. **vf-OS'** Project Management Approach focuses on developing in-depth feasibility projects and analysis upfront in order to create an appropriate project strategy, governance and delivery structure. Following this approach, detailed work breakdown structures, resource plans and delivery timeline schedules will be covered with the proposed methodology. This approach helps to maximise project delivery performance (cost, time, scope and quality), while minimising project risks.
- **Innovation management:** Although the European Operational Concept Validation Methodology (E-OCVM) (E-OCVM, 2010) was created initially as a framework to provide structure and transparency in the validation of air traffic management, its methodology suits perfectly **vf-OS**. Its aim is to achieve consistency in the collaboration of independent R&D organisations, while leaving freedom to define the most practical planning and execution of individual activities. As such, E-OCVM methodology (See figure below) will be used for the successful implementation and embrace of creative ideas and concept validation during the project.
- **Knowledge management:** As part of the work packages management, the project will implement an electronic document repository and exchange system to facilitate the sharing of written information. The knowledge management strategy itself will be based around communication and tacit knowledge sharing rather than relying entirely on the written documents as the knowledge products. The management strategy defined within the project supports the view that people need to get together to share knowledge and build understanding, and that this process needs to be facilitated.
- **Quality management: Quality Assurance (QA)** procedures will be established at the outset and applied to all activities in **compliance with the ISO 9000 standards**. It will be the joint responsibility of all partners until the complete discharge of all obligations of **vf-OS**. The main goals of the QA procedures are: documenting and assessing the project progress, evaluating the contribution of the **on-going results** to the project objectives and discovering deviations at an early stage and initiating remedial actions (if necessary) as soon as possible. At the beginning of the project, the PC will establish the Project Guide & Quality Plan in the form of a Handbook that will describe the project management and quality assurance procedures including deliverable reviewing and will be mandated for all beneficiaries and individuals. Quality assurance procedures will include qualitative and quantitative assessment measures for milestones and deliverables that will be key elements in following the project progress. Internal project reporting will ensure that eventual problems or delays in project progress will be detected rapidly and corrective actions will be taken if necessary.

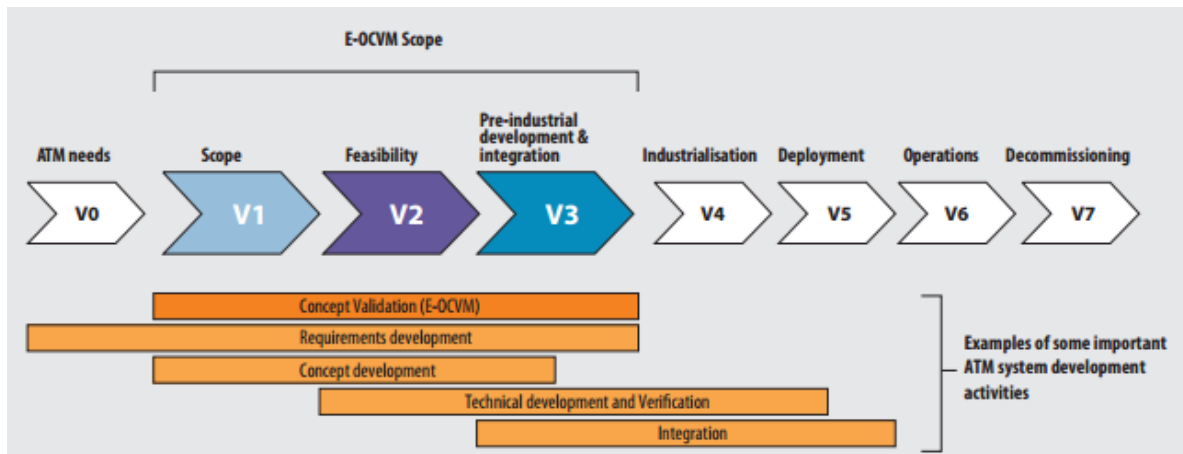


Figure 11: E-OCVM lifecycle steps.

- Risk Management:** Risk management also aims to reduce the risk areas in the project lifecycle. **Proper risk management helps to avoid project crisis and improving problem solving** by managing risks early in the project life cycle. Formal risk management processes together with the Quality Management will be used at the overall project level and within each WP to identify all risks to the successful completion of the work. The criteria for assessment and management will be defined in the Project Handbook & Quality Plan. The main focus will concern identifying risks, analysing risks, deciding the risk response strategy, monitoring risks and action plans, assisting partners in managing the risks, communicating risk progress as well as status information with partners and the Commission, and embedding the risk management into the overall *vf-OS* management process.

Each risk will be analysed in terms of **likelihood of occurrence** and **potential impact** on project progress. Risk avoidance measures or mitigation plans will be proposed by the appropriate WP leader and agreed by the PC or PMB as appropriate. Each risk will be assessed and if necessary mitigation actions will be taken. Significant risks are maintained at the project level by the PM and within each WP by the WP leader. It is the WP leaders' responsibility to maintain, open and close the risks of their WP and to escalate accordingly. All meetings at all levels will include a review of risks in their agenda. Changed status of the risks will be reported in the minutes of the meeting.

- Meetings:** The following table presents the different kind of meetings during the project:

Meeting	Rough Occurrence
Board of Partners - BOP	Once per year
Project Technical Committee - PTC	Every 4 months
Work Package meetings – WP Leaders	Every 4 months
Impact Support Group - ISG	Once per year

The various meetings will be synchronised as far as possible to minimise travelling costs. BOP and ISG will most probably meet in the same periods of time than the EC Review in order to maximise the alignment of dates. The PTC and the WPs teams will be permanently active and will meet when necessary by electronic conference. Matching with WPs Meetings, the PTC will meet approximately seven times during the project. Note that the costs for travel are specifically calculated from these at around 450€ per day which matches rates found in practice. They adjust for the number of participants expected from each partner; e.g. the coordinator will typically need to travel more than other partners. This does not imply that 450€ is a limit or minimum but simply this was the calculation basis.

- Reporting:** Progress of the activities will be monitored by the PC on a frequent basis. Each partner is responsible for producing periodic cost statements and management control reports that contain the current status of the active work packages they are performing. Internal tools for performance assessment will be used. These reports can be phased out for each concurrent WP. The objective is to detect and foresee possible slips to schedule or other problems (e.g. weakly-specified requirements) without raising bureaucracy. These control reports can also be used to produce the final deliverables to be submitted to the EC. The EU defined reporting periods are M1-18 and M19-36 and in addition quarterly and possibly half yearly reporting (additional aspects) may be required. In addition the internal project management reporting will be monthly for man-power usage and the activity undertaken
- Conflict resolution:** Day to day conflicts will be dealt with frank and open discussion, with the goal of attempting to reach a consensus decision. If necessary, the WP leader of the relevant work package will make a decision. However, if all else fails, it has been agreed by all participants that initially all issues will be



escalated to the BOP for resolution. Decisions of the BOP will be taken as much as possible in consensus. Voting rules and quorum will be as follow:

- The Committee shall not decide validly unless 2/3 of its members are present or represented (quorum) except if a quorum is not reached and then additional rules shall apply as defined in the CA
- In case voting is required, each member (or its designated representative) shall have a maximum of one vote irrespective if they may have multiple roles
- Members where there is an issue of Default/Termination/Resignation being discussed may not vote on that item.
- Defaulting members may not vote
- Decisions shall be taken by a majority of 2/3 (two-thirds) of the votes cast and not counting abstention or spoilt votes

Decisions by the BOP will always try to pursue consensus among partners as much as possible. These points will be duly included in the Consortium Agreement (CA) of the project that will specify all the internal rules to apply for conflict resolution. This will ensure that everything is equally understood by all parties and will avoid overlooked areas.

- **IPR and legal issues:** *vf-OS's* consortium will manage Intellectual Property Rights (IPR) in a way that will encourage openness among partners and allow the securing access to their background so maximising the potential for future exploitation of the projects results (see section 2.2.2.5). The CA will also include clauses regulating the rules of confidentiality among members of the consortium and also external parties which may be granted access to *vf-OS* IPR. The main points related to the ownership of knowledge, understanding knowledge as background provided and foreground generated, are:
  - **Background**, previous knowledge and rights, remain the property of the Party that brings it into the Project:
    - Any Background shall remain the sole property of its owner, whether it was acquired and/or generated prior to the project start date or independently apart from the Project
    - The owner of the Background shall ensure access to it, even in the case of expulsion of the Consortium, if applicable, or situation where employees or external collaborations have rights to the knowledge
  - **Foreground (also known as Results in H2020)**, as knowledge and rights generated in the development of the Project, shall be the property of the Party carrying out the work leading to that *foreground*:
    - A Party's undertaking generates information to be used in the project - this information belongs to that Party. Where several Parties have jointly carried out work generating foreground and where their respective contribution to the work cannot be ascertained, they shall have joint ownership
    - A Party's activity generates an invention, which may be patentable - that Party has the right where Foreground is capable of industrial or commercial application related to the Project, to apply for a patent for the invention, and will own the patent

Transferring of background and foreground will be subject to requirements established on the GA and the CA.

- **Deliverable Precision:** To ensure that deliverable are focused and to the point, and so ensuring the focus on *vf-OS* is on practical and useable research and innovation, as a guide *vf-OS* paper deliverables should be around 50 pages in length at a maximum although in justified circumstance they can be longer and already it is noted that from past consortium experience the Functional/Technical specification will most likely be around 100 and 200 pages each (although see notes of using on-line system for technical specification). This system minimises the verbosity, repetition, and redundancy and increase the focus on the practical aspects of the project and the overall impact rather than filling filing cabinets.
- **Software Deliverables** (i.e. regarding the Software deliverables which relate to Nature 'OTHER in WP4-7): For the different tasks relating to these deliverables, a single public report document per WP will be delivered on a 6-month basis during the duration of the WP. These reports will describe the cross-WP status and will also allow the sharing of information that could be used for the dissemination of the project results without at the same time revealing vital strategic information. Each active task will provide updates to this public report as a living document with each task lead being responsible for providing such input to the work package leader who will consolidate it. The last version will include the different improvements, solved bugs and feedback from the users on the different modules of each WP. In addition the report will include installation details of the software outputs (where relevant) and the location of the relevant sources/executables. Beyond this report no additional paper reporting will be expected for such deliverables and the software itself will be the deliverable and simply be pointed to from the single relevant document for the Workpackage

### 3.2.3 Decision-making mechanisms

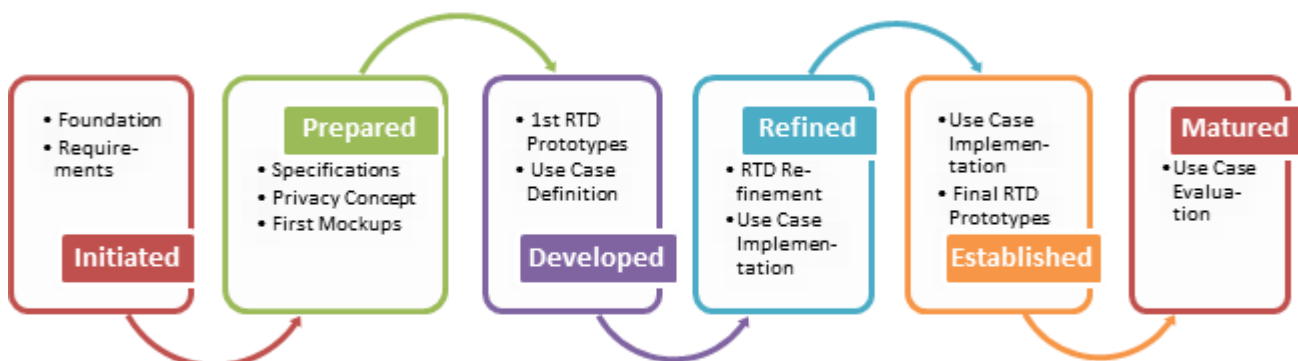
While the management structure has been described in-depth in section 3.3.1, the mechanisms for decision making, regarding the decision type and management body, are informatively explained in the table below. These will be précised on the Consortium Agreement and Project conflict:

**Table 13:** *vf-OS* Decision-making mechanisms

Description	Body	Procedure
Managing significant risks and issues that may affect the consecution of the objectives of a workpackage	WPL	• Day-to-day management
	PMB	• When requested by the WPL • Periodically, by meeting of WPLs and PMB members to oversee evolution and development of project
Managing significant risks and issues that may affect the consecution of the objectives of the whole project	WPL	• Day-to-day
	PMB	• When requested by the WPL • Periodically, by meeting of WPLs and PMB members to oversee evolution and development of project
	BOP	• On demand (by PMB, when exceeds PMB's attributions)
Fund distribution	PC	• In series with the EU distribution over the duration of the project
Financial Administration	PC & PM	• Day-to-day administration of funds
	BOP	• Supervision and approval of cost reports
Financial and contractual issues resolution	PC & PM	• By request of one or more members of the Consortium
Arbitration authority	PMB & BOP	• By request of one or more members of the Consortium
Operative project management and consecution of objectives	WPL	• Day-to-day management and supervision of the WPs
	PM	• When required by the WPL • Periodically, by meeting of WPLs and PMB • Members to oversee evolution and development of project
Ensuring compliance with project plan and quality of deliverables	WPL	• Day-to-day management and supervision of the WPs
	PMB, PM, TM, SM	• When requested by the WPL
	PTC	• Operational decisions related to the scientific-technical part of the project
Impact	WPL	• Initial definition of guidelines
	PMB	• Approval of guidelines of exploitation and dissemination
	ISG	• Participation in initial market analysis • Provide feedback on the project outcomes, exploitation procedures and alignment with market needs

### 3.2.4 Milestones

*vf-OS* is composed of six different milestones which are outlined in the figure below. These milestones are used to provide a timeline of the project and they also define a generic orientation for the state of each component.



**Figure 12:** Project Milestones Overview.

The milestones of the *vf-OS* Project are shown in the following table:



**Table 14:** List of milestones

Mileston one #	Mileston e name	Related Work package(s)	Due date (Months)	Means of verification
<b>Research</b>				
R1	Initiated	WP1 (Vision – Requirements) WP2 (Architecture) WP8 (Pilots – Phase I) WP9 (Business Case) WP10 (website and initial materials) WP11 (PM)	M9	<ul style="list-style-type: none"> <li>Vision and Baseline established</li> <li>Target market described</li> <li>Business Cases understood and Initial Strategies prepared</li> <li>Methodologies and techniques defined/underway</li> <li>Scenarios defined</li> <li>Requirements analysed</li> <li>Functional specifications prepared</li> <li>Impact Strategy, Website and Early Dissemination</li> <li>First Exploitation Plan prepared</li> <li>Management Handbooks/Plans established</li> </ul>
R2	Prepared	WP2 (Architecture) WP3 (Kernel) WP4 (I/O)	M12	<ul style="list-style-type: none"> <li>Global Architecture defined</li> <li>Technical specifications including Mockups prepared</li> <li>Security and Privacy Concept produced</li> <li>Kernel/FI-Ware Framework defined and first Enablers Prototyped</li> <li>I/O Tool Kit specified</li> </ul>
R3	Developed	WP3 (Kernel) WP4 (I/O) WP5 (Data/Connect) WP9 (Business Case)	M18	<ul style="list-style-type: none"> <li>Developed prototypes of initial background work packages</li> <li>First OAK Developments accomplished</li> <li>Use case definitions updated</li> <li>All specifications defined</li> <li>Second Exploitation Plans</li> </ul>
R4	Refined	WP3 (Kernel) WP4 (I/O) WP5 (Data/Connect) WP6 (OAK) WP7 (Platform) WP8 (Pilots)	M24	<ul style="list-style-type: none"> <li>Refined and final prototypes of initial background work packages Kernel and I/O</li> <li>Developed prototypes of Data/Connect work packages</li> <li>First prototypes of OAK and Platform components</li> <li>First phase of use case demonstrators – Smart Apps Development (initial) focus</li> <li>Research Workshop Successful</li> </ul>
R5	Established	WP6 (OAK) WP7 (Platform) WP8 (Pilots) WP9 (Business Case)	M30	<ul style="list-style-type: none"> <li>Established and final prototype for Data/Connect of OAK and Platform components</li> <li>Second phase of use case demonstrators – Apps Validation (interim)</li> </ul>
R6	Matured	WP6 (OAK) WP7 (Platform) WP8 (Pilots) WP9 (Business Case)	M36	<ul style="list-style-type: none"> <li>Use case pilots are full installed and deployed</li> <li>Completion of all outstanding components including platform</li> <li>User Evaluation and Validation finished</li> <li>Industrial Workshop Successful</li> <li>Final Exploitation Plans</li> </ul>
<b>Administrative</b>				
A1	Period 1 Success	WP11	M9	<ul style="list-style-type: none"> <li>First period of the project accomplished and review successful</li> </ul>
A2	Period 2 Success	WP11	M18	<ul style="list-style-type: none"> <li>Second period of the project accomplished and review successful and second funding tranche release</li> </ul>
A3	Period 3 Success	WP11	M36	<ul style="list-style-type: none"> <li>Third period of the project accomplished and review successful and third funding tranche release</li> </ul>

### 3.2.5 Critical risks and mitigating actions

**Table 15:** Critical risks for implementation

Risk	WP	Likely	Impact	Proposed risk-mitigation measures
<b>Failure to</b>	WP11	HIGH	MEDIUM	The project management methodology used for <i>vf-OS</i> includes

<b>meet milestones</b>				high visibility of progress, early identification of problems and risks, and allow for quick response to changes or deviations that may affect the plan of the project. The PMB is a key figure in the process of collaboration with WP leaders in the early detection and resolution of problems
<b>Loss of Beneficiary</b>	WP11	LOW	HIGH	<i>vf-OS</i> consortium will by default see if the activity can be handled internally and if not look for another organisation with similar competences and characteristics
<b>Under/over estimation of effort</b>	ALL	HIGH	LOW	This risk will be handled by monitoring the planned versus the actual effort required by each task. Indicators and statistics will be included in the periodic progress reports. However, even if under-planned parties subscribed to a task must deliver results according to specifications, agreements, and expectations
<b>Resource phase-in difficulties</b>	ALL	HIGH	LOW	A familiarisation plan will be set up to allow easy integration of new people in the project. The amount of time needed to train new resources to work on the project will be defined and considered as part of the staffing plan
<b>Lack of coordination</b>	WP11	LOW	HIGH	This risk will be managed through meetings and fluent communication in order to promote the collaboration and organisation among partners
<b>Integration issues</b>	WP8	MEDIUM	MEDIUM	Integration issues may occur when installing and implementing <i>vf-OS</i> results at users' sites. A specific task in WP7 addresses this
<b>Delay of the evaluation results</b>	ALL	MEDIUM	HIGH	This risk depends on validation activities required to the pilot test environments and it can be mitigated through a tight co-operation with the support of the development teams
<b>Poor outreach of knowledge</b>	WP10	LOW	MEDIUM	This risk is handled by the development of the Impact Plan, which will detail and schedule the dissemination activities that should be performed in order to achieve the expected project results. Dissemination will be continuously monitored by Performance Indicators.
<b>Difficulties in exploitation</b>	WP9	LOW	HIGH	This risk is handled by the development of a detailed Exploitation Plan, which will include a classification of the potential exploitable results, the project partners that will invest time and effort in each result, intentions of each partner with regard to the dissemination and use of all results and conflicts of interest and weaknesses related to exploitation issues

### 3.3 Consortium as a whole

Information to support this is identified in the full partner profiles which are detailed in Section 4.1. Beyond the information provided in such section, *vf-OS*, through the development of *vf-OS* Consortium Knowledge Map (KMap) will show the suitability of the consortium.

Manufacturing is naturally an inter-disciplinary topic and the topics covered in *vf-OS* mean that partners from different fields must cooperate and collaborate. Also, it is important that industry partners do not only play a role as use case topic provider, but that their needs and views are fundamental to the RTD carried out within the project. Thus, the *vf-OS* consortium is equally divided between partners with a background in Manufacturing (IKERLAN, UPV, UNINOVA and LYON2) and ICT (ICE, CMS, ASC and ALM). All ICT partners have extensive experiences in the Factories of the Future field, as will be presented in Section 4.1.

#### 3.3.1 *vf-OS* Knowledge Map

One of the factors that impacts directly in the quality of the consortium is the expertise, core competences and activity interests that shapes the technical knowledge of *vf-OS* research partners and technology providers and how this knowledge fits all the requirements of the project. *vf-OS* has defined the so-called "*Knowledge Map*" (*vf-OS* KMap) of the research partners and technology providers, to perform a diagnostic of the extent of suitability among the consortium.

Roles in each work package have been assigned to partners according to their Key (K) and Strong (S) technical knowledge. The composition of the partnership meets all the criteria of the project. In order to summarise the *vf-OS* knowledge basis, Table 17 shows the main technical knowledge areas covering the WPs' objectives of the *vf-OS* research partners and technology providers.

Besides the research and technological partner's knowledge domains, all the consortium partners have expertise in different management domains, as it is shown in Table 16.

**Table 16: *vf-OS* Partners Management expertise**

	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	MASS	VS	CON	KBZ	APR	TARDY
EU Project Management	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		
Vision and Market	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Security and Privacy Concepts	✓	✓	✓		✓		✓	✓	✓			✓		
Exploitation and Sustainability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Impact, Networking and Visibility	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

**Table 17: *vf-OS* Research and ICT partners' technical knowledge and fulfilment of *vf-OS* project objectives.**

N	Technical Competence	ICE	IKERLAN	UNINOVA	UPV	CMS	LYON2	ASC	ALM	Objectives							
										WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8
1	Advanced human-machine interaction		K		K					X	X		X		X		X
2	Artificial Intelligence methodologies		S	K	S				K			X		X			X
3	Cloud Computing	S	S	S		K		K	S	X	X	X	X	X	X	X	X
4	Cloud Marketplace	K				K		K	S		X				X	X	X
5	Cloud Models	K	S		S	K		K	S		X	X			X	X	
6	Cloud Platforms	S	K			K		S	S		X	X	X	X	X	X	
7	Collaborative Business Processes		S	K	K	S	S			X			X			X	X
8	Collaborative Manufacturing and Logistics	K	S		K		S	S	S	X			X			X	X
9	Collaborative Networks		S	K	K	S	S	S		X			X			X	X
10	Cyber Physical Systems (CPS)	K	K	S	S		K	S		X	X	X	X	X	X	X	X
11	Data Analytics	K	K	K	S		K		S			X		X			X
12	Data Harmonisation	K	K	K				S				X		X			X
13	Data Infrastructure Middleware	K	K	S		K	S	K	S			X	X	X			
14	Data Storage and Scalability	S	K	K			K	K				X	X	X			
15	De-centralized Planning and Control		S	S	K				K	X	X			X			X
16	Digital Platforms	K	S			K		K			X	X	X	X	X	X	
17	Enterprise Interoperability	S		S	K	S	S	S	K		X	X	X	X	X	X	X
18	Factory Optimization				K				K	X						X	X
19	Factory Virtualization	K	S		S		K			X	X	X	X	X	X	X	X
20	Internet of Everything (IoE)		S	K		K		S				X	X	X			X
21	Internet of Things (IoT)		S	S		K			K			X	X	X			X
22	Knowledge Protection	S			S		K	K			X		X	X		X	X
23	Logistics Processes Optimization				K				K	X			X				X
24	Machine-to-Machine (M2M) Communication		K				K					X	X				X
25	Manufacturing Processes Optimization				K		K		K	X						X	X
26	Manufacturing Value Chains		S	K	K					X	X					X	X
27	Modelling and Simulation		S		K	S	K		K	X						X	X
28	Monitoring and Tracking Objects		K		S			S	K				X	X			X
29	Open Innovation	S	K		S			K		X	X				X	X	
30	Open Source		S			K	K				X	X	X		X	X	
31	Operations Management	K			K	S	K		S	X						X	X
32	Real-time Architectures for Interoperability			K		K					X	X	X	X	X	X	
33	Resources Virtualisation	S	K						K			X	X		X		X
34	Security and Privacy					K		K	S		X		X	X	X	X	X
35	Security by Design	S				K		K			X		X		X		X
36	Smart Connected Objects	S	S	K					K		X	X	X		X		X
37	Supply Chain Management	K	S		K		S		K	X						X	X
38	Supply Chain Optimization				K				K	X						X	X

### 3.3.2 Involvement of the industrial partners

The *vf-OS* consortium strengthens the **involvement of industrial partners** not only in implementing and testing *vf-OS* results but also in research and innovation activities. The research work is highly charged to the R&D partners although the industrial user partners play an important role in these activities and without their contributions, the research and innovation activities would not be able to be performed in a satisfactory way. The

*vf-OS* industrial partners are involved in most of the project activities although their main contribution is in the piloting activities (WP8) due to their nature. The efforts' distribution among the partners and their contribution shows great complementarities in the *vf-OS* consortium. The selection of the different industrial partners has been a great challenge since the main objective of the consortium is to ensure a well-balanced distribution. The involvement of the selected industrial partners ensures better skills planning, a more coherent dialogue, and collaboration in the research and innovation and industrial perspectives, taking into account the needs of industrial scenarios and ensuring an adequate exploitation of complementarities and synergies among the consortium.

The key staff of the industrial partners has management skills, what is a relevant asset due to fact that they have the perspective from both strategic and operational point of view. Therefore, they have the skills and the appropriate competences to make research and understand the objectives of the *vf-OS* project.

### 3.3.3 Suitability of the *vf-OS* consortium

The excellence of the project consortium (*vf-OS* research partners and technology providers) has been analysed from two perspectives: (i) from the technical knowledge viewpoint, through the KMap, that shows that the members of the consortium have the required competences to develop the project tasks and (ii) from the management point of view, through the analysis performed in Table 18 showing that the consortium is also strategically capable.

## 3.4 Resources to be committed

Partners already committed resources to the project concept and original proposal beyond those usually required. As demonstrated in the previous section, the consortium partners already attained a high level of experience and skills in the areas necessary for the successful completion of the *vf-OS* project. All the partners will contribute with highly skilled personnel at appropriate moments of the project, being able to mobilise the right people at the right time. While the key personnel, who will be involved in all or most of the *vf-OS* projects existence are explicitly mentioned in Section 4, the consortium partners guarantee that additional people will become available as needed.

The costs presented in the project mainly cover direct necessary personnel costs and other direct costs such as: travel and subsistence for the meetings planned during the project, costs related to the preparation of the Certificates on the Financial Statements (CFS) and costs related to the cloud infrastructure.

- **Direct personnel costs:** The human effort estimates (Table 18) have been calculated involving all the partners of the consortium and taking into account their key and strong competences to be aligned with the WPs tasks. The coordination of efforts has been developed with several iteration loops to ensure that all the members of the *vf-OS* consortium agrees to and is committed to the final figures, and the presented person-months accurately relate to the work to be done and are well balanced. All participants involved in the *vf-OS* project have utilised sources to determine their contribution and verified that the funds will be available to carry out the work, as specified in the budget table in section 3. These summary figures are supported by detailed task-based figures as identified in the annex and which show the resource split between tasks mandated on the partners.
- **Other direct costs:**

**Table 18:** Summary of *vf-OS* staff effort

N	PARTNER	P*M	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	
1	ICE	117	5.5	9	16	0	38	0	4	4	2.5	7	31	<b>117.00</b>
2	IKERLAN	69.5	3.5	8	0	8	22	0	4	4.5	13	5.5	1	<b>69.50</b>
3	UNINOVA	87	6	6	30	0	21	0	4	4.5	1.25	7.75	6.5	<b>87.00</b>
4	UPV	77.5	8	10	0	27	0	0	4	8	3.75	8.75	8	<b>77.50</b>
5	CMS	87.5	5.5	7	0	0	0	62	5	4	1.25	1.75	1	<b>87.50</b>
6	LYON2	63	2	6	16	27	0	0	4	4	1.25	1.75	1	<b>63.00</b>
7	ASC	91.5	3	12.5	0	0	0	32	32	4	1.25	1.75	5	<b>91.50</b>
8	ALM	86.5	4.5	6	0	12	0	12	44	4	1.25	1.75	1	<b>86.50</b>
9	MASS	31	6.5	1.5	0	0	2	0	0	17	1.25	1.75	1	<b>31.00</b>
10	VS	26	4.5	1.5	0	0	2	0	0	14	1.25	1.75	1	<b>26.00</b>
11	CON	41.5	5.5	1.5	0	0	2	0	6	17	2.5	6	1	<b>41.50</b>
12	KBZ	72	4.5	3	24	0	2	0	0	18	8	11.5	1	<b>72.00</b>
13	APR	26	4.5	1.5	0	0	2	0	0	14	1.25	1.75	1	<b>26.00</b>
14	TARDY	26	4.5	1.5	0	0	2	0	0	14	1.25	1.75	1	<b>26.00</b>

*vf-OS* will not have subcontracting costs. The analysis of the core competences of the members of *vf-OS* has revealed the suitability of the composition of the consortium. All the project's requirements and needs will be fulfilled by the *vf-OS* partners due to their expertise and skills.

The total expected budget for all the activities planned within *vf-OS* is **7.758.580 €**. In total, almost 92% corresponds to personnel costs and 6% to other direct costs.

The % of direct costs vs personnel costs based on the estimated DOA costs is specified as:

N	PARTNER	PERSONNEL	OTHER DIRECT COSTS	TOTAL	ODC%
1	ICE	1,170,000.00	71,875.00	1,241,875.00	6.1%
2	IKERLAN	513,605.00	47,500.00	561,105.00	9.2%
3	UNINOVA	810,187.50	73,751.25	883,938.75	9.1%
4	UPV	480,112.50	78,448.75	558,561.25	16.3%
5	CMS	656,250.00	51,250.00	707,500.00	7.8%
6	LYON2	472,500.00	48,750.00	521,250.00	10.3%
7	ASC	791,475.00	50,625.00	842,100.00	6.4%
8	ALM	810,937.50	48,750.00	859,687.50	6.0%
9	MASS	189,750.00	20,375.00	210,125.00	10.7%
10	VS	133,250.00	19,375.00	152,625.00	14.5%
11	CON	271,562.50	19,375.00	290,937.50	7.1%
12	KBZ	477,000.00	23,125.00	500,125.00	4.8%
13	APR	195,000.00	19,375.00	214,375.00	9.9%
14	TARDY	195,000.00	19,375.00	214,375.00	9.9%
		<b>7,166,630.00</b>	<b>591,950.00</b>	<b>7,758,580.00</b>	
		<b>92%</b>	<b>8%</b>	<b>100%</b>	

Thus only UPV is in excess of the 15% limit and its resources and justification are described below. Note that since these are estimated figures and the actuals will be generated within the project it may be that UPV do not exceed this 15% figure in practice or conversely that other partners, especially those near the limit such as VS, will exceed it and this will be duly justified in project reporting periods.

#### Note on travel which applies to all partners.

Travel and subsistence: vf-OS has considered travelling as a relevant resource to improve and increase the communication and transferring of information among the entire consortium related to research, innovation, technological, piloting, dissemination, exploitation and managerial activities. Moreover, other direct costs also cover the preparation of the Certificates on the Financial Statements (CFS).

The project considers travelling as a relevant resource to improve and increase the communication and transferring of information among the entire consortium related to research, innovation, technological, piloting, dissemination, exploitation and managerial activities and as identified in section 3.2.2 and the bullet on meetings. In addition there will be EU related meetings such as clustering and reviews. The consortium will also consider the use of internal “summer schools” or “internal hackathons” during certain phases of the project – these are week or even two week meetings at economic locations in which all partners can get together and perform real communal technical work and have proved effective in other project; examples include when finalising specification, integration work etc

The general budget for travel is based on past and proven project experience which suggests a budget of 450€ per person, per day, for ‘internal’ meetings including all travel, accommodation, and subsistence costs. A travel estimate of around 2000€ has proven adequate for ‘external’ meeting which relate to conference, workshops, promotional events etc and includes the additional element of registration fees.

