EUROPEAN COMMISSION
Research Executive Agency

Director

GRANT AGREEMENT

NUMBER 870697 — DUET

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

on the one part,

the **Research Executive Agency (REA)** ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

represented for the purposes of signature of this Agreement by Head of Unit, Research Executive Agency , Industrial Leadership and Societal Challenges, Inclusive, Innovative and Reflective Societies, Corinna AMTING,

and

on the other part,

1. 'the coordinator':

VLAAMSE GEWEST (AIV), established in AVENUE DU PORT 88, BRUSSEL 1000, Belgium, VAT number: BE0316380841, represented for the purposes of signing the Agreement by Lieven RAES

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

2. **INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM (IMEC)**, established in KAPELDREEF 75, LEUVEN 3001, Belgium, VAT number: BE0425260668,

3. **KATHOLIEKE UNIVERSITEIT LEUVEN (KUL)**, established in OUDE MARKT 13, LEUVEN 3000, Belgium, VAT number: BE0419052173,

4. **ATHENS TECHNOLOGY CENTER ANONYMI BIOMICHANIKI EMPORIKI KAI TECHNIKI ETAIREIA EFARMOGON YPSILIS TECHNOLOGIAS (ATC)**, established in RIZAREIOU 10, ATHINA 152 33, Greece, VAT number: EL094360380,

5. **21C CONSULTANCY LIMITED (21c)**, established in THE WORK PLACE, LADBROKE GROVE 105, LONDON W11 1PG, United Kingdom, VAT number: GB868818265,

6. **AEGIS IT RESEARCH LTD (AEG)**, established in 20-22 WENLOCK ROAD, LONDON N1 7GU, United Kingdom,

7. **OPEN & AGILE SMART CITIES (OASC)**, established in PLEINLAAN 9, BRUSSEL 1050, Belgium, VAT number: BE0686623804,

8. **GRIMALDI STUDIO LEGALE SPRL (GSL)**, established in BOULEVARD DE WATERLOO 30, Brussels 1000, Belgium,

9. **DIMOS ATHINAION EPICHEIRISI MICHANOGRAFISIS (DAEM)**, established in LIOSSION 22, ATHENS 104 38, Greece, VAT number: EL090033107,

10. **virtualcitySYSTEMS GmbH (VCS)**, established in Tauentzienstraße 7 b/c, Berlin 10789, Germany, VAT number: DE244937391,

11. **NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO (TNO)**, established in ANNA VAN BUERENPLEIN 1, DEN HAAG 2595 DA, Netherlands, VAT number: NL002875718B01,

12. **PLAN4ALL ZS (P4All)**, established in K RYBNICKU 557, HORNI BRIZA 330 12, Czechia,

13. **SPRAVA INFORMACNICH TECHNOLOGII MESTA PLZNE, PRISPEVKOVA ORGANIZACE (PLZ)**, established in DOMINIKANSKA 4, PLZEN 301 00, Czechia, VAT number: CZ66362717,

14. **IS-practice (ISP)**, established in Renkinstraat 71, Schaarbeek 1030, Belgium, VAT number: BE0478042526,

15. **ETAIREIA ELEYTHEROY LOGISMIKOY LOGISMIKOY ANOIKTOY KODIKA (GFOSS)**, established in MESOGEION AVENUE 56, ATHINA 115 27, Greece, VAT number: EL998092605,

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

2a Additional information on the estimated budget

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

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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 '**Digital Urban European Twins for smarter decision making**' — '**DUET**' **('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 December 2019 ('**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 linked third party) and budget category (see Articles 5, 6, and 14).

4.2 Budget transfers

The estimated budget breakdown indicated in Annex 2 may be adjusted — without an amendment (see Article 55) — by transfers of amounts between beneficiaries, budget categories and/or forms of costs set out in Annex 2, 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 3 995 532.50** (three million nine hundred and ninety five thousand five hundred and thirty two EURO and fifty eurocents).

5.2 Form of grant, reimbursement rates and forms of costs

The grant reimburses **100% of the eligible costs of the beneficiaries and the linked third parties that are non-profit legal entities and 70% of the eligible costs of the beneficiaries that are profit legal entities** (see Article 6) (‘**reimbursement of eligible costs grant**’) (see Annex 2).

The estimated eligible costs of the action are EUR **4 544 457.50** (four million five hundred and forty four thousand four hundred and fifty seven EURO and fifty eurocents).

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 2a (**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**:

- for costs of internally invoiced goods and services: on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (‘**unit costs**’);
- for all other 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 Agency — 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 substantial errors, irregularities or fraud or serious breach of 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 and linked third parties (see Article 20) and approved by the Agency (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 Agency.

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 or to a linked third party 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 substantial errors, irregularities or fraud or serious breach of obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the Agency will calculate the reduced grant amount by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors,

irregularities or fraud or 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 Agency 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 Agency 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 Agency 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 the seriousness of the errors, irregularities or fraud or 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 2a or calculated by the beneficiary in accordance with its usual cost accounting practices (see Article 6.2, Point A and Article 6.2.D.5)

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

<u>Types of eligible personnel costs</u>

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[1] 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' means any part of the remuneration which exceeds what the person would be paid for time worked in projects funded by national schemes.

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 conditions similar to those of an employee (in particular regarding the way the work is organised, the tasks that are performed and the premises where they are performed);

(b) the result of the work carried out belongs to the beneficiary (unless exceptionally agreed otherwise), and

[1] 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.

(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.

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 2a 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 2a 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 are:

{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** (i.e. budget categories A.1, A.2, A.3): the hourly rate is calculated *per full financial year*, as follows:

{actual annual personnel costs (excluding additional remuneration) for the person

divided by

number of annual productive hours}.

using the personnel costs and the number of productive hours for each full financial year covered by the reporting period concerned. 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.

As an alternative, beneficiaries may calculate the hourly rate *per month*, as follows:

{actual monthly personnel cost (excluding additional remuneration) for the person

divided by

{number of annual productive hours / 12}}

using the personnel costs for each month and (one twelfth of) the annual productive hours calculated according to either option (i) or (iii) above, i.e.:

- fixed number of hours or
- standard annual productive hours.

Time spent on **parental leave** may not be deducted when calculating the hourly rate per month. However, beneficiaries may declare personnel costs incurred in periods of parental leave in proportion to the time the person worked on the action in that financial year.

If parts of a basic remuneration are generated over a period longer than a month, the beneficiaries may include only the share which is generated in the month (irrespective of the amount actually paid for that month).

Each beneficiary must use only one option (per full financial year or per month) for each full financial year;

(b) for personnel costs declared on the basis of **unit costs** (i.e. budget categories A.1, A.2, A.4, A.5): 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 2a (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'**[2] 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[3]);

(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.

[2] '**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.

[3] For the definition, see Article 2(6) of the H2020 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'.

D.5 **Costs of internally invoiced goods and services** directly used for the action are eligible, if:

(a) they are declared on the basis of a unit cost calculated in accordance with the beneficiary's usual cost accounting practices;

(b) the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;

(c) the unit cost is calculated using the actual costs for the good or service recorded in the beneficiary's accounts, excluding any ineligible cost or costs included in other budget categories.

The actual costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating the costs, reasonable and correspond to objective and verifiable information;

(d) the unit cost excludes any costs of items which are not directly linked to the production of the invoiced goods or service.

'Internally invoiced goods and services' means goods or services which are provided by the beneficiary directly for the action and which the beneficiary values on the basis of its usual cost accounting practices.

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[4] financed by the EU or Euratom budget cannot declare indirect costs for the period covered by the operating grant, unless they can demonstrate that the operating grant does not cover any costs of the action.

F. Specific cost category(ies)

Not applicable

6.3 Conditions for costs of linked third parties to be eligible

[4] 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 ('**Financial Regulation No 966/2012**')(OJ L 218, 26.10.2012, p.1): '**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.

Costs incurred by linked third parties are eligible if they fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 14.1.1.

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 or linked third party), 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 Agency;

(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 Agency 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, unless it can demonstrate that the operating grant does not cover any costs of the action.

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);
- call upon international partners to implement action tasks described in Annex 1 (see Article 14a).

In these cases, the beneficiaries retain sole responsibility towards the Agency 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 Agency, 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[5] (or 2014/24/EU[6]) or 'contracting entities' within the meaning of Directive 2004/17/EC[7] (or 2014/25/EU[8]) 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 Agency 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 Agency, the Commission, the European Court of Auditors

[5] 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).

[6] Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC. (OJ L 94, 28.03.2014, p. 65).

[7] 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)

[8] Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC (OJ L 94, 28.03.2014, p. 243).

(ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

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 Agency 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 Agency, 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 Agency 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 Agency, 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 2014/24/EU) or 'contracting entities' within the meaning of Directive 2004/17/EC (or 2014/25/EU) 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

14.1 Rules for calling upon linked third parties to implement part of the action

14.1.1 The following **affiliated entities**[10] and **third parties with a legal link to a beneficiary**[11] ('**linked third parties**') may implement the action tasks attributed to them in Annex 1:

[10] For the definition see Article 2.1(2) 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
- 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.

- ZAPADOCESKA UNIVERZITA V PLZNI (UWB), affiliated or linked to P4All

The linked third parties may declare as eligible the costs they incur for implementing the action tasks in accordance with Article 6.3.

The beneficiaries must ensure that the Agency, 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 linked third parties.

14.1.2 The beneficiaries must ensure that their obligations under Articles 18, 20, 35, 36 and 38 also apply to their linked third parties.

14.2 Consequences of non-compliance

If any obligation under Article 14.1.1 is breached, the costs of the linked third party will be ineligible (see Article 6) and will be rejected (see Article 42).

If any obligation under Article 14.1.2 is breached, the grant may be reduced (see Article 43).

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

ARTICLE 14a — IMPLEMENTATION OF ACTION TASKS BY INTERNATIONAL PARTNERS

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

[11] '**Third party with a legal link to a beneficiary**' is any legal entity which has a legal link to the beneficiary implying collaboration that is not limited to the action.

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 Participant Portal 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 Agency 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 or those of its linked third parties and

(ii) changes in the name, address, legal form, organisation type of its linked third parties;

(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 Article 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 Agency 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 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.

The beneficiaries and linked third parties 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 Agency 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.

For costs declared by linked third parties (see Article 14), it is the beneficiary that must keep the originals of the financial statements and the certificates on the financial statements of the linked third parties.

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 Agency 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 Agency (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 12
- RP2: from month 13 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 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**'.

The report must indicate the communication activities;

(iii) a **summary** for publication by the Agency;

(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 and from each linked third party, 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 and linked third parties 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 Agency.

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 and each linked third party 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 and from each linked third party, for the reporting period concerned;

(iii) not applicable;

(iv) a '**periodic summary financial statement**', 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**', 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 and for each linked third party, 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).

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 and linked third parties 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 and linked third parties 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

If the reports submitted do not comply with this Article, the Agency 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, the Agency may terminate the Agreement (see Article 50) or apply any of the other measures described in Chapter 6.

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 **3 196 426.00** (three million one hundred and ninety six thousand four hundred and twenty six EURO).

The Agency 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 **199 776.63** (one hundred and ninety nine thousand seven hundred and seventy six EURO and sixty three eurocents), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the Agency 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 Agency 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 Agency 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 and the linked third parties (see Article 20) and approved by the Agency (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 Agency 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 Agency 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 beneficiaries' consent — against any other amount owed by a beneficiary to the Agency, the Commission or another 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 Agency 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 Agency 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 Agency 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: ING BELGIQUE
Full name of the account holder: KB HR INFORM VLAANDEREN
IBAN code: BE30375111756611

21.9 Costs of payment transfers

The cost of the payment transfers is borne as follows:

- the Agency 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 Agency 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 Agency 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 Agency and the Commission

22.1.1 Right to carry out checks

The Agency or 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 Agency or the Commission may be assisted by external persons or bodies.

The Agency or the Commission may also request additional information in accordance with Article 17. The Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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 Agency or 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[16] and No 2185/96[17] (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[18], the European Court of Auditors (ECA) may — at any moment during implementation of the action or afterwards — carry out audits.

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**').

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[16] 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).

[17] 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).

[18] 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).

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

22.5.2 Findings in other grants

The Agency or 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 Agency or 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 Agency or 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 Agency or the Commission in justified cases.

The Agency or the Commission may then start a rejection procedure in accordance with Article 42, on the basis of:

- the revised financial statements, if approved;
- the proposed alternative correction method, if accepted

or

- the initially notified correction rate for extrapolation, if it 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.

22.5.3.2 If the findings concern **substantial errors**, **irregularities or fraud** or **serious breach of obligations**: 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 Agency or 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.

The Agency or the Commission may then start a reduction procedure in accordance with Article 43, on the basis of:

- the proposed alternative flat-rate, if accepted

or

- the initially notified flat-rate, if it does not receive any observations or does not accept the observations or the proposed 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 Agency or 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 Agency or 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 Agency 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[19].

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 Agency may apply any of the measures described in Chapter 6.

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

[19] 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.

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[20] established in an EU Member State or '**associated country**'[21], 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.

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).

[20] For the definition, see 'affiliated entity' footnote (Article 14.1).

[21] 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.

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 Agency ownership, to protect results

26.4.1 The Agency 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 Agency 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 Agency decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

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

26.4.2 The Agency 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 Agency 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 Agency 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 Agency 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 Agency 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 Agency 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 870697".

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 Agency 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 870697".