Further that a travel –estimate– for partners is as follows and any deviancy from this will need to be handled by the consortium procedures and within the total budget ceilings of the project as a whole and individual partners – for example partners cannot just ‘attend any conference’ but this will need to be part of both the impact plan and their financial capacity/budget to attend. Finally more highly engaged partners have been provisioned with greater budget since they will need to commit more resources to the various events.

Concerning the number of attendees mentioned: These are again estimates based on the role and scope of the partner and are neither limitations or minimisations expected and indeed will vary from time to time dependent on which aspect a partner is working on at the time.

Concerning the location of the plenary and other cross partner meetings: This shall be done by consensus and if none shall be made by the PMB. However, the principle of fair-share shall apply such that the costs/benefits of the meeting shall be circulated around each partner in turn although adjusting also for their share of the project

and capacity/want to host such events. It is also noted that the meetings, such as plenary meetings or summer schools, may not be at the location of the partner but held in external venue or even venues not in countries of a partner provided that it is more efficient to do so for financial or productivity reasons.

N	PARTNER	OTHER DIRECT COSTS	TRAVELS INTERNAL			TRAVELS EXTERNAL		
		TRAVELS	Num	Persons	Cost	Num	Persons	Cost
1	ICE	46,500.00	10	3	1,350.00	3	1	2,000.00
2	IKERLAN	33,000.00	10	2	1,350.00	3	1	2,000.00
3	UNINOVA	33,000.00	10	2	1,350.00	3	1	2,000.00
4	UPV	46,500.00	10	3	1,350.00	3	1	2,000.00
5	CMS	33,000.00	10	2	1,350.00	3	1	2,000.00
6	LYON2	33,000.00	10	2	1,350.00	3	1	2,000.00
7	ASC	33,000.00	10	2	1,350.00	3	1	2,000.00
8	ALM	33,000.00	10	2	1,350.00	3	1	2,000.00
9	MASS	13,500.00	10	1	1,350.00	0	0	2,000.00
10	VS	13,500.00	10	1	1,350.00	0	0	2,000.00
11	CONSULGAL	13,500.00	10	1	1,350.00	0	0	2,000.00
12	KBZ	13,500.00	10	1	1,350.00	0	0	2,000.00
13	APR	13,500.00	10	1	1,350.00	0	0	2,000.00
14	TARDY	13,500.00	10	1	1,350.00	0	0	2,000.00
		372,000.00						
		4.79%						

Note on equipment which applies to all partners: Every partner has been provided an equipment allocation related to their size in the consortium and their role. This equipment can vary from partner to partner – for example some academics may spend on need resources for dedicated researches (e.g. PCs), RTD partners might need to purchase sensors, storage tasks parties might need to purchase cloud storage etc

One particular aspect of this is the need for a resilient build and integration server which may include the hosting of prototypes. There is a range of possibilities and it is estimated at approximately 100-150€ per month with thus a maximum cost of €5400 over the project life time. Partners ICE has volunteered to run this server but with man-power resource from the technical set-up task T10.5. Its 3K budget will be dedicated to this but any cost above this will be shared equally among the RTD partners (all except MASS, VS, APR, TARDY, CON) and managed internally.

N	PARTNER	EQUIPMENT
1	ICE	3,000.00
2	IKERLAN	2,000.00
3	UNINOVA	3,001.00
4	UPV	3,000.00
5	CMS	3,000.00
6	LYON2	3,000.00
7	ASC	3,000.00
8	ALM	3,000.00
9	MASS	2,800.00
10	VS	2,000.00
11	CON	2,000.00
12	KBZ	2,000.00
13	APR	2,000.00
14	TARDY	2,000.00

**Table 19:** Description of other Direct Costs > 15% of Personnel Costs



ID 4/UPV	Cost (€)	Justification
<b>Travel</b>	46.500 €	For internal travel UPV has been budgeted to travel 10 times with approximately 3 researchers. Along with the coordinator as Technical Manager UPV is expected to have a greater role at plenaries and particularly at technical meetings. For external travel UPV has been budget for 3 travels along with all partners and which highlights the importance of dissemination actions of the vf-OS results.
<b>Equipment</b>	3.000 €	See generic Equipment justification
<b>Dissemination Material</b>	10.000 €	As aforementioned, UPV is very committed with dissemination actions. Therefore, a cost of 10.000 € has been estimated in order to develop dissemination materials such as project leaflets, banners, posters etc in order to give visibility to the achievements and results generated within the project. Moreover, in this cost category, UPV has also considered the potential cost related to the publication with gold open access (if necessary). Note that this budget is ring-fenced and under project and workpackage management control also since it made on behalf of the consortium.
<b>Audits</b>	3.259 €	Due to the fact that the UPV requested EU contribution is higher than 325.000€, UPV estimated a cost of 3.259€ for the preparation of the Certificates on the Financial Statements.
<b>Total</b>	<b>62.759 €</b>	

## 4. MEMBERS OF THE CONSORTIUM

### 4.1 Participants

#### 4.1.1 Information Catalyst for Enterprise Ltd.

<b>Participant No.</b>	1	<b>Organisation Name</b>	Information Catalyst for Enterprise Limited
<b>Country</b>	 United Kingdom	<b>Short Name</b>	ICE
<b>Type</b>	Technology Provider SME	<b>Logo</b>	

**Information Catalyst (ICE)** is a UK SME. Founded in the late 1990s ICE started as a specialist consultancy assisting partners on commercial, RTD, software development and RDI activity. Its domain is sector generic but is orientated towards the business integration, business partnership, data value, project management and the RDI outsourcing sector. ICE is an SME providing support and services to leading organisations such as TIE, Vintura, Riverland, EAN International, Offis, the European Standards Institute (CEN), Ascora, and the European Commission. Key ICE personnel have been active in multiple large-scale EU projects, including as coordinator, project manager and WP/Tasks leads; these include FOF orientated projects: CREMA, ARUM, Adventure Premanus as well as others such as SAM, ALFRED, STASIS, NESSI 2010, ARUM, NEXOF-RA, SOA4All. In addition ICE personnel have been active in multiple voluntary bodies; for example:

- Big Data Value Association (BDVA) where it provides/ed and sponsoring resources as Secretary General and Secretariat
- Board member of the Networked Software and Service Initiative (NESSI) where it has also been Steering Committee vice-chair and SME lead
- Several standardisation initiatives in ISO and CEN/ISSS, such as ISO10303-236, eBiz-TCF, funStep, etc

[www.informationcatalyst.com](http://www.informationcatalyst.com)

#### Main Competences Related to the vf-OS Project

ICE will provide the vf-OS project with its RTD competences in software systems, services integration, data analytics, data harmonisation and process. In terms of management, ICE is Project Manager and Coordinator. It has acted as coordinator, WP lead, Technical Lead, Task Leads, Dissemination Lead, Project Manager both in commercial and research environments. ICE will bring into vf-OS the results of these projects, its experience and knowledge in interoperability solutions, and approaches and services description. ICE CEO also has provided the Big Data Value Association (BDV PPP Private Counterpart) Secretary General role.

#### Contribution to vf-OS Project

ICE is the Project Coordinator and, as such, leads the Project Management and RTD Management (WP11). In addition, ICE leads the WP5 related with Virtual Factory Data and Connect, providing its experience in data management, harmonisation, analysis and interoperability. ICE vice leads the Vision, Scenarios, and Requirements of the project (WP1) in order to reassert the project vision and also the Impact Workpackage (WP10). In terms of tasks, ICE leads the following ones: Project Vision Consensus Document (T1.1), Global Architecture Definition (T2.1) providing its experience in transforming the requirements collected in WP1 into particular software components specifications, vf-OS Process Enabler (T3.5) supporting the definition and implementation of the kernel processor and the management of system calls and resources, Data Harmonisation (T5.3) and Data Analytics (T5.4) – the two latter being because of its competency in Big Data. Finally, ICE will contribute to most exploitation tasks (WP9) in order to improve its products with new features coming from the execution of vf-OS and to most impact activities (WP10) through its experience in organising events (project workshops and similar dissemination events) such as the semantic web and in exploitation activities.

No.	Collaborators Profile
C 1	<b>Mr Stuart CAMPBELL (Male)</b> is Director of ICE with a Degree in Electronic and Manufacturing Engineering,

	and has served roles such as Chief Technical Officer of TIE responsible for defining strategy, tactical planning, operational delivery and portraying TIE's technical direction and products. Stuart has been involved in the field of e-Business since 1989 and has held positions at ICL (now Fujitsu), the Western European EDIFACT Board based within the European Commission, the European Standards, CMASS and TIE. He is SME Board member of the European NESSI initiative and was inaugural Secretary General of the Big Data Value Association responsible for the Private side of the Big Data Value Public Private Partnership. Stuart has managed several large-scale projects like e.g. EU FP6 (STASIS) and FP7 (SAM) projects, international product development and outsourced projects. ( <a href="mailto:stuart.campbell@informationcatalyst.com">stuart.campbell@informationcatalyst.com</a> ).
C 2	<b>Mr Oscar GARCÍA (Male)</b> is a Senior Researcher, Project Manager and a Computer Science Engineer (MEng) from the Valencian Polytechnic University. He has more than 10 years of experience in participating in EU projects related to IT interoperability and integration touching topics such as system integration, semantic integration, e-Learning, multimedia systems or e-Commerce. In addition, Oscar has a wide experience analysing in-house and cross-supply-chain business processes in different scenarios seeking interoperability solutions being the manufacturing industry the key stakeholder. He has participated to several clusters regarding furniture manufacturing such as funStep and also the Adventure Mini-Cluster initiative. Oscar has been managing the administration of a whole set of FP7 projects dealing from Project Periodic Reports to Financial Administration and including Audit assessment and is versed with Agile methodologies and Tools such as Jira. ( <a href="mailto:oscar.garcia@informationcatalyst.com">oscar.garcia@informationcatalyst.com</a> ).
C 3	<b>Ms Ann CAMPBELL (Female)</b> is an administrator within ICE responsible for financial, control, accounting, record keeping, travel arrangements, expenses, time recording and other procedures. She has worked in ICE for the previous five years handling such matters within the context of EU projects. Before this she has worked for Sainsbury's, Belong and in the voluntary sector. ( <a href="mailto:ann.letts@informationcatalyst.com">ann.letts@informationcatalyst.com</a> )

#### Relevant Publications and/or Products, Services (up to 5)

As a commercial company ICE has limited involvement in academic papers however, papers related to personnel have included:

- Costa, R., Garcia, O., Nuñez, M. J., Maló, P., & Gonçalves, R. (2007). Integrated solution to support enterprise interoperability at the business process level on e-Procurement. In *Enterprise Interoperability II* (pp. 89-100). Springer London
- Abels, S., Chepegin, V., & Campbell, S. (2009, July). Semantic Interoperability for Technology-Enhanced Learning Platforms. In *Advanced Learning Technologies, 2009. ICAALT 2009. Ninth IEEE International Conference on* (pp. 564-568). IEEE
- Abels, S., Campbell, S., & Sheikhhasan, H. (2008). Stasis-creating an eclipse based semantic mapping platform. *eChallenges 2008*
- Henning, P., Swertz, C., Zander, S., García, O., Parodi, E. (2015). Personalized learning pathways obtained from didactical reasoning. *International Journal of Artificial Intelligence in Education* (accepted for publication)

#### Relevant Previous Projects or Activities (up to 5)

- ICE has been responsible for the launch of flagship products such as for clients such as Semantic Integrator, SmartBridge and webCommerce
- ICE personnel are seconded and heavily involved in the NESSI and BDV initiatives culminating with NESSI Partner (and ICE client) TIE being selected as co-chair for the NESSI European Technology Platform and Stuart Campbell selected as the Big Data Value Associations Secretary General
- FP6-IST: STASIS "Software for ambient semantic interoperable services"**  
ICE conceptualised the EU FP6 STASIS project dealing with semantic interoperability and data harmonisation which was exploited into productisation by a client of ICE and with ICE's help
- FP7-ICT: SAM "Dynamic Social and Media Content Syndication for 2nd Screen"**  
ICE and related personnel have coordinated EU Project STASIS and SAM and acted as joint technical lead of Adventure as well as leading many WPs and Tasks with all having achieved good to excellent results. Other involved projects include FP7-ICT: PREMANUS "Product Remanufacturing Service System", FP7-ICT: ARUM "Adaptive Production Management", H2020-FoF: CREMA "Cloud-based Rapid Elastic Manufacturing", CREATE, ALFRED, INTUITEL, ACCEPT, SEAMLESS, SEEMseed SOA4ALL, NESSI2010.
- ICE Delivered dissemination concepts and setups including winning an ICT category first place at ICT2013 and 2nd place overall at ICT2010.

### Significant infrastructure

As a software development company and a services hosting organisation ICE has access to internal tools and methodologies of assistance to vf-OS.

#### 4.1.2 Ikerlan SCL

<b>Participant No.</b>	2	<b>Organisation Name</b>	Ikerlan SCL
<b>Country</b>	 Spain	<b>Short Name</b>	IKERLAN
<b>Type</b>	Research Non-profit	<b>Logo</b>	

**IKERLAN** is a Spanish, private, and non-profit Technology Centre created in 1974, member of IK4 Alliance and a technological R&D actor within the Mondragon Corporation. IKERLAN is a point of reference for innovation, dedicated to advanced technology transfer to industry and comprehensive product development (from concept to implementation) for a wide variety of domains: transport (railway and vertical), automation, industry, medical, home appliances, etc. IKERLAN works closely with companies to improve their competitiveness through the application of technological knowledge to develop innovative products and, on the other hand, new tools and methodologies for implementation in design and production processes. It has a staff of more than 200 qualified researchers and engineers, with experience in interdisciplinary work and capable of tackling complex problems. As a centre of excellence in the transfer of technology, more than 800 R&D projects were completed so far in cooperation with companies developing new products and implementing customised systems in design and manufacturing processes.

[www.ikerlan.es](http://www.ikerlan.es)

### Main Competences Related to the vf-OS Project

IKERLAN will contribute to vf-OS project with experts from 2 research groups:

- The Advanced Manufacturing Technologies Group (AMT), which is formed by 14 people with extensive experience in participation in EU, national and regional research projects, has knowledge in vf-OS related domains such as User Scenarios definition, Requirements specification and Business Models and Exploitation activities. In this sense, AMT provides models, methodologies and tools which will be strengthened through participation in vf-OS.
- The Software Production Technologies Group (SPT), with 12 people forming the research group, is involved in several EU projects such as FP7 MultiPARTES (as coordinator), FP7 MONDO, FP7 DREAMS or FP7 ARROWHEAD. SPT provides an extensive set of competences directly related to the domain of vf-OS such as the use of novel techniques, tools and languages for applying IoT in industrial domains (SCADA systems). Also, SPT has a wide experience in smart data acquisition, stream, integration and monitoring including data analytics and modelling applying advanced techniques for data processing such as CEP. Big Data techniques and Cloud-based solutions for analysis and prediction in industrial domains with particular focus on Maintenance and Advanced Manufacturing operations are also used. This expertise is reinforced through participation in the H2020-FoF-2014-1-637066: CREMA Cloud-based Rapid Elastic Manufacturing and H2020-ECSEL-2014-1-662189: MANTIS Cyber Physical System based Proactive Collaborative Maintenance EU projects.

### Contribution to vf-OS Project

IKERLAN will lead WP9 Business Model and Exploitation and Tasks T9.1, T9.3, T9.4 and T9.5, contributing with its broad knowledge and experience gathered from many research and technology transfer projects to industrial companies in order to establish new business models and strategies opportunities for vf-OS exploitation. Also, it will be actively involved in WP1, contributing to the industrial scenarios characterisation (T1.3) and Requirements Specification (T1.5), as well as identifying and analysing existing technologies and solutions (T1.4). Regarding WP2, IKERLAN will have a relevant contribution to all tasks of this work package, leading T2.4 related to security and privacy concepts. Additional contribution will be leading T4.4, where security issues related to data access will be

of concern. Furthermore, IKERLAN will vice lead WP5 Virtual Factory Data and Connect and lead T5.2 (Data Storage), providing expertise gathered in several projects related to data collection from devices such as PLC, sensors or RFID, virtualisation and resource modelling, data storage and data analytics. Also, IKERLAN will contribute to platform development and integration (WP7) and support the deployment of validation scenarios (T8.1), especially those related to Pilot 1: Manufacturing & Logistic – Automation (T8.2). Finally, IKERLAN will also work on impact activities (WP10) through different channels, such as impact on local media, industrial corporation newsletter, social media, industrial workshops and working groups within the Mondragon Corporation group.

No.	Collaborators Profile
C 1	<p><b>Eduardo SAIZ (Male)</b> graduated in Industrial Engineering in 1984 at the University of Bilbao. In addition, he holds the APICS certificate (1995). Since 1986, he has worked at IK4-IKERLAN as project manager, first in the Production Systems department and from 2001 until today in the Advanced Manufacturing Technologies Area. He is involved in several European Research projects (FP5 TNEE, FP7 REMPLANET, H2020 MANTIS, H2020 CREMA, H2020 C2NET), leading work packages and tasks. Also, he has led and taken part in several R&amp;D projects funded by the Spanish/Basque Governments related to Collaborative Business Processes, Scheduling Systems, Production Planning, Analysis and Simulation of Production Systems. He has served as a reviewer of several research projects within the Basque Government program ALDATU, focused on Innovation in Companies Organisation. He has authored several peer-reviewed scientific publications in systems and software engineering conferences like IMCM&amp;PETO, MCPC, WSC, IFAC MIM, etc. The keywords that define his current work are: Synchronised Manufacturing, Supply Network Design and Configuration, Supply Network Simulation, Supply Chain Management and Extended Enterprises. (<a href="mailto:esaiz@ikerlan.es">esaiz@ikerlan.es</a>)</p>
C 2	<p><b>Karmele INTXAUSTI (Female)</b> obtained her Computer Science Engineering degree from the University of the Basque Country in 1980, a Master in Business Administration from University of Deusto in 2002 and a Master in Statistical Learning and Data Mining from the Spanish Open University in 2012. From 1982 to 1986, she worked as a lecturer in the Computer Science Department of the University of the Basque Country. From 1987 to 2001, she worked in the Artificial Intelligence department in IKERLAN, and from 2001 to 2013 in the Technologies Department. Currently, she is researcher in the Advanced Manufacturing Technologies Department. (<a href="mailto:kintxausti@ikerlan.es">kintxausti@ikerlan.es</a>)</p>
C 3	<p><b>Santi CHARRAMENDIETA (Male)</b> Dipl. Ing. Santi Charramendieta has been with IKERLAN since 1997. In recent years, he has focused his research activities on the engineering of railway control embedded systems based on model-driven product-line approach. At the same time, he has complemented this work with the use of these techniques for wind power control systems in a cloud computing environment. He is currently coordinating a research line on cyber physical cloud for wind power scenario. (<a href="mailto:scharramendieta@ikerlan.es">scharramendieta@ikerlan.es</a>)</p>
C 4	<p><b>Dr. Eduardo CASTELLANO (Male)</b> has been with IKERLAN since 1997. He is currently coordinating the H2020 SME technology innovation management, SME instrument, through the Strategic Innovation area. His fields of expertise are Technology Innovation Management, Business Models Innovation and Business Development. He leads SMEs and large enterprises RTD industrial projects in these fields (e.g. coached-mentored the development of over 10 technology-based new businesses), as well as the technology exploitation strategy in national and European research projects. He has authored several peer-reviewed publications and is also programme committee member, panel group member and journal reviewer in different conferences, journals and special interest groups (e.g. McKinsey Quarterly Executive) related to the cited research domains. He has a Ph.D. in Management Systems (UPVEHU), Industrial Engineer (TECNUN), and visiting researcher in the Complexity Research Group of the London School of Economics. He also holds postgraduates in Logistics (ICIL) and Microeconomics of Competitiveness (Deusto-Harvard). (<a href="mailto:ecastellano@ikerlan.es">ecastellano@ikerlan.es</a>)</p>
C 5	<p><b>Angel CONDE (Male)</b> is with IKERLAN since 2015. During this year, he has focused on developing the IK4-Data Processing Platform for various research projects. The developed Platform allows to IKERLAN to focus on solving Big Data problems (ingestion/storage/analytics using different algorithms) and deployment to private and public clouds. He has already obtained his Ph.D. in Computer Science (UPV/EHU), which uses Data Mining, Natural Language Processing, and Machine Learning techniques in order to gather semantic knowledge from written textbooks. Moreover, he holds a M.S. in Advanced Computer Systems (UPV/EHU), a Bachelor</p>



Degree in Computer Science (UPV/EHU) and visiting researcher in the Cognitive Computation Group of the University of Illinois. ([aconde@ikerlan.es](mailto:aconde@ikerlan.es))

### Relevant Publications and/or Products, Services (up to 5)

- Murguzur, A., Intxausti, K., Urbiet, A., Trujillo, S., & Sagardui, G. (2014). Process Flexibility in Service Orchestration: A Systematic Literature Review. *International Journal of Cooperative Information Systems*, 23(03), 1430001
- Saiz, E., Castellano, E., Sanchis, R., & Poler, R. Model for the Integration of Product, Process and Supply Network in Mass Customisation Scenarios. *Intelligent Non-hierarchical Manufacturing Networks*, 41-72
- Agirre, A., Estevez, E., & Marcos, M. (2014, September). Resource management support for SCA based distributed applications. In *Emerging Technology and Factory Automation (ETFA), 2014 IEEE* (pp. 1-4). IEEE
- Zugasti, E., Gonzalez, A. G., Anduaga, J., Arregui, M. A., & Martinez, F. (2013, January). A Comparative Assessment of Two SHM Damage Detection Methods in a Laboratory Tower. In *Advances in Science and Technology* (Vol. 83, pp. 232-239)
- Val, I., Casado, F., Rodriguez, P. M., & Arriola, A. (2014, September). FPGA-based wideband channel emulator for evaluation of Wireless Sensor Networks in industrial environments. In *Emerging Technology and Factory Automation (ETFA), 2014 IEEE* (pp. 1-7). IEEE.

### Relevant Previous Projects or Activities (up to 5)

- **H2020-ECSEL: MANTIS “Cyber Physical System based Proactive Collaborative Maintenance”**  
IKERLAN is working in several tasks related to the use case of predictive maintenance for a press manufacturer by defining the user and platform requirements, identifying and developing both sensors and communications technologies to be applied and data analytics for root failure causes and remaining use life of main components of the machines.
- **H2020-FoF: CREMA “Cloud-based Rapid Elastic Manufacturing”**  
IKERLAN is working in tasks for defining the CREMA platform architecture and its functional/technical specifications, including security and privacy issues. Also, it is involved in data modelling and services virtualisation and abstraction tasks for data collection and interoperability issues. Frameworks for cloud manufacturing process optimisation and stakeholders’ collaboration are other activities where IKERLAN plays a strong role. Finally, it is involved in piloting the use case of machinery maintenance and contributing to maximise CREMA’s impact in IPR, exploitation and standardisation activities.
- **H2020-FoF: C2NET “Cloud Collaborative Manufacturing Networks”**  
IKERLAN is responsible for leading the WP1, where activities for defining user requirements, functional and non-functional specifications of the C2NET platform and use case scenarios validation are conducted. Additionally, it has a strong contribution in the definition of the architecture and technical specifications, as well as the implementation of C2NET platform. Also, IKERLAN is participating in specifying and developing optimisation algorithms for manufacturing plans optimisation and playing a main role in business models and exploitation activities for maximising C2NET impact.
- **FP7-JTI-ARTEMIS: ARROWHEAD “Ahead of the future (Internet of Things and Service Oriented Architectures”**  
The main contribution of IKERLAN is in the pilot domain. It is participating in the development and validation of the whole eco-sufficient home pilot, with a main focus on the interoperable and WAN connectable multi-resources smart meter platform. Related to research activities, IKERLAN has contributed to the state-of-the-art analysis and technical requirements for energy sufficiency in the home domain (middleware protocols and information models standards). It is also participating in the description/specification/design and implementation of home domain devices and the services they offer, targeting interoperability, integration and migration aspects of legacy and new components, with main focus on the multi-resources smart meter.
- **FP7-ICT: MULTIPARTES “Multi-cores Partitioning for Trusted Embedded Systems”**  
IKERLAN has integrated hypervisor based multicore partitioning technology to develop mixed-criticality technology applied to embedded systems. In particular, IKERLAN's work focused on a wind power use case. Key areas of work done include road to certification and modelling tools.

#### 4.1.3 UNINOVA - Instituto de Desenvolvimento de Novas Tecnologias

Participant No.	3	Organisation Name	UNINOVA - Instituto de Desenvolvimento de Novas Tecnologias
Country	 Portugal	Short Name	UNINOVA
Type	Research & Academia Non-profit	Logo	

**UNINOVA - INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS (UNINOVA)** is a multidisciplinary, independent, and non-profit research institute employing around 180 persons, located in the metropolitan area of Lisbon. It was formed in 1986 by the faculty of S&T of the University Nova de Lisboa (FCT-UNL - [www.fct.unl.pt](http://www.fct.unl.pt)), a group of industrial associations, a financial holding, and up to 30 companies. It is an active partner of Madan Parque ([www.madanparque.pt](http://www.madanparque.pt)), a business facilitator and accelerator, incubating Micro and SME's through several layers of support to entrepreneurial activity.

The main aim of UNINOVA is to pursue excellence in scientific research, technical development, advanced training and education. By working closely with industry and universities, technological innovations are transferred into profitable business concepts and existing products further developed to match new industrial requirements. Due to its tight connection with the University and Madan Parque, UNINOVA has hosted and supported the development several PhD thesis, as well as the creation of several successful spin-offs.

CTS-GRIS is the UNINOVA department that will be involved in the proposal, providing the following areas of expertise for the proposal:

- Strategies for interoperability and information integration using standards, standards reuse and harmonisation, intelligent mapping, and meta-modelling
- Intelligent infrastructures and architectures
- Ontologies and semantic interoperability
- Distributed systems for integrated data management
- Open platforms, architectures and toolkits to support and accelerate the implementation and adoption of local and web-based electronic data interchange using and integrating standards and "de facto" standards, like UN/EDIFACT, ISO/STEP, XML, IDL, etc.
- Platforms and services for automatised web-based conformance and interoperability assessment activities, as well as frameworks for test-beds
- Design and development of integrators and translators for applications and web front-ends in integrated manufacturing environments and electronic customer-manufacturer relationships
- IoT and embedded systems

The institute is strongly committed to eEurope and to Lisbon Strategy, being involved in many activities that support/enable the developments and actions towards the knowledge economy. UNINOVA has managed and participated in many national and international research programmes (ESPRIT, BRITE, IMS, IST, ICT, NMP, INNOVA, etc.) with experience in RTD in industrial systems interoperability, future Internet enterprise systems, e-learning and e-training activities, and standards based activities (e.g. ISO TC184/SC4). The group also coordinated the IMS SMART-fm framework, creating a community (funStep community) with more than 700 members, and also supported the launch of several spin-off companies using research results.

The impact and results achieved through these activities is both on the academic and scientific community, with papers published in chapters of books, international scientific journals and conferences. These results are also in use by industrial research projects addressing interoperability topics, and have been source for further scientific and technical innovations towards seamless interoperable environments. These include standardisation communities. The work developed resulted in several international awards.

[www.uninova.pt](http://www.uninova.pt)



### Main Competences Related to the vf-OS Project

UNINOVA will provide its expertise to the vf-OS project in the following domains: Enterprise Interoperability; Sustainable Interoperability; Model Driven Architectures (MDA); Service Oriented Environments; Cloud-based Services; Cyber Physical Systems (CPS); Sensors & IoT Devices; Information and Knowledge Modelling; Product and Process Modelling; Knowledge Management; Supply Chain Management; Product Life Cycle Integration; Agent-based Monitoring and Evaluation Techniques.

### Contribution to vf-OS Project

UNINOVA will be responsible for leading WP3, which is the specification and development of the Virtual Factory System Kernel. The major focus of UNINOVA on WP3 will be on the coordination of the tasks related with the vf-OS Kernel conceptualisation (T3.1) and development of FI-WARE generic enablers (T3.2) for the vf-OS Kernel. UNINOVA will participate in WP5, leading Task 5.1, which deals with vf-OS data infrastructure middleware. UNINOVA will contribute with the specification of adapters for ETL, the management of sensor data through NoSQL repositories, the development of a highly-scalable semantic data storage for vf-OS events, and the development of data analytics. UNINOVA will participate in exploitation activities (WP9) at the academic level due to its close relationship with the Universidade Nova de Lisboa and promoting the project results within standards communities. Finally, UNINOVA will actively participate in WP10, namely in leading Tasks 10.4 and 10.5 with expertise in organising scientific and industry-driven workshops and on the standardisation activities.

No.	Collaborators Profile
C 1	<p><b>Ricardo GONCALVES, PhD (Male).</b> Ricardo Jardim-Goncalves holds a PhD degree and received his habilitation (Agregação) in Industrial Information Systems by the New University of Lisbon (UNL). He is an Associate Professor at the New University of Lisbon, Faculty of Sciences and Technology, and a Senior Researcher at UNINOVA – Instituto de Desenvolvimento de Novas Tecnologia. He has graduated in Computer Science, with MSc in Operational Research and Systems Engineering. His research activities have been focused on Interoperability of Complex Systems. He has been researching in European Commission funded projects during the last 20 years, with more than 150 papers published in conferences, journals and books. He is principal researcher in GRIS (Grupo para a investigação em Interoperabilidade de Sistemas; Group for Research in Interoperability of Systems) at UNINOVA (Instituto para o Desenvolvimento de Novas Tecnologias), CTS (Centro para as Tecnologias e Sistemas). He is project leader in ISO TC184/SC4. (rg@uninova.pt)</p>
C 2	<p><b>Dr. Carlos AGOSTINHO (Male).</b> Senior Researcher at UNINOVA Center of Technology and Systems (CTS), he holds a PhD in the area of industrial information systems by the Faculty of Science and Technology of the NOVA University of Lisbon (FCT/UNL) and has an MSc in Computer Science from the same school. He is deeply involved in the areas of Product and Process Meta-modeling, Interoperability and Knowledge Management since his participation in projects like CEN/AIDIMA/2002/004 funSTEP AP-DIS and IST-2001-52224 SMART-fm. He is experienced in research and coordination activities due to his work in several national and international research and development projects in UNINOVA since 2001, where he developed skills in the areas of standardisation, model-based and semantic interoperability applying MDA/MDI technologies. Currently his research is targeting dynamic environments and how principles from complex systems can contribute towards a self-sustainable interoperability. (ca@uninova.pt)</p>
C 3	<p><b>Raquel MELO (Female)</b> is an Electrical and Computer Engineering PhD student and a researcher at UNINOVA - CTS centre since 2012. She has a MSc in Electrical and Computer Engineering by the Faculty of Science and Technology of the NOVA University of Lisbon (FCT/UNL). She is performing research in the area of Interoperability of Systems, with special focus in Interoperability and Integration for IoT, being involved at the moment in the FP7 FI-PPP FITMAN project (<a href="http://www.fitman-fi.eu">www.fitman-fi.eu</a>), having also participated in the ARTEMIS SIMPLE (<a href="http://www.simple-artemis.eu">www.simple-artemis.eu</a>) project and FP7 EAR-IT (<a href="http://www.ear-it.eu">www.ear-it.eu</a>) project. (ram@uninova.pt)</p>

### Relevant Publications, Products and/or Services (up to 5)

- Agostinho, C., Ducq, Y., Zacharewicz, G., Sarraipa, J., Lampathaki, F., Poler, R., & Jardim-Goncalves, R. (2015). Towards a sustainable interoperability in networked enterprise information systems: Trends of knowledge and model-driven technology. *Computers in Industry*

- Agostinho, C., & Jardim-Goncalves, R. (2015). Sustaining interoperability of networked liquid-sensing enterprises: A complex systems perspective. *Annual Reviews in Control*, 39, 128-143
- Spirito, M., Pastrone, C., Soldatos, J., Giaffreda, R., Doukas, C., Muñoz, L., ... Agostinho, C. (2014). Internet of Things Applications - Research and Innovation to Market Deployment (Chapter 7). In O. Vermesan & P. Friess (Eds.), *Internet of Things – From Research and Innovation to Market Deployment* (pp. 243–286). River Publisher
- Figueiras, P., Melo, R., Costa, R., Agostinho, C., Lima, C., Jardim-Goncalves, R. (2015), *A Semantic Enrichment approach based on the Vector Space Model supporting Interoperability in Product Design*, in *Conference: ASME International Mechanical Engineering Congress and Exposition 2015*, Nov 2015 Houston Texas
- Ghimire, S., Melo, R., Ferreira, J., Agostinho, C., & Goncalves, R. (2015, October). Continuous Data Collection Framework for Manufacturing Industries. In *On the Move to Meaningful Internet Systems: OTM 2015 Workshops* (pp. 29-40). Springer International Publishing




#### Relevant Previous Projects or Activities (up to 5)

- **H2020-FoF C2NET: “Cloud Collaborative Manufacturing Networks”**  
UNINOVA is the leader of the C2NET Data Collection Framework, working on the specification of methods and tools to support the data collection from both industrial shop-floor and legacy system. It is also responsible for the project knowledge base specification and implementation, contextualising the collected data and making it available for the remaining C2NET services of optimisation and collaboration.
- **FP7-ICT OSMOSE: “OSMOsis applications for the Sensing Enterprise”**  
UNINOVA is the leader of the OSMOSE Industrial Scenarios Definition and Requirements Identification, working on the specification of the osmosis overall middleware architecture, as well as the specification and implementation of the osmosis business process modelling architecture and toolbox. It is also responsible for the event knowledge base specification and implementation, which provides the necessary support of the middleware event-driven architecture.
- **FP7-ICT-FOF MSEE: “Manufacturing Service Ecosystem”**  
UNINOVA has been a main participant in the specification of the model-driven service engineering architecture (MDSEA) and implementation of the model transformation framework. Together, they provide the modelling and service development support for the enterprises that want to move from a product-centric market into a service centric one, where the value is in on the services provided to the customer.
- **FP7-2011-NMP-ICT-FoF IMAGINE: “ Innovative End-to-end Management of Dynamic Manufacturing Networks”**  
UNINOVA led the Dynamic Manufacturing Networks (DMN) definition, and in the definition of a generic methodology to rule the use cases of the IMAGINE platform. It developed the blueprints reference model, and it was responsible for the testing approach of the IMAGINE platform components. UNINOVA designed the portlets/functions to enable the management of the semantic used in the platform and for the semantic alignment between the enterprises and ERP legacy systems. It developed the web services enabling the transformation of the data coming from legacy systems to be inserted in the IMAGINE Platform blueprints, including the developed adapter configuration in end users’ servers. UNINOVA was responsible in developing the IMAGINE training program and the courses materials as in participating in their execution and in the dissemination of the project.

#### Significant Infrastructure

UNINOVA has laboratories with computational equipment and access to teaching labs at New University of Lisbon where teaching actions are coordinated by UNINOVA’s Professors.

#### 4.1.4 Universitat Politècnica de València – Research Centre on Production Management and Engineering (CIGIP)

<b>Participant No.</b>	4	<b>Organisation name</b>	Universitat Politècnica de València	
<b>Country</b>	 Spain	<b>Short name</b>	UPV	
<b>Type</b>	Research & Academia Non-profit	<b>Logo</b>	 UNIVERSITAT POLITÈCNICA DE VALÈNCIA	

The **Universitat Politècnica de València (UPV)** is a Spanish Public University with 13 High Technical Schools of Engineers, including 30 Bachelors and 60 Masters courses. The staff is more than 5,300 (2,700 teaching and research, 800 research and 1,800 administrative), with more than 38,000 students. In 2013, its budget was roughly 353 million Euro. UPV is very active in R&D Projects and contracts with private companies, the incomes in 2012 produced by these activities were 30 million Euro.

The Research Centre on Production Management and Engineering (CIGIP) is at the leading edge of enterprise modelling, manufacturing planning research, manufacturing assembly, distribution and service supply chain management research issues. CIGIP has more than 30 members, including professors, associate professors and full researchers dedicated to teaching and R&D in different areas of Operations and Production Management. Since 1994, CIGIP has participated in several European and Spanish Research Projects, and several R&D contracts with regional industrial firms from different industrial sectors.

[www.upv.es](http://www.upv.es); [www.cigip.upv.es](http://www.cigip.upv.es)

#### Main Competences Related to the vf-OS Project

UPV will contribute to vf-OS expertise in the following domains: Business Process Modelling and Reengineering; Collaborative Business Processes; Decision Support Systems; Demand Forecasting; Enterprise Architectures; Enterprise Integration; Enterprise Interoperability; Knowledge Management; Life Cycle Assessment; Manufacturing Processes Design, Management and Monitoring; Manufacturing Processes Simulation and Optimisation; Mass Customisation; Operations Strategy, Planning and Execution; Risk Management; Supply Chain Management; Supply Network Design; Supply Network Simulation and Optimisation and Virtual Factory.

#### Contribution to vf-OS Project

UPV will be responsible for leading the WP1 to reassert the project vision, coordinating the tasks related with the definition of vf-OS reference framework, and the overall requirements depicting the envisioned Virtual Factory Operating System. Within WP1, UPV will lead Task 1.4, in which existing solutions and technologies in the context of vf-OS will be identified and analysed. UPV will also lead WP4, in which the Virtual Factory inputs and outputs are addressed; specifically tasks T4.1 and T4.2 will be led by UPV, providing its experience in the development of devices drivers and open APIs. UPV will vice lead WP2 and WP11. Regarding WP2, UPV will participate in Task 2.2, providing its knowledge, experience and competences in the architectures design and the definition of functional of architectural components. UPV will support ICE as leader of WP11 with RTD management (leading Task 11.4). UPV will participate in WP8, leading Task 8.1 for the validation scenarios, providing its experience in enterprise consultancies in different sectors. UPV will also participate in exploitation activities (WP9), providing its expertise as technology transfer and consultancy. Finally, UPV will contribute also to the project dissemination (WP10). Specifically, UPV will lead Task 10.2 related with the project dissemination, publishing the project results through publications, materials, Internet and intranet.

No.	Collaborators Profile
C 1	<b>Mr. Raul POLER (Male).</b> Professor in Operations Management and Operations Research at the Universitat Politècnica de València. He is director of the CIGIP. He has led several Spanish Government Projects and European Projects (e.g. he has been the Coordinator of FP7 NMP2-SL-2009-229333 REMPLANET and the Technical Manager of H2020 FoF-1-2014-636909 C2NET). He has published over 100 research papers in a number of leading journals and in several international conferences. He is director of the INTEROP-VLab and chair of its Education Committee. He is the chair of the Education Activity of the IFIP WG 5.8 Enterprise

	Interoperability. His key research topics include Enterprise Modelling, Collaborative Networks, Supply Chain Management, Knowledge Management, Production Planning and Control, Decision Support Systems, Evolutionary Algorithms. ( <a href="mailto:rpoler@cigip.upv.es">rpoler@cigip.upv.es</a> )
C 2	<b>Mr. Angel ORTIZ (Male).</b> Professor in Supply Chain Management at the Universitat Politècnica de València. He is research manager at the CIGIP. He has led several Spanish Government Projects and European Projects. His major research interests are Supply Chain Management, Enterprise Integration and BPM. He has published several papers in books, journals and conferences. He is member of the IFAC/IFIP Task Force on Enterprise Integration. ( <a href="mailto:aortiz@cigip.upv.es">aortiz@cigip.upv.es</a> )
C 3	<b>Mrs. Josefa MULA (Female).</b> Associate Professor in Operations Management and Operations Research at the Universitat Politècnica de València. She is a member of the Scientific Committee of the Research Centre on Production Management and Engineering (CIGIP). Her key research topics include operations management, supply chain management and business modelling. She has published (in collaboration) more than 60 research papers in a number of leading journals. She has co-authored the books "Supply Chain Simulation: A System Dynamics Approach for Improving Performance" and "Operations Research Problems. Statements and Solutions". She is an editor of Journal of Industrial Engineering and Management, International Journal of Production Management and Engineering, Intelligent Industrial Systems and Scientific World Journal and an editorial board member of the Journal of Industrial Engineering. ( <a href="mailto:fmula@cigip.upv.es">fmula@cigip.upv.es</a> )
C 4	<b>Mrs. Raquel SANCHIS (Female).</b> Industrial Engineer, senior researcher at the CIGIP and Assistant Professor in Operations Management and Operations Research at the Universitat Politècnica de València. She has worked as a project manager in INTERVAL (the Spanish pole of the INTEROP-VLab) and also in the production area in industry for 5 years. She has been the project manager and currently is technical agent of European Research Projects (e.g. project manager of FP7 NMP2-SL-2009- 229333 REMPLANET and technical agent of H2020 FoF-1-2014-636909 C2NET). She performs research work in the fields of Knowledge Management, Business Process Modelling, Enterprise Resilience, Integrated Quality Systems and Environment, and Supply Chain Management. She has managed and participated in several Spanish and European research projects and enterprise consultancies and she has authored several papers in journals and conferences. ( <a href="mailto:rsanchis@cigip.upv.es">rsanchis@cigip.upv.es</a> )
C 5	<b>Mrs. Beatriz ANDRES (Female).</b> Industrial Engineer, senior researcher at the CIGIP and PhD student in Enterprise Engineering and Production program from the Universitat Politècnica de Valencia (UPV). She has a Master's Degree in Advanced Engineering in Production, Logistics and Supply Chain of UPV. She received a research grant from the Support Program for Research and Development 2010 (PAID) of UPV and a research grant from the Val i+d Programme for Novel Researchers ACIF/2012/006 by the Valencian Government. She is working in European Community's H2020 Programme (H2020/2014-2020) under grant agreement n°636909, "Cloud Collaborative Manufacturing Networks (C2NET)". Her current research focuses on the areas of Sustainable Collaborative Networks and modelling in System Dynamics, Decentralised Decision Making Processes, Non-hierarchical Manufacturing Networks, Health, Hygiene and Safety at Work and Processes Control. ( <a href="mailto:bandres@cigip.upv.es">bandres@cigip.upv.es</a> )

#### Relevant Publications and/or Products, Services (up to 5)

- Andres, B., & Poler, R. (2015). Models, guidelines and tools for the integration of collaborative processes in non-hierarchical manufacturing networks: a review. *International Journal of Computer Integrated Manufacturing*, (ahead-of-print), 1-36
- Hernández, J. E., Lyons, A. C., Poler, R., Mula, J., & Goncalves, R. (2014). A reference architecture for the collaborative planning modelling process in multi-tier supply chain networks: a Zachman-based approach. *Production Planning & Control*, 25(13-14), 1118-1134
- Poler, R., & Mula, J. (2011). Forecasting model selection through out-of-sample rolling horizon weighted errors. *Expert Systems with Applications*, 38 (12), 14778-14785
- Saiz, E., Castellano, E., Sanchis, R., & Poler, R. Model for the Integration of Product, Process and Supply Network in Mass Customization Scenarios. *Intelligent Non-hierarchical Manufacturing Networks*, 41-72
- Sanchis, R., Saiz, E., Castellano, E., & Poler, R. (2012). Order fulfilment strategies in the capital goods sector. An empirical research. In *Industrial Engineering: Innovative Networks* (pp. 257-264). Springer London


### Relevant Previous Projects or Activities (up to 5)

- H2020-FoF: C2NET “Cloud Collaborative Manufacturing Networks”**  
 UPV is in charge of the technical management of the project. UPV is working on the development of tools to support manufacturing networks in the optimisation of manufacturing and logistics assets by the collaborative computation of production plans, replenishment plans and delivery plans in order to achieve shorter delivery times, better speed and consistency of schedules, higher use of productive resources and energy savings.
- FP7-FI-ICT: FITMAN “Future Internet Technologies for Manufacturing”**  
 UPV has participated in the design and development of FITMAN experimentation sites and in the definition of the lessons learned, recommendations and best practices. UPV's main participation is related to the Digital Factory Trials: instantiation, adaptation and experimentation in which UPV has been working on the development of the digital factory trials generic platform and its modules: (i) Furniture Trends Forecasting for Product Development; (ii) Opinion Mining in Furniture Product and (iii) Collaborative Work for Product Design.
- FP7-NMP: REMPLANET “Resilient Multi-Plant Networks”**  
 UPV was the coordinator of REMPLANET. UPV participated in the definition of the operational REMPLANET Model and the REMPLANET Simulation and Optimisation Decision Support. Moreover, UPV developed ColNET, a service oriented platform for extended business process management which was implemented in a piloting activity.
- FP6-IST-1: INTEROP “Interoperability Research for Networked Enterprises Applications and Software”**  
 UPV was the leader in the development of the INTEROP e-Learning platform and Education Program on Interoperability. Moreover, it also participated in the development of the Knowledge Map and Glossary about interoperability.
- FP5-GROWTH-GRD1-CT: ECOSELL “Extended Collaborative Selling Chain”**  
 UPV performed its research within ECOSELL focusing on the order promising process of a product-pack (P-P) in the extended collaborative selling chain.

### Significant Infrastructure

- Desktop Virtualisation Server for Virtual Desktop Infrastructure (VDI): IBM® System x3550 M4 server, 2 Intel Xeon E5-2620 processors 6 cores, 64GB RAM, 2 IBM SAS disks 6Gbps – 300GB -10K RPM, IBM 6Gb SAS HBA controller, 2 High Efficiency Platinum AC Power Supply.
- Disk storage system: IBM Storwize® V3700 SFF Dual Control, 2U modular disk system, 6 Gb SAS and 1 Gb iSCSI host interface, Maximum disk drives, Small form-factor (SFF) enclosure, 24 x 2.5-in. Drives, 4 GB cache (per controller) standard, Redundant, hot-swappable power supplies and fans, 14 disks 600GB 2.5 in 10K 6Gb SAS HDD with internal virtualisation and thin provisioning.

#### 4.1.5 Caixa Mágica Software, S.A.

Participant No.	5	Organisation Name	Caixa Mágica Software, S.A.
Country	 Portugal	Short Name	CMS
Type	Technology provider SME	Logo	

**Caixa Mágica Software (CMS)** is a Portuguese SME, a leader in multiple segments of the Open Source market in Portugal. It offers competent professional services on Linux systems, software package distribution and management, algorithms and solvers, networks and systems, virtualisation and development of mobile systems (particularly for Android). Since 2000, CMS has marketed and distributed the Linux Caixa Mágica (LCM) distribution, developed firmware for Android mobile phones, and created one of the most popular Android App



Markets worldwide, its spin-off Aptoide (<http://aptoide.com>). CMS is actively involved with the R&D communities, as well as Linux and Open Source communities, organising a popular annual event in this area (<http://eventolinux.org>) in Lisbon.

CMS has an extensive experience in solving integration problems in Open Source, actively supporting IT solutions for the Public Administration, namely by participating in the developments of the Portuguese ID Citizen Card system, as well as being part of research consortia in order to make this system compatible with the ones from other European countries. In addition to these research projects (e.g., STORK2, e-SENS), which have the strong support of the European Union, CMS has a long history of participation in major projects (e.g., H2020 C2NET, FP7 TIMBUS, FP7 ULOOP, FP7 PROSE among others) in the various EU investment framework programs for R&D, in such diverse areas as the interoperability of systems, innovative architectures, Cloud/Internet of Things environments, digital preservation, safety, and standardisation of new technologies. From this extensive experience, CMS has acquired strong competences in innovation and development, both in the development of Open Source solutions and in the integration of solutions and applications, adding value with its contributions. Moreover, its main focus is the development of solutions for the industry.

CMS aims to create and develop robust technology solutions based on Open Source software for consumer and business markets. It has a proud record of more than 800,000 personal computers with their OS Linux Caixa Mágica installed in Portuguese schools and personal computers belonging to students, as well as more than 8,000 computers delivered in Mexico. It has strong partnerships with the Portuguese Public Administration, with the Portuguese Armed Forces, with large scale hardware distributors such as JPIK, Intel, and Insys, and has been involved in major European projects (including acting as lead).

[caixamagica.pt](http://caixamagica.pt)

#### Main Competences Related to the vf-OS Project

CMS has significant experience in the development of Open Source solutions and in the integration of applications, which is an added-value given the scope of participation in this project. Particularly, CMS has already successfully led the integration and development work packages in other large EU-funded projects (e.g., TIMBUS and ULOOP), having developed managing structures and skills for this matter. Also, its core is industry application development, which has also a high value in this project.

#### Contribution to vf-OS Project

CMS will be responsible for leading WP6, for the vf-OS Open Applications Development Kit (OAK), taking advantage of its experience in this area to be able to provide the best resolution of the defined scope requirements into the implementation and validation of the implemented open applications. CMS will lead the OAK SDK (T6.1), T6.4 OAK Studio, and T6.5 OAK Developer Engagement Hub. In WP7 CMS will providing its software development experience and participating as a lead in Task 7.4 Developer Engagement & Training. Moreover, it will participate in WP1, leading the elicitation of the requirements and definition (T1.5) of the architecture. Finally, CMS will contribute to exploitation tasks (WP9), offering its expertise as an SME provider of commercial Open Source products and services, and will contribute to tasks in WP10 by presenting vf-OS results in numerous events in which it participates or hosts, and in the OpenSourceProjects.eu platform.

No.	Collaborators Profile
C 1	<p><b>Carlos COUTINHO (Male)</b> is the CEO and R&amp;D Manager at Caixa Mágica Software in Lisbon, Portugal. He holds a Ph.D. degree in Electrical and Computer Engineering, awarded in 2013 by the New University of Lisbon (FCT-UNL), Portugal, where he also performs research, with interests in Enterprise Interoperability, Adaptable Platforms and Systems, SOA, and Model-Driven Engineering. He has more than 10 years of experience teaching the fields of IT at Portuguese universities ISEL, ISCAL, ISGB and ISCTE, and has supervised one MSc student. He has five publications in international scientific journals (with ISI-IF) and more than twenty publications in peer-reviewed international conferences, and is part of the review committee of four scientific journals and six yearly international conferences. He also holds a PMI-PMP® title and has a post-graduation in Project Management by Instituto Superior Bissaya-Barreto (ISBB) in Coimbra, Portugal. He has more than twenty years of experience as an engineer in the enterprise IT area, working in several fields from ICT, Services, Public Administration and the Aerospace industry, in several multinational projects in CMS and other companies like Alcatel, Siemens and Critical Software. He participated and was the company responsible in multiple European Projects like Athena (FP6), TIMBUS (FP7), C2NET (H2020), and numerous ESA projects (EGOS, OCDT, S2K and Galileo). (<a href="mailto:carlos.coutinho@caixamagica.pt">carlos.coutinho@caixamagica.pt</a>)</p>

C 2	<b>Paulo TREZENTOS (Male)</b> was awarded a PhD from IST Lisbon, is the Research Director and co-founder of SME companies Caixa Mágica Software and Aptoide and an Assistant Professor at the Lisbon university ISCTE. At ISCTE he teaches classes on Operating Systems and Computer Architectures since 1999. He participated in several European RTD, FP6 and FP7 Projects such as OPIMA, OCTALIS, OCCAMM, MANCOOSI, EDOS, ULOOP and TIMBUS and was a participant in the Global Grid Forum meetings and the ESA projects (HICOD 2000). He was awarded the “Prémio Milénio 2000 Expresso” prize for Linux Caixa Mágica. He is author and co-author of four books on the subjects of Linux and Open Source. ( <a href="mailto:paulo.trezentos@caixamagica.pt">paulo.trezentos@caixamagica.pt</a> )
C 3	<b>Vasco SILVA (Male)</b> is the CTO and Project Manager at Caixa Mágica Software, the leading Portuguese Linux distribution. He is responsible for managing numerous consulting projects at CMS in e-government, public administration and industry projects, particularly in projects involving digital identity and digital signatures. He is the project manager in the development of the middleware for Portuguese e-ID national cards. He has participated in the Mancoosi EU-funded project, and is responsible for CMS's role in the EU-funded project STORK2.0-ICT project – Secure Identity Across Borders Linked 2.0. ( <a href="mailto:vasco.silva@caixamagica.pt">vasco.silva@caixamagica.pt</a> )

#### Relevant Publications and/or Products, Services (up to 5)

- Jardim-Goncalves, R., Coutinho, C., Cretan, A., da Silva, C. F., & Ghodous, P. (2014). Collaborative Negotiation for Ontology-driven Enterprise Businesses. *Computers in Industry*, 65(9), 1232-1241
- Trezentos, P., Lynce, I., & Oliveira, A. L. (2010, September). Apt-pbo: Solving the Software Dependency Problem Using Pseudo-Boolean Optimization. In *Proceedings of the IEEE/ACM International Conference on Automated Software Engineering* (pp. 427-436). ACM
- Coutinho, C., Cretan, A., da Silva, C. F., Ghodous, P., & Jardim-Goncalves, R. (2014). Service-based Negotiation for Advanced Collaboration in Enterprise Networks. *Journal of Intelligent Manufacturing*, 1-16.
- Coutinho, C., Simoes, J., Marques, L., Nunes, M., & Martins, N. (2014, May). Framework for the Development of Static and Flexible Collaborative Solutions. In *Proceedings of the International Conference on Information Systems and Design of Communication* (pp. 79-84). ACM
- Matos, A., Thomson, J., & Trezentos, P. (2011). Preparing FLOSS for Future Network Paradigms: A Survey on Linux Network Management. In *Open Source Systems: Grounding Research* (pp. 75-89). Springer Berlin Heidelberg

#### Relevant Previous Projects or Activities (up to 5)

- H2020-FoF: C2NET “Cloud Collaborative Manufacturing Networks”**  
CMS is responsible for the main tasks concerning platform/software/services integration, validation and testing in Cloud environments, contributing also for the platform architecture, services and APIs definition and validation, as well as supporting the implementation of the platform in the pilot projects.
- CIP-ICTPA: STORK 2.0 “Secure idenTity acROss boRders linKed 2.0”**  
This project looked to improve the results of the STORK Project, for realising a single European electronic identification & authentication area. The activities performed by CMS included developments on the digital signature part and support of the e-Gov pilot.
- FP7-ICT: PROSE “Promoting Open Source in European Projects”**  
CMS was the Project Leader. This project was very important for the TrustedOpenApps project as one of PROSE's outcomes was a portal dedicated to host Open Source European projects source code: <http://opensourceprojects.eu>.
- FP7-ICT-IP: TIMBUS “Digital Preservation for Timeless Business Processes and Services”**  
In this project CMS led the development and implementation work-packages, empowering its experience in integration, design and development.
- FP7-ICT-STREP: ULOOP “User-centric Wireless Local-Loop”**  
In this project, CMS led the integration work-package, integrating the contributions of all partners in this very technological project into a common framework solution.



#### Significant Infrastructure

Caixa Mágica Software is an SME located at Lisbon, Portugal. It holds a set of infrastructures, including:

- 4 racks
- 4 UPSs
- 23 Dell PowerEdge servers (each with 2 CPUs Quad Core Xeon / 8 Gb RAM)
- 92 uSATA HotSwap disks, each with 750 GB



#### 4.1.6 Université Lumière Lyon 2

<b>Participant No.</b>	6	<b>Organisation Name</b>	Université Lumière Lyon 2
<b>Country</b>	 France	<b>Short Name</b>	LYON2
<b>Type</b>	Research & Academia Non-profit	<b>Logo</b>	

The **Université Lumière Lyon 2 (LYON2)** develops undergraduate, master and doctorate courses in several fields. With 377 degree courses for more than 27,500 students (2013) and 38 research labs, the University of Lyon 2 is distinguished among other universities in France. The DISP lab at the university of Lyon 2 develops research in enterprise and information system engineering with applications in industrial manufacturing. This research covers the topics of software engineering, business process management, business performance evaluation and analysis, knowledge management, etc.

[www.univ-lyon2.fr](http://www.univ-lyon2.fr)

#### Main Competences Related to the vf-OS Project

The particular expertise of LYON2 research team remains at the development, the integration and the assessment of new service-based business applications in industry. In order to support the Virtual Factory system definition in WP3, LYON2 brings its experience in the development of future Internet technologies for business applications engineering by proposing the following competences:

- Enterprise architecture
- The specification, development, deployment and performance assessment of business processes in industry
- The development of knowledge models aiming to extract, preserve and reuse related industrial capabilities in order to accelerate the development of new processes
- The development model-driven capabilities as support for business applications: model transformation, multi-scale interoperability, ontology-based alignment, etc.
- The optimisation of business processes implementation and infrastructure: Business Activity Monitoring, Application Response Time Measurement, etc.
- Context-based front-end and pervasive systems

For the development of the kernel connectivity in WP4, LYON2 proposes its technical competences in:

- Model driven engineering
- Model driven Interoperability
- Service based integration
- Ontology oriented business rules for business applications
- Formal semantic rules for service orchestration

For the test and application of vf-OS project solutions, LYON2 shares experience and lessons learned from previous projects and industrial collaborations for:

- Impact analysis
- Business performance analysis
- Governance rules and traceability

#### Contribution to vf-OS Project

LYON2 will vice lead for WP3, supporting the development of Virtual Factory System Kernel conceptualisation and development; specifically LYON2 will lead T3.3 FI-WARE Manufacturing Enablers. Moreover, LYON2 will also vice lead WP4, in which the Virtual Factory inputs and outputs are addressed; specifically Task 4.3 APIs Connectors will be led by LYON2, providing its experience in the development of devices drivers and open APIs connectors. LYON2 will also support the development, integration and validation of the collaborative business scenario as described at the 3rd pilot (WP8). LYON2 will participate in WP9, defining its exploitation roadmap based on the APR - TARDY pilot as an illustration of the collaboration benefits in virtual factories, and in WP10 through dissemination activities at the academic (international journals, conferences and national working groups) and industrial levels.

No.	Collaborators Profile
C 1	<p><b>Dr. Néjib MOALLA (Male)</b>, Associate Professor in the University of Lyon 2 and member of the DISP laboratory. As a computer science engineer, he starts his research with a Master's thesis in 2004. At Lyon 2, he finished his PhD thesis in 2007 and his habilitation in 2015. He held the responsibility of project management department between 2008 and 2012. His research activities deal with Information System Engineering for the extended enterprise. After collecting great experience in industry (Sanofi Pasteur, etc.), he develops research concepts in Ontology Engineering, Knowledge Management, Service Oriented Architectures, etc., and proposes interoperable ICT architectures for manufacturing systems in industry. Furthermore, he contributes to the development of interoperability concepts within the European Virtual Laboratory Interop-Vlab at the GIS Interop-Grande-Region. He is involved in several national and international cooperation projects: FP7 ICT FI-PPP FITMAN, FP7 NMP EasyIMP, Erasmus mundus (eLink, cLink, eTourism, Fusion, etc.). He is a member of several International Program Committees (IPC) for various international journals and conferences. Dr. Moalla will bring his experience in enterprise architectural frameworks (Zachman, Togaf, etc.) and software engineering and databases (BEA, Oracle Weblogic, Oracle BPM/SOA applications, etc.) necessary to the development of the proposal. (<a href="mailto:Nejib.Moalla@univ-lyon2.fr">Nejib.Moalla@univ-lyon2.fr</a>)</p>
C 2	<p><b>Dr. Yacine OUZROUT (Male)</b> is a Computer Scientist in the Supply Chain &amp; Product Lifecycle Management group of the DISP Laboratory at the University Lumiere Lyon2 (ULL). He obtained his PhD in Computer Engineering from the National Institute of Technology of Lyon (INSA), and his HDR (Habilitation Thesis) in 2012 from the University Lyon 2. Currently, he is an Associate Professor at ULL. He is the director of the Institute of Technology of his university. His research interests include multi-agent systems, simulation, decision support systems, and distributed information systems. Dr. Ouzrout has been involved in several European projects: Asia-Link project East-West (2004-2007), Erasmus-Mundus cLink, SQUARE and ETHICS-FED Euro-Thai Projects (2009-2010) and is currently the local coordinator (ULL) of the Sustainable E-Tourism project and cLink Erasmus Mundus Action 2 project cLink. (<a href="mailto:Yacine.Ouzrout@univ-lyon2.fr">Yacine.Ouzrout@univ-lyon2.fr</a>)</p>

#### Relevant Publications and/or Products, Services (up to 5)

- Hachicha, M., Fahad, M., Moalla, N., & Ouzrout, Y. (2015). Performance Assessment Architecture for Collaborative Business Processes in BPM-SOA-based Environment. *Data & Knowledge Engineering*
- Fahad, M., Boissier, O., Maret, P., Moalla, N., & Gravier, C. (2014). Smart Places: Multi-agent Based Smart Mobile Virtual Community Management System. *Applied Intelligence*, 41(4), 1024-1042
- Chhun, S., Moalla, N., & Ouzrout, Y. (2014). QoS Ontology for Service Selection and Reuse. *Journal of Intelligent Manufacturing*, 1-13
- Fahad, M., Moalla, N., & Bouras, A. (2012). Detection and Resolution of Semantic Inconsistency and Redundancy in an Automatic Ontology Merging System. *Journal of Intelligent Information Systems*, 39(2), 535-557
- Fahad, M., Moalla, N., Bouras, A., Qadir, M. A., & Farukh, M. (2011). Towards Classification of Web Ontologies for the Emerging Semantic Web. *J. UCS*, 17(7), 1021-1042

LYON2 will provide to this project shared results, prototypes and lessons learned from previous released projects. It concentrates recent proof of concepts (POCs) and public deliverables from developed and ongoing projects dealing with Key Enabling Technologies for manufacturing.

#### Relevant Previous Projects or Activities (up to 5)

- FP7-FI-ICT: FITMAN "Future Internet Technologies for Manufacturing"**  
Under the FP7 ICT FI-PPP FITMAN project, LYON2 developed a prototype for plastic industry integrating FI enablers to enhance the information quality for some collaborative business processes.
- FP7-NMP-ICT-FOF (RTD): EasyIMP "Collaborative Development of Intelligent Wearable Meta-Products in the Cloud"**  
Under the FP7 NMP ICT FOF EasyIMP project, LYON2 developed the concepts the smart meta-product. In this project, we already explore the concepts of Cyber Physical Systems and we analyse the capabilities of ERP system to be more reactive to real time data collected from devises.
- LTKR "Long Term Knowledge Retention" International cooperative action founded by the NIST (USA).**  
Under LTKR digital preservation project, LYON2 developed an integrated platform for knowledge retention and reuse. This platform conforms to the OAIS reference model and integrates relevant objects and functions released under several FP6 and FP7 projects. We plan to deploy these results to structure the specification of industrialisation processes steps and the connection with product parts.
- ARTS-EDF: "Interoperability of Catalogues Between Business Applications" - National industrial research**

**project founded by EDF France**

Under a national industrial research project ARTS-EDF, LYON2 developed model transformation facilities (ATL framework) in order to exchange project catalogues through business applications. The meta-modelling abstractions and transformation rules will be helpful to deal with semantic interoperability barriers.