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 Agency 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

Regarding the digital research data generated in the action (‘**data**’), the beneficiaries must:

(a) deposit in a research data repository and take measures to make it possible for third parties to access, mine, exploit, reproduce and disseminate — free of charge for any user — the following:

(i) the data, including associated metadata, needed to validate the results presented in scientific publications, as soon as possible;

(ii) not applicable;

(iii) other data, including associated metadata, as specified and within the deadlines laid down in the 'data management plan' (see Annex 1);

(b) provide information — via the repository — about tools and instruments at the disposal of the beneficiaries and necessary for validating the results (and — where possible — provide the tools and instruments themselves).

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.

As an exception, the beneficiaries do not have to ensure open access to specific parts of their research data under Point (a)(i) and (iii), if the achievement of the action's main objective (as described in Annex 1) would be jeopardised by making those specific parts of the research data openly accessible. In this case, the data management plan must contain the reasons for not giving access.

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

Unless the Agency 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 870697".

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 Agency.

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 Agency responsibility

Any dissemination of results must indicate that it reflects only the author's view and that the Agency 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 access 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 Agency 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[23], 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 Agency 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 Agency may apply any of the measures described in Chapter 6.

ARTICLE 34 — ETHICS AND RESEARCH INTEGRITY

34.1 Obligation to comply with ethical and research integrity principles

[23] 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).

The beneficiaries must carry out the action in compliance with:

(a) ethical principles (including the highest standards of research integrity)

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 or for activities which destroy human embryos (for example, for obtaining stem cells).

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.

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity[24].

This implies compliance with the following fundamental principles:

- **reliability** in ensuring the quality of research reflected in the design, the methodology, the analysis and the use of resources;

- **honesty** in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair and unbiased way;

- **respect** for colleagues, research participants, society, ecosystems, cultural heritage and the environment;

- **accountability** for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts

and means that beneficiaries must ensure that persons carrying out research tasks follow the good research practices and refrain from the research integrity violations described in this Code.

This does not change the other obligations under this Agreement or obligations under applicable international, EU or national law, all of which still apply.

34.2 Activities raising ethical issues

[24] European Code of Conduct for Research Integrity of ALLEA (All European Academies) http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf

Activities raising ethical issues must comply with the '**ethics requirements**' set out as deliverables in Annex 1.

Before the beginning of an activity raising an ethical issue, each beneficiary must have obtained:

(a) any ethics committee opinion required under national law and

(b) any notification or authorisation for activities raising ethical issues required under national and/or European law

needed for implementing the action tasks in question.

The documents must be kept on file and be submitted upon request by the coordinator to the Agency (see Article 52). If they are not in English, they must be submitted together with an English summary, which shows that the action tasks in question are covered and includes the conclusions of the committee or authority concerned (if available).

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, in addition to Article 34.1, only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the Agency (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 Agency 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 Agency 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 Agency 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 Agency may disclose confidential information to its staff, other EU institutions and bodies. It may disclose confidential information to 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[25], 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;

[25] 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).

(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.

ARTICLE 37 — SECURITY-RELATED OBLIGATIONS

37.1 Results with a security recommendation

Not applicable

37.2 Classified information

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 Agency (see Article 52).

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

Unless the Agency 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 870697".

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 870697".

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 Agency.

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 Agency and Commission responsibility

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

38.2 Communication activities by the Agency and the Commission

38.2.1 Right to use beneficiaries' materials, documents or information

The Agency and 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 received 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.

If the Agency's or the Commission's use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the Agency or 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 Agency, 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[27], without the right to reproduce or exploit;

(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 Agency or 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 Agency or the Commission will insert the following information:

"© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the Research Executive Agency (REA) and 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 Agency and the Commission

Any personal data under the Agreement will be processed by the Agency or the Commission under Regulation No 45/2001[28] and according to the 'notifications of the processing operations' to the Data Protection Officer (DPO) of the Agency or the Commission (publicly accessible in the DPO register).

Such data will be processed by the '**data controller**' of the Agency or the Commission for the purposes

[27] 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.

[28] 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).

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 privacy statement(s) that are published on the Agency and the Commission websites.

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

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 Agency or the Commission. For this purpose, they must provide them with the privacy statement(s) (see above), before transmitting their data to the Agency or the Commission.

39.3 Consequences of non-compliance

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

ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE AGENCY

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

If the Agency 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 Agency.

CHAPTER 5 DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

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

41.1 Roles and responsibility towards the Agency

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 Agency expressly relieves them of this obligation.

The **financial responsibility** of each beneficiary is governed by Article 44.

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 Participant Portal 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 its linked third parties 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 Agency or the Commission under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the Agency or 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 Agency (in particular, providing the Agency with the information described in Article 17), unless the Agreement specifies otherwise;

(iii) request and review any documents or information required by the Agency and verify their completeness and correctness before passing them on to the Agency;

(iv) submit the deliverables and reports to the Agency (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 Agency of the amounts paid to each beneficiary, when required under the Agreement (see Articles 44 and 50) or requested by the Agency.

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including linked third parties).

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 — SANCTIONS — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE

SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — SANCTIONS

ARTICLE 42 — REJECTION OF INELIGIBLE COSTS

42.1 Conditions

The Agency will — after **termination of the participation of a beneficiary**, 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).

The rejection may also be based on the **extension of findings from other grants to this grant** (see Article 22.5.2).

42.2 Ineligible costs to be rejected — Calculation — Procedure

Ineligible costs will be rejected in full.

If the rejection of costs does not lead to a recovery (see Article 44), the Agency will formally notify the coordinator or beneficiary concerned of 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 Agency of its disagreement and the reasons why.

If the rejection of costs leads to a recovery, the Agency will follow the contradictory procedure with pre-information letter set out in Article 44.

42.3 Effects

If the Agency 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 Agency rejects costs **after termination of the participation of a beneficiary**, it will deduct them from the costs declared by the beneficiary in the termination report and include the rejection in the calculation after termination (see Article 50.2 and 50.3).

If the Agency — **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 Agency 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

The Agency may — **after termination of the participation of a beneficiary**, **at the payment of the balance** or **afterwards** — reduce the grant amount (see Article 5.1), if :

(a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

(b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) 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).

43.2 Amount to be reduced — Calculation — Procedure

The amount of the reduction will be proportionate to the seriousness of the errors, irregularities or fraud or breach of obligations.

Before reduction of the grant, the Agency 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 Agency 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 Agency reduces the grant **after termination of the participation of a beneficiary**, it will calculate the reduced grant amount for that beneficiary and then determine the amount due to that beneficiary (see Article 50.2 and 50.3).

If the Agency reduces the grant **at 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 Agency 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 Agency will recover the difference (see Article 44).

ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

44.1 Amount to be recovered — Calculation — Procedure

The Agency 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 (including

undue amounts paid by the Agency for costs declared by its linked third parties), 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 Agency 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 Agency or 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 Agency, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Agency or 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 Agency or 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[29] 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 Agency 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

[29] 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).

- inviting the coordinator to submit observations within 30 days of receiving notification.

If no observations are submitted or the Agency 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 Agency by the date in the debit note and has not submitted the report on the distribution of payments: the Agency or the Commission will **recover** the amount set out in the debit note from the coordinator (see below).

If the coordinator does not repay the Agency by the date in the debit note, but has submitted the report on the distribution of payments: the Agency 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 Agency multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned

plus

its linked third parties' costs declared in the final summary financial statement and approved by the Agency multiplied by the reimbursement rate set out in Article 5.2 for each linked third party concerned}

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 Agency or 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 Agency, the Commission or another executive agency (from the EU or Euratom budget).

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

(b) by **drawing on the Guarantee Fund**. The Agency or 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 Agency or 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 Agency.

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

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

plus

its linked third parties' costs declared in the final summary financial statement and approved by the Agency multiplied by the reimbursement rate set out in Article 5.2 for each linked third party concerned}

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)}.

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

The Agency 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 Agency 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 Agency or 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 Agency, the Commission or another executive agency (from the EU or Euratom budget).

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

(b) by **drawing on the Guarantee Fund**. The Agency or 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 Agency or 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 SANCTIONS

In addition to contractual measures, the Agency or the Commission may also adopt administrative sanctions under Articles 106 and 131(4) of the Financial Regulation No 966/2012 (i.e. exclusion from future procurement contracts, grants, prizes and expert contracts and/or financial penalties).

SECTION 2 LIABILITY FOR DAMAGES

ARTICLE 46 — LIABILITY FOR DAMAGES

46.1 Liability of the Agency

The Agency 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 Agency 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

Except in case of force majeure (see Article 51), the beneficiaries must compensate the Agency 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.

SECTION 3 SUSPENSION AND TERMINATION

ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE

47.1 Conditions

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

The suspension will **take effect** the day notification is sent by the Agency (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 Agency 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 Agency 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 Agency may — at any moment — suspend payments, in whole or in part and interim payments or the payment of the balance for one or more beneficiaries, if:

(a) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed or is suspected of having committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

(b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) 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).

If payments are suspended for one or more beneficiaries, the Agency will make partial payment(s) for the part(s) not suspended. If suspension concerns the payment of the balance, — once suspension is lifted — the payment or the recovery of the amount(s) concerned will be considered the payment of the balance that closes the action.

48.2 Procedure

Before suspending payments, the Agency will formally notify the coordinator or beneficiary concerned:

- 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 Agency 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 Agency.

If the conditions for resuming payments are met, the suspension will be **lifted**. The Agency will formally notify the coordinator or beneficiary concerned.

During the suspension, the periodic report(s) for all reporting periods except the last one (see Article 20.3), must not contain any individual financial statements from the beneficiary concerned and its linked third parties. The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last 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 Agency 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 Agency.

Once circumstances allow for implementation to resume, the coordinator must immediately formally notify the Agency 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 Agency

49.2.1 Conditions

The Agency may suspend implementation of the action or any part of it, if:

(a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed or is suspected of having committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles);

(b) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) 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) the action is suspected of having lost its scientific or technological relevance.

49.2.2 Procedure

Before suspending implementation of the action, the Agency will formally notify the coordinator or beneficiary concerned:

- 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 Agency 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 (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 or beneficiary concerned 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 Agency (see Article 46).

Suspension of the action implementation does not affect the Agency'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 Agency (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 Agency 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 Agency 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 Agency 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, 40, 42, 43 and 44) 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 Agency (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 Agency 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 Agency (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 Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary and its linked third parties in the termination report and approved by the Agency.

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.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

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 Agency 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 Agency 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 Agency 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 Agency the amount due and the Agency 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 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 Agency 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 Agency the amount due. The Agency 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 Agency 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 Agency 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, 40, 42, 43 and 44) continue to apply.

50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the Agency

50.3.1 Conditions

The Agency 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 (or those

of its linked third parties) 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;

(l) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles);

(m) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) 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);

(n) despite a specific request by the Agency, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its linked third parties or international partners that is in one of the situations under points (e), (f), (g), (k), (l) or (m) and to reallocate its tasks.

50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the Agency will formally notify the coordinator or beneficiary concerned:

- 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 Agency of the measures to ensure compliance with the obligations under the Agreement.

If the Agency does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the coordinator or beneficiary concerned **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), (l.ii) and (n) 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.

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 reports (see Articles 20.8 and 50.3.1(l)), the coordinator may not submit any reports after termination.

If the Agency 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 Agency 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 Agency's right to reduce the grant (see Article 43) or to impose administrative sanctions (Article 45).

The beneficiaries may not claim damages due to termination by the Agency (see Article 46).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) 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 Agency (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 Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary and its linked third parties in the termination report and approved by the Agency.

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.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud

or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

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 Agency 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 Agency 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 Agency 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 Agency the amount due and the Agency 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 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 Agency 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 Agency the amount due. The Agency 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 Agency 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 Agency 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, 40, 42, 43 and 44) 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.

All communication must be made through the Participant Portal **electronic** exchange system and using the forms and templates provided there.

If — after the payment of the balance — the Agency finds that a formal notification was not accessed, a second formal notification will be made by registered post with proof of delivery ('formal notification on **paper**'). Deadlines will be calculated from the moment of the second notification.

Communications in the electronic exchange system must be made by persons authorised according to the Participant Portal Terms & Conditions. 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 Participant Portal Terms & Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Agency and 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 Agency 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 Agency** must be sent to the official mailing address indicated on the Agency's website.

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 Participant Portal 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[30], 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, and
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The Agency 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 Agency 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

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.

[30] 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).

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 Agency'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 sanctions, 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. Actions against offsetting and enforceable decisions must be brought against the Commission (not against the Agency).

ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT

The Agreement will enter into force on the day of signature by the Agency or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

Lieven RAES with ECAS id nraeslie signed in the Participant Portal on 31/10/2019 at 09:31:16 (transaction id SigId-135609-OzZ1OjtxNvvVcMokKcJDni28r3Wfs3xfjmxAe4MAzXFo4Gevd2Uiq8rW0AWMw1ZCS68UGs9oYcFze4eNzuPwIb4-rS0vSrmBGYCcOZiQTX79WS-NzzxI4t7nFkMDuy25lsJ7VxdA0Y0QPTI43FwyKsI4MK0).
Timestamp by third party at
Thu Oct 31 09:31:23 CET 2019

For the Agency

Signed by Danielle BARBIEUX with ECAS id barbide as an authorised representative on 13-11-2019 12:20:40 (transaction id SigId-16288-XnS1i6SVQclue2kk5YGKuFCnXw78WHKEYAHCZizomhpmzJVCc6gCUEHp1yE62IlzzkrOzWhxke8x6oLGs2Z460U-rS0vSrmBGYCg83u8uLaUrK-jnlAh6kbYeEtEy3E07k7AlS6Z5UW7yMxhxIgYrSbqJi)
Wed Nov 13 12:20:44 CET 2019

EUROPEAN COMMISSION
Research Executive Agency
Inclusive, Innovative and Reflective Societies

ANNEX 1 (part A)

Innovation action

NUMBER — 870697 — DUET

Table of Contents

1.1. The project summary

Project Number [1]	870697	Project Acronym [2]	DUET

One form per project

General information

Project title [3]	Digital Urban European Twins for smarter decision making
Starting date [4]	01/12/2019
Duration in months [5]	36
Call (part) identifier [6]	H2020-SC6-GOVERNANCE-2019
Topic	DT-GOVERNANCE-12-2019-2020 Pilot on using the European cloud infrastructure for public administrations
Fixed EC Keywords	Public sector information, Cloud Infrastructures, Open data, Public sector innovation, Open government
Free keywords	digital twin, 3D, co-creation, smart city, HPC, traffic, pollution & noise modelling, big data, geospatial data, analytics, linked open data, GIS, transport, urban planning, policy, public involvement

Abstract [7]

DUET is an Innovation project designed to leverage the advanced capabilities of cloud and high-performance computing (HPC) to evolve the traditional public policy making cycle using large open data sources. The aim is to help public sector decision-making become more democratic and effective, both in the short and long term, through the development and use of Digital Twins for policy impact exploration and experimentation in entire cities and regions. These digital replicas of a cities system will
(a) enhance day-to-day city management by helping city managers react quickly to real-time events through rapid experimentation of different decision impacts, and
(b) ensure longer term policy decisions are more effective and trusted by enabling city managers from different units, to explore and discuss with citizens and businesses city issues in a visual, easy-to-digest way via a common view.
Thanks to the 3D interface public administrations will, for the first time, more easily harness the collective intelligence of ALL policy stakeholders to tackle complex, systemic policy problems that require innovative thinking from multi-sectors to develop transformative solutions.
Developed and tested in cities and Regions at different points in their digital transformation journeys – Flanders Region, Belgium, the City of Athens, Greece and City of Pilsen, Czech Republic – DUET will create the concept of Policy-Ready-Data-as-a-Service and ensure all cities across Europe will be able to create their own their own Digital Twins that address ethical considerations around data use whilst also complying with Europe's stringent privacy and security regulations.

1.2. List of Beneficiaries

Project Number [1]	870697	Project Acronym [2]	DUET

List of Beneficiaries

No	Name	Short name	Country	Project entry month[8]	Project exit month
1	VLAAMSE GEWEST	AIV	Belgium	1	36
2	INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM	IMEC	Belgium	1	36
3	KATHOLIEKE UNIVERSITEIT LEUVEN	KUL	Belgium	1	36
4	ATHENS TECHNOLOGY CENTER ANONYMI BIOMICHANIKI EMPORIKI KAI TECHNIKI ETAIREIA EFARMOGON YPSILIS TECHNOLOGIAS	ATC	Greece	1	36
5	21C CONSULTANCY LIMITED	21c	United Kingdom	1	36
6	AEGIS IT RESEARCH LTD	AEG	United Kingdom	1	36
7	OPEN & AGILE SMART CITIES	OASC	Belgium	1	36
8	GRIMALDI STUDIO LEGALE SPRL	GSL	Belgium	1	36
9	DIMOS ATHINAION EPICHEIRISI MICHANOGRAFISIS	DAEM	Greece	1	36
10	virtualcitySYSTEMS GmbH	VCS	Germany	1	36
11	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	TNO	Netherlands	1	36
12	PLAN4ALL ZS	P4All	Czechia	1	36
13	SPRAVA INFORMACNICH TECHNOLOGII MESTA PLZNE, PRISPEVKOVA ORGANIZACE	PLZ	Czechia	1	36
14	IS-practice	ISP	Belgium	1	36
15	ETAIREIA ELEYTHEROY LOGISMIKOY LOGISMIKOY ANOIKTOY KODIKA	GFOSS	Greece	1	36

1.3. Workplan Tables - Detailed Implementation

1.3.1. WT1 List of work packages

WP Number[9]	WP Title	Lead beneficiary[10]	Person-months[11]	Start month[12]	End month[13]
WP1	Ethics, privacy and legal requirements for a European Cloud infrastructure	8 - GSL	34.00	1	36
WP2	User-centric design for advanced decision-making practices	2 - IMEC	72.50	1	30
WP3	Defining the DUET Environment: Cloud, HPC infrastructure, security, modeling, semantics & standardisation	2 - IMEC	72.00	1	32
WP4	DUET Front-end environment set-up: Analytics, 2D/3D visualizations & simulation	10 - VCS	89.50	7	30
WP5	DUET System Integration	4 - ATC	51.50	8	36
WP6	Pilot scenarios, deployment, and impact validation	7 - OASC	78.00	8	36
WP7	Dissemination, ecosystem management and exploitation	5 - 21c	74.00	1	36
WP8	Project, risk and quality management	1 - AIV	60.50	1	36
WP9	Ethics requirements	1 - AIV	N/A	1	36
		Total	532.00		

1.3.2. WT2 list of deliverables

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Legal Landscape and Requirements Plan	WP1	8 - GSL	Report	Public	4
D1.2	Cities Guide to Legal Compliance for Data-Driven Decision Making It. 1	WP1	8 - GSL	Report	Public	10
D1.3	Cities Guide to Legal Compliance for Data-Driven Decision Making It. 2	WP1	8 - GSL	Report	Public	20
D1.4	Cities Guide to Legal Compliance for Data-Driven Decision Making It. 3	WP1	8 - GSL	Report	Public	30
D1.5	Ethical Principles for using Data-Driven Decision in the Cloud It. 1	WP1	8 - GSL	Report	Public	15
D1.6	Ethical Principles for using Data-Driven Decision in the Cloud It. 2	WP1	8 - GSL	Report	Public	36
D1.7	Recommendations for European Cloud Infrastructure	WP1	8 - GSL	Report	Public	32
D2.1	Policy Network Canvas – stage I	WP2	2 - IMEC	Report	Public	4
D2.2	Scenario specifications of the DUET solution	WP2	2 - IMEC	Report	Public	5
D2.3	Final list of user requirements for the DUET solution	WP2	2 - IMEC	Report	Public	7
D2.4	Cloud Based Business Models Analysis	WP2	2 - IMEC	Report	Public	18
D2.5	Policy Network Canvas – stage II	WP2	2 - IMEC	Report	Public	30
D3.1	IoT stack and API specifications v1	WP3	2 - IMEC	Report	Public	9
D3.2	IoT stack and API specifications v2	WP3	2 - IMEC	Report	Public	18
D3.3	Smart City domains, models and interaction frameworks v1	WP3	3 - KUL	Report	Public	6

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.4	Smart City domains, models and interaction frameworks v2	WP3	3 - KUL	Report	Public	24
D3.5	Cloud design for model calibration and simulation	WP3	11 - TNO	Report	Public	12
D3.6	OSLO Extensions for the Digital Twin - current status	WP3	1 - AIV	Report	Public	18
D3.7	OSLO Extensions for the Digital Twin - final	WP3	1 - AIV	Report	Public	32
D3.8	Digital Twin data broker specification and tools v1	WP3	2 - IMEC	Report	Public	12
D3.9	Digital Twin data broker specification and tools v2	WP3	2 - IMEC	Report	Public	24
D3.10	Multi Layered security model specification (by design)	WP3	6 - AEG	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D3.11	Multi Layered security model specification (final)	WP3	6 - AEG	Report	Confidential, only for members of the consortium (including the Commission Services)	24
D4.1	Front end Mock Ups	WP4	10 - VCS	Demonstrator	Public	9
D4.2	DUET Data Integration	WP4	11 - TNO	Demonstrator	Public	12
D4.3	DUET Simulation models	WP4	11 - TNO	Demonstrator	Public	18
D4.4	DUET visualization Components v1	WP4	10 - VCS	Demonstrator	Public	18
D4.5	DUET standard reports and data analysis tools	WP4	11 - TNO	Report	Public	18
D4.6	Implementation of the DUET UI/Dash boarding platform	WP4	10 - VCS	Demonstrator	Public	18
D4.7	DUET Visualization components v2	WP4	10 - VCS	Demonstrator	Public	30
D5.1	System Architecture & Implementation Plan	WP5	4 - ATC	Report	Confidential, only for members of the consortium (including the	8

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
					Commission Services)	
D5.2	Initial Digital Twin Prototype	WP5	4 - ATC	Demonstrator	Public	18
D5.3	Maintenance and Support Plan	WP5	4 - ATC	Report	Public	33
D5.4	Final Digital Twin Prototype	WP5	4 - ATC	Demonstrator	Public	36
D6.1	Pilot Operations Plan	WP6	7 - OASC	Report	Public	12
D6.2	Personalising the Digital Twins	WP6	7 - OASC	Report	Public	18
D6.3	Pilot Testing Cycle Report 1	WP6	7 - OASC	Report	Public	22
D6.4	Pilot Testing Cycle Report 2	WP6	7 - OASC	Report	Public	28
D6.5	Pilot Testing Cycle Report 3	WP6	7 - OASC	Report	Public	34
D6.6	Pilot Evaluation Report	WP6	2 - IMEC	Report	Public	35
D7.1	Enhanced Communication, Dissemination and Exploitation roadmap	WP7	5 - 21c	Report	Public	3
D7.2	DUET Portal v1	WP7	5 - 21c	Demonstrator	Public	3
D7.3	DUET portal v2	WP7	5 - 21c	Demonstrator	Public	14
D7.4	DUET portal v3	WP7	5 - 21c	Demonstrator	Public	23
D7.5	DUET portal v4	WP7	5 - 21c	Demonstrator	Public	33
D7.6	Business and Exploitation Scenarios v1	WP7	2 - IMEC	Report	Public	18
D7.7	Business and exploitation scenarios (final)	WP7	2 - IMEC	Report	Public	30
D7.8	Digital Twins for Policy Making Starter Kit with Accompanying Book	WP7	5 - 21c	Demonstrator	Public	32
D7.9	Policy Brief	WP7	5 - 21c	Report	Public	36
D8.1	Project Vision	WP8	1 - AIV	Report	Public	1
D8.2	Project Management Handbook	WP8	14 - ISP	Report	Confidential, only for members of the consortium (including the Commission Services)	2

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D8.3	Data Management and Modeling Plan	WP8	1 - AIV	ORDP: Open Research Data Pilot	Public	6
D9.1	H - Requirement No. 1	WP9	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.2	H - Requirement No. 2	WP9	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.3	H - Requirement No. 3	WP9	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.4	POPD - Requirement No. 4	WP9	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.5	POPD - Requirement No. 5	WP9	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3

1.3.3. WT3 Work package descriptions

Work package number [9]	WP1	**Lead beneficiary** [10]	8 - GSL
Work package title	Ethics, privacy and legal requirements for a European Cloud infrastructure		
Start month	1	**End month**	36

Objectives

Using cloud for sharing and re-using data between a number of different stakeholders raises a number of ethical considerations for public administrations. How to handle them is vital to the success of DUETs approach. Developing an awareness of these considerations in decision-making can incentivise policy-makers to work more considerately, helping to ensure trust in the outcomes amongst wider stakeholders. This work package explores compliance with these requirements, using legal, standards and principle-based approaches for addressing the key challenges. Specific objectives include:

- Identification and prioritisation of the main ethical and legal requirements;
- Understanding differences and commonalities at the national level;
- Exploring the best way to find common-practices (standards) to tackle core issues;
- Refining good practice based on pilot validation;
- Providing recommendations to advance the use of a European Cloud Infrastructure for policy making.

Description of work and role of partners

WP1 - Ethics, privacy and legal requirements for a European Cloud infrastructure [Months: 1-36]
GSL, AIV, IMEC, KUL, ATC, 21c, AEG, OASC, DAEM, VCS, TNO, P4All, PLZ, ISP, GFOSS
Task 1.1. Identification of legal and ethical considerations (M1 - M36)
Lead: GSL. Support: AIV, IMEC, GSL, DAEM, PLZ
From the start of the project, the Data Protection Officers, and any Ethics/Compliance Managers within the public administration pilots will be engaged to understand (a) how they manage existing processes regarding both decision-making and cloud/technology use. Whilst they will be included in the user-requirements design-thinking activities of WP2, this task provides a deeper dive into their needs, creating an opportunity to identify new issues and areas of concern. Activities will include round-table brainstorming and deep-dive interviews. The knowledge from these exercises, combined with the experience of DUETs lawyers and social scientist will help create a prioritized lists of ethical and legal concerns with current practices and identified opportunities for improvement , and gaps that need to be addressed.

Task 1.2 Ensuring legal compliance (M2 - M36)
Lead: GSL. Support: AIV, DAEM, PLZ
Review and compare legal requirements/response between the pilot sites to understand commonalities and differences at the National level and how these link to the European level (e.g. EC Data Protection Directive 95/46). Identify effectiveness of existing practices and ensure good practice processes are fed into the pilot sites, review effectiveness, identify any legal gaps. Create easy to understand/follow guide to ensuring legal compliance to accompany DUETs Digital Twin offering.