- **EMA21 cLINK “Centre of excellence for Learning, Innovation, Networking and Knowledge”**

Under the cLINK project, we developed advanced monitoring capabilities to supervise the performance of service-based applications. We developed business activity monitoring helping to simulate any network evolution demand and proposes some reorganisation recommendations. The results will help to guarantee the stability of the new use-case IT application.

### Significant Infrastructure

In order to support the development of the business scenario defined with the two SMEs, LYON2 provides IT infrastructure to support the instantiated platform. Thereby, LYON2 provides the necessary development and testing application server infrastructures, as well as application platforms, databases and code quality testing tools and protocols. From the organisational side, we plan to hire one post-doc position and integrate one PhD candidate in order to accentuate the development and the validation of R&D activity.

#### 4.1.7 Ascora GmbH

Participant No.	7	Organisation Name	Ascora GmbH
Country	 Germany	Short Name	ASC
Type	Technology Provider SME	Logo	

**Ascora GmbH (ASC)** is an SME IT company based in northern Germany (Lower Saxony). Since 1994, Ascora GmbH has been developing and selling software as an Independent Software Vendor with products that are used around the world. In 2007, Ascora GmbH extended its range to provide business solutions. It offers IT consulting services to national and international companies. ASC is involved in several projects within the research and innovation domain. Ascora offers a variety of services, with the expertise in the domains of system integration and the development and prototyping of SOA based solutions (services).

Ascora has broad expertise in realising personalised applications with a strong focus for creating fully adaptive solutions based on service oriented architectures and distributed system integration. Ascora has strong experience in connecting different IT systems from a data perspective and from a semantic perspective.

In addition to its business solutions, Ascora is one of the leading providers of software apps in Germany. Ascora software solutions are used by over 8 Mio users with over 2.5 Mio newsletter subscribers,, distributed under own labels and under third party white-label approaches. Applications include desktop applications as well as web and mobile apps.

Ascora has broad expertise within the virtual manufacturing domain. Ascora has been the technical lead and the vice-coordinator of the FP7 Adventure project for realising a “plug & play” factory approach. Additionally, Ascora is coordinating the H2020 CREMA project, realising cloud-based rapid elastic manufacturing based on the XaaS and cloud model.

Ascora is actively contributing to standards and is active in the European Committee for Standardization (CEN). Additionally, Ascora is an active member of the Organization of Independent Software Vendors (OISV), the largest ISV association in the world. Moreover, Ascora is a member of the NESSI ETP (Networked European Software and Services Initiative) and the Net!Works ETP (European Technology Platform for Communications Networks and Services) as the NEM Initiative (Networked & Electronic Media) and the BDVA (Big Data Value Association).

[ascora.net](http://ascora.net)

### Main Competences Related to the vf-OS Project

ASC brings extensive knowledge in the software development domain and acts as a core technical partner in the project. ASC is leading several complex ICT projects for its own products and for national and international clients, where it makes use of modern technologies which will be brought to vf-OS. This includes data storage and management expertise, as well as experience in service oriented architectures. One of the main areas of activities is the usage and development of scalable and cloud based systems, where ASC is already active using cloud based technologies within its own products. ASC also leads several key RTD projects including the Cloudi/o project for secure and scalable cloud storage solutions.

ASC has broad experience in connecting different ICT systems and its knowledge in the collaboration and interoperability domain will be a key benefit for vf-OS. This includes the usage of open formats, open and extendible protocols, as well as support for collaborative design and data exchange via next generation hardware devices (e.g. wearable computers). Analogously, ASC brings in its expertise in the messaging and communication domain for connecting ICT systems via open and secure infrastructures.

ASC is one of the largest application developers in northern Germany with over 8 million active users and 2.5 million newsletter subscribers. As such, Ascora has broad expertise on creating and managing applications and on the needs that developers will require for new software development. This expertise will be brought into vf-OS, especially in the context of the mApp SDK development in WP6 and propagation.

### Contribution to vf-OS Project

ASC will lead WP2, coordinating the tasks for developing the Virtual Factory Operating System Architecture, bringing its broad expertise in technical aspects; within this work package ASC will lead Task 2.3 (Technical Specification). ASC will vice lead WP6 Open Applications Development Kit (OAK) and will focus on Task 6.3 for developing the OAK front-end environment. ASC is the vice leader of WP7, participating in Tasks 7.2 and 7.5, providing its experience in technical specifications as well as the prototype implementations and integration of the project. ASC will participate in WP11, leading Task 11.5 Technical Set Up and Quality Toolset. Finally, ASC will contribute to exploitation activities (WP9) through its expertise defining the collaborative and its exploitation plan and it will disseminate vf-OS findings (WP10) through different associations and initiatives (OISV, NESSI ETP, Net!Works).

No.	Collaborators Profile
C 1	<b>Dr Sven ABELS (Male)</b> received a Bachelor degree (BSc), Master's degree (Dipl.-Inform) and a PhD Degree from the University of Oldenburg, Germany. He is one of the founders of the International Journal of Interoperability in Business Information Systems (IBIS). Sven organised several international workshops and has over 40 publications in journals, proceedings and books. Sven received several awards and honours in the last years. Sven has been working as a consultant for international companies and has been involved in a broad number of international projects. Since 2007, Sven focuses as the Chief Executive Officer (CEO) of Ascora GmbH on initiating products in the ICT domain, helping ASC's clients to exceed their boundaries. His research and business interests are on smart business solutions offering end-to-end integration of IT systems for customers in the health and manufacturing industries. ( <a href="mailto:abels@ascora.de">abels@ascora.de</a> ).
C 2	<b>Mr Danny PAPE (Male)</b> has broad experience in constructing and developing complex IT landscapes. Danny holds a Bachelor degree (BSc) in computing science and gained detailed knowledge in creating mobile, desktop and web based system. Within Ascora, Danny has coordinated several IT software products including their full lifecycle and brought them to the market. Additionally, Danny was actively involved in the RTD projects OPDIS, Cloudi/o and CREMA as well as in the commercial innovation activities for the Ascora SensorSpot platform. ( <a href="mailto:pape@ascora.de">pape@ascora.de</a> )
C 3	<b>Ms Elina NEUGEBAUER (Female)</b> has received a Bachelor of Media Engineering and Operations CCI from the Chamber of Industry and Commerce Bremen, Germany. She has over 9 years of experience in the IT development area with a wide know-how of Usability & User Experience and Design. Elina works as the head of design and user interaction at Ascora GmbH. She has been involved in desktop applications as well as mobile environments including Android and iPhone/iPad projects for national and international markets. Elina has been involved in several RTD projects such as the OPDIS II project covering not only the user experience parts but also the modelling of data flows and system interaction. Elina has achieved several

professional certificates and is also the head of training for qualified IT specialist & media designer in Ascora.  
[\(neugebauer@ascora.de\)](mailto:neugebauer@ascora.de)

### Relevant Publications and/or Products, Services (up to 5)

As a commercial company, ASC has limited involvement in academic papers. However, personnel have published papers, including:

- Shamsuzzoha, A.; Abels, S. Küspert, S.; Helo, P. (2014) "Smart Collaborative Processes Monitoring in Real-time Business Environment: Applications of Internet of Things and Cloud-data Repository". Proceedings of the 16th International Conference on Enterprise Information Systems, ICEIS 2014, Portugal
- Hao, Y., Karbowski, R., Shamsuzzoha, A., & Helo, P. (2013). Designing of Cloud-Based Virtual Factory Information System. In *Advances in Sustainable and Competitive Manufacturing Systems* (pp. 415-426). Springer International Publishing.
- Hans, R., Zöllner, S., Abels, S., Miede, A., & Steinmetz, R. (2013). Enabling Collaboration in Virtual Manufacturing Enterprises with Cloud Computing. Proceedings of the 19th Americas Conference on Information Systems (AMCIS 2013)
- Schulte, S., Schuller, D., Steinmetz, R., & Abels, S. (2012). Plug-and-play Virtual Factories. *IEEE Internet Computing*, (5), 78-82.
- Abels, S., Beenken, P., Pries, C., Uslar, M. (2011) A Standards-Based Security Approach with Interoperable Interfaces for the Smart Grid, Enterprise Interoperability: Iwei 2011 Proceedings, ISTE Ltd and John Wiley & Sons Inc, 2011

### Relevant Previous Projects or Activities (up to 5)

- **H2020-EeB: ACCEPT "Assistant for Quality Check during Construction Execution Processes for Energy-efficient building"**.  
 Ascora is the Project Coordinator of ACCEPT and is a key technical partner of the project with a core focus on the app creation and the SDK building for apps on top of ACCEPT allowing developers to create mApps for the building industry. Ascora is also a key partner in the secure exchange of information between industry suppliers within large building facilities.
- **FP7-NMP-ICT-FoF: ADVENTURE "ADaptive Virtual ENTERprise ManufacTURING Environment" and FP7-ICT:-SAM "Socialising Around Media"**.  
 Ascora has been the technical lead of Adventure. Ascora has implemented the Ascora Cloud Storage, which is used within the two previous projects and may be reused within vf-OS for storing assets of virtual factories. The cloud storage contains sophisticated approaches for scalability and scalability.
- **H2020-ICT: EuDEco "Modelling the European data economy"**  
 Ascora is a core ICT partner handling big data related issues within Europe from a technological level. This contains the analysis for technological trends for data management but also the creation of industry and policy recommendations towards preparing for and benefiting from a European Data Economy.
- **The Ascora SensorSpot project.**  
 Ascora is coordinating this project. It provides a holistic sensor system for domestic room sensors including the flexible measurement of air quality, temperature, CO2 and VOC.
- **H2020-FoF: CREMA "Cloud-based Rapid Elastic Manufacturing"**  
 Ascora is coordinating this H2020 project dealing with virtual factories and their infrastructure. Within CREMA Ascora coordinates the creation of a scalable cloud platform connecting sensors and providing them in the XaaS approach. This includes a marketplace for virtual factory assets.

### Significant Infrastructure

Ascora has experience in running and hosting server environments, and maintains build and integration environments for several internal and external projects. Furthermore, Ascora has a lot of experience in handling current collaboration- and versioning tools for a qualified cooperation work. Among others, Ascora is maintaining the technical infrastructure from the following RTD projects on its servers: ADVENTURE, SIMPLI-CITY, ALFRED, OPDIS, Cloudi/o, BeWell, NeuroCare, Glassistant and ACCEPT.



#### 4.1.8 Almende B.V.

<b>Participant No.</b>	8	<b>Organisation Name</b>	Almende B.V.
<b>Country</b>	 The Netherlands	<b>Short Name</b>	ALM
<b>Type</b>	Technology Provider SME	<b>Logo</b>	

**Almende B.V. (ALM)** is a Dutch high-tech commercial research company investigating and developing self-organised critical agent-based solutions to sustain and improve the coalition formation and coordination of communication and collaboration across evolving networks of humans and existing ICT infrastructures. It performs basic research in multi-agent system theory and self-organised criticality of complex networks. In addition, it performs related applied research in robotics, logistics, transport, crisis management, data centre management, building management, energy grids and health care network management.

ALM acquires continuously ample experience in national and European projects on research and development of ICT tools and systems for integrated agent-based management and decision support with humans in the loop. Its subsidiaries [ASK Community Systems](#), [Deal Services](#), [DOBots](#), [LUNA](#), [Sense Observation Systems](#) and [Rotterdam Community Solutions](#) further develop and integrate the research findings into innovative product and service portfolios for diverse sectors.

[www.almende.com](http://www.almende.com)

#### Main Competences Related to the vf-OS Project

ALM will contribute to the vf-OS project with experts in the domains of: Data Integration and Middleware; Distributed Software System and Service Modelling, Simulation and Verification; Software Engineering; System Integration; (Manufacturing and Logistics) Factory Network Management Modelling, Analytics and Optimisation; Recommender Systems.

#### Contribution to vf-OS Project

As an expert in software development and system integration ALM will be leading and contributing to Task 1.3 Provider Scenarios Characterisation. In addition, ALM will be responsible for Task 6.2 and developing the OAK System Dashboard - Control Panel and Task Manager, bringing in its broad technical expertise in building dashboards for diverse application domains. For similar reasons, ALM will lead WP7, and lead and contribute to Task 7.1 vf-Platform Environment and Task 7.3 vf-Service Provision Framework. Moreover, as an incubator, ALM will define a roadmap for transferring and transforming its vf-OS results in WP9 into basic technology for manufacturing and other industries. Finally, ALM will disseminate its vf-OS findings in international conferences and journals (WP10).

No.	Collaborators Profile
C 1	<b>Andries STAM (Male)</b> holds a Ph.D. in Computer Science (2009) from the University of Leiden, the Netherlands. His thesis concerns the formal modelling of the interaction in distributed evolving software systems. Currently, he is heading the development of the core technology assets of ALM and its subsidiaries. ( <a href="mailto:andries@almende.org">andries@almende.org</a> )
C 2	<b>Ludo STELLINGWERFF (Male)</b> holds a M.Sc. in Software Engineering (2010) from University of Liverpool, UK. He has more than twelve years of hands-on software engineering experience in developing robust and scalable distributed software-agent systems. As Senior Software Engineer he developed EVE. ( <a href="mailto:ludo@almende.org">ludo@almende.org</a> )
C 3	<b>Suki VAN BEUSEKOM (Male)</b> holds a B.Sc. in Computer Science from Hague University, the Netherlands (2011). His thesis focused application of semantic models in multi-agent systems to generally improve planning and coordination in the transport sector. As Software Engineer he developed ASIMOV. ( <a href="mailto:suki@almende.org">suki@almende.org</a> )

### Relevant Publications and/or Products, Services (up to 5)

- De Jong, J., Stellingwerff, L., & Pazienza, G. E. (2013, October). Eve: a novel open-source web-based agent platform. In *Systems, Man, and Cybernetics (SMC), 2013 IEEE International Conference on* (pp. 1537-1541). IEEE
- De Jong, J., & Pazienza, G. E. (2013). Browser-Based Graph Visualization of Dynamic Data with VisGraph. In *Graph Drawing* (p. 518)
- Stam, A., & Salden, A. (2008, September). Towards composition of distributed evolving services: the Credo approach. In *Proceedings of the 2nd International Conference on Autonomic Computing and Communication Systems* (p. 21). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering)

### Relevant Previous Projects or Activities (up to 5)

- **ARTEMIS ASP4: SIMPLE “Self-organizing intelligent middleware platform for manufacturing and logistics enterprises”**  
ALM was responsible for the development of self-organising middleware adaptable to not only heterogeneous but also novel hardware platforms and business IT systems.
- **FP7-NMP-ICT-FoF: ARUM “Adaptive pRodUction Management”**  
ALM was responsible for the development of MIDAS, an agent-based platform for classification and detection of manufacturing incidents and anomalies, and ASIMOV, an agent-based platform for modeling, simulation and visualisation of strategic planning and the real-time dynamic, time-, cost- and risk-oriented re-planning of aircraft, aircraft interiors and ship manufacturing operations.

### Significant Infrastructure

- [Eve](#): an open multipurpose web-based language- and platform-independent agent platform for the integration of heterogeneous systems → vf-OS Enablers + APIs Connectors + vf-Platform Environment.
- [Vis.js](#): a JavaScript browser-based visualisation library capable to handle large amounts of dynamic data while enabling the user data interaction → OAK System Dashboard - Control Panel and Task Manager.
- [MIDAS](#): an agent-based platform for classification and detection of logistics and manufacturing network incidents and anomalies → OAK System Dashboard - Control Panel and Task Manager.
- [ASIMOV](#): an agent-based platform for modelling, simulation and visualisation of strategic planning and the real-time dynamic, time-, cost- and risk-oriented re-planning of manufacturing operations → OAK System Dashboard - Control Panel and Task Manager.

#### 4.1.9 Mondragon Assembly Sociedad Cooperativa

Participant No.	9	Organisation Name	Mondragon Assembly Sociedad Cooperativa
Country	 Spain	Short Name	MASS
Type	Industry - End User SME	Logo	

**Mondragon Assembly Sociedad Cooperativa (MASS)** designs and manufactures systems and equipment for process automation. We integrate a wide range of commercial elements in our systems and we develop tailor-made solutions to adapt to our customers' requirements providing the most profitable solution in each case.

Mondragon Assembly is in the market for over 30 years providing, in tight collaboration with clients, cost effective solutions in accordance with their needs of automation of the assembly processes. The main sectors of activity for MASS are automotive, photovoltaic, medical and cosmetic. Machinery developing for these cutting-edge sectors involves wide range of technologies to be implemented and very precise control-monitoring techniques have to be handled.

Mondragon Assembly started its activities in the Photovoltaic Sector in 2001. In view of the important growth of the solar market the decision has been taken to focus on this sector from two sides:

- Standard product catalogue



- Solutions adapted to the concrete needs of the customers productive systems, for machines as well as for complete manufacturing lines

Today Mondragon Assembly offers a complete solution for the photovoltaic module manufacturing process (turn-key). Line configuration is completely flexible, so it can adapt to the different production needs and the different levels of automation required in each case.

- In crystalline silicon cell production: Mondragon Assembly has developed laser edge isolation, cell testing and ink-jet nanosilver depositing machinery.
- In thin film sector: Mondragon Assembly has worked in amorphous silicon and in CIGS technologies with reference companies, developing customised solutions.

[www.mondragon-assembly.com/en/mondragon-assembly](http://www.mondragon-assembly.com/en/mondragon-assembly)

### Main Competences Related to the vf-OS Project

MASS is involved in other FP7 projects where very smart and flexible production lines are being developed. Mondragon Assembly is participating in SMART-FLEX project, where a PV production line is being upgraded for façade elements integrating PV cells, where a software interface enables architects to design and “print” on a PV line the just the required façade elements. MASS is also participating in a project where self-learning algorithms are being introduced in laser welding machine, enabling a continuous improvement of the laser parameters.

### Contribution to vf-OS Project

MASS will lead WP8 vf Smart Application Piloting and Validation, as one of the enterprises participating in the vf-OS pilots. MASS will participate in Task 8.1 Validation Scenarios. Specifically, MASS will lead Task 8.2 Pilot 1: Manufacturing & Logistic – Automation “Spare-parts advanced management in automation production equipment”. MASS will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results. Relevant machine data selection, data exporting to smart-apps and definition of the specifications to be fulfilled by the apps will be done by MASS. In connection with this user role MASS will also lead T1.2 – Use Case characterisation

No.	Collaborators Profile
C 1	<b>Jean Philippe AGUERRE (Male).</b> DEA in electro-mechanic engineering, since 1995 employed by Mondragon Assembly, at present as R&D manager and R&D department leader. Large experience in national and European research projects, mainly focused on development of new manufacturing equipment and processes. ( <a href="mailto:jph.aguerre@mondragon-assembly.com">jph.aguerre@mondragon-assembly.com</a> )
C 2	<b>Jesus Maria VITERI (Male).</b> Master degree in automatic and electronic engineering, since 1994 employed by Mondragon Assembly, at present as responsible of electronic department. Specific competences in artificial vision systems and robotics. ( <a href="mailto:Viteri@mondragon-assembly.com">Viteri@mondragon-assembly.com</a> )
C 3	<b>Eduardo García Zalama (Male).</b> Master degree in mechanical engineering, since 2006 employed by Mondragon Assembly. At present mechanical designer of new machines for new sectors. Specific competences in finite element simulation software, acoustics and vibration. ( <a href="mailto:e.garcia@mondragon-assembly.com">e.garcia@mondragon-assembly.com</a> )

### Relevant Previous Projects or Activities (up to 5)

- **H2020-FoF: COMBILASER “COMbination of non-contact, high speed monitoring and non-destructive techniques applicable to LASER Based Manufacturing through a self-learning system”.**  
MASS is working on WP5 and WP6 integrating monitoring systems and laser process, in order to build a compact solution integrating self-learning algorithm.
- **FP7-NMP-ICT-FOF (RTD): HINMICO “High throughput integrated technologies for multimaterial functional Micro Components”.**  
MASS is working in WP4 developing smart actuators for gripping micro-parts, and positioning them into assembly processes.
- **FP7-NMP-ICT-FOF: APPOLO “Hub of Application Laboratories for Equipment Assessment in Laser Based Manufacturing”.**  
MASS is working on developing laser scribing tool for thin film PV for WP3) and developing a laser induced forward transfer process in WP7.

- **FP7-ENERGY: SMART-FLEX “Demonstration at industrial scale of the FLeXible manufacturing of SMART multifunctional photovoltaic building elements”.**  
MASS is working on WP4 and WP5, upgrading a conventional PV production line, enabling façade element production directly designed by the architect.
- **FP7-GC-ELECTROCHEMICAL-STORAGE: GREENLION “Advanced manufacturing processes for Low Cost Greener Li-Ion batteries”.**  
MASS has been working on WP4 and WP5 design a flexible production line for lithium-ion batteries.

### Significant Infrastructure

Mondragon Assembly Group has four production plants located in Queretaro (Mexico), Stockach (Germany), Orange (France) and the headquarters in Aretxabaleta (Spain). Mondragon Assembly's main plant has the following characteristics: (i) plant 1500 \* 3 = 4500 m<sup>2</sup> own + 2000m<sup>2</sup> offices (with engineering software); (ii) cranes up to 200 tonnes and (iii) It employs 90 people. Apart from these production plants, Mondragon Assembly has business delegations to capture orders in other strategic markets: a commercial office in San Diego (USA), and commercial offices in India and China.

To continuously advance methodology, Mondragon Assembly created in 2003 an R&D centre, Koniker S.Coop, in collaboration with other companies from the Mondragon Group. This R&D centre is oriented to make innovations and develop new products that are specially oriented with the needs of Mondragon Assembly.

#### 4.1.10 Via Solis UAB

Participant No.	10	Organisation name	Via Solis UAB
Country	 Lithuania	Short name	VS
Type	Industry - End User SME	Logo	

Via Solis UAB (VS) was founded in 2009. VS is a producer of PV modules with the main target of becoming a reliable partner of global renewable energy industry and to create a place where tomorrow's solar technologies are born. More than 4 million Euro was granted to Via Solis from European Regional Development Fund<sup>17</sup> for building up of the cutting edge PV manufacturing facilities with the flexible production line for innovative glass/glass type c-Si modules of 60 MW annual capacity mainly targeted to BIPV and modern architectural applications. The plant became fully operational in the middle of 2012. As a manufacturer of multifunctional smart PV module that can be customised to meet project-specific architectural requirements, VS is a partner and consultant when it comes to designing, planning and constructing innovative, energy-optimised solar solutions for the building envelope.

Innovative module technology requires active interaction with global technology development leaders and the most innovative material and equipment suppliers. Therefore, the company is constantly focused on participation in different research and innovation projects and on networking in global trade fairs, summits and conferences in order to gain up to date knowledge and improve the competences. It is a member of Lithuanian Photovoltaic Technologies Cluster that brings together 15 high-tech companies, 7 academic institutions and is dedicated to enhance the global integration and competitiveness of Lithuanian photovoltaic value chain. The mentioned Cluster is a member of European Photovoltaic Industry Association (EPIA).

[www.viasolis.eu](http://www.viasolis.eu)

### Main Competences Related to the vf-OS Project

VS has a previous experience in the integration of advanced factory management tools in real production. A production control, enabling direct product ordering from a client software dedicated to architects, has been developed in other project, which is being implemented in production line and being used as factory managing tool. VS' production engineering team is highly skilled in programming in multiple languages, and is able to directly interact with software developers of the consortium.

### Contribution to vf-OS Project

VS will participate in the WP8 vf Smart Application Piloting and Validation as being one of the pilot enterprises. VS will thus participate in Task 8.1 Validation Scenarios in the Task 8.2 Pilot 1: Manufacturing & Logistic – Automation “Spare-parts advanced management in automation production equipment”. VS will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results.

No.	Collaborators Profile
C 1	<b>Rimvydas KAROBLIS (Male)</b> – since 2010 President of VS with main activities and responsibilities of development of new innovative technology and solutions; strategic business development and renewable energy resource, practical use and applications. Bachelor’s degree in Business management (Kaunas University of Technology, Lithuania 1998). Since 2008 he is an active member of Lithuanian Association of Solar Energy and since 2009 – Photovoltaic Technology and Business association (LT). ( <a href="mailto:rimvydas@viasolis.eu">rimvydas@viasolis.eu</a> )
C 2	<b>Gailimantas VENSKUTONIS (Male)</b> – In 2008 has graduated Electric and electronic engineering master degree and is continuing his PhD studies within the same field. Since 2014 is a production line engineer in VS with the main responsibilities in electric diagnostics, troubleshooting, improvement of technological process of PV module production. Since 2015 is a Production manager of VS photovoltaic modules manufacturing line. ( <a href="mailto:info@viasolis.eu">info@viasolis.eu</a> )
C3	<b>Modestas PIKUTIS (Male)</b> – Graduated from Vilnius Gediminas Technical university completed its PhD thesis in January 2016. Expert in glass-glass PV modules manufacturing, definition of technological process parameters and in implementation of repetitive-flow manufacturing approach.



### Relevant Previous Projects or Activities (up to 5)

- FP7-ENERGY: **SMARTFLEX** “Demonstration at industrial scale of the FLeXible manufacturing of SMART multifunctional photovoltaic building elements”  
VS participated in RTD activities as well as demonstration tasks
- VS has participated in the following relevant projects from European Regional Development Fund:
- VP2-1.3-ŪM-01-K-02-304: “Preparation for a research of Photovoltaic module manufacturing materials”
  - VP2-1.3-ŪM-01-K-02-305: “Preparation for a research of household refrigeration appliances manufacturing materials”
  - VP2-1.3-ŪM-02-K-02-079: **NANOPLAST** “New generation of insulating porous material development using functional nanomaterials”
  - VP2-1.4-ŪM-02-K-01-001: **PVPLIUS** “Open access RTD infrastructure of Photovoltaic Technologies Cluster”

### Significant Infrastructure

Facilities in VS: the flexible PV module manufacturing line, composed of Solar cell (SC) testing and sorting system (included in soldering system), Glass washing system, System for cutting of lamination films (EVA, PVB or analogous) and back sheet, Soldering system (Stringer) and System for placing of SC on glass (Lay up), System of manual joining, quality control and placing of films, Lamination system, Edge sealing system, Fastening of junction box placing system, Testing of V-A parameters and High voltage testing, The System for setting module framing-mounting parts, Packing system, Production sorting system, Conveyor system and Process Control system for the PV modules. The manufacturing line is located in 3000 m2 area in low energy building together with other Lithuanian PV value chain manufacturers (solar cells, BOS)

#### 4.1.11 CONSULGAL - Engenharia e Gestao SA.

Participant No.	11	Organisation Name	CONSULGAL –Engenharia e Gestão, S.A
Country	 Portugal	Short Name	CON
Type	Large enterprise	Logo	

Established in 1985, 100% owned by Portuguese shareholders, **CONSULGAL – Engenharia e Gestão, S.A. (CONSULGAL)** is presently one of the major Portuguese consultancy companies, providing a wide range of multi-disciplinary services to its Clients in engineering fields, particularly those related to Project Management and Works Supervision.

We pursue the development of state of the art techniques that respond to the current market needs and requirements and we are systematically improving our services with innovative and competitive solutions, pursuing our vision of being an important services provider and a group with a solid international presence, capable of developing quality consultancy technical services that effectively represent added value to our Clients. CONSULGAL Group has won for its companies and staff wide credibility and reputation, both national and internationally, through its ethical values, integrity, professionalism, technical capacity and efficient performance.

CONSULGAL is the parent company of a group of companies with permanent links to international firms of great prestige, specialised in several areas and covering a wide range of complementary activities, namely, SISAQUA, MOTTCONSULT, MARMA and CARGOGAL. CONSULGAL has subsidiaries in Brazil, Macau, Romania, Hungary, Bulgaria, Angola, Mozambique and Libya, and has carried out projects in other markets such as Poland, FYROM, Turkey, Cape Verde, São Tomé e Príncipe, among others.

In its activity, CONSULGAL covers a wide range of services in several areas, focusing particularly in multidisciplinary project teams coordination, providing a set of consultancy and management services to governmental and private entities in Portugal and abroad, comprising economical and technical studies, consultancy, architecture and engineering design, project management, planning and works coordination and supervision, covering the whole range of Engineering fields and related subjects.

CONSULGAL is registered as Consultant at the EBRD – European Bank for Reconstruction and Development, WB – The World Bank and at the BAD - African Bank for Development and is linked to various national and international organisations.

CONSULGAL's Integrated Quality, Environmental and Health&Safety at Work Management System is certified, according to the requirements of ISO 9001, ISO 14001 and ISO18001, by APCER and IQNet.

[www.consulgal.pt](http://www.consulgal.pt)

#### Main Competences Related to the vf-OS Project

CONSULGAL brings extensive expertise in construction supervision, construction management and engineering, and a profound knowledge of construction industry and construction methodologies. CONSULGAL's positioning in a typical construction project is that of hub between the various stakeholders and of guarantor, towards its client, of the contract agreement fulfilment. This positioning allows us to interact with suppliers, contractors, designers, workers, institutions, municipalities and even the population. It allows us also to have a clear insight of the difficulties involved in the implementation of a construction project and of its impact on its surroundings. Our technical and managerial expertise is constantly brought about for problem solving and the definition of innovative ways to approach the projects

CONSULGAL has participated in other innovation projects, funded by the EU, in which our profound knowledge of construction, our capacity to face new and challenging situations and our "out of the box" way of thinking have proved to be of great relevance. These are competences that we intend to bring to and maximise in this project.

#### Contribution to vf-OS Project

CONSULGAL will vice-lead WP8 vf Smart Application Piloting and Validation, as one of the enterprises participating in the vf-OS pilots. CONSULGAL will specifically participate in Task 8.1 Validation Scenarios. CONSULGAL will lead the Task 8.3 Pilot 2: Construction – Industrialisation: "Virtual Construction Factory". CONSULGAL will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results. Moreover, CONSUGAL will also participate in WP1, as a vice-leader of T1.2 User

Scenarios Characterisation. Finally, CONSUGAL will participate in WP9 by supporting the definition of vf-OS exploitation strategy and the collaborative and its individual exploitation plan and in impact activities, publicising vf-OS to its clients and partners contributing to achieve the objectives of WP10.