Task 1.3 Exploring ethical responses (M1 - M36)
Lead: AIV. Support: ALL Partners
The mismanagement of information and the misuse of private data raises serious ethical concerns, which must be addressed in order to encourage trust in the system. The DUET Consortium will create an ‘ethics working group’ with an ethics lead who will identify ethical concerns throughout the project, log them, and embed precautionary mitigation actions into the project development plans. The ethics log will be reviewed and updated during the design thinking user requirements gathering (WP2), functional requirements development (WP3) as well as sprint-planning and pilot/project meetings (WP4,5 and 6) to ensure these fundamental issues are addressed. The DUET Expert Steering Panel (set up in WP8) also contain members experience in the ethical issues of using cloud-based technology and data-driven decision making to provide an extra layer of accountability. To ensure future replications of DUET or other similar solutions, help build public confidence in data assisted decisions, DUET will publish an ethical code of conduct with shared principles, thereby kick-starting new standards in this area.

Task 1.4 Providing recommendations to the European Cloud Infrastructure program (M25-M32)
Lead: GSL. Support: AIV, DAEM, PLZ

To ensure the work of DUET benefits wider communities, the Consortium will use lessons learned during its Innovation Action and process them to provide a set of recommendations to the Commission on how to move forward with European Cloud Infrastructure in a manner that provides easier access to HPC capabilities through the Cloud, so all cities can benefit from DUETs Digital Twin (Policy Ready Data-as-a-Service) approach.

Participation per Partner

Partner number and short name	WP1 effort
1 - AIV	5.50
2 - IMEC	1.00
3 - KUL	0.50
4 - ATC	0.50
5 - 21c	1.00
6 - AEG	0.50
7 - OASC	0.50
8 - GSL	14.00
9 - DAEM	4.00
10 - VCS	0.50
11 - TNO	0.50
12 - P4All	0.25
UWB	0.25
13 - PLZ	4.00
14 - ISP	0.50
15 - GFOSS	0.50
Total	34.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Legal Landscape and Requirements Plan	8 - GSL	Report	Public	4
D1.2	Cities Guide to Legal Compliance for Data-Driven Decision Making It. 1	8 - GSL	Report	Public	10
D1.3	Cities Guide to Legal Compliance for Data-Driven Decision Making It. 2	8 - GSL	Report	Public	20
D1.4	Cities Guide to Legal Compliance for Data-	8 - GSL	Report	Public	30

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	Driven Decision Making It. 3				
D1.5	Ethical Principles for using Data-Driven Decision in the Cloud It. 1	8 - GSL	Report	Public	15
D1.6	Ethical Principles for using Data-Driven Decision in the Cloud It. 2	8 - GSL	Report	Public	36
D1.7	Recommendations for European Cloud Infrastructure	8 - GSL	Report	Public	32

Description of deliverables

D1.1: Legal Landscape and Requirements Plan (M4) Public
Understanding of legal landscape related to DUETs concept and plan for ensuring legal requirements are met.

D1.2-4.: Cities Guide to Legal Compliance for Data-Driven Decision Making (M10, M20, M30) Public
Easy to understand guide for cities on the legal necessities for data-driven policy making.

D1.5-6: Ethical Principles for using Data-Driven Decision in the Cloud (M15, M36) Public
An ethical code of conduct for cities to adopt and adhere to for data-driven decision making.

D1.7: Recommendations for European Cloud Infrastructure (M32) Public
Lessons learned and recommendations to provide Policy Ready-Data-as-a-Service (PRD-a-a-S).

D1.1 : Legal Landscape and Requirements Plan [4]

Understanding of legal landscape related to DUETs concept and plan for ensuring legal requirements are met.

D1.2 : Cities Guide to Legal Compliance for Data-Driven Decision Making It. 1 [10]

Easy to understand guide for cities on the legal necessities for data-driven policy making.

D1.3 : Cities Guide to Legal Compliance for Data-Driven Decision Making It. 2 [20]

Easy to understand guide for cities on the legal necessities for data-driven policy making.

D1.4 : Cities Guide to Legal Compliance for Data-Driven Decision Making It. 3 [30]

Easy to understand guide for cities on the legal necessities for data-driven policy making.

D1.5 : Ethical Principles for using Data-Driven Decision in the Cloud It. 1 [15]

An ethical code of conduct for cities to adopt and adhere to for data-driven decision making.

D1.6 : Ethical Principles for using Data-Driven Decision in the Cloud It. 2 [36]

An ethical code of conduct for cities to adopt and adhere to for data-driven decision making.

D1.7 : Recommendations for European Cloud Infrastructure [32]

Lessons learned and recommendations to provide Policy Ready-Data-as-a-Service (PRD-a-a-S).

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP2	Lead beneficiary [10]	2 - IMEC
Work package title	User-centric design for advanced decision-making practices		
Start month	1	End month	30

Objectives

This work package has the objective to set up an iterative design process with prospective end-users through a variety of research and design techniques. The iterative design process will ensure that the Digital Twin concept becomes highly usable and accessible for various end users (open data managers, smart city strategists, policy makers, businesses, and citizens), that enable them to develop better evidence-based policies. Therefore, a user and business requirement analysis will be set up to guarantee a usable and sustainable Digital Twin solution for the involved cities: Specific objectives include:

- Identification and engagement of key stakeholders that affect data driven policy making through the creation of a Policy Network Canvas
- Needs identification of stakeholders through user requirement analysis with user scenarios, workshops and wireframes
- Exploration of business model requirements for the sustainability and exploitation of DUET in pilot cities

Description of work and role of partners

WP2 - User-centric design for advanced decision-making practices [Months: 1-30]
IMEC, AIV, KUL, ATC, 21c, OASC, DAEM, TNO, PLZ, GFOSS
Task 2.1. Policy (Value) Network Analysis (M1 - M30)
Lead: IMEC. Support: AIV, 21C, DAEM, PLZ, GFOSS
This task has the objective to identify the key stakeholders that affect data driven policy making in each DUET pilot, and to explore the links between them in the policy making lifecycle. For each pilot city, a Policy Network Canvas will map the main stakeholders, current (visualization) tools for policy making, information flows and big datasets in health, environment and mobility, and current bottlenecks that occur in the generation and analysis of big data. The canvas will be constructed through expert interviews and/or collaborative focus groups with selected stakeholders from the pilot sites in each major phase of the project (policy design, implementation and evaluation). Through the update of the canvas, DUETs role in overcoming challenges in using big data for policy making will be revealed. Results are reported in D2.1, and updated in D2.5.

Task 2.2. Scenario specifications of the DUET solution (M1-M5)
Lead: IMEC. Support: AIV, 21C, DAEM, PLZ, GFOSS
Besides the description of the current workflow in the Policy Network Canvas (T2.1), a future scenario will be written entailing the “what if” situation of how processes will look like when DUET is implemented. The future scenario will cover questions about (1) Issue identification for the Digital Twin concept with definition of themes, datasets and integrations of tools, (2) Setting of goals and policy objectives, (3) Policy pre-evaluation through the Digital Twin concept, (4) Demonstrating and consultation process through the Digital Twin and (5) Evaluation. The future scenario will be written through consultation rounds (collaborative workshops, interviews, etc.) with key users from each pilot site, and together with DUETs designers and product owners. During this stage, first ideas for features, functions and other elements are gathered (reported in D2.2).

Task 2.3. Co-creation of the Digital Twin concept (M5- M7)
Lead: IMEC. Support: AIV, 21C, DAEM, PLZ, GFOSS
This task has the objective to validate the future scenario of T2.2 through co-creation workshops with a broader set of prospective end-users (smart city managers, policy makers, thematic experts in health, environment or mobility, communication, businesses, citizens, etc.). In each city, two co-creation workshops will take place, organized by local pilot leads, with a combination of methods and tools to understand the different aspects (social, technical, business) of the DUET solution, and that follows a funnel approach for defining the final use case. The usage of wireframes in the iteration of the workshops should also help to reflect about the concept of data literacy as an inquiry process (e.g. access data, convert data, combine data, using appropriate visualization, transform data into information, etc.). The outcome is a list of user requirements (functional and non-functional) reported in D2.3, that will be of direct input for the technical team (WP3 – WP5).

Task 2.4. Cloud Based Business Models (M12 - M18)
Lead: ATC. Support: AIV ,IMEC, KUL, 21C, OASC, DAEM, TNO, PLZ, GFOSS

As a cloud infrastructure will never consist of one physical or business entity, collaboration, interoperability and (economic) sustainability are key in this space. In order to position DUET vis a vis the state of the art, a business model analysis on the current practices in the sector will be carried out in this task. It will examine the business models of established and innovative business practices of commercial and non-commercial solutions, and distill key insights relevant for the sustainability and exploitation of DUET. The work performed in this task (D2.4) will feed business requirements directly into the exploitation scenarios developed in task 7.4.

Participation per Partner

Partner number and short name	WP2 effort
1 - AIV	7.00
2 - IMEC	11.00
3 - KUL	1.00
4 - ATC	5.00
5 - 21c	14.00
7 - OASC	1.00
9 - DAEM	10.00
11 - TNO	1.00
13 - PLZ	10.00
15 - GFOSS	12.50
Total	72.50

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D2.1	Policy Network Canvas – stage I	2 - IMEC	Report	Public	4
D2.2	Scenario specifications of the DUET solution	2 - IMEC	Report	Public	5
D2.3	Final list of user requirements for the DUET solution	2 - IMEC	Report	Public	7
D2.4	Cloud Based Business Models Analysis	2 - IMEC	Report	Public	18
D2.5	Policy Network Canvas – stage II	2 - IMEC	Report	Public	30

Description of deliverables

D2.1 – Policy Network Canvas – stage I (M4) Public
Mapping of relevant stakeholders, current processes and information flows.

D2.2 – Scenario specifications of the DUET solution (M5) Public
Future scenario specifications with a first list of user requirements.

D2.3 – Final list of user requirements for the DUET solution (M7) Public

Validated future scenario and final list of user requirements to support technical implementation.

D2.4 - Cloud Based Business Models Analysis (M18) Public
State of the art of current cloud based business models.

D2.5 – Policy Network Canvas – stage II (M30) Public
Updated mapping of all the relevant stakeholders, current processes and information flows.

D2.1 : Policy Network Canvas – stage I [4]

Mapping of relevant stakeholders, current processes and information flows.

D2.2 : Scenario specifications of the DUET solution [5]

Future scenario specifications with a first list of user requirements.

D2.3 : Final list of user requirements for the DUET solution [7]

Validated future scenario and final list of user requirements to support technical implementation.

D2.4 : Cloud Based Business Models Analysis [18]

State of the art of current cloud-based business models.

D2.5 : Policy Network Canvas – stage II [30]

Updated mapping of all the relevant stakeholders, current processes and information flows.

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**
MS1	Project Design	1 - AIV	7	Project Vision and structure set up, user scenarios and requirements defined
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group

Work package number [9]	WP3	Lead beneficiary [10]	2 - IMEC
Work package title	Defining the DUET Environment: Cloud, HPC infrastructure, security, modeling, semantics & standardisation		
Start month	1	End month	32

Objectives

Defining the Digital Twin Blueprint based on functional and technical requirements using semantic and IT standards. Designing a cloud infrastructure that supports HPC and complex modeling for evidence-based policy making in a Digital Twin context.

Description of work and role of partners

WP3 - Defining the DUET Environment: Cloud, HPC infrastructure, security, modeling, semantics & standardisation [Months: 1-32]
IMEC, AIV, KUL, ATC, AEG, OASC, DAEM, TNO, P4All, PLZ
Task 3.1. IoT stack and data API design (M4 - M18)
Lead: IMEC, support: OASC
IoT devices (sensors) are the primary source of data for the smart city. They capture and store the data points. Both the current state, which is stored in the context database and the historical data, which is available in a geo time series database are in scope. The IoT stack needs an open and uniform way of disclosing the data securely. This task relates to identifying a viable IoT architecture that matches the requirements for the digital twin as the prime consumer of their data. This will be done by validating selected architectures in testbed projects in the context of the Digital Twin.

Task 3.2. Smart City domains, models, interaction frameworks (M1 - M24)
Lead: KUL, Support: IMEC, DAEM, TNO, PLZ
Digital Twins are fed by real-time data to represent data-driven models which combine historical data sets and real-time data generated by IoT sensors. By using an interoperability framework, data and events can be consumed and produced by different domain models. Both processes (consuming and producing) can trigger interactions between unrelated models in different domains. These interactions generate the most valuable insights. Identifying which smart city domains (like, e.g. air quality, mobility) are relevant and which ones are not, is key to building a useful and relevant digital twin.
Manipulation of properties to create hypothetical scenarios is critical to allow simulations of "what-if" scenarios without additional infrastructure changes, or expenditure for cities. The goal is to create a common interactions framework that the Digital Twin can react to, but also communicate to interested data models.

Task 3.3. HPC and cloud design for model calibration and simulation (M7- M12)
Lead: TNO, support: KUL, ATC, UWB
Calibration and validation of the simulation models are necessary to ensure those simulation outcomes are as accurate as possible. These processes includes importing historical data sets, building up histories when they don't exist, and comparing and validating historical data against real-time measurements. This process requires appropriate computing power. DUET should offer a way of leveraging the available computing power in the cloud for this purpose.
This task includes the adaptation, calibration and validation of the environmental Air, Noise and Traffic models. Currently, these models are part of TNO's Urban Strategy platform. When setting standards for HPC, cloud and data, these models will be adapted conform the DUET architecture and standards.

Task 3.4. Generic data standards and specific Standards for Open and Linked Organisations (OSLO) (M4 - M32)
Lead: AIV, support: IMEC, TNO
Digital Twins need firm semantic interpretations to be more than just a standard database. They are an ecosystem of datasets each shedding light on public space from their perspective. Starting with the OSLO interoperability framework currently used by Flanders, DUET will create new connectors and artefacts to connect data to the Digital Twin easily.
Based on the outcome of task 3.2, this task covers a survey of existing Digital Twin software components and how they can be used and altered to specific domain needs. Based on the results of this exercise, Duet creates extensions of the OSLO toolchain for the software to generate the desired domain models.

Task 3.5. Digital Twin Broker and API design (M7 - M24)
Lead: IMEC, support: ATC

The heart of the digital twin is, in fact, a data broker that accumulates data from heterogeneous sources including IoT stacks and 3rd party (city) databases. DUET needs a scalable toolkit for combining and storing this data for making it available to the digital twin. DUET should ensure that the data can be accessed within the requirements of the digital twin, ensuring fast access and scalability where needed. Additionally, sensitive data needs to be adequately protected by the security measures devised in task 3.6. The project will consider existing work such as certain components of the OASC Synchronicity framework in order to build a workable API and data storage approach.

Task 3.6. Security and Privacy model (M7 - M30)
Lead: AEG, support: IMEC, ATC
This task includes the definition and deployment of the mechanisms that will ensure the delivery of a platform with different levels of security and a solid implementation of authentication, authorisation, and accounting. Security has to be at the same level for all types of applications, and the required protection has to span across multiple communication protocols to support diverse data sources empowering these applications. Access control and identity management delegation to all layers of the platform will allow for auditing of data access and support conditional access to data and generated analytics. The identity management solution will be able to provide a smart identity to all agents, devices and citizens which interact with the IoT Gateway providing data to the Digital twin. The task will be strongly connected with requirements emerging from WP1 to ensure ethical and legal approaches to security implementation.

Participation per Partner

Partner number and short name	WP3 effort
1 - AIV	9.00
2 - IMEC	13.50
3 - KUL	8.00
4 - ATC	9.00
6 - AEG	10.00
7 - OASC	3.00
9 - DAEM	3.00
11 - TNO	7.00
12 - P4All	0.00
UWB	6.50
13 - PLZ	3.00
Total	72.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.1	IoT stack and API specifications v1	2 - IMEC	Report	Public	9
D3.2	IoT stack and API specifications v2	2 - IMEC	Report	Public	18
D3.3	Smart City domains, models and interaction frameworks v1	3 - KUL	Report	Public	6

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.4	Smart City domains, models and interaction frameworks v2	3 - KUL	Report	Public	24
D3.5	Cloud design for model calibration and simulation	11 - TNO	Report	Public	12
D3.6	OSLO Extensions for the Digital Twin - current status	1 - AIV	Report	Public	18
D3.7	OSLO Extensions for the Digital Twin - final	1 - AIV	Report	Public	32
D3.8	Digital Twin data broker specification and tools v1	2 - IMEC	Report	Public	12
D3.9	Digital Twin data broker specification and tools v2	2 - IMEC	Report	Public	24
D3.10	Multi Layered security model specification (by design)	6 - AEG	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D3.11	Multi Layered security model specification (final)	6 - AEG	Report	Confidential, only for members of the consortium (including the Commission Services)	24

Description of deliverables

D3.1 - D3.2. IoT stack and API specifications (M9, M18) (Public)
A detailed specification of the IoT stacks from southbound agents until northbound API will be specified along with possibly usable implementations for use in DUET.

D3.3 - D3.4. Smart City domains, models and interaction frameworks (M6, M24) (Public)
Appropriate smart city domains are listed along with applicable models and interaction frameworks that will drive the DUET simulations.

D3.5. Cloud design for model calibration and simulation (M12) (Public)
Specification for the use of cloud and HPC to calibrate models and calculate simulations.

D3.6. - D3.7. OSLO Extensions for the Digital Twin (M18 - M32) (Public)
Definition of the OSLO data standard extensions and the necessary adaptations required to the models - overview of the current status (D3.6), finalized document (D3.7).

D3.8 - D3.9. Digital Twin data broker specification and tools (M12, M24) (Public)
Detailed specification of the twin data aggregator, the broker API including the necessary support for open linked data formats and the smart city data marketplace.

D3.10 - D3.11. Multi Layered security model specification (M12, M24) (Confidential)
Security by design specification (D3.10) and Final security specification (D3.11) for a multilayered security framework for the digital twin.

D3.1 : IoT stack and API specifications v1 [9]

A detailed specification of the IoT stacks from southbound agents until northbound API will be specified along with possibly usable implementations for use in DUET.

D3.2 : IoT stack and API specifications v2 [18]

A detailed specification of the IoT stacks from southbound agents until northbound API will be specified along with possibly usable implementations for use in DUET.

D3.3 : Smart City domains, models and interaction frameworks v1 [6]

Appropriate smart city domains are listed along with applicable models and interaction frameworks that will drive the DUET simulations.

D3.4 : Smart City domains, models and interaction frameworks v2 [24]

Appropriate smart city domains are listed along with applicable models and interaction frameworks that will drive the DUET simulations.

D3.5 : Cloud design for model calibration and simulation [12]

Specification for the use of cloud and HPC to calibrate models and calculate simulations.

D3.6 : OSLO Extensions for the Digital Twin - current status [18]

Definition of the OSLO data standard extensions and the necessary adaptations required to the models - overview of the current status.

D3.7 : OSLO Extensions for the Digital Twin - final [32]

Definition of the OSLO data standard extensions and the necessary adaptations required to the models - overview of the finalized document.

D3.8 : Digital Twin data broker specification and tools v1 [12]

Detailed specification of the twin data aggregator, the broker API including the necessary support for open linked data formats and the smart city data marketplace.

D3.9 : Digital Twin data broker specification and tools v2 [24]

Detailed specification of the twin data aggregator, the broker API including the necessary support for open linked data formats and the smart city data marketplace.

D3.10 : Multi Layered security model specification (by design) [12]

Security by design specification for a multilayered security framework for the digital twin.

D3.11 : Multi Layered security model specification (final) [24]

Final security specification for a multilayered security framework for the digital twin.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Release Alfa	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group
MS4	Release Open Beta	1 - AIV	24	Solution Release Open Beta available for Open User Group

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.

Work package number [9]	WP4	Lead beneficiary [10]	10 - VCS
Work package title	DUET Front-end environment set-up: Analytics, 2D/3D visualizations & simulation		
Start month	7	End month	30

Objectives

Creating a Digital Twin front-end presenting the results to multiple stakeholders (citizens, policy makers, city managers). This front-end will present the results of the HPC modeling and simulations in 2D, 3D and will provide an interactive and advanced dashboard containing components like scenario comparison, voting/gamification, interactive data visualization.

Description of work and role of partners

WP4 - DUET Front-end environment set-up: Analytics, 2D/3D visualizations & simulation [Months: 7-30]
VCS, AIV, IMEC, KUL, ATC, AEG, TNO, P4All
Task 4.1. Model Visualization (M7-M30)
Lead: TNO. Support: IMEC, KUL, VCS, TNO, UWB
This task covers the implementation of relevant models regarding traffic, air quality and noise. The traffic model will produce time dependent measures such as traffic flows, delays, congestion levels for every road within the considered region for different scenarios. The air quality model and noise model will help to visualize the effect of changes in the traffic model.

Task 4.2. 2D and 3D Visualization (M7-M30)
Lead: VCS. Support: AIV, IMEC, ATC, TNO, P4ALL, UWB
This task covers the implementation of relevant visualizations for policy support. This includes heat maps (built with WebGLayer technology) and interpolations of data, sensor display, current sensor state and sensor health checks.

Task 4.3. UX/UI design, dash boarding and interaction support (M7-M30)
Lead: VCS Support: ATC, UWB
UX/UI design and dashboards to match functionalities with ease of use and the required functionalities for the different user groups citizens, policy makers and city managers. Additionally, support for interactions with the models and straightforward access to running simulations needs to be provided.

Task 4.4. Data analysis & Visualizations (M10-M30)
Lead: TNO. Support: AIV, IMEC, KUL, AEG, VCS, P4ALL
In this task the data sources having been specified will be appropriately processed. A suitable data lake will be designed and deployed. Two different analysis and visualization systems will be implemented. An advanced and elaborate system will be made available to authorized users (data analysts, system administrators, policy makers). It will assist them to analyze data and reach decisions. A second system, with a carefully selected set of visualizations and tables, will be made public and targeted the citizens. Both systems will be able to present real-time data in an engaging and meaningful manner.

Task 4.5. Information integration (M13-M30)
Lead: VCS Support: IMEC
The digital Twin essentially integrates data from different sources, including, but not limited, to IoT data, smart city data bases, external data (such as weather and other conditions), Citizen Science data, Geo Tagging data and so on. This task covers the implementation of all the data sources to ensure data interpretability for the digital twin solution\platform.

Participation per Partner

Partner number and short name	WP4 effort
1 - AIV	8.00
2 - IMEC	8.00
3 - KUL	3.50

Partner number and short name	WP4 effort
4 - ATC	6.00
6 - AEG	3.50
10 - VCS	27.50
11 - TNO	10.50
12 - P4All	14.25
UWB	8.25
Total	89.50

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.1	Front end Mock Ups	10 - VCS	Demonstrator	Public	9
D4.2	DUET Data Integration	11 - TNO	Demonstrator	Public	12
D4.3	DUET Simulation models	11 - TNO	Demonstrator	Public	18
D4.4	DUET visualization Components v1	10 - VCS	Demonstrator	Public	18
D4.5	DUET standard reports and data analysis tools	11 - TNO	Report	Public	18
D4.6	Implementation of the DUET UI/Dash boarding platform	10 - VCS	Demonstrator	Public	18
D4.7	DUET Visualization components v2	10 - VCS	Demonstrator	Public	30

Description of deliverables

D4.1: User Interface Design (M9) (Public)
Front-end prototypes to be validated with the end users before development. Includes dashboarding& interaction design.

D4.2: DUET Data Integration (M12) (Public)
Implementation of the necessary data integration systems for visualisation of all relevant data.

D4.3: DUET Simulation models (M18) (Public)
Implementation of the different simulation models.

D4.4, D4.7: DUET Visualisation components [M18, M30] (Public)
Implementation of different re-usable visualisations (2D and 3D) for DUET for integration in dashboards and reports.

D4.5: DUET standard reports and data analysis tools (M18) (Public)
Defining and implementing the necessary analysis and reporting tools.

D4.6: Implementation of the DUET UI/Dashboarding platform (M18) (Public)
Implementation of validated User Interface Design and integration of all the UI components.

D4.1 : Front end Mock Ups [9]

Front-end prototypes to be validated with the end users before development. Includes dash-boarding & interaction design.

D4.2 : DUET Data Integration [12]

Implementation of the necessary data integration systems for visualization of all relevant data.

D4.3 : DUET Simulation models [18]

Implementation of the different simulation models.

D4.4 : DUET visualization Components v1 [18]

Implementation of different re-usable visualizations (2D and 3D) for DUET for integration in dashboards and reports.

D4.5 : DUET standard reports and data analysis tools [18]

Defining and implementing the necessary analysis and reporting tools.

D4.6 : Implementation of the DUET UI/Dash boarding platform [18]

Implementation of validated User Interface Design and integration of all the UI components.

D4.7 : DUET Visualization components v2 [30]

Implementation of different re-usable visualizations (2D and 3D) for DUET for integration in dashboards and reports.

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**
MS2	Release Alfa	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group
MS4	Release Open Beta	1 - AIV	24	Solution Release Open Beta available for Open User Group
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.

Work package number [9]	WP5	Lead beneficiary [10]	4 - ATC
Work package title	DUET System Integration		
Start month	8	End month	36

Objectives

This work package will provide the core integration activities of the project. Based on the user requirements and specifications coming from WP1& WP2 and the output of the modules materialized in WP3-WP4. Once these components have been developed, the integration phase will begin and allow for the completion of a working integrated system. The Integration will address the building of a reliable and manageable core system that is replicable and extendable.

Description of work and role of partners

WP5 - DUET System Integration [Months: 8-36]
ATC, AIV, IMEC, KUL, AEG, VCS, TNO, P4All
Task 5.1.System Architecture (M8- M12)
Lead: ATC. Support: AIV, IMEC, KUL, VCS, TNO, P4All, UWB
This task will deal with designing the complete system architecture, which will satisfy the specified functional and non-functional requirements. The work to be conducted includes the specification of the logical structure of the system, giving special focus on the integration framework defining the programming interfaces that will enable the interaction and communication among the individual components. It should be noted that DUET implementation phase involves a series of development sprints to develop, extend and customize existing technological assets in accordance with an agile development philosophy to constantly build and update a Digital Twin platform based on feedback received from the users.