No.	Collaborators Profile
C 1	<p><b>Paulo RODRIGUES (Male)</b> holds a 5-year Degree in Chemical Engineering by IST-UTL (Higher Institute of Technology at the University of Technology of Lisbon, Portugal), and an MSc and a PhD in Biochemical Engineering by UMIST (University of Manchester Institute of Science and Technology, UK). Dr. Rodrigues is International Projects Coordinator for Eastern Europe and Responsible for Institutional Relations and Innovation at Consulgal. He coordinated Consulgal's participation in the project FITMAN – Future Internet Technologies for MANufacturing, co-financed by FP7, being responsible for developing the case-study, setting the KPIs, testing the application developed and representing the company at the implementing consortium. He is responsible for market researches, identifying project opportunities, market strategy definition, commercial offers coordination and project implementation support for international projects. (<a href="mailto:paulo.rodrigues@consulgal.pt">paulo.rodrigues@consulgal.pt</a>)</p>
C 2	<p><b>José SOUSA MATOS (Male)</b> holds a 5-year Degree in Civil Engineering by the University of Luanda and a Postgraduate degree in Geotechnology from the Nova University of Lisbon. He has 35 years of professional experience in leading complex projects, being the Project Director for the rehabilitation of Oporto Airport, of Picote Dam and of Baixo Sabor Dam, among others. As Project Director he coordinates the supervision team and acts as interface between the Client, the supervision team, public institutions and the Works Contractor. He has a profound knowledge of construction, construction supervision and construction management (<a href="mailto:sousa.matos@consulgal.pt">sousa.matos@consulgal.pt</a>)</p>
C 3	<p><b>Susana MARTINS (Female)</b> holds a 5-year Degree in Civil Engineering by Independent University of Lisbon. With 15 years professional experience, she is currently Director of Environmental Infrastructures Construction Supervision, being responsible for managing the supervision teams and for interfacing with the Client. She has managed complex works such the Alcantara Wastewater Treatment Plant (700 000 PE) construction supervision, or the Seixal organic waste composting plant. She acts also, in some contracts, as Quality Manager having, thus, an excellent understanding of the requirements each party involved in a construction project needs to fulfil (<a href="mailto:susana.martins@consulgal.pt">susana.martins@consulgal.pt</a>)</p>

#### Relevant Publications and/or Products, Services (up to 5)

Relevant services:

- Construction supervision of Budapest Airport Terminal 2 Expansion (Dec. 2008 – Aug. 2012)
- Project management and construction supervision of the new Port of Nacala, in Mozambique (Mar. 2012 – Mar. 2016)
- Detailed design for São Paulo Metro expansion (since Mar. 2013)
- Project Management and construction supervision of Oporto Metro (Aug. 2005 to Mar. 2012)
- Construction supervision of Lugoj – Deva motorway, in Romania (Jul. 2010 – Jul.2016)

#### Relevant Previous Projects or Activities (up to 5)

- **FP7-FI-ICT: FITMAN “Future Internet Technologies for Manufacturing”.**  
Consulgal developed the case-study used as base for the development of an application, based on FIWARE, for the control of concrete in a construction site. The project used as model was the Baixo Sabor Dam and the application was later tested also in the rehabilitation of Estoril Grand Hotel.
- **FP5-IST: SABARECO “Satellite-Based Remote Multi-Project Reporting and Controlling in Construction Industry”**

#### Significant Infrastructure

CONSULGAL is developing its own Cloud infrastructure. Additionally, we have ca. 100 desktop high performance computers and over 200 mobile devices (computers, smartphones, and tablets). CONSULGAL has also its own soils and concrete testing laboratory and a design division with software for design development using BIM.



#### 4.1.12 Knowledgebiz LDA

<b>Participant No.</b>	12	<b>Organisation Name</b>	Knowledgebiz LDA
<b>Country</b>	 Portugal	<b>Short Name</b>	KBZ
<b>Type</b>	SME	<b>Logo</b>	

**Knowledgebiz LDA (KBZ)** is a Portuguese innovation and information systems consultancy company. KBZ is a spin-off company from Neobiz Consulting and with a close ties with Faculdade de Ciências e Tecnologia da UNL. The company's main mission is to deliver innovative information systems design and implementation. It specialises in developing strategies for interoperability and information integration using standards and establishing new standards, standards' reuse and harmonisation; intelligent mapping, meta-modelling, open platforms, architectures and toolkits to support and speed-up the implementation and adoption of local and web-based Electronic Data Interchange using and integrating standards and "de facto" standards, like UN/EDIFACT, ISO/STEP, XML, IDL, etc. KBZ has also being active on technology enhanced learning and adaptive training for the development of companies' internal competencies. KBZ is among the pioneers in Portugal on addressing business interoperability in disparate economic sectors such as the paper sector, or the architectural, engineering and construction sector (AEC).

[www.madanparque.pt/pt/empresa/knowledgebiz-consulting](http://www.madanparque.pt/pt/empresa/knowledgebiz-consulting)

#### Main Competences Related to the vf-OS Project

KBZ develops strategy and architectural design to cooperative and collaborative information systems solutions, on inter-organisational and international environments. KBZ has developed its competences on providing architectures for information systems in complex networks, covering the whole product life-cycle including training and standardisation. KBZ analyses, designs and implements industrial and service engineering and management solutions, namely business models and strategic management performance systems, using sophisticated methodologies for decision modelling. KBZ has strong links with academia and research centres. Its partners, and part of the 10 people team, are lecturers in the university or have some form of bond with academia. KBZ is a reference for training in major Portuguese public and private organisations. KBZ has recently developed competencies on Machine Learning and Big Data industrial projects on the Hospitality and Insurance sectors, particularly on the development of processing data extracted from social networks and web sites through crawlers and wrappers, and knowledge representation through ontologies, supported by cloud-based systems. Also, its experience in technology enhanced learning resulted in a platform for adaptive learning suitable to deliver training customised to different profiles, tailored training programmes and delivery methods.

#### Contribution to vf-OS Project

KBZ will vice lead WP9 Business Model and Exploitation, and will participate as a leader in Task 9.2 Exploitation Business Models, contributing with its wide knowledge in the exploitation of appropriate business models and strategies for vf-OS exploitation. Moreover, KBZ will lead WP10, coordinating the strategies and activities of vf-OS impact, leading Task 10.1 and Task 10.3. KBZ has strong participation in WP8 and will participate in the Task 8.3 Pilot 2: Construction – Industrialisation: "Virtual Construction Factory". KBZ will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results. KBZ will also participate in the task defined in WP1 for the Vision, Scenarios and Requirements. Finally, KBZ will participate in exploitation activities providing its ability to apply the know-how gained in vf-OS project and in dissemination tasks (WP10).

No.	Collaborators Profile
C 1	<b>Prof. António GRILO (Male)</b> has a 5 year bachelor degree in Civil Engineering at IST-UTL, Portugal, a MSc in IT by University of Salford, UK, and a PhD in Industrial Engineering – e-Business, by University of Salford, UK. He

	<p>is the CEO of Neobiz Consulting since 2005. In 2009, he also became the CEO of Knowledgebiz. António will lead the company's involvement in the project and will lead WP6. He has been an Information and Management Systems consultant since 1995. António is an Assistant Professor at the Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, in Portugal, in the Department of Mechanical and Industrial Engineering and Management. He has over 90 papers, books and chapters published on interoperability and information systems. Prof. António Grilo is a DG CONNECT expert consultant since 2000, working as an external evaluator and reviewer in various EC projects. He has been the co-editor of the European Commission report "Unleashing the Potential of the European Knowledge Economy: Value Proposition for Enterprise Interoperability", and leading author of the book "Building Information Model and the Competitiveness of the Construction Sector". He is the Coordinator of several research projects namely VORTAL SOCIAL APPS, SEMANTIK, 3i BUILDING, and participant as an external Scientific Expert on FP7 projects ENSEMBLE and RESILIENCE, and more recently he is the coordinator of the H2020 Startup Europe DIGISTART project and Coordinator of the winning phase III FABULOUS FI-PPP Open Call: CoProdDev - Cloud enabled collaborative platform for products development. (<a href="mailto:Antonio.grilo@neobiz-consulting.pt">Antonio.grilo@neobiz-consulting.pt</a>)</p>
C 2	<p><b>Mirla OLIVEIRA (Female)</b> has a 5 years degree in Information Technology, and a MSc in Financial Management. She has 20 years of experience in large-scale ICT projects, particularly in the banking, insurance and AEC sectors. In the last 8 years, she has been involved in Business Interoperability projects, and more recently in FI-WARE platform development in FITMAN project. She is PMP certified by PMI. (<a href="mailto:mirla.oliveira@knwoledgebiz.pt">mirla.oliveira@knwoledgebiz.pt</a>)</p>
C 3	<p><b>Tahereh NODEHI (Female)</b> has recently finished a PhD in Electrical and Computer Engineering by Faculdade de Ciências e Tecnologia da UNL, having developed a research work in MDA-SOA based Framework for Intercloud Interoperability. She has a MSc in Computer in Engineering, having developed a dissertation in Routing in Networks with Limited Forwarding Capability" (Mobile Ad-Hoc Wireless Networks). She has strong competencies in Cloud Computing and Cloud Interoperability, MDA and SOA concepts research areas, and Generic Algorithm with Agent Based Simulation Modeling. (<a href="mailto:tahereh.nodehi@knwoledgebiz.pt">tahereh.nodehi@knwoledgebiz.pt</a>)</p>

#### Relevant Publications and/or Products, Services (up to 5)

- Jardim-Goncalves, R., Grilo, A., Agostinho, C., Lampathaki, F., & Charalabidis, Y. (2013). Systematisation of Interoperability Body of Knowledge: the foundation for Enterprise Interoperability as a science. *Enterprise Information Systems*, 7(1), 7-32
- Grilo, A., & Jardim-Goncalves, R. (2013). Cloud-Marketplaces: Distributed e-procurement for the AEC sector. *Advanced Engineering Informatics*, 27(2), 160-172
- Marques-Lucena, C., Sarraipa, J., Fonseca, J., Grilo, A., & Jardim-Goncalves, R. (2015). Framework for customers' sentiment analysis. In *Intelligent Systems' 2014* (pp. 849-860). Springer International Publishing.
- Mehrbod, A., Zutshi, A., & Grilo, A. (2014). Semantic and Syntactic Matching of e-Catalogues-Using Vector Space Model. In *ICE-B 11th International Conference on e-Business, Part of ICETE 2014 - 11th International Joint Conference on e-Business and Telecommunications*, (pp. 224-229)
- Grilo, A., Jardim-Goncalves, R., & Ghimire, S. (2013, July). Cloud-Marketplace: New paradigm for e-marketplaces. In *Technology Management in the IT-Driven Services (PICMET), 2013 Proceedings of PICMET'13*: (pp. 555-561). IEEE

#### Relevant Previous Projects or Activities (up to 5)

- H2020-ICT: DIGISTART "Support Ecosystems for Digital Startups"**  
The project aims to foster the development of entrepreneurship in university ecosystems, and the main participation on the project is related with providing agent-based simulation tools for analysing the performance of various configurations of the business models. This is particularly related with WP9 Business Model and Exploitation of this proposal.
- ISOFIN**  
This project developed an ontology and web-services based infrastructure to the insurance and banking industry. The participation of the KBZ was related with the development of the ontology and of the development of interoperability-related web services for heterogeneous applications. This project is well aligned with WP3 Virtual Factory System Kernel.
- SEMANTIK**  
This project aims to develop a semantic web competitive intelligence tool, applied to hospitality industry and



paper retailing, having developed crawlers and wrappers to web sites. This project is aligned with WP3 Virtual Factory System Kernel.

#### Significant Infrastructure

KBZ has its main office and development facilities in the Madan Parque ([www.madanparque.pt/en](http://www.madanparque.pt/en)), the science park of Faculdade de Ciências and Tecnologia da Universidade NOVA de Lisboa. The facilities combine office space with labs and development areas, with excellent conditions for testing the outputs of the project. KBZ is one of the enterprises incubated in the park ([www.madanparque.pt/pt/empresa/knowledgebiz-consulting](http://www.madanparque.pt/pt/empresa/knowledgebiz-consulting)), as a result from an active knowledge transfer initiative from research and development at the university to a stronger market approach. KBZ uses its active position in the science park and experience from its collaborators in the field of information systems engineering and business models and exploitation so that it can contribute to an effective knowledge transfer of the project results to the market. KBZ uses Madan Parque facilities for physical infrastructure and FCT-UNL's as a human capital pool of researchers and post-graduates for their projects.

#### 4.1.13 Applications Plastiques du Rhone SAS APR

Participant No.	13	Organisation Name	Applications Plastiques du Rhone SAS
Country	 France	Short Name	APR
Type	Industry - End User SME	Logo	

**APPLICATIONS PLASTIQUES DU RHONE (APR)** company was founded in 1974. Its business activities are in the plastic manufacturing industry. To meet the customer expectations over its 40 years of existence it has built other technical solutions such as boilers, injection, trading, and thermoforming or moulding by casting. Certified ISO 2001 since 2005, it continues to improve customer satisfaction and maintains diversified IT based collaboration with its main partners (AREVA, SCHNEIDER, IVECO, NEC AERO, etc.).

[www.apr-plastiques.fr](http://www.apr-plastiques.fr)

#### Main Competences Related to the vf-OS Project

APR accelerates its development through its "CAP 2020" programme. It is about a set of challenges to reach by 2020. The refocusing of its business activities on energy, transport, water treatment, food processing and industrial electronics, can provide even greater responsiveness to the requirements of its customers. In this perspective, the enhancement of IT based industrialisation capabilities will help APR to propose more valuable services to its customers. With its turnover increasing by 30% in the last three years, APR confirms its motivation to test new Internet based capabilities as one of its strategic growth perspectives.

#### Contribution to vf-OS Project

APR has strong participation in WP8 and will participate in the Task 8.4 Pilot 3: Manufacturing Assembly: Collaboration - "Towards new business collaboration channels in Virtual Factory", as member of the collaborative business scenario to be developed with the TARDY SME. As presented in the different WPs, the new smart applications will help to evaluate the capability of the both partners to collaboratively produce a new customer project. The targeted smart application will guide to select of the best suited engineering and industrialisation capabilities. Moreover, APR will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results. APR will also participate in the task defined in WP1 for the Vision, Scenarios and Requirements. APR will participate in WP9 by supporting the definition of vf-OS exploitation strategy and the collaborative and its individual exploitation plan. Finally, APR will disseminate (WP10) vf-OS project among plastic industry with the regional economic cluster in France (Plastipolis) and other partners of different sectors.

No.	Collaborators Profile
C 1	<b>Arnaud LOUVEL (Male)</b> is the general director of APR since 2001. He holds a Master's in computer science and a Management and Business Administration from the IFG. Firstly he integrated APR as computer system manager (for ERP integration). Then he took over the financial management responsibility and later the production. One of the current management objectives consists of the investment in the IT perspective as the future of business collaboration. Many valuable customers are already performing IT based collaboration and future market opportunities should be there. Louvel supports this position with the shareholders of the company. Louvel will be supported by business and IT collaborators. ( <a href="mailto:alouvel@apr.eu">alouvel@apr.eu</a> )
C 2	<b>Benjamin MENGHINI (Male)</b> is the IT manager of APR. He graduated from the University of Lyon 2 and the IT department supports the development of the production systems and related business collaborative processes. Benjamin brings competences in computer science, project management and change management support in industry. ( <a href="mailto:informatique@apr.eu">informatique@apr.eu</a> )

#### Relevant Publications and/or Products, Services (up to 5)

Under FP7-FI-ICT-2013-604674: FITMAN "Future Internet Technologies for Manufacturing" project, APR developed new FI-based system as support for personalised collaboration with selected sets of customers and suppliers. The proposed system is developed by integrating 3 Generic Enablers from the FI-WARE platform, 3 Specific Enablers from the FITMAN project and 4 open sources.

#### Relevant Previous Projects or Activities (up to 5)

- **FP7-FI-ICT-2013-604674: FITMAN "Future Internet Technologies for Manufacturing"**  
Under the FITMAN project, APR supports the development of a prototype for plastic industry integrating FI enablers to enhance the information quality for six collaborative business processes with customers and suppliers.
- **Crutch Clip: "Smart Support for Underground Electrical Networks"**  
Through the support of an innovative development action supported by the national agency for industrial innovation (OSEO) in France, APR develops its specific catalogue of products and publishes patents to protect APR innovative solutions, especially those for construction industry.

#### Significant Infrastructure

In order to support the business acceleration capabilities to be developed under this project, APR industry provides the following facilities:

- IT infrastructure to support the new business processes for product industrialisation acceleration
- The interaction with pilot partners to test the relevance of the new solution developed under this project

#### 4.1.14 Tardy SAS

Participant No.	14	Organisation Name	Tardy SAS
Country	 France	Short Name	TARDY
Type	Industry - End User SME	Logo	

Since 1949, **TARDY SA (TARDY)** is identified as an active player in mechanical industry in the south east France. It offers a high level of design knowledge and a large park of advanced manufacturing equipment serving the machining and engineering of mechanical parts (4kg to 40T). Its turnover is 11 million Euro (direct export 6 %) and it is entirely a family business. Moreover, it is certified with ISO 9001 and EN 9100.

[www.tardy.fr](http://www.tardy.fr)

### Main Competences Related to the vf-OS Project

The IT strategy of Tardy targets the maximisation of interoperability with customer software and proposes several collaboration channels helping to detect and track customer projects. In this perspective, Tardy brings to the vf-OS project its expertise in collaborative supply chain enablers and their impacts at the business level.

### Contribution to vf-OS Project

TARDY has strong participation in WP8 and will participate in the Task 8.4 Pilot 3: Manufacturing Assembly: Collaboration - "Towards new business collaboration channels in Virtual Factory", as member of the collaborative business scenario to be developed with the APR SME. The targeted smart applications will help to evaluate the capability of the both partners to collaboratively produce new customer project proposals and will guide to select of the best suited engineering and industrialisation capabilities. TARDY will participate in the tasks related to collecting the base data, structuring and testing the solution and communicating the results. TARDY will also participate in the task defined in WP1 for the Vision, Scenarios and Requirements. TARDY will participate in WP9 by supporting the definition of vf-OS exploitation strategy and the collaborative and its individual exploitation plan. Finally, TARDY will disseminate the vf-OS project among their partners in the metal industry, contributing to the achievement of WP10 objectives.

No.	Collaborators Profile
C 1	<b>Jean Régis TARDY (Male)</b> is the president of his family company. He assumes several responsibilities in sales and marketing allowing him to be more close to his customers and their expectations. Jean Régis drives the development of Tardy company in order to improve their mechanical design capabilities, as well as transformation technologies. The IT strategy of Tardy covers the acquisition of the main specialised mechanical software solutions as well as solutions helping to improve the capacity of the company in terms of collaboration, quality insurance, security, etc. ( <a href="mailto:JRTARDY@tardy.fr">JRTARDY@tardy.fr</a> )
C 2	<b>Francine FANGET (Female)</b> is the quality manager of Tardy SAS and she have in charge the development and the maintain of quality certification (EN 9100 and ISO 9001). She drives the management of product quality throughout its lifecycle in connexion with the QMS of Tardy. She also manages the non-conformance procedures. With several competences in QMS,QHSE, etc. Francine FANGET participates to the validation and the integration of the pilote proposed by Tardy. ( <a href="mailto:FFRANGET@tardy.fr">FFRANGET@tardy.fr</a> )

### Relevant Publications and/or Products, Services (up to 5)

- **Technical Reference Frame - TRF: "constitution of business domain service portfolio".**  
Facing the diversity of customers' business domains (aeronautics, defence, space, etc.), Tardy develops service portfolio concepts helping to constitute the roadmap of each business domain with respect to the specificity of related products and regulations. This generic template is instantiated for each new project in order to guarantee the completeness of project development channels and help to save time and effort for blue works.

### Relevant Previous Projects or Activities (up to 5)

- **ACIEM – TARDY: "Concurrent Engineering in Collaboration"**  
In order to improve its design and realisation capabilities, Tardy develops local IT project targeting the decrease of project costs and delays. The design to cost topic was addressed by better integration between machine-to-machine and software – to – machines at the shop-floor. The concurrent engineering topic was introduced through new collaborative methods for pipelining customers' projects design.

### Significant Infrastructure

In order to support the collaborative objective with APR partner, TARDY will open its IT infrastructure to create the common smart application. The deployment of BigData, CPS, and others new paradigms are in the core of Tardy IT strategy. Therefore, TARDY fully support the development, test and validation of the new IT enablers proposed within vf-OS project.

## **4.2 Third Parties Involved in the Project**

It is not planned that third parties will be involved in the vf-OS project with possible exception of Information Catalyst (ICE) who is currently establishing ICE Spain and ICE Lithuania. These will be a 100% Subsidiary of ICE (UK) and the former will most probably be formally recorded as a 'Representation Office' under Spanish law. They will thus be classed as an affiliated entity and be legally linked to the ICE beneficiary and is compliant with GA Article 14. They will consist of generic software and management resources used by ICE UK and thus may be involved in any relevant part of the project.

## 5. ETHICS AND SECURITY

### 5.1 Ethical Issues

The European Commission directives on ethical rules are primarily concerned with issues that are outside the scope of vf-OS.

The project will primarily process information on the partners' products and company information and there are no plans to treat personal data (whether identified by name or not) of the partners. However, should this happen, all the information related to individuals (including pictures and digital signature, if any) will be managed after explicit consensus and in compliance with the European and national legislation of the countries of interest. Thus, all participants in vf-OS project will conform to the legislation and regulations in force in the countries where the research will be carried out as well the EC Ethical Legislation, where the most relevant rules to the project are:

- The Charter of Fundamental Rights of the EU
- Council Directive 83/570/EEC of 26 October 1983 amending Directives 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data

During the vf Smart Application Piloting and Validation phases, it might be possible that end users will introduce personal information, but it will be performed, stored, and processed according to ethical principles that, in any case, represent the normal behaviour of the partners:

- The candidate companies/users will be carefully informed about benefits, costs, and implications of the proposed innovation. Also, the procedure to follow for introducing innovation will be explained in detail
- The parties will be required to agree on the planned procedure and to follow it
- The parties are completely free to accept or reject the proposal, or withdraw at any stage of the innovation introduction process

Attention is also put on security issues, as the parties must warrant that no drawback or damage can come from adopting the proposed innovation even at the experimental stage. This is particularly important to ensure trust and confidence since the ICT service is provided in service form; meaning that the software is running on a centralised server in the case that the companies use vf-OS via Internet in the cloud. Security will be pursued in three main directions that call for proper security protocols:

- Confidentiality: Ensuring that information is not accessed by unauthorised persons
- Authentication: Ensuring that the users of critical functions are the persons they claim to be
- Integrity: Ensuring that external occurrences cannot alter the information in such a way to be not detected by authorised persons

Also "external" data, including that of beneficiaries and external data warehouses, could potentially contain personalised information. It can be assumed that if the sources are in Europe they would (must) also be coherent with the same directives putting appropriate policies or approval in place such that identifiable information has been pre-approved for access. However, to be certain for all attached warehouse this question will be specifically commented on during the initial phases of the project in WP1.

Finally, some of the partners may plan to exploit the project results towards developing countries in Europe. They are aware that this must be performed according to ethical procedures that force ascertaining the existence of a correct relation between local conditions, real benefits given by the innovation and cost that the receiving companies have to pay. Nevertheless, the Consortium Agreement will rule all these and other aspects and will set up the conditions of exploitation. A further discussion on this Personal Data issue is addressed below.

### 5.2 Policy Issues

In order to spread awareness and knowledge and to explore the wider societal implications of the proposed work, vf-OS will closely cooperate with various organisations where applicable and it will collaborate with other projects. The experience of the project partners will lead to a synergy of work and a close cooperation between multiple EU projects. Furthermore, those contacts can be useful when organising the workshops and when bringing together experts from various domains. vf-OS will use its networks to collect research results and to

foster an active and meaningful discussion about its topics. The result of those activities will be formulated as policy recommendations that could be used by the EC for standardisation issues in the various initiatives where the European Union/Commission may collect such information.

vf-OS will have to deal with a large number of issues that might be different for every European country. There are a lot of political and economic constraints that directly depend on the physical location of a company. Most projects completely ignore those differences and treat all companies equal.

However, in order to provide a genuine benefit for the companies, vf-OS has to bear in mind these political and economic differences. For example, two companies might have different political laws or different taxes regardless of the technologies available in vf-OS, etc. This might lead to differences when changing a technological infrastructure (e.g. when switching to a new technology), since it might influence the costs-effectiveness of a process.

### 5.3 Security

- Activities or results raising security issues: NO
- 'EU-classified information' as background or results: NO



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**Annex A: Informative Resource Grid (XLS vs 5)**

WP / Task			Lead	Vice	ICE	MASS	IKERLAN	UNINOV	UPV	CMS	LYON2	ASC	ALM	APR	VS	CON	KBZ	TARDY
					P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
<b>WP1: Vision, Scenarios and Requirements</b>			UPV	ICE														
WP1	T1.1	Vision Consensus	ICE	0	3	2	1	1	2	1	1	1	2	1	1	1	1.5	1
	T1.2	User Scenarios Characterization	MASS	0		4		2						2	2	1	1.5	2
	T1.3	Provider Scenarios Characterization	ALM	0	1.5		1			1		1	2					
	T1.4	Existing Solutions and Technologies	UPV	0	0.5	0.5	1	2	3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	T1.5	Requirements Specification	CMS	0	0.5	1	0.5	1	3	3	0.5	0.5		1	1	1	1	1
<b>WP2: Virtual Factory Operating System Architecture</b>			ASC	UPV														
WP2	T2.1	Global Architecture Definition	ICE	0	4	0.5	2	2	3	2	2	3	2	0.5	0.5	0.5	0.5	0.5
	T2.2	Functional Specification & Modeling	UPV	0	3	1	2	2	4	2	2	3	2	1	1	1	1	1
	T2.3	Technical Specification	ASC	0	2		2	2	3	2	2	6	2				1	
	T2.4	Holistic Security and Privacy Considerations	IKERLAN	0			2			1		0.5					0.5	
<b>WP3: Virtual Factory System Kernel</b>			UNINOV	LYON2														
WP3	T3.1	vf-OS Kernel and FI-WARE Framework	UNINOV	0				8			3						5	
	T3.2	FI-WARE Generic Enablers	UNINOV	0				14			0						5	
	T3.3	FI-WARE Manufacturing Enablers	LYON2	0				8			9						0	
	T3.4	vf-OS Enablers	KBZ	0				0			4						14	
	T3.5	vf-OS Process Enabler	ICE	0	16			0									0	
<b>WP4: Virtual Factory I/O</b>			UPV	LYON2														
WP4	T4.1	Devices Driver and Open API Tool	UPV	0					7		0		0					
			UPV	0					9		9		4					
	T4.2	Devices Drivers	UPV	0					11		0		8					
	T4.3	APIs Connectors	LYON2	0				0			18		0					
	T4.4	Security & Data Access	IKERLAN	0			8						0					
<b>WP5: Virtual Factory Data and Connect</b>			ICE	IKERLAN														
WP5	T5.1	Data Infrastructure Middleware	UNINOV	0		0.5	6	12						0.5	0.5	0.5	0.5	0.5
	T5.2	Data Storage	IKERLAN	0		0.5	5	5				0		0.5	0.5	0.5	0.5	0.5
	T5.3	Data Harmonisation	ICE	0	18	0.5	0	8						0.5	0.5	0.5	0.5	0.5
	T5.4	Data Analytics	ICE	0	17	0.5	11	0						0.5	0.5	0.5	0.5	0.5
<b>WP6: Open Applications Development Kit (OAK)</b>			CMS	ASC														
WP6	T6.1	OAK SDK and Documentation	CMS	0					21		0	0						
			CMS	0					3		3	2						
	T6.2	OAK System Dashboard - Control	ALM	0					0			10						
	T6.3	OAK Front End Environment	ASC	0	0				0		26							
	T6.4	OAK Studio	CMS	0	0				31		0							
	T6.5	OAK Developer Engagement Hub	CMS	0					7		3							
<b>WP7: Platform and Integration</b>			ALM	ASC														
WP7	T7.1	vf-Platform Environment	ALM	0					0		0	23						
	T7.2	vf-mApp Store & Marketplace	ASC	0					0		26	0						
	T7.3	vf-Service Provision Framework	ALM	0							0	17				6		
	T7.4	Developer Engagement & Training	CMS	0	2		2	2	2	3	2	2	2					
	T7.5	Integration and Bug Fixing	ASC	0	2		2	2	2	2	2	4	2					
<b>WP8: vf Smart Application Piloting and Validation</b>			MASS	CON														
WP8	T8.1	Validation Scenarios	UPV	0		5	0.5	0.5	4					4	4	4	4	4
	T8.2	Pilot 1: Manufacturing & Logistics	MASS	0		13	4			4			4		10			
	T8.3	Pilot 2: Construction – Industrial	CON	0	4			4								13	14	
	T8.4	Pilot 3: Manufacturing Assembly	TARDY	0					4		4	4		10				10
<b>WP9: Business Model and Exploitation</b>			IKERLAN	KBZ														
WP9	T9.1	Business Case Opportunities and Risks	IKERLAN	0	0.25	0.25	3	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2	0.25
	T9.2	Exploitation Business Models	KBZ	0	0.25	0.25	2	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	3	0.25
	T9.3	Exploitation Strategy	IKERLAN	0	1	0.25	4	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1	1	0.25
	T9.4	Collaborative and Partner Value	IKERLAN	0	1	0.5	4	0.5	1.5	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5
<b>WP10: Impact</b>			KBZ	ICE														
WP10	T10.1	Impact Strategy and Plan	KBZ	0	1	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1	2	0.25
	T10.2	Dissemination Materials, Interactions	UPV	0	1				4								2	
	T10.3	Impact Activities	KBZ	0	2	1	3	1	1	1	1	1	1	1	1	2	4	1
	T10.4	Scientific and Industrial Workshops	UNINOV	0	1	0.5	0.5	4	1	0.5	0.5	0.5	0.5	0.5	0.5	3	0.5	0.5
	T10.5	Standards, Clustering and Interactions	UNINOV	0	2		1	4	1								3	
<b>WP11: Project and RTD Management</b>			ICE	UPV														
WP11	T11.1	Project Set Up, Metrics, and Quality	ICE	0	6	0.25	0.25	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	T11.2	Strategic and Operational Coordination	ICE	0	20													
	T11.3	EU Liaison and Reporting	ICE	0	3	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			ICE	0	3	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			ICE	0	2	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	T11.4	RTD Management	UPV	0					6			1						
	T11.5	Technical Set Up and Quality Testing	ASC	0					1			3						