Task 5.2. Platform Integration (M13 - M30)
Lead: ATC. Support: IMEC, KUL, VCS, P4All, UWB
This task will use the System Architecture as described in D5.1 to ensure a smooth implementation and integration of all the technical components into a replicable and transferable platform (D5.2). This will be done with the use of a scalable cloud infrastructure in mind. Also the necessary scale and requirements of the DUET pilots and the EU cloud principles, ethics and legal issues will be considered. This task will also include the development of the platform front end which will be based on the user requirements gathered in WP2. For each type of end-user, when accessing the Digital Twin, will be directed to the tools and services packaged in a manner that appeals to their needs. The look and feel of the interface will be influenced by the work of WP4 in order to create a harmonised look and feel among all modules. The Interface will include an identification and security layer which will be enhanced based upon the outputs of the discussions with the user community over the course of the project. As a development team, DUET will follow the latest trends of UI and UX design patterns and principles in order to provide the best user experience to our customers. Apart from applying common and well-established patterns, Duet will also follow the best practices in usability, regarding every tiny detail of the application (error messages, wordings, titles, colors, fonts etc.). The most important element is that this task will involve the careful and considered integration of all components prepared in WP3 and WP4 into the structure of the Digital Twin to provide a fully functional Evidence based Policy Making Support system.
The platform will be developed in four phases, each ending with a release corresponding to project milestones (Alfa release, Closed Beta release, Open Beta release, Release Candidate) . First, the platform will be tested internally by the consortium. The Beta releases will be tested by actual end users within the closed and open user groups respectively while the Release Candidate will be tested by the 'Sister User Group) (see WP6 for details). Technical testing of the foreseen functionalities will be performed in WP5 (T5.3) while users' evaluation is foreseen in WP6.

Task 5.3. Technical Assessment & Testing (M13 - M36)
Lead: ATC. Support: IMEC, KUL, AEG, VCS, TNO, P4All, UWB
This task will incorporate the testing, review and validation of the platform by technical partners and relevant third parties. The aim is to ensure the correct functioning of the platform before it is released to the pilot leads for personalisation during the closed user group validation phase. To this end, the principal action will be beta-testing of the infrastructure which will involve load testing and security testing. The technical review will also operate as a feedback process during the closed user group phase of the pilots allowing feedback and changes to be implemented before general release.

Task 5.4. Maintenance, Operation & Updates (M19- M36)
Lead: ATC. Support: IMEC, KUL, AEG, VCS, TNO, P4All, UWB
To ensure that the continuous support of the platforms, this task will create a plan for the maintenance and (if necessary) updates to be performed during the lifetime of the project. Maintenance is involves three individual tasks. The first is the operational maintenance, to ensure the continued running of the platform. The second addresses the incorrect functioning of the platform (bug fixes). And the third, covers change requests e.g. suggested changes in the functioning of the software. The pilot cities local IT partners will have a "first line" assistance role with ATC in the "back-office" activities required for the functioning of the platform.

Participation per Partner

Partner number and short name	WP5 effort
1 - AIV	2.00
2 - IMEC	8.00
3 - KUL	4.00
4 - ATC	21.00
6 - AEG	1.50
10 - VCS	6.50
11 - TNO	2.50
12 - P4All	3.00
UWB	3.00
Total	51.50

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	System Architecture & Implementation Plan	4 - ATC	Report	Confidential, only for members of the consortium (including the Commission Services)	8
D5.2	Initial Digital Twin Prototype	4 - ATC	Demonstrator	Public	18
D5.3	Maintenance and Support Plan	4 - ATC	Report	Public	33
D5.4	Final Digital Twin Prototype	4 - ATC	Demonstrator	Public	36

Description of deliverables

D5.1: System Architecture & Implementation Plan (ATC) – M8 (Confidential)
This is the report for detailing the design of the system architecture including the user interfaces and technical specifications. It also provides a detailed implementation plan on how to integrate/link all the components.

D5.2: Initial Digital Twin Prototype (ATC) – M18 (Public)
This deliverable will be the first official prototype (Closed Beta Release) of the platform (built via sprint iterations).

D5.3: Maintenance and Support Plan (ATC)- M33 (Public)
Plan with responsibilities and actions on how the Digital Twins will be supported after the end of the project.

D5.4: Final Digital Twin Prototype (ATC)- M36 (Public)
This deliverable will be the final official prototype of the platform (built via sprint iterations).

D5.1 : System Architecture & Implementation Plan [8]

This is the report for detailing the design of the system architecture including the user interfaces and technical specifications. It also provides a detailed implementation plan on how to integrate/link all the components.

D5.2 : Initial Digital Twin Prototype [18]

This deliverable will be the first official prototype (Closed Beta Release) of the platform (built via sprint iterations).

D5.3 : Maintenance and Support Plan [33]

Plan with responsibilities and actions on how the Digital Twins will be supported after the end of the project.

D5.4 : Final Digital Twin Prototype [36]

This deliverable will be the final official prototype of the platform (built via sprint iterations).

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**
MS2	Release Alfa	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group
MS4	Release Open Beta	1 - AIV	24	Solution Release Open Beta available for Open User Group
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.

Work package number [9]	WP6	Lead beneficiary [10]	7 - OASC
Work package title	Pilot scenarios, deployment, and impact validation		
Start month	8	End month	36

Objectives

This work package will test and validate the DUET Digital Twins in the region of Flanders and in the cities of Athens and Pilsen. The pilot activities entail the co-creation and design of policies in a series of cycles, feeding the results back into the overall project solution. This ensures the applicability and replicability of the Digital Twins and processes in a real-world setting. In fact, the pilot cities which will be part of this test run have been chosen such that they each face similar policy challenges (related to mobility, urban planning, health and environment) but are sufficiently diverse in terms of decision-making processes that the results can be applicable across a range of cities and regions all over in Europe.
The objectives of this work package can be summarized as follows:
● To define concrete scenarios for the design or implementation or evaluation of policies in each of the pilots, which are in line with the local government's strategy and which will provide solutions to actual challenges;
● Co-create the new policy design or evaluate existing policy effectiveness using the Digital Twins to simulate potential impacts of specific decisions on the real world;
● Validate the impact of Digital Twin use on policy-making through quantitative and qualitative methods on the local, regional/National and European Level.

Description of work and role of partners

WP6 - Pilot scenarios, deployment, and impact validation [Months: 8-36]
OASC, AIV, IMEC, ATC, 21c, DAEM, PLZ, ISP, GFOSS
Task 6.1.Pilot Preparation Planning (M8 - M12)
Lead: OASC. Support: AIV, DAEM, PLZ, ISP
This task covers the creation of a pilot operations plan to cover all the testing cycles in the pilot locations. The plan will detail a number of multi-interest policy scenarios (based on outcomes of T2.2) each city/region wishes to use for testing and validation purposes along with the design thinking/co-creation techniques to be adopted. Key stakeholders will be identified and tactics for their engagement will be outlined. Evaluation actions will be embedded throughout the plan to ensure all piloting activities help to systematically examine the acceptance and value of the DUET solution in general, the main determinants (i.e. factors affecting levels of acceptance), as well as measure the effective pilot outcomes as defined in section 1.3.2. The methodology will consist of both qualitative and quantitative measures (i.e. a questionnaire and interviews) and during this task the exact and measurable KPIs for each pilot will be determined in agreement with the consortium, based on the expected outcomes of the pilots.

Task 6.2. Personalizing the Digital Twins (M12-M18)
Lead: ATC. Support: AIV, IMEC, OASC
Each pilot region/city will work with the WP5 lead to personalize their Digital Twin with the data models and data sources identified in their pilot operations plan. This personalization process will lead to the creation of digital sisters that are comparable, but each has its own specialities and local differences. The Functional requirements will be used to describe the needs of the cities based on the outcome of WP2. The Policy needs will be translated into policy modeling based on available processed data to support the modeling as described in the data management plan. The model will be visualized using 2D and 3D techniques together with a dashboard tailored to the needs of the user groups in the city. The personalization will be based on the key user requests and on IT standards to enhance replicability. The outcome of the personalization exercise will allow us to test the transferability and collaboration on a broader scale and will provide input for the WP 7 Dissemination activities to maximize the DUET impact.

Task 6.3.Pilot Testing Cycles (M13-M34)
Lead: OASC. Support: AIV, IMEC, ATC, DAEM, PLZ, ISP
For each of the policy scenarios, the pilots will employ use of the Digital Twins to either design, implement or evaluate a policy and understand its impact and perception on multiple areas of a city. Real-time predictive simulations showing the expected impact of particular policy options will allow decision makers and stakeholders to work interactively and collaboratively come to an informed decision. The Alfa Release of the platform (M12) will be first tested internally by the consortium partners. The subsequent releases (Release Closed Beta in M18, Release Open Beta in M24 and Release Candidate in M30) will be tested by the following end user groups:

● Closed User Group: Provides an opportunity for each pilot to test their individual Twins with a small number of colleagues to ensure the Digital Twins work as planned. The closed group will test not only the functionality of the Twins but also how well the co-creation activities work. Refinements to both the technology and the processes will be made before moving to:
● Open User Group: During these test cycles the Digital Twins will be used in parallel with traditional city operations and policy making processes such as consultations. Stakeholders participating in the traditional methodologies will be asked to use the Digital Twins for investigation to bolster their knowledge of a policy issue and to work together to help find a solution for the issue.
● Sister User Groups: Data models and APIs will be exchanged between the pilot cities to explore the concept of Policy Ready Data as a Service and test scalability and transferability of the data models between the Twins. Outcomes of policy collaboration will be shared to explore how Digital Twins can be used towards common National or EU level policies

Task 6.4.Evaluation and Validation (M16 - M35)
Lead: IMEC. Support: AIV, 21C, OASC, ISP
Based on the qualitative and quantitative measures developed in task 6.1, this task will evaluate the pilot activities in DUET. The pilot-specific KPIs defined in T6.1 will be applied to each pilot via a survey and (phone) interviews will be conducted with pilot leaders to identify successes and challenges. Data gathered from the questionnaires and interviews will be processed and used to improve the DUET solution (T5.3), help inform the business modeling (T2.4) and the sustainability planning (T7.4). The main learnings from the pilots will be summarized in a brief evaluation report (D6.6).

Participation per Partner

Partner number and short name	WP6 effort
1 - AIV	9.50
2 - IMEC	7.00
4 - ATC	10.00
5 - 21c	3.00
7 - OASC	14.50
9 - DAEM	13.00
13 - PLZ	13.00
14 - ISP	6.50
15 - GFOSS	1.50
Total	78.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.1	Pilot Operations Plan	7 - OASC	Report	Public	12
D6.2	Personalising the Digital Twins	7 - OASC	Report	Public	18
D6.3	Pilot Testing Cycle Report 1	7 - OASC	Report	Public	22
D6.4	Pilot Testing Cycle Report 2	7 - OASC	Report	Public	28

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.5	Pilot Testing Cycle Report 3	7 - OASC	Report	Public	34
D6.6	Pilot Evaluation Report	2 - IMEC	Report	Public	35

Description of deliverables

D6.1: Pilot Operations Plan (M12) (Public)
Roadmap for all pilot operations including scenarios, implementation, roles and evaluation actions.

D6.2: Personalized Twins (M18) (Public)
Twins populated and personalized with data and simulations for each pilot site.

D6.3-5: Pilot Testing Cycle Reports (M22, M28, M34) (Public)
Feedback from each testing cycle to technical team and ethics teams and improve co-creation.

D6.6: Pilot Evaluation Report (M35) (Public)
Assessment of the effectiveness of using Digital Twins for evidence-based policy making.

D6.1 : Pilot Operations Plan [12]

Roadmap for all pilot operations including scenarios, implementation, roles and evaluation actions.

D6.2 : Personalising the Digital Twins [18]

Twins populated and personalized with data and simulations for each pilot site.

D6.3 : Pilot Testing Cycle Report 1 [22]

Feedback from each testing cycle to technical team and ethics teams and improve co-creation.

D6.4 : Pilot Testing Cycle Report 2 [28]

Feedback from each testing cycle to technical team and ethics teams and improve co-creation.

D6.5 : Pilot Testing Cycle Report 3 [34]

Feedback from each testing cycle to technical team and ethics teams and improve co-creation.

D6.6 : Pilot Evaluation Report [35]

Assessment of the effectiveness of using Digital Twins for evidence-based policy making.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Release Alfa	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group
MS4	Release Open Beta	1 - AIV	24	Solution Release Open Beta available for Open User Group

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.

Work package number [9]	WP7	Lead beneficiary [10]	5 - 21c
Work package title	Dissemination, ecosystem management and exploitation		
Start month	1	End month	36

Objectives

WP7 aims at deploying stakeholder engagement and management strategies to ensure (a) general awareness raising of DUET, and the use of cloud and digital twins for policy making, across Europe, as well as (b) targeting results to specific audiences in order to increase impact and achieve a sustainable future for the project. Specific goals include:
- Raise general awareness on the themes and results of DUETs among non-specialist audiences;
- Use targeted strategies and activities to engage and influence specific stakeholder groups to use and adopt DUET's innovative Digital Twin approach;
- Deploy standardization activities as an additional mechanism for exploitation and dissemination of project results as well as identifying relevant standards to enrich technical work packages;
- Define business-oriented exploitation approaches for the project's value opportunities, business models and business plans basics. Establish consortium's individual and collaborative strategies.

Description of work and role of partners

WP7 - Dissemination, ecosystem management and exploitation [Months: 1-36]
21c, AIV, IMEC, KUL, ATC, AEG, OASC, GSL, DAEM, VCS, TNO, P4All, PLZ, ISP, GFOSS
Task 7.1. Development of Impact Realization Roadmap (M1 - M3)
Lead: 21C. Support: AIV, IMEC, OASC, DAEM, PLZ, GFOSS
This crucial first task involves the setup and maintenance of the Enhanced Communication, Dissemination and Exploitation roadmap (ECDER). The easy to follow document will bridge the separate communication, dissemination and exploitation activities covered in this WP with an overarching strategy to form a holistic approach to all levels of promotion, helping partners understand what type of engagement is needed, why, where, when and how. A draft roadmap reflecting the overall strategy of all promotional tools and activities has already been outlined (see Section 2.2). The roadmap itself consists of a target audience and interests matrix along with a set of strategies with detailed activity tables per project phase. The Roadmap will not only guarantee communication and dissemination happens at the right times for the right purposes but will ensure all planned activities are monitored to assess performance so future tactics can be updated and refined based on feedback.

Task 7.2. Dissemination Kits for Partners (M2- M36)
Lead: 21C, AIV, OASC
Dissemination objectives, strategies, tactics and messages change depending on the phase of the project (design, innovation, validation) so a Dissemination Kit will be issued to all Consortium partners at the start of each phase. These will outline the specific campaigns and messages to be used, along with new versions of marketing collateral - leaflets, social media images, posters, giveaways etc. to be utilized along with a major review of the project website. This approach ensures consistency of brand and messaging across Europe.

Task 7.3. Ecosystem Engagement, Growth and Management (M3- M36)
Lead: 21C, Support: ALL PARTNERS
This task includes all the activities undertaken to build an ecosystem around the use of DUETs Digital Twins for evidence-based policy making following the ECDER. Activities include setting up the project website (later to become the DUET Digital Twin Starter Kit), supporting stakeholder engagement at the pilot sites, dissemination of results by clustering and knowledge exchange with other projects, social media campaigns, speaking at conferences, interactive workshops, and publications of papers, newsletter creation and distribution and other creative activities. DUET contains two network organizations Plan4All and OASC who organize workshops /stands /seminars /expos at government ICT events where results can be showcased.

Task 7.4. Sustainability Through Exploitation and Commercialization (M13- M36)
Lead: IMEC. Support: 21C, OASC, ISP
Based on the initial business model analysis performed in task 2.4, this task will identify exploitation scenarios for DUET, outside of the project context. This means taking the insights gathered in task 2.4 and applying them to the innovative characteristics of DUET, in order to ensure sustainability of the developed solutions, after the project has run its course. Using a business model sustainability framework, different potential and realistic exploitation scenarios

will be developed, based on input from the project partners and the DUET community. One currently defined action is the creation of the DUET Digital Twin Starter Kit (digital resources) and accompanying (online) business book that will help other cities accelerate the speed at which they set up their own Digital Twin for policy making. The decision to include a book alongside interactive digital content is due to a large gap in the market on this topic, and the fact that it's a core method of upskilling that many policy makers still rely on. Business books on data and innovation are highly popular, and the book can be developed in a cost-effective way and be distributed through print-on-demand via Amazon who has a far wider reach to audiences than any other network.

Participation per Partner

Partner number and short name	WP7 effort
1 - AIV	5.00
2 - IMEC	6.50
3 - KUL	0.50
4 - ATC	0.50
5 - 21c	31.00
6 - AEG	0.50
7 - OASC	15.00
8 - GSL	1.00
9 - DAEM	3.00
10 - VCS	1.00
11 - TNO	0.50
12 - P4All	0.50
UWB	0.50
13 - PLZ	3.00
14 - ISP	3.00
15 - GFOSS	2.50
Total	74.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D7.1	Enhanced Communication, Dissemination and Exploitation roadmap	5 - 21c	Report	Public	3
D7.2	DUET Portal v1	5 - 21c	Demonstrator	Public	3
D7.3	DUET portal v2	5 - 21c	Demonstrator	Public	14
D7.4	DUET portal v3	5 - 21c	Demonstrator	Public	23
D7.5	DUET portal v4	5 - 21c	Demonstrator	Public	33

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D7.6	Business and Exploitation Scenarios v1	2 - IMEC	Report	Public	18
D7.7	Business and exploitation scenarios (final)	2 - IMEC	Report	Public	30
D7.8	Digital Twins for Policy Making Starter Kit with Accompanying Book	5 - 21c	Demonstrator	Public	32
D7.9	Policy Brief	5 - 21c	Report	Public	36

Description of deliverables

D7.1: Enhanced Communication, Dissemination and Exploitation Roadmap (M3) (Public)
An overarching strategy to ensure dissemination, communication and exploitation plans are linked and in harmony.

D7.2-5: DUET Portal (M3, M14, M23, M33) (Public)
Creative digital entrance to DUETs solution, packaged and built around user-needs and not as a traditional dry EU project site. Positions DUET as a reusable product from the start. The Portal will become the basis for the D7.8 DUET start kit, which will easily enable new cities and regions to create their own Digital Twin.

D7.6-7: Business and Exploitation Scenarios (M18, M30) (Public)
Business model outline with joint and individual exploitation strategies with harmonious actions for implementation and clear partner roles. Also contains requirements and go to market strategy for DUETS Digital Twins Starter Kit.

D7.8: Packaged tools, lessons and support in the Portal using videos and interactive content enabling cities to create their own DUET Digital Twins. Supplemented by a published business book, available through Amazon in order to ensure wider reach and in-depth content on the new age of policy making using Digital Twins. Contains roadmap, lessons, case studies and advice on how to get started. Supplements guides created in WP1 and the commercial digital products created during the project.

D7.9: Policy Brief (M36) (Public)
A 'policy brief' at the end of the project as the final document for policy makers, including a targeted EC policy maker roundtable as a dissemination activity (this can be part of a parallel event).

D7.1 : Enhanced Communication, Dissemination and Exploitation roadmap [3]

An overarching strategy to ensure dissemination, communication and exploitation plans are linked and in harmony.

D7.2 : DUET Portal v1 [3]

Creative digital entrance to DUETs solution, packaged and built around user-needs and not as a traditional dry EU project site. Positions DUET as a reusable product from the start. The Portal will become the basis for the D7.8 DUET start kit, which will easily enable new cities and regions to create their own Digital Twin.

D7.3 : DUET portal v2 [14]

Creative digital entrance to DUETs solution, packaged and built around user-needs and not as a traditional dry EU project site. Positions DUET as a reusable product from the start. The Portal will become the basis for the D7.8 DUET start kit, which will easily enable new cities and regions to create their own Digital Twin.

D7.4 : DUET portal v3 [23]

Creative digital entrance to DUETs solution, packaged and built around user-needs and not as a traditional dry EU project site. Positions DUET as a reusable product from the start. The Portal will become the basis for the D7.8 DUET start kit, which will easily enable new cities and regions to create their own Digital Twin.

D7.5 : DUET portal v4 [33]

Creative digital entrance to DUETs solution, packaged and built around user-needs and not as a traditional dry EU project site. Positions DUET as a reusable product from the start. The Portal will become the basis for the D7.8 DUET start kit, which will easily enable new cities and regions to create their own Digital Twin.

D7.6 : Business and Exploitation Scenarios v1 [18]

Business model outline with joint and individual exploitation strategies with harmonious actions for implementation and clear partner roles. Also contains requirements and go to market strategy for DUETS Digital Twins Starter Kit.

D7.7 : Business and exploitation scenarios (final) [30]

Business model outline with joint and individual exploitation strategies with harmonious actions for implementation and clear partner roles. Also contains requirements and go to market strategy for DUETS Digital Twins Starter Kit. This deliverable also includes the development of the business plan.

D7.8 : Digital Twins for Policy Making Starter Kit with Accompanying Book [32]

Packaged tools, lessons and support in the Portal using videos and interactive content enabling cities to create their own DUET Digital Twins. Supplemented by a published business book, available through Amazon in order to ensure wider reach and in-depth content on the new age of policy making using Digital Twins. Contains roadmap, lessons, case studies and advice on how to get started. Supplements guides created in WP1 and the commercial digital products created during the project.

D7.9 : Policy Brief [36]

'Policy brief' at the end of the project as the final document for policy makers, including a targeted EC policy maker roundtable as a dissemination activity (this can be part of a parallel event).

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.
MS6	Project completed	1 - AIV	36	Project tasks completed, exploitation phase starts

Work package number [9]	WP8	Lead beneficiary [10]	1 - AIV
Work package title	Project, risk and quality management		
Start month	1	End month	36

Objectives

This WP will be under the responsibility of the coordinator and will last throughout the entire project lifecycle. The objective of the work package is to implement and coordinate the use of a trusted project management methodology to: maintain and work towards the vision of the project, monitor the overall performance of the project, ensure all outputs are delivered in time and to budget, ensure the quality criteria for all outputs are met, keep the project on track and manage all risks and issues, administer project resources and monitor project expenses, ensure configuration of all project documentation, promote project visibility, guarantee that all data management issues are properly considered and respond to and support all the project partners.

Description of work and role of partners

WP8 - Project, risk and quality management [Months: 1-36]
AIV, IMEC, KUL, ATC, 21c, AEG, OASC, GSL, DAEM, VCS, TNO, P4All, PLZ, ISP, GFOSS
Task 8.1. Project Vision and Strategic Direction (M01 - M36)
Lead: AIV. Support: IMEC, ATC, 21C, ISP
This task will first focus on developing a shared vision of the projects end-state so that the partners have a clear view of the future of DUET to work towards. It involves the organization of an interactive session during the project kick off meeting engaging all project stakeholders. This session will draw out the expectations of the partners and help the diverse participating groups to make the initial steps towards a common understanding. The project vision will be re-discussed annually (M12, M24) so that it remains up-to-date, corresponds to the business reality and addresses any future challenges that arise during the project. The project Coordinator owns the vision and works with the Project Manager to guide its implementation over the course of the project, ensuring all activities in the project remain focused on the end goal. This stops scope creep and/or unnecessary effort on irrelevant activities.

Task 8.2 Project Planning and Daily Administration (M01 - M36)
Lead: ISP. Support: ALL PARTNERS
Project Management is undertaken by the qualified project management office of ISP who are responsible for the day-to-day management of the project, under the strategic guidance of the Project Coordinator. It starts with the production of a live project management plan and project handbook for partners. Other tasks consist of a managing regular conference calls and project meetings, controlling deadlines and delivery dates, producing management documentation, performing quality control and risk management, resolving issues and conflicts, collecting cost statements and any other financial reports, acting as the liaison point of contact with the Coordination, managing partner IPR and stakeholder enquiries. ISP will set up a communication platform and online workspace to manage the project. ISP will manage the quality assurance process for all outputs and all partners will be involved in peer-reviewing deliverables as instructed by the project manager. AIV will have the final sign-off of all deliverables before submission to the Commission.

Task 8.3 Data Management Plans (M01 - M36)
Lead: AIV. Support: IMEC, KUL, ATC, DAEM, VCS, TNO, P4All, PLZ, ISP, GFOSS
This task documents and describes the data management life cycle for all data sets that will be collected, processed or generated by the research project. It outlines how the identified data will be handled during the project, and even after the project is completed, describing what will be collected, processed or generated, following the EC methodology and standards, whether and how this data will be shared and/or made open, and how it will be curated and preserved. Whilst this task is a project management endeavor it will support the ethics and legal work of WP1.

Task 8.4. Expert Panel Engagement and Management (M01 - M36)
Lead: AIV. Support: ATC, ISP
The project's strategic vision is supported through the engagement of deep specialist experts on an independent panel which is set up to act as a critical friend to the project. The panel reviews deliverables and outputs and provides steering advice to the Coordinator who weighs up the adoption and implementation of the advice against the Vision.

Task 8.5 Interim Progress Reporting and Reviews (M01 - M36)
Lead: ISP. Support: AIV

Performance monitoring goes beyond controlling performance in the fundamental areas of budget and schedule. It also addresses the monitoring, measurement and management of the project's scope, quality, partner satisfaction, user satisfaction and the interdependent team relationships. To fulfill regular project and performance monitoring requirements the Project Manager will coordinate regular feedback from all the partners on activities completed, time spent, issues faced, deliverables achieved in the form of interim reports. These interim reports will be shared with the Commission.
A risk assessment will be performed the first months of the project and re-assessed regularly. ISP will be responsible for collating the interim reports. Each WP-leader will be responsible for reporting progress to the project manager. Once a year a consortium meeting with all partners will be organized. Intermediate project meetings will be held in each of the three pilot sites (Flanders, Athens and Pilsen) approximately every 4 months; the Project Manager will attend these meetings. Ad-hoc conference calls will be organized around 'thematic' issues, only partners involved in these issues will be obliged to participate in this conference, however all partners will be welcome to join.

Participation per Partner

Partner number and short name	WP8 effort
1 - AIV	14.00
2 - IMEC	2.00
3 - KUL	1.50
4 - ATC	3.00
5 - 21c	2.00
6 - AEG	1.00
7 - OASC	1.00
8 - GSL	1.00
9 - DAEM	2.00
10 - VCS	1.50
11 - TNO	1.00
12 - P4All	1.00
UWB	0.50
13 - PLZ	2.00
14 - ISP	26.00
15 - GFOSS	1.00
Total	60.50

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D8.1	Project Vision	1 - AIV	Report	Public	1
D8.2	Project Management Handbook	14 - ISP	Report	Confidential, only for members of the consortium (including	2

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
				the Commission Services)	
D8.3	Data Management and Modeling Plan	1 - AIV	ORDP: Open Research Data Pilot	Public	6

Description of deliverables

D8.1, D8.4, D8.7: Project Vision (M1, M12, M24) (Public)
One-page deliverable summarizing the results of the project visioning process. Updated on a yearly basis.