## Annex B: EU vs vf-OS Deliverable IDs

DELIVERABLES				EU Global ID	EU WP ID	vf-OS D#
WP / Task						
<b>WP1: Vision, Scenarios and Requirements</b>						
WP1	T1.1	Vision Consensus	vfOS - ID1.1 - Vision Consensus(M3)	1	1	D1.1
	T1.2	Users scenarios chara	vfOS - ID1.2 - Users scenarios characterization(M4)	2	2	D1.2
	T1.3	Providers scenarios ch	vfOS - ID1.3 - Providers scenarios characterization(M4)	3	3	D1.3
	T1.4	Existing SOTA Analysis	vfOS - ID1.4a - Existing SOTA Analysis(M6)	4	4	D1.4a
	T1.4	Existing SOTA Analysis	vfOS - ID1.4b - Existing SOTA Analysis(M18)	5	5	D1.4b
	T1.4	Existing SOTA Analysis	vfOS - ID1.4c - Existing SOTA Analysis(M30)	6	6	D1.4c
	T1.5	Requirements Specific	vfOS - ID1.5 - Requirements Specification(M6)	7	7	D1.5
<b>WP2: Virtual Factory Operating System Architecture</b>						
WP2	T2.1	Global Architecture De	vfOS - ID2.1 - Global Architecture Definition(M7)	8	1	D2.1
	T2.2	Functional Specificatio	vfOS - ID2.2 - Functional Specification & Mockups(M9)	9	2	D2.2
	T2.3	Technical Specificatio	vfOS - ID2.3 - Technical Specification(M12)	10	3	D2.3
	T2.4	Holistic Security and P	vfOS - ID2.4 - Holistic Security and Privacy Concept(M10)	11	4	D2.4
<b>WP3: Virtual Factory System Kernel</b>						
WP3	T3.1	vf-OS Kernal and FI-W	vfOS - ID3.1 - vf-OS Kernal and FI-WARE Framework(M10)	12	1	D3.1
	T3.2	FI-WARE Generic Enab	vfOS - ID3.2a - FI-WARE Generic Enablers(M12)	13	2	D3.2a
	T3.2	FI-WARE Generic Enab	vfOS - ID3.2b - FI-WARE Generic Enablers(M18)	14	3	D3.2b
	T3.2	FI-WARE Generic Enab	vfOS - ID3.2c - FI-WARE Generic Enablers(M24)	15	4	D3.2c
	T3.3	FI-WARE Manufacturi	vfOS - ID3.3a - FI-WARE Manufacturing Enablers(M12)	16	5	D3.3a
	T3.3	FI-WARE Manufacturi	vfOS - ID3.3b - FI-WARE Manufacturing Enablers(M18)	17	6	D3.3b
	T3.3	FI-WARE Manufacturi	vfOS - ID3.3c - FI-WARE Manufacturing Enablers(M24)	18	7	D3.3c
	T3.4	vf-OS Enablers	vfOS - ID3.4a - vf-OS Enablers(M12)	19	8	D3.4a
	T3.4	vf-OS Enablers	vfOS - ID3.4b - vf-OS Enablers(M18)	20	9	D3.4b
	T3.4	vf-OS Enablers	vfOS - ID3.4c - vf-OS Enablers(M24)	21	10	D3.4c
	T3.5	vf-OS Process Enabler	vfOS - ID3.5a - vf-OS Process Enabler(M12)	22	11	D3.5a
	T3.5	vf-OS Process Enabler	vfOS - ID3.5b - vf-OS Process Enabler(M18)	23	12	D3.5b
	T3.5	vf-OS Process Enabler	vfOS - ID3.5c - vf-OS Process Enabler(M24)	24	13	D3.5c
<b>WP4: Virtual Factory I/O</b>						
WP4	T4.1	Devices Driver/API To	vfOS - ID4.1.1 - Devices Driver/API Toolkit - Specifications(M12)	25	1	D4.1.1
		Devices Driver/API To	vfOS - ID4.1.2a - Devices Driver/API Toolkit - Software(M18)	26	2	D4.1.2a
		Devices Driver/API To	vfOS - ID4.1.2b - Devices Driver/API Toolkit - Software(M24)	27	3	D4.1.2b
	T4.2	Devices Drivers	vfOS - ID4.2a - Devices Drivers(M24)	28	4	D4.2a
	T4.2	Devices Drivers	vfOS - ID4.2b - Devices Drivers(M30)	29	5	D4.2b
	T4.2	Devices Drivers	vfOS - ID4.2c - Devices Drivers(M33)	30	6	D4.2c
	T4.3	APIs Connectors	vfOS - ID4.3a - APIs Connectors(M24)	31	7	D4.3a
	T4.3	APIs Connectors	vfOS - ID4.3b - APIs Connectors(M30)	32	8	D4.3b
	T4.3	APIs Connectors	vfOS - ID4.3c - APIs Connectors(M33)	33	9	D4.3c
	T4.4	Security & Data Acces	vfOS - ID4.4a - Security & Data Access(M18)	34	10	D4.4a
	T4.4	Security & Data Acces	vfOS - ID4.4b - Security & Data Access(M24)	35	11	D4.4b
<b>WP5: Virtual Factory Data and Connect</b>						
WP5	T5.1	Data Infrastructure M	vfOS - ID5.1a - Data Infrastructure Middleware(M18)	36	1	D5.1a
	T5.1	Data Infrastructure M	vfOS - ID5.1b - Data Infrastructure Middleware(M24)	37	2	D5.1b
	T5.1	Data Infrastructure M	vfOS - ID5.1c - Data Infrastructure Middleware(M30)	38	3	D5.1c
	T5.2	Data Storage	vfOS - ID5.2a - Data Storage(M18)	39	4	D5.2a
	T5.2	Data Storage	vfOS - ID5.2b - Data Storage(M24)	40	5	D5.2b
	T5.2	Data Storage	vfOS - ID5.2c - Data Storage(M30)	41	6	D5.2c
	T5.3	Data Harmonisation	vfOS - ID5.3a - Data Harmonisation(M18)	42	7	D5.3a
	T5.3	Data Harmonisation	vfOS - ID5.3b - Data Harmonisation(M24)	43	8	D5.3b
	T5.3	Data Harmonisation	vfOS - ID5.3c - Data Harmonisation(M30)	44	9	D5.3c
	T5.4	Data Analytics	vfOS - ID5.4a - Data Analytics(M18)	45	10	D5.4a
	T5.4	Data Analytics	vfOS - ID5.4b - Data Analytics(M24)	46	11	D5.4b
	T5.4	Data Analytics	vfOS - ID5.4c - Data Analytics(M30)	47	12	D5.4c
<b>WP6: Open Applications Development Kit (OAK)</b>						
WP6	T6.1	OAK SDK - Software	vfOS - ID6.1.1a - OAK SDK - Software(M24)	48	1	D6.1.1a
	T6.1	OAK SDK - Software	vfOS - ID6.1.1b - OAK SDK - Software(M30)	49	2	D6.1.1b
	T6.1	OAK SDK - Software	vfOS - ID6.1.1c - OAK SDK - Software(M36)	50	3	D6.1.1c
		OAK SDK - Documenta	vfOS - ID6.1.2a - OAK SDK - Documentation(M24)	51	4	D6.1.2a
		OAK SDK - Documenta	vfOS - ID6.1.2b - OAK SDK - Documentation(M30)	52	5	D6.1.2b
		OAK SDK - Documenta	vfOS - ID6.1.2c - OAK SDK - Documentation(M36)	53	6	D6.1.2c
	T6.2	OAK System Dashboar	vfOS - ID6.2a - OAK System Dashboard(M24)	54	7	D6.2a
	T6.2	OAK System Dashboar	vfOS - ID6.2b - OAK System Dashboard(M30)	55	8	D6.2b
	T6.2	OAK System Dashboar	vfOS - ID6.2c - OAK System Dashboard(M36)	56	9	D6.2c
	T6.3	OAK Front End	vfOS - ID6.3a - OAK Front End (M24)	57	10	D6.3a
	T6.3	OAK Front End	vfOS - ID6.3b - OAK Front End (M30)	58	11	D6.3b
	T6.3	OAK Front End	vfOS - ID6.3c - OAK Front End (M36)	59	12	D6.3c
	T6.4	OAK Studio	vfOS - ID6.4a - OAK Studio(M30)	60	13	D6.4a
	T6.4	OAK Studio	vfOS - ID6.4b - OAK Studio(M36)	61	14	D6.4b
	T6.5	OAK Developer Engage	vfOS - ID6.5a - OAK Developer Engagement Hub(M30)	62	15	D6.5a
	T6.5	OAK Developer Engage	vfOS - ID6.5b - OAK Developer Engagement Hub(M36)	63	16	D6.5b



WP7: Platform and Integration					
WP7	T7.1	vf-Platform Environment	vfOS - ID7.1a - vf-Platform Environment(M24)	64	1 D7.1a
	T7.1	vf-Platform Environment	vfOS - ID7.1b - vf-Platform Environment(M30)	65	2 D7.1b
	T7.1	vf-Platform Environment	vfOS - ID7.1c - vf-Platform Environment(M36)	66	3 D7.1c
	T7.2	vf- mApp Store & Marketplace	vfOS - ID7.2a - vf- mApp Store & Marketplace(M24)	67	4 D7.2a
	T7.2	vf- mApp Store & Marketplace	vfOS - ID7.2b - vf- mApp Store & Marketplace(M30)	68	5 D7.2b
	T7.2	vf- mApp Store & Marketplace	vfOS - ID7.2c - vf- mApp Store & Marketplace(M36)	69	6 D7.2c
	T7.3	vf-Service Provision	vfOS - ID7.3a - vf-Service Provision Framework(M24)	70	7 D7.3a
	T7.3	vf-Service Provision	vfOS - ID7.3b - vf-Service Provision Framework(M30)	71	8 D7.3b
	T7.3	vf-Service Provision	vfOS - ID7.3c - vf-Service Provision Framework(M36)	72	9 D7.3c
WP7	T7.4	Developer Engagement	vfOS - ID7.4 - Developer Engagement & Training(M36)	73	10 D7.4
	T7.5	Software Integration	vfOS - ID7.5 - Software Integration Report(M36)	74	11 D7.5
WP8: vf Smart Application Piloting and Validation					
WP8	T8.1	Validation Scenarios	vfOS - ID8.1a - Validation Scenarios(M6)	75	1 D8.1a
	T8.1	Validation Scenarios	vfOS - ID8.1b - Validation Scenarios(M12)	76	2 D8.1b
	T8.1	Validation Scenarios	vfOS - ID8.1c - Validation Scenarios(M24)	77	3 D8.1c
	T8.1	Validation Scenarios	vfOS - ID8.1d - Validation Scenarios(M36)	78	4 D8.1d
	T8.2	Pilot 1: Manufacturing	vfOS - ID8.2a - Pilot 1: Manufacturing & Logistic – Automation	79	5 D8.2a
	T8.2	Pilot 1: Manufacturing	vfOS - ID8.2b - Pilot 1: Manufacturing & Logistic – Automation	80	6 D8.2b
	T8.2	Pilot 1: Manufacturing	vfOS - ID8.2c - Pilot 1: Manufacturing & Logistic – Automation	81	7 D8.2c
	T8.3	Pilot 2: Construction	vfOS - ID8.3a - Pilot 2: Construction – Industrialisation(M24)	82	8 D8.3a
	T8.3	Pilot 2: Construction	vfOS - ID8.3b - Pilot 2: Construction – Industrialisation(M30)	83	9 D8.3b
	T8.3	Pilot 2: Construction	vfOS - ID8.3c - Pilot 2: Construction – Industrialisation(M36)	84	10 D8.3c
	T8.4	Pilot 3: Manufacturing	vfOS - ID8.4a - Pilot 3: Manufacturing Assembly: Collaboration	85	11 D8.4a
	T8.4	Pilot 3: Manufacturing	vfOS - ID8.4b - Pilot 3: Manufacturing Assembly: Collaboration	86	12 D8.4b
	T8.4	Pilot 3: Manufacturing	vfOS - ID8.4c - Pilot 3: Manufacturing Assembly: Collaboration	87	13 D8.4c
WP9: Business Model and Exploitation					
WP9	T9.1	Business Case Opportunities	vfOS - ID9.1 - Business Case Opportunities and Value Mapping	88	1 D9.1
	T9.2	Exploitation Business Models	vfOS - ID9.2 - Exploitation Business Models(M9)	89	2 D9.2
	T9.3	Exploitation Strategy	vfOS - ID9.3 - Exploitation Strategy(M9)	90	3 D9.3
	T9.4	Collaborative and Partner Value Propositions	vfOS - ID9.4a - Collaborative and Partner Value Propositions	91	4 D9.4a
	T9.4	Collaborative and Partner Value Propositions	vfOS - ID9.4b - Collaborative and Partner Value Propositions	92	5 D9.4b
	T9.4	Collaborative and Partner Value Propositions	vfOS - ID9.4c - Collaborative and Partner Value Propositions	93	6 D9.4c
WP10: Impact					
WP10	T10.1	Impact Strategy and Plan	vfOS - ID10.1 - Impact Strategy and Plan(M3)	94	1 D10.1
	T10.2	Dissemination Report	vfOS - ID10.2a - Dissemination Report(M3)	95	2 D10.2a
	T10.2	Dissemination Report	vfOS - ID10.2b - Dissemination Report(M9)	96	3 D10.2b
	T10.2	Dissemination Report	vfOS - ID10.2c - Dissemination Report(M18)	97	4 D10.2c
	T10.2	Dissemination Report	vfOS - ID10.2d - Dissemination Report(M36)	98	5 D10.2d
	T10.3	Impact Activity Reports	vfOS - ID10.3a - Impact Activity Reports(M9)	99	7 D10.3a
	T10.3	Impact Activity Reports	vfOS - ID10.3b - Impact Activity Reports(M18)	100	8 D10.3b
	T10.3	Impact Activity Reports	vfOS - ID10.3c - Impact Activity Reports(M36)	101	9 D10.3c
	T10.4	Workshops Reports	vfOS - ID10.4a - Workshops Reports(M26)	102	10 D10.4a
	T10.4	Workshops Reports	vfOS - ID10.4b - Workshops Reports(M35)	103	11 D10.4b
WP10	T10.5	[See D10.3 Impact Report]	vfOS - [See D10.3 - [See D10.3 Impact Report](M)		See D10.5
WP11: Project and RTD Management					
WP11	T11.1	Project Handbook & Quality Plan	vfOS - ID11.1 - Project Handbook & Quality Plan(M2)	104	1 D11.1
	T11.2	N/A	vfOS - I - N/A(M)		
	T11.3	Quarterly Reports	vfOS - ID11.3.1a - Quarterly Reports(M3)	105	2 D11.3.1a
	T11.3	Quarterly Reports	vfOS - ID11.3.1b - Quarterly Reports(M6)	106	3 D11.3.1b
	T11.3	Quarterly Reports	vfOS - ID11.3.1c - Quarterly Reports(M9)	107	4 D11.3.1c
	T11.3	Quarterly Reports	vfOS - ID11.3.1d - Quarterly Reports(M12)	108	5 D11.3.1d
	T11.3	Quarterly Reports	vfOS - ID11.3.1e - Quarterly Reports(M15)	109	6 D11.3.1e
	T11.3	Quarterly Reports	vfOS - ID11.3.1f - Quarterly Reports(M18)	110	7 D11.3.1f
	T11.3	Quarterly Reports	vfOS - ID11.3.1g - Quarterly Reports(M21)	111	8 D11.3.1g
	T11.3	Quarterly Reports	vfOS - ID11.3.1h - Quarterly Reports(M24)	112	9 D11.3.1h
	T11.3	Quarterly Reports	vfOS - ID11.3.1i - Quarterly Reports(M27)	113	10 D11.3.1i
	T11.3	Quarterly Reports	vfOS - ID11.3.1j - Quarterly Reports(M30)	114	11 D11.3.1j
	T11.3	Quarterly Reports	vfOS - ID11.3.1k - Quarterly Reports(M33)	115	12 D11.3.1k
	T11.3	Quarterly Reports	vfOS - ID11.3.1l - Quarterly Reports(M36)	116	13 D11.3.1l
	T11.3	Period Reports	vfOS - ID11.3.2a - Period Reports(M9)	117	14 D11.3.2a
	T11.3	Period Reports	vfOS - ID11.3.2b - Period Reports(M18)	118	15 D11.3.2b
	T11.3	Period Reports	vfOS - ID11.3.2c - Period Reports(M36)	119	16 D11.3.2c
	T11.3	Final Reports	vfOS - ID11.3.3 - Final Reports(M36)	120	17 D11.3.3
	T11.4	N/A	vfOS - I - N/A(M)		
	T11.5	Technical Set Up and Quality Toolset	vfOS - ID11.5 - Technical Set Up and Quality Toolset (M12 & O)	121	18 D11.5



ESTIMATED BUDGET FOR THE ACTION (page 1 of 2)

	Estimated eligible <sup>1</sup> costs (per budget category)									EU contribution			Additional information		
	A. Direct personnel costs				B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs	E. Indirect costs <sup>2</sup>	Total costs	Reimbursement rate %	Maximum EU contribution <sup>3</sup>	Maximum grant amount <sup>4</sup>	Information for indirect costs	Information for auditors	Other information:
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary				D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving EU funding
Form of costs <sup>6</sup>	Actual	Unit <sup>7</sup>	Unit <sup>8</sup>		Actual	Actual	Actual	Flat-rate <sup>9</sup>							
								25%							
	(a)	Total (b)	No hours	Total (c)	(d)	(e)	(f)	(g)=0,25x ((a)+(b)+(c)+(f) +[(h1)+(h2)]-(m))	(i)= (a)+(b)+(c)+(d)+(e)+(f)+(g)+(h1)+(h2)+(h3)	(j)	(k)	(l)	(m)	Yes/No	
1. ICE	936000.00	0.00	0	0.00	0.00	0.00	57500.00	248375.00	1241875.00	100.00	1241875.00	1241875.00	0.00	No	
2. IKERLAN	410884.00	0.00	0	0.00	0.00	0.00	38000.00	112221.00	561105.00	100.00	561105.00	561105.00	0.00	No	
3. UNINOVA	648151.00	0.00	0	0.00	0.00	0.00	59000.00	176787.75	883938.75	100.00	883938.75	883938.75	0.00	No	
4. UPV	384090.00	0.00	0	0.00	0.00	0.00	62759.00	111712.25	558561.25	100.00	558561.25	558561.25	0.00	No	
5. CMS	525000.00	0.00	0	0.00	0.00	0.00	41000.00	141500.00	707500.00	100.00	707500.00	707500.00	0.00	No	
6. LYON2	378000.00	0.00	0	0.00	0.00	0.00	39000.00	104250.00	521250.00	100.00	521250.00	521250.00	0.00	No	
7. ASC	0.00	633180.00	0	0.00	0.00	0.00	40500.00	168420.00	842100.00	100.00	842100.00	842100.00	0.00	No	
8. ALM	648750.00	0.00	0	0.00	0.00	0.00	39000.00	171937.50	859687.50	100.00	859687.50	859687.50	0.00	No	
9. MASS	151800.00	0.00	0	0.00	0.00	0.00	16300.00	42025.00	210125.00	100.00	210125.00	210125.00	0.00	No	
10. VS	106600.00	0.00	0	0.00	0.00	0.00	15500.00	30525.00	152625.00	100.00	152625.00	152625.00	0.00	No	
11. CONSULGAL	217250.00	0.00	0	0.00	0.00	0.00	15500.00	58187.50	290937.50	100.00	290937.50	290937.50	0.00	No	
12. KBZ	381600.00	0.00	0	0.00	0.00	0.00	18500.00	100025.00	500125.00	100.00	500125.00	500125.00	0.00	No	
13. APR	156000.00	0.00	0	0.00	0.00	0.00	15500.00	42875.00	214375.00	100.00	214375.00	214375.00	0.00	No	
14. Tardy	156000.00	0.00	0	0.00	0.00	0.00	15500.00	42875.00	214375.00	100.00	214375.00	214375.00	0.00	No	
Total consortium	5100125.00	633180.00		0.00	0.00	0.00	473559.00	1551716.00	7758580.00		7758580.00	7758580.00	0.00		0.00

ESTIMATED BUDGET FOR THE ACTION (page 2 of 2)

- (1) See Article 6 for the eligibility conditions
- (2) The indirect costs covered by the operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary that receives an operating grant during the action's duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant (see Article 6.2.E).
- (3) This is the theoretical amount of EU contribution that the system calculates automatically (by multiplying all the budgeted costs by the reimbursement rate). This theoretical amount is capped by the 'maximum grant amount' (that the Commission/Agency decided to grant for the action) (see Article 5.1).
- (4) The 'maximum grant amount' is the maximum grant amount decided by the Commission/Agency. It normally corresponds to the requested grant, but may be lower.
- (5) Depending on its type, this specific cost category will or will not cover indirect costs. Specific unit costs that include indirect costs are: costs for energy efficiency measures in buildings, access costs for providing trans-national access to research infrastructure and costs for clinical studies.
- (6) See Article 5 for the forms of costs
- (7) Unit : hours worked on the action; costs per unit (hourly rate) : calculated according to beneficiary's usual accounting practice
- (8) See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
- (9) Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs
- (10) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
- (11) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc)
- (12) Only specific unit costs that do not include indirect costs
- (13) See Article 9 for beneficiaries not receiving EU funding
- (14) Only for linked third parties that receive EU funding

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**IKERLAN SCL (IKERLAN) S.COOP.**, 1282, established in P JOSE MARIA ARIZMENDIARRIETA 2, MONDRAGON 20500, Spain, ESF20079828 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('2')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, *represented by the European Commission ('the Commission')*,

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS-ASSOCIACAO (UNINOVA)** IPSS, not applicable, established in CAMPUS DA CAPARICA QUINTA DA TORRE, CAPARICA 2829-516, Portugal, PT501797173 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('3')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU'), represented by the European Commission ('the Commission'),*

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**UNIVERSITAT POLITECNICA DE VALENCIA (UPV)**, 027/46014816, established in CAMINO DE VERA SN EDIFICIO 3A, VALENCIA 46022, Spain, ESQ4618002B ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('4')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission ('the Commission'),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**CAIXA MAGICA SOFTWARE LDA (CMS) LDA**, 506945901, established in RUA SOEIRO PEREIRA GOMES LOTE 1 4 B EDIFICIO ESPANHA, LISBOA 1600 196, Portugal, PT506945901 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('5')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission ('the Commission'),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary



## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**UNIVERSITE LUMIERE LYON 2 (LYON2)**, 196917751, established in 86 RUE PASTEUR, LYON CEDEX 07 69365, France, FR82196917751 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('6')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by *the European Commission ('the Commission')*,

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**ASCORA GMBH (ASC)** GMBH, HRB201973, established in BIRKENALLEE 43, GANDERKESEE 27777, Germany, DE257809394 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('7')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU'), represented by the European Commission ('the Commission'),*

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary



## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**ALMENDE B.V. (ALM)** BV, 24307997, established in STATIONSPLEIN 45 UNIT A1.205-207, ROTTERDAM 3013 AK, Netherlands, NL809028736B01 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('8')

**in Grant Agreement No** 723710 ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU'), represented by the European Commission ('the Commission'),*

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**MONDRAGON ASSEMBLY SOCIEDAD COOPERATIVA (MASS) S.COOP.**, SS621, established in POLIGONO INDUSTRIAL BAINETXE 5A, ARETXABALETA 20550, Spain, ESF20165940 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('9')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission (*'the Commission'*),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**VIA SOLIS UAB (VS)** UAB, 302430053, established in NAUJOJI GATVE 138 G, ALYTUS 62175, Lithuania, LT100005604112 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('10')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU'), represented by the European Commission ('the Commission'),*

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**CONSULGAL - CONSULTORES DE ENGENHARIA E GESTAO SA (CONSULGAL)** SA, 501515011, established in AV SALVADOR ALLENDE 25, OEIRAS 2780 163, Portugal, PT501515011 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('11')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission (*'the Commission'*),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary



## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**KNOWLEDGEBIZ CONSULTING-SOCIEDADE DE CONSULTORIA EM GASTAO LDA (KBZ) LDA**, 507888367, established in CAMPUS FACULDADE DE CIENCIA E TECNOLOGIA/ UNIVERSID DE LISBOA, EDIFICIO UNINOVA, CAPARICA 2829 516, Portugal, PT507888367 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('12')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission (*'the Commission'*),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**APPLICATIONS PLASTIQUES DU RHONE SAS (APR) SAS**, 972501571, established in RUE JULES FERRY 21 ZI DU BAS PONTET, ST SYMPHORIEN D OZON 69360, France, FR29972501571 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('13')

**in Grant Agreement No 723710** ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU')*, represented by the European Commission (*'the Commission'*),

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

## ANNEX 3

### ACCESSION FORM FOR BENEFICIARIES

**ETABLISSEMENTS TARDY (Tardy)** SAS, 305832263, established in 409 RUE DU CANAL, LA GRAND-CROIX 42320, France, FR88305832263 ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

**hereby agrees**

**to become *beneficiary*** No ('14')

**in Grant Agreement No** 723710 ('the Agreement')

**between** INFORMATION CATALYST FOR ENTERPRISE LTD **and** *the European Union ('the EU'), represented by the European Commission ('the Commission'),*

**for the action entitled** 'Virtual Factory Open Operating System (vf-OS)'.

**and mandates**

**the *coordinator*** to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement the grant in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

🖨️ print format A4  
landscape

MODEL ANNEX 4 FOR H2020 GENERAL MGA — MULTI

FINANCIAL STATEMENT FOR [BENEFICIARY [name]/ LINKED THIRD PARTY [name]] FOR REPORTING PERIOD [reporting period]

	Eligible <sup>1</sup> costs (per budget category)												Receipts	EU contribution				Additional information	
	A. Direct personnel costs				B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs		E. Indirect costs <sup>2</sup>		[F. Costs of ... ]		Total costs	Receipts	Reimbursement rate %	Maximum EU contribution <sup>3</sup>	Requested EU contribution	Information for indirect costs :  Costs of in-kind contributions not used on premises	
	A.1 Employees (or equivalent)		A.4 SME owners without salary				D.1 Travel	[D.4 Costs of large research infrastructure]		[F.1 Costs of ...]			Receipts of the action, to be reported in the last reporting period, according to Article 5.3.3						
	A.2 Natural persons under direct contract		A.5 Beneficiaries that are natural persons without salary				D.2 Equipment												
	A.3 Seconded persons						D.3 Other goods and services												
[A.6 Personnel for providing access to research infrastructure]																			
Form of costs <sup>4</sup>	Actual	Unit	Unit		Actual	Actual	Actual	Actual	Flat-rate <sup>5</sup>	Unit		Unit							
									25%										
	a	Total b	No hours	Total c	d	[e]	f	[g]	h=0,25 x (a+b+c+f+[g] + [i1] <sup>6</sup> +[i2] <sup>6</sup> - o)		No units	Total [i1]	Total [i2]	j = a+b+c+d+[e] +f+[g] +h+[i1] +[i2]	k	l	m	n	o
[short name beneficiary/linked third party]																			

The beneficiary/linked third party hereby confirms that:  
The information provided is complete, reliable and true.  
The costs declared are eligible (see Article 6).  
The costs can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 17, 18 and 22).  
For the last reporting period: that all the receipts have been declared (see Article 5.3.3).

📌 Please declare all eligible costs, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Only amounts that were declared in your individual financial statements can be taken into account lateron, in order to replace other costs that are found to be ineligible.

<sup>1</sup> See Article 6 for the eligibility conditions

<sup>2</sup> The indirect costs claimed must be free of any amounts covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.2.E). If you have received an operating grant during this reporting period, you cannot claim any indirect costs.

<sup>3</sup> This is the *theoretical* amount of EU contribution that the system calculates automatically (by multiplying the reimbursement rate by the total costs declared). The amount you request (in the column 'requested EU contribution') may have to be less (e.g. if you and the other beneficiaries are above budget, if the 90% limit (see Article 21) is reached, etc).

<sup>4</sup> See Article 5 for the form of costs

<sup>5</sup> Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs (see Article 6.2.E)

<sup>6</sup> Only specific unit costs that do not include indirect costs

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## ANNEX 5

### MODEL FOR THE CERTIFICATE ON THE FINANCIAL STATEMENTS

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data

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**Terms of Reference for an Independent Report of Factual Findings on costs declared under a Grant Agreement financed under the Horizon 2020 Research and Innovation Framework Programme**

This document sets out the **‘Terms of Reference (ToR)’** under which

[OPTION 1: [insert name of the beneficiary] (*‘the Beneficiary’*)] [OPTION 2: [insert name of the linked third party] (*‘the Linked Third Party’*), third party linked to the Beneficiary [insert name of the beneficiary] (*‘the Beneficiary’*)]

agrees to engage

[insert legal name of the auditor] (*‘the Auditor’*)

to produce an independent report of factual findings (*‘the Report’*) concerning the Financial Statement(s)<sup>1</sup> drawn up by the [Beneficiary] [Linked Third Party] for the Horizon 2020 grant agreement [insert number of the grant agreement, title of the action, acronym and duration from/to] (*‘the Agreement’*), and

to issue a Certificate on the Financial Statements’ (*‘CFS’*) referred to in Article 20.4 of the Agreement based on the compulsory reporting template stipulated by the Commission.

The Agreement has been concluded under the Horizon 2020 Research and Innovation Framework Programme (H2020) between the Beneficiary and [OPTION 1: *the European Union, represented by the European Commission (‘the Commission’)*][OPTION 2: *the European Atomic Energy Community (Euratom,) represented by the European Commission (‘the Commission’)*][OPTION 3: *the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’).*]

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<sup>1</sup> By which costs under the Agreement are declared (see template ‘Model Financial Statements’ in Annex 4 to the Grant Agreement).

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The *[Commission]* *[Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only.  
The *[European Union]**[Euratom]**[Agency]* is not a party to this engagement.

### 1.1 Subject of the engagement

The coordinator must submit to the *[Commission]**[Agency]* the final report within 60 days following the end of the last reporting period which should include, amongst other documents, a CFS for each beneficiary and for each linked third party that requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 20.4 of the Agreement). The CFS must cover all reporting periods of the beneficiary or linked third party indicated above.

The Beneficiary must submit to the coordinator the CFS for itself and for its linked third party(ies), if the CFS must be included in the final report according to Article 20.4 of the Agreement..

The CFS is composed of two separate documents:

- The Terms of Reference ('the ToR') to be signed by the *[Beneficiary]* *[Linked Third Party]* and the Auditor;
- The Auditor's Independent Report of Factual Findings ('the Report') to be issued on the Auditor's letterhead, dated, stamped and signed by the Auditor (or the competent public officer) which includes the agreed-upon procedures ('the Procedures') to be performed by the Auditor, and the standard factual findings ('the Findings') to be confirmed by the Auditor.

If the CFS must be included in the final report according to Article 20.4 of the Agreement, the request for payment of the balance relating to the Agreement cannot be made without the CFS. However, the payment for reimbursement of costs covered by the CFS does not preclude the *[Commission]*,*[Agency]*, the European Anti-Fraud Office and the European Court of Auditors from carrying out checks, reviews, audits and investigations in accordance with Article 22 of the Agreement.

### 1.2 Responsibilities

The *[Beneficiary]* *[Linked Third Party]*:



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- must draw up the Financial Statement(s) for the action financed by the Agreement in compliance with the obligations under the Agreement. The Financial Statement(s) must be drawn up according to the *[Beneficiary's] [Linked Third Party's]* accounting and book-keeping system and the underlying accounts and records;
- must send the Financial Statement(s) to the Auditor;
- is responsible and liable for the accuracy of the Financial Statement(s);
- is responsible for the completeness and accuracy of the information provided to enable the Auditor to carry out the Procedures. It must provide the Auditor with a written representation letter supporting these statements. The written representation letter must state the period covered by the statements and must be dated;
- accepts that the Auditor cannot carry out the Procedures unless it is given full access to the *[Beneficiary's] [Linked Third Party's]* staff and accounting as well as any other relevant records and documentation.

### The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

### The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the *[Beneficiary's] [Linked Third Party's]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with this ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement, the Auditor does not provide an audit opinion or a statement of assurance.

## 1.3 Applicable Standards

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The Auditor must comply with these Terms of Reference and with<sup>2</sup>:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the [Commission][Agency] requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there is no conflict of interests in establishing this Report between the Auditor and the Beneficiary *[and the Linked Third Party]*, and must specify - if the service is invoiced - the total fee paid to the Auditor for providing the Report.

### 1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7).

Under Article 22 of the Agreement, the [Commission] [Agency], the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from [the European Union] [Euratom] budget. This includes work related to this engagement. The Auditor must provide access to all working papers (e.g. recalculation of hourly rates, verification of the time declared for the action) related to this assignment if the [Commission] [Agency], the European Anti-Fraud Office or the European Court of Auditors requests them.

### 1.5 Timing

The Report must be provided by [dd Month yyyy].

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<sup>2</sup> Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

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## 1.6 Other terms

*[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]*

[legal name of the Auditor] [legal name of the [Beneficiary][Linked Third Party]]

[name & function of authorised representative] [name & function of authorised representative]

[dd Month yyyy]

[dd Month yyyy]

Signature of the Auditor

Signature of the [Beneficiary][Linked Third Party]

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**Independent Report of Factual Findings on costs declared under Horizon 2020 Research and  
Innovation Framework Programme**

*(To be printed on the Auditor's letterhead)*

To

[ name of contact person(s)], [Position]

[ *Beneficiary's* *Linked Third Party's* name ]

[ Address]

[ dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: *insert name of the beneficiary*] ('the Beneficiary')] [OPTION 2: *insert name of the  
linked third party*] ('the Linked Third Party'), third party linked to the Beneficiary [*insert name of the  
beneficiary*] ('the Beneficiary'),

we

[name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

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have carried out the procedures agreed with you regarding the costs declared in the Financial Statement(s)<sup>3</sup> of the [Beneficiary] [Linked Third Party] concerning the grant agreement

[insert grant agreement reference: number, title of the action and acronym] ('the Agreement'),

with a total cost declared of

[total amount] EUR,

and a total of actual costs and 'direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices' declared of

[sum of total actual costs and total direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices] EUR

and **hereby provide our Independent Report of Factual Findings ('the Report')** using the compulsory report format agreed with you.

### **The Report**

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') examined.

The Procedures were carried out solely to assist the [Commission] [Agency] in evaluating whether the [Beneficiary's] [Linked Third Party's] costs in the accompanying Financial Statement(s) were declared in accordance with the Agreement. The [Commission] [Agency] draws its own conclusions from the Report and any additional information it may require.

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<sup>3</sup> By which the Beneficiary declares costs under the Agreement (see template 'Model Financial Statement' in Annex 4 to the Agreement).

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The scope of the Procedures was defined by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence. Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, the Auditor does not give a statement of assurance on the Financial Statements.

Had the Auditor carried out additional procedures or an audit of the [Beneficiary's] [Linked Third Party's] Financial Statements in accordance with International Standards on Auditing or International Standards on Review Engagements, other matters might have come to its attention and would have been included in the Report.

**Not applicable Findings**

We examined the Financial Statement(s) stated above and considered the following Findings not applicable:

*Explanation (to be removed from the Report):*

*If a Finding was not applicable, it must be marked as 'N.A.' ('Not applicable') in the corresponding row on the right-hand column of the table and means that the Finding did not have to be corroborated by the Auditor and the related Procedure(s) did not have to be carried out.*

*The reasons of the non-application of a certain Finding must be obvious i.e.*

- i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable;*
- ii) if the condition set to apply certain Procedure(s) are not met the related Finding(s) and those Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than euro' the Procedure and Finding related to 'beneficiaries with accounts established in euro' are not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.*

**List here all Findings considered not applicable for the present engagement and explain the reasons of the non-applicability.**

....

**Exceptions**

Apart from the exceptions listed below, the [Beneficiary] [Linked Third Party] provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and evaluate the Findings.

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### Explanation (to be removed from the Report):

- If the Auditor was not able to successfully complete a procedure requested, it must be marked as 'E' ('Exception') in the corresponding row on the right-hand column of the table. The reason such as the inability to reconcile key information or the unavailability of data that prevents the Auditor from carrying out the Procedure must be indicated below.
- If the Auditor cannot corroborate a standard finding after having carried out the corresponding procedure, it must also be marked as 'E' ('Exception') and, where possible, the reasons why the Finding was not fulfilled and its possible impact must be explained here below.

**List here any exceptions and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, include the corresponding amount.**

....

### Example (to be removed from the Report):

1. The Beneficiary was unable to substantiate the Finding number 1 on ... because ....
2. Finding number 30 was not fulfilled because the methodology used by the Beneficiary to calculate unit costs was different from the one approved by the Commission. The differences were as follows: ...
3. After carrying out the agreed procedures to confirm the Finding number 31, the Auditor found a difference of \_\_\_\_\_ EUR. The difference can be explained by ...

### Further Remarks

In addition to reporting on the results of the specific procedures carried out, the Auditor would like to make the following general remarks:

### Example (to be removed from the Report):

1. Regarding Finding number 8 the conditions for additional remuneration were considered as fulfilled because ...
2. In order to be able to confirm the Finding number 15 we carried out the following additional procedures: ....

### Use of this Report

This Report may be used only for the purpose described in the above objective. It was prepared solely for the confidential use of the [Beneficiary] [Linked Third Party] and the [Commission] [Agency], and only to be submitted to the [Commission] [Agency] in connection with the requirements set out in Article 20.4 of the Agreement. The Report may not be used by the [Beneficiary] [Linked Third Party] or by the [Commission] [Agency] for any other purpose, nor may it



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be distributed to any other parties. The [Commission] [Agency] may only disclose the Report to authorised parties, in particular to the European Anti-Fraud Office (OLAF) and the European Court of Auditors.

This Report relates only to the Financial Statement(s) submitted to the [Commission] [Agency] by the [Beneficiary] [Linked Third Party] for the Agreement. Therefore, it does not extend to any other of the [Beneficiary's] [Linked Third Party's] Financial Statement(s).

There was no conflict of interest<sup>4</sup> between the Auditor and the Beneficiary [and Linked Third Party] in establishing this Report. The total fee paid to the Auditor for providing the Report was EUR [ ] (including EUR [ ] of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance.

[legal name of the Auditor]

[name and function of an authorised representative]

[dd Month yyyy]

Signature of the Auditor

---

<sup>4</sup> A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

**Agreed-upon procedures to be performed and standard factual findings to be confirmed by the Auditor**

The European Commission reserves the right to i) provide the auditor with additional guidance regarding the procedures to be followed or the facts to be ascertained and the way in which to present them (this may include sample coverage and findings) or to ii) change the procedures, by notifying the Beneficiary in writing. The procedures carried out by the auditor to confirm the standard factual finding are listed in the table below.

If this certificate relates to a Linked Third Party, any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

The 'result' column has three different options: 'C', 'E' and 'N.A.':

- 'C' stands for 'confirmed' and means that the auditor can confirm the 'standard factual finding' and, therefore, there is no exception to be reported.
- 'E' stands for 'exception' and means that the Auditor carried out the procedures but cannot confirm the 'standard factual finding', or that the Auditor was not able to carry out a specific procedure (e.g. because it was impossible to reconcile key information or data were unavailable),
- 'N.A.' stands for 'not applicable' and means that the Finding did not have to be examined by the Auditor and the related Procedure(s) did not have to be carried out. The reasons of the non-application of a certain Finding must be obvious i.e. i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable; ii) if the condition set to apply certain Procedure(s) are not met then the related Finding(s) and Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than the euro' the Procedure related to 'beneficiaries with accounts established in euro' is not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A	<b>ACTUAL PERSONNEL COSTS AND UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICE</b>		

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>The Auditor draws a sample of persons whose costs were declared in the Financial Statement(s) to carry out the procedures indicated in the consecutive points of this section A.</p> <p><i>(The sample should be selected randomly so that it is representative. Full coverage is required if there are fewer than 10 people (including employees, natural persons working under a direct contract and personnel seconded by a third party), otherwise the sample should have a minimum of 10 people, or 10% of the total, whichever number is the highest)</i></p> <p>The Auditor sampled [ ] people out of the total of [ ] people.</p>		
A.1	<p><b>PERSONNEL COSTS</b></p> <p><u>For the persons included in the sample and working under an employment contract or equivalent act (general procedures for individual actual personnel costs and personnel costs declared as unit costs)</u></p> <p>To confirm standard factual findings 1-5 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> <li>○ a list of the persons included in the sample indicating the period(s) during which they worked for the action, their position (classification or category) and type of contract;</li> <li>○ the payslips of the employees included in the sample;</li> <li>○ reconciliation of the personnel costs declared in the Financial Statement(s) with the accounting system (project accounting and general ledger) and payroll system;</li> <li>○ information concerning the employment status and employment conditions of personnel included in the sample, in particular their employment contracts or equivalent;</li> </ul>	1) The employees were i) directly hired by the Beneficiary in accordance with its national legislation, ii) under the Beneficiary's sole technical supervision and responsibility and iii) remunerated in accordance with the Beneficiary's usual practices.	
		2) Personnel costs were recorded in the Beneficiary's accounts/payroll system.	
		3) Costs were adequately supported and reconciled with the accounts and payroll	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>the Beneficiary's usual policy regarding payroll matters (e.g. salary policy, overtime policy, variable pay);</li> <li>applicable national law on taxes, labour and social security and</li> <li>any other document that supports the personnel costs declared.</li> </ul> <p>The Auditor also verified the eligibility of all components of the retribution (see Article 6 GA) and recalculated the personnel costs for employees included in the sample.</p>	records.	
		4) Personnel costs did not contain any ineligible elements.	
		5) There were no discrepancies between the personnel costs charged to the action and the costs recalculated by the Auditor.	
	<p><i>Further procedures if 'additional remuneration' is paid</i></p> <p>To confirm standard factual findings 6-9 listed in the next column, the Auditor:</p> <ul style="list-style-type: none"> <li>reviewed relevant documents provided by the Beneficiary (legal form, legal/statutory obligations, the Beneficiary's usual policy on additional remuneration, criteria used for its calculation...);</li> <li>recalculated the amount of additional remuneration eligible for the action based on the supporting documents received (full-time or part-time work, exclusive or non-exclusive dedication to the action, etc.) to arrive at the applicable FTE/year and pro-rata rate (see data collected in the course of carrying out the procedures under A.2 'Productive hours' and A.4 'Time recording system').</li> </ul>	6) The Beneficiary paying "additional remuneration" was a non-profit legal entity.	
		7) The amount of additional remuneration paid corresponded to the Beneficiary's usual remuneration practices and was consistently paid whenever the same kind of work or expertise was required.	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>IF ANY PART OF THE REMUNERATION PAID TO THE EMPLOYEE IS NOT MANDATORY ACCORDING TO THE NATIONAL LAW OR THE EMPLOYMENT CONTRACT ("ADDITIONAL REMUNERATION") AND IS ELIGIBLE UNDER THE PROVISIONS OF ARTICLE 6.2.A.1, THIS CAN BE CHARGED AS ELIGIBLE COST TO THE ACTION UP TO THE FOLLOWING AMOUNT:</i></p> <p>(A) <i>IF THE PERSON WORKS FULL TIME AND EXCLUSIVELY ON THE ACTION DURING THE FULL YEAR: UP TO EUR 8 000/YEAR;</i></p> <p>(B) <i>IF THE PERSON WORKS EXCLUSIVELY ON THE ACTION BUT NOT FULL-TIME OR NOT FOR THE FULL YEAR: UP TO THE CORRESPONDING PRO-RATA AMOUNT OF EUR 8 000, OR</i></p> <p>(C) <i>IF THE PERSON DOES NOT WORK EXCLUSIVELY ON THE ACTION: UP TO A PRO-RATA AMOUNT CALCULATED IN ACCORDANCE TO ARTICLE 6.2.A.1.</i></p>	8) The criteria used to calculate the additional remuneration were objective and generally applied by the Beneficiary regardless of the source of funding used.	
		9) The amount of additional remuneration included in the personnel costs charged to the action was capped at EUR 8,000 per FTE/year (up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).	
	<p><i>Additional procedures in case “unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices” is applied:</i></p> <p>Apart from carrying out the procedures indicated above to confirm standard factual findings 1-5 and, if applicable, also 6-9, the Auditor carried out following procedures to confirm standard factual findings 10-13 listed in the next column:</p>	10) The personnel costs included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. This methodology was consistently used in all H2020 actions.	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>obtained a description of the Beneficiary's usual cost accounting practice to calculate unit costs;</li> <li>reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS;</li> <li>verified the employees included in the sample were charged under the correct category (in accordance with the criteria used by the Beneficiary to establish personnel categories) by reviewing the contract/HR-record or analytical accounting records;</li> <li>verified that there is no difference between the total amount of personnel costs used in calculating the cost per unit and the total amount of personnel costs recorded in the statutory accounts;</li> <li>verified whether actual personnel costs were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, objective and supported by documents.</li> </ul>	11) The employees were charged under the correct category.	
		12) Total personnel costs used in calculating the unit costs were consistent with the expenses recorded in the statutory accounts.	
		13) Any estimated or budgeted element used by the Beneficiary in its unit-cost calculation were relevant for calculating personnel costs and corresponded to objective and verifiable information.	
	<p><u>For natural persons included in the sample and working with the Beneficiary under a direct contract other than an employment contract, such as consultants (no subcontractors).</u></p> <p>To confirm standard factual findings 14-18 listed in the next column the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> <li>the contracts, especially the cost, contract duration, work description, place of work, ownership of the results and reporting obligations to the Beneficiary;</li> </ul>	14) The natural persons reported to the Beneficiary (worked under the Beneficiary's instructions).	
		15) They worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>the employment conditions of staff in the same category to compare costs and;</li> <li>any other document that supports the costs declared and its registration (e.g. invoices, accounting records, etc.).</li> </ul>	16) The results of work carried out belong to the Beneficiary.	
		17) Their costs were not significantly different from those for staff who performed similar tasks under an employment contract with the Beneficiary.	
		18) The costs were supported by audit evidence and registered in the accounts.	
	<p><u>For personnel seconded by a third party and included in the sample (not subcontractors)</u></p> <p>To confirm standard factual findings 19-22 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> <li>their secondment contract(s) notably regarding costs, duration, work description, place of work and ownership of the results;</li> <li>if there is reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution against payment): any documentation that supports the costs declared (e.g. contract, invoice, bank payment, and proof of registration in its accounting/payroll, etc.) and reconciliation of the Financial Statement(s) with the accounting system (project accounting and general ledger) as well as any proof that the amount invoiced by the third party did not include any profit;</li> </ul>	19) Seconded personnel reported to the Beneficiary and worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	
		20) The results of work carried out belong to the Beneficiary.	
		<p><i>If personnel is seconded against payment:</i></p> <p>21) The costs declared were supported with documentation and recorded in the</p>	



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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>if there is no reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution free of charge): a proof of the actual cost borne by the Third Party for the resource made available free of charge to the Beneficiary such as a statement of costs incurred by the Third Party and proof of the registration in the Third Party's accounting/payroll;</li> <li>any other document that supports the costs declared (e.g. invoices, etc.).</li> </ul>	<p>Beneficiary's accounts. The third party did not include any profit.</p> <p><i>If personnel is seconded free of charge:</i></p> <p>22) The costs declared did not exceed the third party's cost as recorded in the accounts of the third party and were supported with documentation.</p>	
<b>A.2</b>	<p><b>PRODUCTIVE HOURS</b></p> <p>To confirm standard factual findings 23-28 listed in the next column, the Auditor reviewed relevant documents, especially national legislation, labour agreements and contracts and time records of the persons included in the sample, to verify that:</p> <ul style="list-style-type: none"> <li>the annual productive hours applied were calculated in accordance with one of the methods described below,</li> <li>the full-time equivalent (FTEs) ratios for employees not working full-time were correctly calculated.</li> </ul>	<p>23) The Beneficiary applied method <i>[choose one option and delete the others]</i></p> <p><b>[A: 1720 hours]</b></p> <p><b>[B: the 'total number of hours worked']</b></p> <p><b>[C: 'annual productive hours' used correspond to usual accounting practices]</b></p>	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>If the Beneficiary applied method B, the auditor verified that the correctness in which the total number of hours worked was calculated and that the contracts specified the annual workable hours.</p> <p>If the Beneficiary applied method C, the auditor verified that the ‘annual productive hours’ applied when calculating the hourly rate were equivalent to at least 90 % of the ‘standard annual workable hours’. The Auditor can only do this if the calculation of the standard annual workable hours can be supported by records, such as national legislation, labour agreements, and contracts.</p> <p><i>BENEFICIARY’S PRODUCTIVE HOURS’ FOR PERSONS WORKING FULL TIME SHALL BE ONE OF THE FOLLOWING METHODS:</i></p> <p><b>A. 1720 ANNUAL PRODUCTIVE HOURS (PRO-RATA FOR PERSONS NOT WORKING FULL-TIME)</b></p> <p><b>B. THE TOTAL NUMBER OF HOURS WORKED BY THE PERSON FOR THE BENEFICIARY IN THE YEAR (THIS METHOD IS ALSO REFERRED TO AS ‘TOTAL NUMBER OF HOURS WORKED’ IN THE NEXT COLUMN). THE CALCULATION OF THE TOTAL NUMBER OF HOURS WORKED WAS DONE AS FOLLOWS: ANNUAL WORKABLE HOURS OF THE PERSON ACCORDING TO THE EMPLOYMENT CONTRACT, APPLICABLE LABOUR AGREEMENT OR NATIONAL LAW PLUS OVERTIME WORKED MINUS ABSENCES (SUCH AS SICK LEAVE OR SPECIAL LEAVE).</b></p>	24) Productive hours were calculated annually.	
		25) For employees not working full-time the full-time equivalent (FTE) ratio was correctly applied.	
		<p><i>If the Beneficiary applied method B.</i></p> <p>26) The calculation of the number of ‘annual workable hours’, overtime and absences was verifiable based on the documents provided by the Beneficiary.</p>	
		<p><i>If the Beneficiary applied method C.</i></p> <p>27) The calculation of the number of ‘standard annual workable hours’ was verifiable based on the documents provided by the Beneficiary.</p>	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>C. THE STANDARD NUMBER OF ANNUAL HOURS GENERALLY APPLIED BY THE BENEFICIARY FOR ITS PERSONNEL IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES (THIS METHOD IS ALSO REFERRED TO AS 'TOTAL ANNUAL PRODUCTIVE HOURS' IN THE NEXT COLUMN). THIS NUMBER MUST BE AT LEAST 90% OF THE STANDARD ANNUAL WORKABLE HOURS.</i></p> <p><i>'ANNUAL WORKABLE HOURS' MEANS THE PERIOD DURING WHICH THE PERSONNEL MUST BE WORKING, AT THE EMPLOYER'S DISPOSAL AND CARRYING OUT HIS/HER ACTIVITY OR DUTIES UNDER THE EMPLOYMENT CONTRACT, APPLICABLE COLLECTIVE LABOUR AGREEMENT OR NATIONAL WORKING TIME LEGISLATION.</i></p>	28) The 'annual productive hours' used for calculating the hourly rate were consistent with the usual cost accounting practices of the Beneficiary and were equivalent to at least 90 % of the 'annual workable hours'.	
<b>A.3</b>	<p><b>HOURLY PERSONNEL RATES</b></p> <p><u>I) For unit costs calculated in accordance to the Beneficiary's usual cost accounting practice (unit costs):</u></p> <p>If the Beneficiary has a "Certificate on Methodology to calculate unit costs " (CoMUC) approved by the Commission, the Beneficiary provides the Auditor with a description of the approved methodology and the Commission's letter of acceptance. The Auditor verified that the Beneficiary has indeed used the methodology approved. If so, no further verification is necessary.</p> <p>If the Beneficiary does not have a "Certificate on Methodology" (CoMUC) approved by the</p>	<p>29) The Beneficiary applied [choose one option and delete the other]:</p> <p>[Option I: "Unit costs (hourly rates) were calculated in accordance with the Beneficiary's usual cost accounting practices"]</p> <p>[Option II: Individual hourly rates were applied]</p>	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>Commission, or if the methodology approved was not applied, then the Auditor:</p> <ul style="list-style-type: none"> <li>○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates;</li> <li>○ recalculated the unit costs (hourly rates) of staff included in the sample following the results of the procedures carried out in A.1 and A.2.</li> </ul> <p><u>II) For individual hourly rates:</u></p> <p>The Auditor:</p> <ul style="list-style-type: none"> <li>○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates;</li> <li>○ recalculated the hourly rates of staff included in the sample following the results of the procedures carried out in A.1 and A.2.</li> </ul>	<p><i>For option I concerning unit costs and if the Beneficiary applies the methodology approved by the Commission (CoMUC):</i></p> <p>30) The Beneficiary used the Commission-approved methodology to calculate hourly rates. It corresponded to the organisation's usual cost accounting practices and was applied consistently for all activities irrespective of the source of funding.</p>	
	<p><u>“UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES”:</u></p> <p>IT IS CALCULATED BY DIVIDING THE TOTAL AMOUNT OF PERSONNEL COSTS OF THE CATEGORY TO WHICH THE EMPLOYEE BELONGS VERIFIED IN LINE WITH PROCEDURE A.1 BY THE NUMBER OF FTE AND THE ANNUAL TOTAL PRODUCTIVE HOURS OF THE SAME CATEGORY CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH PROCEDURE A.2.</p> <p><u>HOURLY RATE FOR INDIVIDUAL ACTUAL PERSONAL COSTS:</u></p> <p>IT IS CALCULATED BY DIVIDING THE TOTAL AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH</p>	<p><i>For option I concerning unit costs and if the Beneficiary applies a methodology not approved by the Commission:</i></p> <p>31) The unit costs re-calculated by the Auditor were the same as the rates applied by the Beneficiary.</p>	
		<p><i>For option II concerning individual hourly rates:</i></p>	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<i>PROCEDURE A.1 BY THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2.</i>	32) The individual rates re-calculated by the Auditor were the same as the rates applied by the Beneficiary.	
<b>A.4</b>	<b>TIME RECORDING SYSTEM</b>  To verify that the time recording system ensures the fulfilment of all minimum requirements and that the hours declared for the action were correct, accurate and properly authorised and supported by documentation, the Auditor made the following checks for the persons included in the sample that declare time as worked for the action on the basis of time records: <ul style="list-style-type: none"> <li>○ description of the time recording system provided by the Beneficiary (registration, authorisation, processing in the HR-system);</li> <li>○ its actual implementation;</li> <li>○ time records were signed at least monthly by the employees (on paper or electronically) and authorised by the project manager or another manager;</li> <li>○ the hours declared were worked within the project period;</li> <li>○ there were no hours declared as worked for the action if HR-records showed absence due to holidays or sickness (further cross-checks with travels are carried out in B.1 below) ;</li> </ul>	33) All persons recorded their time dedicated to the action on a <b>daily/ weekly/ monthly</b> basis using a <b>paper/computer-based</b> system. <i>(delete the answers that are not applicable)</i>	
		34) Their time-records were authorised at least monthly by the project manager or other superior.	
		35) Hours declared were worked within the project period and were consistent with the presences/absences recorded in HR-records.	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>the hours charged to the action matched those in the time recording system.</li> </ul> <p><i>ONLY THE HOURS WORKED ON THE ACTION CAN BE CHARGED. ALL WORKING TIME TO BE CHARGED SHOULD BE RECORDED THROUGHOUT THE DURATION OF THE PROJECT, ADEQUATELY SUPPORTED BY EVIDENCE OF THEIR REALITY AND RELIABILITY (SEE SPECIFIC PROVISIONS BELOW FOR PERSONS WORKING EXCLUSIVELY FOR THE ACTION WITHOUT TIME RECORDS).</i></p>	36) There were no discrepancies between the number of hours charged to the action and the number of hours recorded.	
	<p><u>If the persons are working exclusively for the action and without time records</u></p> <p>For the persons selected that worked exclusively for the action without time records, the Auditor verified evidence available demonstrating that they were in reality exclusively dedicated to the action and that the Beneficiary signed a declaration confirming that they have worked exclusively for the action.</p>	37) The exclusive dedication is supported by a declaration signed by the Beneficiary's and by any other evidence gathered.	
<b>B</b>	<b>COSTS OF SUBCONTRACTING</b>		
<b>B.1</b>	<p><b>The Auditor obtained the detail/breakdown of subcontracting costs and sampled [ ] cost items selected randomly</b> (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest</i>).</p> <p>To confirm standard factual findings 38-42 listed in the next column, the Auditor reviewed the</p>	38) The use of claimed subcontracting costs was foreseen in Annex 1 and costs were declared in the Financial Statements under the subcontracting category.	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>following for the items included in the sample:</p> <ul style="list-style-type: none"> <li>the use of subcontractors was foreseen in Annex 1;</li> <li>subcontracting costs were declared in the subcontracting category of the Financial Statement;</li> <li>supporting documents on the selection and award procedure were followed;</li> <li>the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the subcontract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment).</li> </ul> <p>In particular,</p> <ol style="list-style-type: none"> <li>if the Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC or of Directive 2004/17/EC, the Auditor verified that the applicable national law on public procurement was followed and that the subcontracting complied with the Terms and Conditions of the Agreement.</li> <li>if the Beneficiary did not fall under the above-mentioned category the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement..</li> </ol> <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> <li>the subcontracts were not awarded to other Beneficiaries in the consortium;</li> </ul>	<p>39) There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. Subcontracts were awarded in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the caption "Exceptions" of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i></p> <p>40) The subcontracts were not awarded to other Beneficiaries of the consortium.</p>	



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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<ul style="list-style-type: none"> <li>○ there were signed agreements between the Beneficiary and the subcontractor;</li> <li>○ there was evidence that the services were provided by subcontractor;</li> </ul>	41) All subcontracts were supported by signed agreements between the Beneficiary and the subcontractor.	
		42) There was evidence that the services were provided by the subcontractors.	
<b>C</b>	<b>COSTS OF PROVIDING FINANCIAL SUPPORT TO THIRD PARTIES</b>		
<b>C.1</b>	<p><b>The Auditor obtained the detail/breakdown of the costs of providing financial support to third parties and sampled [ ] cost items selected randomly</b> (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest</i>).</p> <p>The Auditor verified that the following minimum conditions were met:</p> <ul style="list-style-type: none"> <li>a) the maximum amount of financial support for each third party did not exceed EUR 60 000, unless explicitly mentioned in Annex 1;</li> <li>b) the financial support to third parties was agreed in Annex 1 of the Agreement and the other provisions on financial support to third parties included in Annex 1 were</li> </ul>	43) All minimum conditions were met	

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Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	respected.		

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D	OTHER ACTUAL DIRECT COSTS		
D.1	<p><b>COSTS OF TRAVEL AND RELATED SUBSISTENCE ALLOWANCES</b></p> <p><b>The Auditor sampled [ ] cost items selected randomly</b> <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).</i></p> <p>The Auditor inspected the sample and verified that:</p> <ul style="list-style-type: none"> <li>○ travel and subsistence costs were consistent with the Beneficiary's usual policy for travel. In this context, the Beneficiary provided evidence of its normal policy for travel costs (e.g. use of first class tickets, reimbursement by the Beneficiary on the basis of actual costs, a lump sum or per diem) to enable the Auditor to compare the travel costs charged with this policy;</li> <li>○ travel costs are correctly identified and allocated to the action (e.g. trips are directly linked to the action) by reviewing relevant supporting documents such as minutes of meetings, workshops or conferences, their registration in the correct project account, their consistency with time records or with the dates/duration of the workshop/conference;</li> <li>○ no ineligible costs or excessive or reckless expenditure was declared.</li> </ul>	44) Costs were incurred, approved and reimbursed in line with the Beneficiary's usual policy for travels.	
		45) There was a link between the trip and the action.	
		46) The supporting documents were consistent with each other regarding subject of the trip, dates, duration and reconciled with time records and accounting.	
		47) No ineligible costs or excessive or reckless expenditure was declared.	
D.2	<p><b>DEPRECIATION COSTS FOR EQUIPMENT, INFRASTRUCTURE OR OTHER ASSETS</b></p> <p><b>The Auditor sampled [ ] cost items selected randomly</b> <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).</i></p> <p>For “equipment, infrastructure or other assets” [from now on called “asset(s)”] selected in the</p>	48) Procurement rules, principles and guides were followed.	
		49) There was a link between the grant agreement and the asset charged to the action.	

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	<p>sample the Auditor verified that:</p> <ul style="list-style-type: none"> <li>○ the assets were acquired in conformity with the Beneficiary's internal guidelines and procedures;</li> <li>○ they were correctly allocated to the action (with supporting documents such as delivery note invoice or any other proof demonstrating the link to the action)</li> <li>○ they were entered in the accounting system;</li> <li>○ the extent to which the assets were used for the action (as a percentage) was supported by reliable documentation (e.g. usage overview table);</li> </ul> <p>The Auditor recalculated the depreciation costs and verified that they were in line with the applicable rules in the Beneficiary's country and with the Beneficiary's usual accounting policy (e.g. depreciation calculated on the acquisition value).</p> <p>The Auditor verified that no ineligible costs such as deductible VAT, exchange rate losses, excessive or reckless expenditure were declared (see Article 6.5 GA).</p>	50) The asset charged to the action was traceable to the accounting records and the underlying documents.	
		51) The depreciation method used to charge the asset to the action was in line with the applicable rules of the Beneficiary's country and the Beneficiary's usual accounting policy.	
		52) The amount charged corresponded to the actual usage for the action.	
		53) No ineligible costs or excessive or reckless expenditure were declared.	
<b>D.3</b>	<p><b>COSTS OF OTHER GOODS AND SERVICES</b></p> <p><b>The Auditor sampled [ ] cost items selected randomly</b> (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest</i>).</p> <p>For the purchase of goods, works or services included in the sample the Auditor verified that:</p> <ul style="list-style-type: none"> <li>○ the contracts did not cover tasks described in Annex 1;</li> </ul>	54) Contracts for works or services did not cover tasks described in Annex 1.	
		55) Costs were allocated to the correct action and the goods were not placed in the inventory of durable equipment.	

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	<ul style="list-style-type: none"> <li>○ they were correctly identified, allocated to the proper action, entered in the accounting system (traceable to underlying documents such as purchase orders, invoices and accounting);</li> <li>○ the goods were not placed in the inventory of durable equipment;</li> <li>○ the costs charged to the action were accounted in line with the Beneficiary's usual accounting practices;</li> <li>○ no ineligible costs or excessive or reckless expenditure were declared (see Article 6 GA).</li> </ul> <p>In addition, the Auditor verified that these goods and services were acquired in conformity with the Beneficiary's internal guidelines and procedures, in particular:</p> <ul style="list-style-type: none"> <li>○ if Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC or of Directive 2004/17/EC, the Auditor verified that the applicable national law on public procurement was followed and that the procurement contract complied with the Terms and Conditions of the Agreement.</li> <li>○ if the Beneficiary did not fall into the category above, the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement.</li> </ul> <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> <li>○ the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the contract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Auditor also verified that the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment);</li> </ul> <p><i>SUCH GOODS AND SERVICES INCLUDE, FOR INSTANCE, CONSUMABLES AND SUPPLIES, DISSEMINATION (INCLUDING OPEN ACCESS), PROTECTION OF RESULTS, SPECIFIC EVALUATION OF THE ACTION IF IT IS REQUIRED BY THE</i></p>	<p>56) The costs were charged in line with the Beneficiary's accounting policy and were adequately supported.</p> <p>57) No ineligible costs or excessive or reckless expenditure were declared. For internal invoices/charges only the cost element was charged, without any mark-ups.</p> <p>58) Procurement rules, principles and guides were followed. There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. The purchases were made in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the</i></p>	
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	AGREEMENT, CERTIFICATES ON THE FINANCIAL STATEMENTS IF THEY ARE REQUIRED BY THE AGREEMENT AND CERTIFICATES ON THE METHODOLOGY, TRANSLATIONS, REPRODUCTION.	<i>caption “Exceptions” of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i>	
D.4	<b>AGGREGATED CAPITALISED AND OPERATING COSTS OF RESEARCH INFRASTRUCTURE</b>  The Auditor ensured the existence of a positive ex-ante assessment (issued by the EC Services) of the cost accounting methodology of the Beneficiary allowing it to apply the guidelines on direct costing for large research infrastructures in Horizon 2020.  <i><b>In the cases that a positive ex-ante assessment has been issued (see the standard factual findings 59-60 on the next column),</b></i>  The Auditor ensured that the beneficiary has applied consistently the methodology that is explained and approved in the positive ex ante assessment;  <i><b>In the cases that a positive ex-ante assessment has NOT been issued (see the standard factual findings 61 on the next column),</b></i>  The Auditor verified that no costs of Large Research Infrastructure have been charged as direct costs in any costs category;	59) The costs declared as direct costs for Large Research Infrastructures (in the appropriate line of the Financial Statement) comply with the methodology described in the positive ex-ante assessment report.	
		60) Any difference between the methodology applied and the one positively assessed was extensively described and adjusted accordingly.	
		61) The direct costs declared were free from any indirect costs items related to the Large Research Infrastructure.	

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	<p><b><i>In the cases that a draft ex-ante assessment report has been issued with recommendation for further changes (see the standard factual findings 61 on the next column),</i></b></p> <ul style="list-style-type: none"> <li>The Auditor followed the same procedure as above (when a positive ex-ante assessment has NOT yet been issued) and paid particular attention (testing reinforced) to the cost items for which the draft ex-ante assessment either rejected the inclusion as direct costs for Large Research Infrastructures or issued recommendations.</li> </ul>		
<b>E</b>	<b>USE OF EXCHANGE RATES</b>		
<b>E.1</b>	<p><u>a) For Beneficiaries with accounts established in a currency other than euros</u></p> <p><b>The Auditor sampled [ ] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement ( full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</b></p> <p><i>COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO AT THE AVERAGE OF THE DAILY EXCHANGE RATES PUBLISHED IN THE C SERIES OF OFFICIAL JOURNAL OF THE EUROPEAN UNION (<a href="https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html">https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html</a> ), DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.</i></p> <p><i>IF NO DAILY EURO EXCHANGE RATE IS PUBLISHED IN THE OFFICIAL JOURNAL OF THE EUROPEAN UNION FOR THE CURRENCY IN QUESTION, CONVERSION SHALL BE MADE AT THE AVERAGE OF THE MONTHLY ACCOUNTING RATES ESTABLISHED BY THE COMMISSION AND PUBLISHED ON ITS WEBSITE (<a href="http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm">http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm</a> ),</i></p>	62) The exchange rates used to convert other currencies into Euros were in accordance with the rules established of the Grant Agreement and there was no difference in the final figures.	



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	DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.		
	<p><u>b) For Beneficiaries with accounts established in euros</u></p> <p><b>The Auditor sampled [ ] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement ( full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</b></p> <p><i>COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO BY APPLYING THE BENEFICIARY’S USUAL ACCOUNTING PRACTICES.</i></p>	63) The Beneficiary applied its usual accounting practices.	

**[legal name of the audit firm]**

**[name and function of an authorised representative]**

**[dd Month yyyy]**

**<Signature of the Auditor>**

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## ANNEX 6

### MODEL FOR THE CERTIFICATE ON THE METHODOLOGY

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data.

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**Terms of reference for an audit engagement for a methodology certificate in connection with one or more grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme**

This document sets out the ‘**Terms of Reference (ToR)**’ under which

[OPTION 1: *[insert name of the beneficiary]* (‘the Beneficiary’)] [OPTION 2: *[insert name of the linked third party]* (‘the Linked Third Party’), third party linked to the Beneficiary *[insert name of the beneficiary]* (‘the Beneficiary’)]

agrees to engage

**[insert legal name of the auditor]** (‘the Auditor’)

to produce an independent report of factual findings (‘the Report’) concerning the *[Beneficiary’s]* *[Linked Third Party’s]* usual accounting practices for calculating and claiming direct personnel costs declared as unit costs (‘the Methodology’) in connection with grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme.

The procedures to be carried out for the assessment of the methodology will be based on the grant agreement(s) detailed below:

**[title and number of the grant agreement(s)]** (‘the Agreement(s)’)

The Agreement(s) has(have) been concluded between the Beneficiary and [OPTION 1: *the European Union, represented by the European Commission* (‘the Commission’)] [OPTION 2: *the European Atomic Energy Community (Euratom), represented by the European Commission* (‘the Commission’)] [OPTION 3: *the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)]* (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’)].

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The *[Commission] [Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only.  
The *[European Union] [Euratom] [Agency]* is not a party to this engagement.

### 1.1 Subject of the engagement

According to Article 18.1.2 of the Agreement, beneficiaries *[and linked third parties]* that declare direct personnel costs as unit costs calculated in accordance with their usual cost accounting practices may submit to the *[Commission] [Agency]*, for approval, a certificate on the methodology ('CoMUC') stating that there are adequate records and documentation to prove that their cost accounting practices used comply with the conditions set out in Point A of Article 6.2.

The subject of this engagement is the CoMUC which is composed of two separate documents:

- the Terms of Reference ('the ToR') to be signed by the *[Beneficiary] [Linked Third Party]* and the Auditor;
- the Auditor's Independent Report of Factual Findings ('the Report') issued on the Auditor's letterhead, dated, stamped and signed by the Auditor which includes; the standard statements ('the Statements') evaluated and signed by the *[Beneficiary] [Linked Third Party]*, the agreed-upon procedures ('the Procedures') performed by the Auditor and the standard factual findings ('the Findings') assessed by the Auditor. The Statements, Procedures and Findings are summarised in the table that forms part of the Report.

The information provided through the Statements, the Procedures and the Findings will enable the Commission to draw conclusions regarding the existence of the *[Beneficiary's] [Linked Third Party's]* usual cost accounting practice and its suitability to ensure that direct personnel costs claimed on that basis comply with the provisions of the Agreement. The Commission draws its own conclusions from the Report and any additional information it may require.

### 1.2 Responsibilities

The parties to this agreement are the *[Beneficiary] [Linked Third Party]* and the Auditor.

The *[Beneficiary] [Linked Third Party]*:

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- is responsible for preparing financial statements for the Agreement(s) ('the Financial Statements') in compliance with those Agreements;
- is responsible for providing the Financial Statement(s) to the Auditor and enabling the Auditor to reconcile them with the [Beneficiary's] [Linked Third Party's] accounting and bookkeeping system and the underlying accounts and records. The Financial Statement(s) will be used as a basis for the procedures which the Auditor will carry out under this ToR;
- is responsible for its Methodology and liable for the accuracy of the Financial Statement(s);
- is responsible for endorsing or refuting the Statements indicated under the heading 'Statements to be made by the Beneficiary/ Linked Third Party' in the first column of the table that forms part of the Report;
- must provide the Auditor with a signed and dated representation letter;
- accepts that the ability of the Auditor to carry out the Procedures effectively depends upon the [Beneficiary] [Linked Third Party] providing full and free access to the [Beneficiary's] [Linked Third Party's] staff and to its accounting and other relevant records.

The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the Beneficiary's *[and Linked Third Party's]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with these ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out and the Findings to be endorsed by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement the Auditor does not provide an audit opinion or a statement of assurance.

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### 1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with<sup>1</sup>:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the Commission requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there was no conflict of interests in establishing this Report between the Auditor and the Beneficiary *[and the Linked Third Party]* that could have a bearing on the Report, and must specify – if the service is invoiced - the total fee paid to the Auditor for providing the Report.

### 1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7 of the Agreement).

Under Article 22 of the Agreement, the Commission, *[the Agency]*, the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are claimed from *[the European Union]* *[Euratom]* budget. This includes work related to this engagement. The Auditor must provide access to all working papers related to this assignment if the Commission, *[the Agency]*, the European Anti-Fraud Office or the European Court of Auditors requests them.

### 1.5 Timing

The Report must be provided by [dd Month yyyy].

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<sup>1</sup> Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

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## 1.6 Other Terms

*[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]*

[legal name of the Auditor]

[legal name of the [Beneficiary] [Linked Third Party]]

[name & title of authorised representative]

[name & title of authorised representative]

[dd Month yyyy]

[dd Month yyyy]

Signature of the Auditor Signature

Signature of the [Beneficiary] [Linked Third Party]



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**Independent report of factual findings on the methodology concerning grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme**

*(To be printed on letterhead paper of the auditor)*

To

[ name of contact person(s)], [Position]

[[Beneficiary's] [Linked Third Party's] name]

[ Address]

[ dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')],

we

[ name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

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have carried out the agreed-upon procedures ('the Procedures') and provide hereby our Independent Report of Factual Findings ('the Report'), concerning the *[Beneficiary's] [Linked Third Party's]* usual accounting practices for calculating and declaring direct personnel costs declared as unit costs ('the Methodology').

You requested certain procedures to be carried out in connection with the grant(s)

[title and number of the grant agreement(s)] ('the Agreement(s)').

## The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes: the standard statements ('the Statements') made by the *[Beneficiary] [Linked Third Party]*, the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') confirmed by us.

The engagement involved carrying out the Procedures and assessing the Findings and the documentation requested appended to this Report, the results of which the Commission uses to draw conclusions regarding the acceptability of the Methodology applied by the *[Beneficiary] [Linked Third Party]*.

The Report covers the methodology used from [dd Month yyyy]. In the event that the *[Beneficiary] [Linked Third Party]* changes this methodology, the Report will not be applicable to any Financial Statement<sup>2</sup> submitted thereafter.

The scope of the Procedures and the definition of the standard statements and findings were determined solely by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence.

Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, we do not

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<sup>2</sup> Financial Statement in this context refers solely to Annex 4 of the Agreement by which the Beneficiary declares costs under the Agreement.

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give a statement of assurance on the costs declared on the basis of the [Beneficiary's] [Linked Third Party's] Methodology. Had we carried out additional procedures or had we performed an audit or review in accordance with these standards, other matters might have come to its attention and would have been included in the Report.

## Exceptions

Apart from the exceptions listed below, the [Beneficiary] [Linked Third Party] agreed with the standard Statements and provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and corroborate the standard Findings.

**List here any exception and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, also indicate the corresponding amount.**

....

*Explanation of possible exceptions in the form of examples (to be removed from the Report):*

- i. the [Beneficiary] [Linked Third Party] did not agree with the standard Statement number ... because...;*
- ii. the Auditor could not carry out the procedure ... established because .... (e.g. due to the inability to reconcile key information or the unavailability or inconsistency of data);*
- iii. the Auditor could not confirm or corroborate the standard Finding number ... because ....*

## Remarks

We would like to add the following remarks relevant for the proper understanding of the Methodology applied by the [Beneficiary] [Linked Third Party] or the results reported:

*Example (to be removed from the Report):*

*Regarding the methodology applied to calculate hourly rates ...*

*Regarding standard Finding 15 it has to be noted that ...*

*The [Beneficiary] [Linked Third Party] explained the deviation from the benchmark statement XXIV concerning time recording for personnel with no exclusive dedication to the action in the following manner:*

*...*

## Annexes

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Please provide the following documents to the auditor and annex them to the report when submitting this CoMUC to the Commission:

1. Brief description of the methodology for calculating personnel costs, productive hours and hourly rates;
2. Brief description of the time recording system in place;
3. An example of the time records used by the [Beneficiary] [Linked Third Party];
4. Description of any budgeted or estimated elements applied, together with an explanation as to why they are relevant for calculating the personnel costs and how they are based on objective and verifiable information;
5. A summary sheet with the hourly rate for direct personnel declared by the [Beneficiary] [Linked Third Party] and recalculated by the Auditor for each staff member included in the sample (the names do not need to be reported);
6. A comparative table summarising for each person selected in the sample a) the time claimed by the [Beneficiary] [Linked Third Party] in the Financial Statement(s) and b) the time according to the time record verified by the Auditor;
7. A copy of the letter of representation provided to the Auditor.

### Use of this Report

This Report has been drawn up solely for the purpose given under Point 1.1 Reasons for the engagement.

### The Report:

- is confidential and is intended to be submitted to the Commission by the [Beneficiary] [Linked Third Party] in connection with Article 18.1.2 of the Agreement;
- may not be used by the [Beneficiary] [Linked Third Party] or by the Commission for any other purpose, nor distributed to any other parties;
- may be disclosed by the Commission only to authorised parties, in particular the European Anti-Fraud Office (OLAF) and the European Court of Auditors.
- relates only to the usual cost accounting practices specified above and does not constitute a report on the Financial Statements of the [Beneficiary] [Linked Third Party].

No conflict of interest<sup>3</sup> exists between the Auditor and the Beneficiary [and the Linked Third Party] that could have a bearing on the Report. The total fee paid to the Auditor for producing the Report was EUR [ ] (including EUR [ ] of deductible VAT).

<sup>3</sup> A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;

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We look forward to discussing our Report with you and would be pleased to provide any further information or assistance which may be required.

Yours sincerely

[legal name of the Auditor]

[name and title of the authorised representative]

[dd Month yyyy]

Signature of the Auditor

- 
- stands to benefit directly should the certificate be accepted;
  - has a close relationship with any person representing the beneficiary;
  - is a director, trustee or partner of the beneficiary; or
  - is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

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**Statements to be made by the Beneficiary/Linked Third Party ('the Statements') and Procedures to be carried out by the Auditor ('the Procedures') and standard factual findings ('the Findings') to be confirmed by the Auditor**

The Commission reserves the right to provide the auditor with guidance regarding the Statements to be made, the Procedures to be carried out or the Findings to be ascertained and the way in which to present them. The Commission reserves the right to vary the Statements, Procedures or Findings by written notification to the Beneficiary/Linked Third Party to adapt the procedures to changes in the grant agreement(s) or to any other circumstances.

If this methodology certificate relates to the Linked Third Party's usual accounting practices for calculating and claiming direct personnel costs declared as unit costs any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

<b>Please explain any discrepancies in the body of the Report.</b>	
<b>Statements to be made by Beneficiary</b>	<b>Procedures to be carried out and Findings to be confirmed by the Auditor</b>
<b>A. Use of the Methodology</b>  I. The cost accounting practice described below has been in use since [dd Month yyyy].  II. The next planned alteration to the methodology used by the Beneficiary will be from [dd Month yyyy].	<b>Procedure:</b>  ✓ The Auditor checked these dates against the documentation the Beneficiary has provided.  <b>Factual finding:</b>  1. The dates provided by the Beneficiary were consistent with the documentation.
<b>B. Description of the Methodology</b>  III. The methodology to calculate unit costs is being used in a consistent manner and is reflected in the relevant procedures.  <i>[Please describe the methodology your entity uses to calculate <u>personnel</u> costs, productive hours and hourly rates, present your description to the Auditor and annex it to this certificate]</i>  <i>[If the statement of section "B. Description of the methodology" cannot be endorsed by the Beneficiary or there is no written methodology to calculate unit costs it should be listed here below and reported as exception by the Auditor in the main Report of</i>	<b>Procedure:</b>  ✓ The Auditor reviewed the description, the relevant manuals and/or internal guidance documents describing the methodology.  <b>Factual finding:</b>  2. The brief description was consistent with the relevant manuals, internal guidance and/or other documentary evidence the Auditor has reviewed.  3. The methodology was generally applied by the Beneficiary as part of its usual costs accounting practices.

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Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<b>Factual Findings:</b> - ...]	
<b>C. Personnel costs</b> <u>General</u> IV. The unit costs (hourly rates) are limited to salaries including during parental leave, social security contributions, taxes and other costs included in the remuneration required under national law and the employment contract or equivalent appointing act; V. Employees are hired directly by the Beneficiary in accordance with national law, and work under its sole supervision and responsibility; VI. The Beneficiary remunerates its employees in accordance with its usual practices. This means that personnel costs are charged in line with the Beneficiary's usual payroll policy (e.g. salary policy, overtime policy, variable pay) and no special conditions exist for employees assigned to tasks relating to the European Union or Euratom, unless explicitly provided for in the grant agreement(s); VII. The Beneficiary allocates its employees to the relevant group/category/cost centre for the purpose of the unit cost calculation in line with the usual cost accounting practice; VIII. Personnel costs are based on the payroll system and accounting system. IX. Any exceptional adjustments of actual personnel costs resulted from relevant budgeted or estimated elements and were based on objective and verifiable information. <i>[Please describe the 'budgeted or estimated elements' and their relevance to personnel costs, and explain how they were reasonable and based on objective and verifiable information, present your explanation to the Auditor and annex it to this certificate].</i> X. Personnel costs claimed do not contain any of the following ineligible costs: costs related to return on capital; debt and debt service charges; provisions for future losses	<b>Procedure:</b> <i>The Auditor draws a sample of employees to carry out the procedures indicated in this section C and the following sections D to F.</i>  <i>[The Auditor has drawn a random sample of 10 full-time equivalents made up of employees assigned to the action(s). If fewer than 10 full-time equivalents are assigned to the action(s), the Auditor has selected a sample of 10 full-time equivalents consisting of all employees assigned to the action(s), complemented by other employees irrespective of their assignments.]. For this sample:</i> <ul style="list-style-type: none"> <li>✓ the Auditor reviewed all documents relating to personnel costs such as employment contracts, payslips, payroll policy (e.g. salary policy, overtime policy, variable pay policy), accounting and payroll records, applicable national tax, labour and social security law and any other documents corroborating the personnel costs claimed;</li> <li>✓ in particular, the Auditor reviewed the employment contracts of the employees in the sample to verify that: <ul style="list-style-type: none"> <li>i. they were employed directly by the Beneficiary in accordance with applicable national legislation;</li> <li>ii. they were working under the sole technical supervision and responsibility of the latter;</li> <li>iii. they were remunerated in accordance with the Beneficiary's usual practices;</li> <li>iv. they were allocated to the correct group/category/cost centre for the purposes of calculating the unit cost in line with the Beneficiary's usual cost accounting practices;</li> </ul> </li> <li>✓ the Auditor verified that any ineligible items or any costs claimed under other costs categories or costs covered by other types of grant or by other grants financed from the European Union budget have not been taken</li> </ul>



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<b>Please explain any discrepancies in the body of the Report.</b>	
<b>Statements to be made by Beneficiary</b>	<b>Procedures to be carried out and Findings to be confirmed by the Auditor</b>
<p>or debts; interest owed; doubtful debts; currency exchange losses; bank costs charged by the Beneficiary's bank for transfers from the Commission/Agency; excessive or reckless expenditure; deductible VAT or costs incurred during suspension of the implementation of the action.</p> <p>XI. Personnel costs were not declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU budget and grants awarded by bodies other than the Commission/Agency for the purpose of implementing the EU budget).</p> <p><u>If additional remuneration as referred to in the grant agreement(s) is paid</u></p> <p>XII. The Beneficiary is a non-profit legal entity;</p> <p>XIII. The additional remuneration is part of the beneficiary's usual remuneration practices and paid consistently whenever the relevant work or expertise is required;</p> <p>XIV. The criteria used to calculate the additional remuneration are objective and generally applied regardless of the source of funding;</p> <p>XV. The additional remuneration included in the personnel costs used to calculate the hourly rates for the grant agreement(s) is capped at EUR 8 000 per full-time equivalent (reduced proportionately if the employee is not assigned exclusively to the action).</p> <p><i>[If certain statement(s) of section "C. Personnel costs" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor in the main Report of</i></p>	<p>into account when calculating the personnel costs;</p> <ul style="list-style-type: none"> <li>✓ the Auditor numerically reconciled the total amount of personnel costs used to calculate the unit cost with the total amount of personnel costs recorded in the statutory accounts and the payroll system.</li> <li>✓ to the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, the Auditor carefully examined those elements and checked the information source to confirm that they correspond to objective and verifiable information;</li> <li>✓ if additional remuneration has been claimed, the Auditor verified that the Beneficiary was a non-profit legal entity, that the amount was capped at EUR 8000 per full-time equivalent and that it was reduced proportionately for employees not assigned exclusively to the action(s).</li> <li>✓ the Auditor recalculated the personnel costs for the employees in the sample.</li> </ul> <p><b>Factual finding:</b></p> <ol style="list-style-type: none"> <li>4. All the components of the remuneration that have been claimed as personnel costs are supported by underlying documentation.</li> <li>5. The employees in the sample were employed directly by the Beneficiary in accordance with applicable national law and were working under its sole supervision and responsibility.</li> <li>6. Their employment contracts were in line with the Beneficiary's usual policy;</li> <li>7. Personnel costs were duly documented and consisted solely of salaries, social security contributions (pension contributions, health insurance, unemployment fund contributions, etc.), taxes and other statutory costs included in the remuneration (holiday pay, thirteenth month's pay, etc.);</li> <li>8. The totals used to calculate the personnel unit costs are consistent with those registered in the payroll and accounting records;</li> <li>9. To the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, those elements were</li> </ol>

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<p><b>Factual Findings:</b></p> <p>- ...]</p>	<p>relevant for calculating the personnel costs and correspond to objective and verifiable information. The budgeted or estimated elements used are: — (indicate the elements and their values).</p> <p>10. Personnel costs contained no ineligible elements;</p> <p>11. Specific conditions for eligibility were fulfilled when additional remuneration was paid: a) the Beneficiary is registered in the grant agreements as a non-profit legal entity; b) it was paid according to objective criteria generally applied regardless of the source of funding used and c) remuneration was capped at EUR 8000 per full-time equivalent (or up to up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).</p>
<p><b>D. Productive hours</b></p> <p>XVI. The number of productive hours per full-time employee applied is <i>[delete as appropriate]</i>:</p> <p>A. 1720 productive hours per year for a person working full-time (corresponding pro-rata for persons not working full time).</p> <p>B. the total number of hours worked in the year by a person for the Beneficiary</p> <p>C. the standard number of annual hours generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the standard annual workable hours.</p> <p><u>If method B is applied</u></p> <p>XVII. The calculation of the total number of hours worked was done as follows: annual workable hours of the person according to the employment contract, applicable labour agreement or national law plus overtime worked minus absences (such as sick leave and special leave).</p> <p>XVIII. 'Annual workable hours' are hours</p>	<p><b>Procedure (same sample basis as for Section C: Personnel costs):</b></p> <ul style="list-style-type: none"> <li>✓ The Auditor verified that the number of productive hours applied is in accordance with method A, B or C.</li> <li>✓ The Auditor checked that the number of productive hours per full-time employee is correct and that it is reduced proportionately for employees not exclusively assigned to the action(s).</li> <li>✓ If method B is applied the Auditor verified i) the manner in which the total number of hours worked was done and ii) that the contract specified the annual workable hours by inspecting all the relevant documents, national legislation, labour agreements and contracts.</li> <li>✓ If method C is applied the Auditor reviewed the manner in which the standard number of working hours per year has been calculated by inspecting all the relevant documents, national legislation, labour agreements and contracts and verified that the number of productive hours per year used for these calculations was at least 90% of the standard number of working hours per year.</li> </ul>

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<p>during which the personnel must be working, at the employer's disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.</p> <p>XIX. The contract (applicable collective labour agreement or national working time legislation) do specify the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>XX. The standard number of productive hours per year is that of a full-time equivalent; for employees not assigned exclusively to the action(s) this number is reduced proportionately.</p> <p>XXI. The number of productive hours per year on which the hourly rate is based i) corresponds to the Beneficiary's usual accounting practices; ii) is at least 90% of the standard number of workable (working) hours per year.</p> <p>XXII. Standard workable (working) hours are hours during which personnel are at the Beneficiary's disposal performing the duties described in the relevant employment contract, collective labour agreement or national labour legislation. The number of standard annual workable (working) hours that the Beneficiary claims is supported by labour contracts, national legislation and other documentary evidence.</p> <p><i>[If certain statement(s) of section "D. Productive hours" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p><b>Factual finding:</b></p> <p><u>General</u></p> <p>12. The Beneficiary applied a number of productive hours consistent with method A, B or C detailed in the left-hand column.</p> <p>13. The number of productive hours per year per full-time employee was accurate and was proportionately reduced for employees not working full-time or exclusively for the action.</p> <p><u>If method B is applied</u></p> <p>14. The number of 'annual workable hours', overtime and absences was verifiable based on the documents provided by the Beneficiary and the calculation of the total number of hours worked was accurate.</p> <p>15. The contract specified the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>16. The calculation of the number of productive hours per year corresponded to the usual costs accounting practice of the Beneficiary.</p> <p>17. The calculation of the standard number of workable (working) hours per year was corroborated by the documents presented by the Beneficiary.</p> <p>18. The number of productive hours per year used for the calculation of the hourly rate was at least 90% of the number of workable (working) hours per year.</p>
<p><b>E. Hourly rates</b></p> <p>The hourly rates are correct because:</p> <p>XXIII. Hourly rates are correctly calculated since they result from dividing annual personnel</p>	<p><b>Procedure</b></p> <p>✓ The Auditor has obtained a list of all personnel rates calculated by the Beneficiary in accordance with the methodology used.</p> <p>✓ The Auditor has obtained a list of all the relevant employees, based on which the</p>

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<p>costs by the productive hours of a given year and group (e.g. staff category or department or cost centre depending on the methodology applied) and they are in line with the statements made in section C. and D. above.</p> <p><i>[If the statement of section 'E. Hourly rates' cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p>personnel rate(s) are calculated.</p> <p>For 10 full-time equivalent employees selected at random (same sample basis as Section C: Personnel costs):</p> <ul style="list-style-type: none"> <li>✓ The Auditor recalculated the hourly rates.</li> <li>✓ The Auditor verified that the methodology applied corresponds to the usual accounting practices of the organisation and is applied consistently for all activities of the organisation on the basis of objective criteria irrespective of the source of funding.</li> </ul> <p><b>Factual finding:</b></p> <p>19. No differences arose from the recalculation of the hourly rate for the employees included in the sample.</p>
<p><b>F. Time recording</b></p> <p>XXIV. Time recording is in place for all persons with no exclusive dedication to one Horizon 2020 action. At least all hours worked in connection with the grant agreement(s) are registered on a <b>daily/weekly/monthly</b> basis <i>[delete as appropriate]</i> using a <b>paper/computer-based system</b> <i>[delete as appropriate]</i>;</p> <p>XXV. For persons exclusively assigned to one Horizon 2020 activity the Beneficiary has either signed a declaration to that effect or has put arrangements in place to record their working time;</p> <p>XXVI. Records of time worked have been signed by the person concerned (on paper or electronically) and approved by the action manager or line manager at least monthly;</p> <p>XXVII. Measures are in place to prevent staff from:</p> <ul style="list-style-type: none"> <li>i. recording the same hours twice,</li> <li>ii. recording working hours during absence periods (e.g. holidays, sick leave),</li> <li>iii. recording more than the number of productive hours per year used to calculate the hourly rates, and</li> </ul>	<p><b>Procedure</b></p> <ul style="list-style-type: none"> <li>✓ The Auditor reviewed the brief description, all relevant manuals and/or internal guidance describing the methodology used to record time.</li> </ul> <p>The Auditor reviewed the time records of the random sample of 10 full-time equivalents referred to under Section C: Personnel costs, and verified in particular:</p> <ul style="list-style-type: none"> <li>✓ that time records were available for all persons with not exclusive assignment to the action;</li> <li>✓ that time records were available for persons working exclusively for a Horizon 2020 action, or, alternatively, that a declaration signed by the Beneficiary was available for them certifying that they were working exclusively for a Horizon 2020 action;</li> <li>✓ that time records were signed and approved in due time and that all minimum requirements were fulfilled;</li> <li>✓ that the persons worked for the action in the periods claimed;</li> <li>✓ that no more hours were claimed than the productive hours used to calculate the hourly</li> </ul>

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<p>iv. recording hours worked outside the action period.</p> <p>XXVIII. No working time was recorded outside the action period;</p> <p>XXIX. No more hours were claimed than the productive hours used to calculate the hourly personnel rates.</p> <p><i>[Please provide a brief description of the <u>time recording system</u> in place together with the measures applied to ensure its reliability to the Auditor and annex it to the present certificate<sup>4</sup>].</i></p> <p><i>[If certain statement(s) of section “F. Time recording” cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:</i></p> <p>- ...]</p>	<p>personnel rates;</p> <ul style="list-style-type: none"> <li>✓ that internal controls were in place to prevent that time is recorded twice, during absences for holidays or sick leave; that more hours are claimed per person per year for Horizon 2020 actions than the number of productive hours per year used to calculate the hourly rates; that working time is recorded outside the action period;</li> <li>✓ the Auditor cross-checked the information with human-resources records to verify consistency and to ensure that the internal controls have been effective. In addition, the Auditor has verified that no more hours were charged to Horizon 2020 actions per person per year than the number of productive hours per year used to calculate the hourly rates, and verified that no time worked outside the action period was charged to the action.</li> </ul> <p><b>Factual finding:</b></p> <ol style="list-style-type: none"> <li>20. The brief description, manuals and/or internal guidance on time recording provided by the Beneficiary were consistent with management reports/records and other documents reviewed and were generally applied by the Beneficiary to produce the financial statements.</li> <li>21. For the random sample time was recorded or, in the case of employees working exclusively for the action, either a signed declaration or time records were available;</li> <li>22. For the random sample the time records were signed by the employee and the action manager/line manager, at least monthly.</li> <li>23. Working time claimed for the action occurred in the periods claimed;</li> <li>24. No more hours were claimed than the number productive hours used to calculate the hourly</li> </ol>

<sup>4</sup> The description of the time recording system must state among others information on the content of the time records, its coverage (full or action time-recording, for all personnel or only for personnel involved in H2020 actions), its degree of detail (whether there is a reference to the particular tasks accomplished), its form, periodicity of the time registration and authorisation (paper or a computer-based system; on a daily, weekly or monthly basis; signed and countersigned by whom), controls applied to prevent double-charging of time or ensure consistency with HR-records such as absences and travels as well as its information flow up to its use for the preparation of the Financial Statements.

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	<p>personnel rates;</p> <p>25. There is proof that the Beneficiary has checked that working time has not been claimed twice, that it is consistent with absence records and the number of productive hours per year, and that no working time has been claimed outside the action period.</p> <p>26. Working time claimed is consistent with that on record at the human-resources department.</p>

**[official name of the [Beneficiary] [Linked Third Party]]**

**[official name of the Auditor]**

**[name and title of authorised representative]**

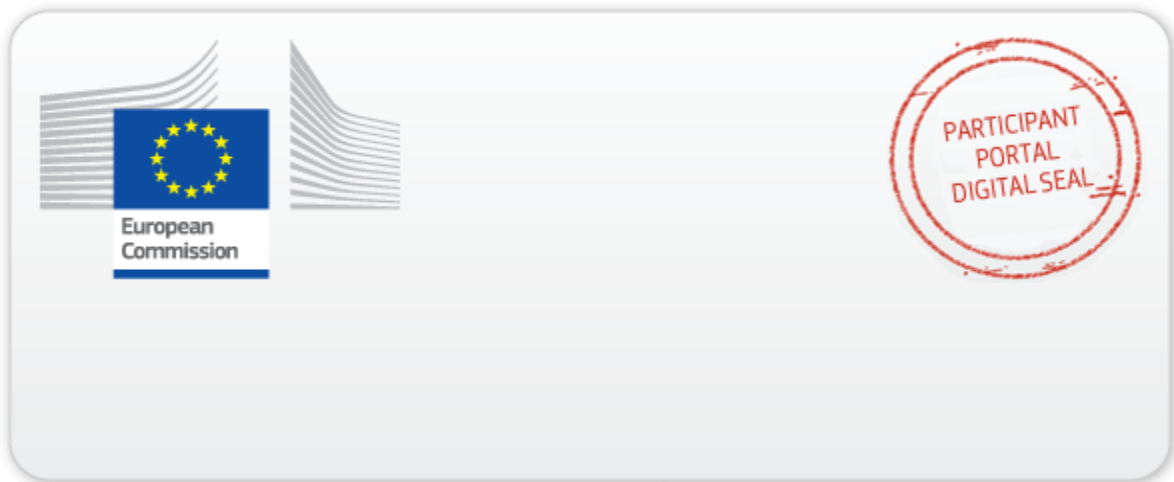
**[name and title of authorised representative]**

**[dd Month yyyy]**

**[dd Month yyyy]**

**<Signature of the [Beneficiary] [Linked Third Party]>**

**<Signature of the Auditor>**



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