D8.2: Project Management Handbook (M2) (Confidential)
Continuously updated guide for partners outlining all activities and responsibilities for delivering the project, with quality plan, risk management procedures, risk logs and list of peer reviewers for all deliverables.

D8.3, D8.5, D8.8, D8.10: Data Management and Modelling Plan (M6, M12, M24, M36) (ORDP)
DMP describes the data management life cycle for all data sets that will be collected, processed or generated by the research project. The DPM will be updated continuously with new submissions at M12, M24 and M36.

D8.6, D8.9, D8.11: Periodic Progress and Budget Report (M12, M24, M36) (Confidential)
Update on progress overall, by WP, consumption of resources, outputs, impacts, risks and issues.

D8.1 : Project Vision [1]

One-page deliverable summarizing the results of the project visioning process. The project vision will be updated on a yearly basis (in M12, M24 and M36).

D8.2 : Project Management Handbook [2]

Continuously updated guide for partners outlining all activities and responsibilities for delivering the project, with quality plan, risk management procedures, risk logs and list of peer reviewers for all deliverables.

D8.3 : Data Management and Modeling Plan [6]

DMP describes the data management life cycle for all data sets that will be collected, processed or generated by the research project. The DPM will be updated continuously with new submissions at M12, M24 and M36.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Project Design	1 - AIV	7	Project Vision and structure set up, user scenarios and requirements defined
MS2	Release Alfa	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	1 - AIV	18	Solution release Closed Beta available for Closed User Group

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS4	Release Open Beta	1 - AIV	24	Solution Release Open Beta available for Open User Group
MS5	Release Candidate & Business Plan	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.
MS6	Project completed	1 - AIV	36	Project tasks completed, exploitation phase starts

Work package number [9]	WP9	Lead beneficiary [10]	1 - AIV
Work package title	Ethics requirements		
Start month	1	End month	36

Objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this work package.

Description of work and role of partners

WP9 - Ethics requirements [Months: 1-36]
AIV
This work package sets out the 'ethics requirements' that the project must comply with.

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D9.1	H - Requirement No. 1	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.2	H - Requirement No. 2	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.3	H - Requirement No. 3	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.4	POPD - Requirement No. 4	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.5	POPD - Requirement No. 5	6 - AEG	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3

Description of deliverables

The 'ethics requirements' that the project must comply with are included as deliverables in this work package.

D9.1 : H - Requirement No. 1 [3]
Details on the procedures and criteria that will be used to identify/recruit research participants must be provided.

D9.2 : H - Requirement No. 2 [3]

The beneficiary must confirm that templates of the informed consent forms and information sheet are kept on file.

D9.3 : H - Requirement No. 3 [3]

The beneficiary must confirm that opinions/approvals by ethics committees and/or competent authorities for the research with humans have been obtained, and are kept on file.

D9.4 : POPD - Requirement No. 4 [3]

Detailed information on the informed consent procedures in regard to data processing must be provided.

D9.5 : POPD - Requirement No. 5 [3]

The beneficiary must confirm that templates of the informed consent forms and information sheets (in language and terms intelligible to the participants) are kept on file.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

1.3.4. WT4 List of milestones

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS1	Project Design	WP2, WP8	1 - AIV	7	Project Vision and structure set up, user scenarios and requirements defined
MS2	Release Alfa	WP3, WP4, WP5, WP6, WP8	1 - AIV	12	Solution release Alfa available available for internal testing, data analyzed, system architecture defined, pilots planned
MS3	Released Closed Beta	WP2, WP3, WP4, WP5, WP6, WP8	1 - AIV	18	Solution release Closed Beta available for Closed User Group
MS4	Release Open Beta	WP3, WP4, WP5, WP6, WP8	1 - AIV	24	Solution Release Open Beta available for Open User Group
MS5	Release Candidate & Business Plan	WP3, WP4, WP5, WP6, WP7, WP8	1 - AIV	30	Solution release Candidate available for Sister User Group, exploitation strategy defined and launched. Business plan developed.
MS6	Project completed	WP7, WP8	1 - AIV	36	Project tasks completed, exploitation phase starts

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	DUET inadvertently breaks privacy requirements through data aggregation.	WP1	A whole work package is dedicated to ethics and privacy heading by a legal Organization. In addition, the Coordinator appoints its own Ethics manager to review processes and data management plans.
2	The project uncovers conflicting legal/ethics requirements between EU and National legislation.	WP1	As most national policy comes from EU regulations this scenario is unlikely. But in the case of conflicts of interest these will be flagged and discussed with relevant stakeholders to agree a way forward and/or a work around.
3	DUET does not attract a good balance of end-users to Design Thinking workshops which skews user requirements.	WP2	IMEC is vastly experienced at end-user engagement through its Living Lab methodologies. Users will be selected by pilot sites and incentives will be provided for the exchange of their time (e.g. Amazon vouchers).
4	User requirements are unrealistic within the scope of the project budget.	WP2	User requirement gathering as part of Design Thinking is intended to be unconstrained to unleash creativity. The prototyping stage with developers will help prioritize features and manage expectations.
5	Poor availability of IoT data which limits usefulness of the Twin in replicating real life.	WP3	If there is no real time IoT data available, the consortium will use either models or historical data available to feed the different parameters of the Digital Twin.
6	Lack of Standards for certain aspects of the Digital Twins which may affect interoperability.	WP3	Ideally, standards are defined before the project starts. However, if not for all parameters. If they are not defined, intermediate formats will be used, or the project will fast track OSLO.
7	Problems with the integration and automation of different data sources and systems.	WP4	To ensure the integration and automation of all necessary data sources and systems all partners support open interfaces and internationally accepted standards. All relevant components have to be cloud-ready.
8	Citizen users do not like the 3D front end interface and do not use the Twin for collaboration.	WP4	Interface will be created agilely with user's acceptance at each sprint step of development. To ensure familiarity with 3D we will expose them to 3D look and feel and generate excitement at the design stage.
9	Functionalities do not meet the requirements of policy makers. Thereby the end solution is not accepted, user satisfaction is at a low score.	WP5	Focus on a user centric design and validation approach, with emphasis on continuous iterations of requirements, development and validation activities. A complete coordinated and user-oriented implementation plan is followed.
10	Development risks related to shifts in state-of-the-art activities or the appearance of disruptive technology affect the envisaged plan.	WP5	The Technical Director reviews technical and business aspects of the project to set directions. Technologies developed will be platform-agnostic to the greatest extent possible and thus flexibly adaptable to a changing environment.

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
11	Low levels of user involvement due to perception that user requirements have not been met.	WP6	Use of agile development in WP5 means each sprint release can be tested with end-users as soon as it is available and feedback for improvements goes directly back to the tech team before the next development sprint begins.
12	City decision making process (e.g. opposition questions or other unexpected circumstances) does not allow the new policy changes to be implemented in time for formal validation.	WP6	DUET understands that policy can take years to formally be accepted and implemented so the Digital Twins focus on operation decisions that impact longer-term policy thereby creating responsive cities. If formal validations cannot be undertake informal and creative solutions will be sought to understand and communicate impact.
13	Difficulty securing speaking slots at high profile European events to promote DUET.	WP7	Consortium partners sit on boards of conferences, invest in stands at conferences and even run own events, conferences and workshops which DUET can leverage for dissemination and exploitation.
14	Agreeing on a shared business plan proves hard due to multiple needs.	WP7	Business model development will be discussed from start of the project. The coordinator will play an independent role as noncommercial partner in case of any problems.
15	Uncertainty around Brexit affects our UK partner.	WP8	In case of Brexit problems our UK partner will register in Ireland or Estonia. If any challenges are insurmountable, tasks can be shifted to OASC, AIV and IMEC.
16	Key milestones or critical deliverables are delayed.	WP8	Continuous analysis of the dependencies established between WP's and outcomes will be monitored on a weekly basis.

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person/Months per Participant
1 - AIV	5.50	7	9	8	2	9.50	5	14	✓	60
2 - IMEC	1	11	13.50	8	8	7	6.50	2		57
3 - KUL	0.50	1	8	3.50	4	0	0.50	1.50		19
4 - ATC	0.50	5	9	6	21	10	0.50	3		55
5 - 21c	1	14	0	0	0	3	31	2		51
6 - AEG	0.50	0	10	3.50	1.50	0	0.50	1		17
7 - OASC	0.50	1	3	0	0	14.50	15	1		35
8 - GSL	14	0	0	0	0	0	1	1		16
9 - DAEM	4	10	3	0	0	13	3	2		35
10 - VCS	0.50	0	0	27.50	6.50	0	1	1.50		37
11 - TNO	0.50	1	7	10.50	2.50	0	0.50	1		23
12 - P4All	0.25	0	0	14.25	3	0	0.50	1		19
· UWB	0.25	0	6.50	8.25	3	0	0.50	0.50		19
13 - PLZ	4	10	3	0	0	13	3	2		35
14 - ISP	0.50	0	0	0	0	6.50	3	26		36
15 - GFOSS	0.50	12.50	0	0	0	1.50	2.50	1		18
Total Person/Months	34	72.50	72	89.50	51.50	78	74	60.50		532

1.3.7. WT7 Tentative schedule of project reviews

Review number [19]	Tentative timing	Planned venue of review	Comments, if any
RV1	14	Date and place to be confirmed	
RV2	36	Data and place to be confirmed	

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
ORDP	Open Research Data Pilot
DATA	data sets, microdata, etc.

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.

History of Changes

Date	Changes compared with the proposal or with previous versions of Annex 1
2019-07-24	**Part A:** • Corrected a typo in the deliverable number in WP5 description (D3.4 to D5.4) **Part B** • Added justification for the selection of the external expert panel and their expertise overview in the Section 3.4.4 Subcontracting • Added profiles of external experts in the Section 4.3 • Based on the request of the beneficiary KUL, added the following formulation regarding the powers of the General Assembly in the section 3.2.1. Organisational Structure: *'For the avoidance of doubt, any change to the Consortium Agreement or any budget-related change to Annex 1 to the Grant Agreement shall only be legally binding between the Parties if agreed in writing and executed by the duly authorised signatories of each Party*.' • Removed the coordinator's Linked Third Party EVIV from the section 4.2. EVIV was only introduced for the AIV's internal admin & finance reasons and due to organisational changes at AIV it is no longer necessary to include EVIV in the project (EVIV had no resource allocated in the proposal)
2019-08-16	**Part A:** • Periodic reports and budget reports removed from the deliverables table as these are standard contractual obligations • Updates of the D8.1 Project Vision and D8.3 Data Management and Modelling Plan removed from the deliverables table as requested by the EC. Instead the annual updates were indicated in the deliverable descriptions. • Added the D7.9 Policy Brief (21C, PU, R, M36), Description: 'policy brief' at the end of the project as the final document for policy makers, including a targeted EC policy maker roundtable as a dissemination activity (this can be part of a parallel event). • Renamed the D7.1 Impact Realisation Roadmap to D7.1 Enhanced Communication, Dissemination and Exploitation roadmap and updated the WP7 tasks description with the new D7.1 name. • Added the development of the business plan as a part of D7.7 Business and Exploitation Scenarios by adding the following in the description: *This deliverable also includes the development of the business plan.* • Added business plan to MS5 in M30. MS renamed to *Release Candidate & Business Plan.* MS5 description extended with: *Business plan developed.* **Part B:** • Updated the Gantt chart with the changes in deliverables listed above • In the section on Quality management, added the following sentence next to the reference to the performance indicators*: the impact framework including indicators will be developed as part of the ECDER and will also include the communication indicators: e.g. hits on the website, social media uptake, etc.).* • Removed the names (section 3.4.4), CV's (section 4.3) and Letters of Commitment (former Annex 1) of the external experts to comply with the awarding conditions for subcontracts. Added a reference to the AIV's public procurement procedure to select the experts (section 3.4.4). • In the tables 3.4.3, added the following sentence for the travel items: *travel items that relate to dissemination should be in line with the ECDER.* Added the CFS cost under the 'Goods and Services' item of AIV • (3.4.3): Updated the 'PM split per Partner' chart to include the missing % figure for AEG and GSL • Section 4.2: o Added a reference to the AIV's public procurement procedure to award the external experts subcontracts o P4All: added the 3rd parties' profiles and tasks where the contribution of seconded personnel (Art. 11) is expected
2019-09-04	**Part A:** • Shifted €15,000 originally budgeted under AIV's 'Other Direct Costs' for the travel and subsistence of the external advisory board to subcontracting. As a result, the AIV's total costs were reduced to €875,000. **Part B** • Removed the €15,000 budgeted for the travel costs of the expert board from the AIV table in Section 3.4.3. and moved it under subcontracting (3.4.4). Updated the total budget figure in section 3.4.2.
2019-09-24	**Part B** – removed the page numbers from the footer and from the ToC as requested by the EC
2019-10-29	**Part A** • replaced beneficiary AEGIS IT RESEARCH UG (PIC 911867804) by AEGIS IT RESEARCH LTD (PIC 925881394) **Part B** (section 4) • replaced participant profile of AEGIS IT RESEARCH UG by the profile of AEGIS IT RESEARCH LTD

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Figures

1. Excellence

DUET is an Innovation project designed to leverage the advanced capabilities of cloud and high-performance computing (HPC) to evolve the traditional public policy making cycle (outlined by Patton & Sawicki[1]) using large open data sources. The aim is to ***help public sector decision-making become more democratic and effective, both in the short and long term, through the development and use of Digital Twins for policy impact exploration and experimentation in entire cities and regions***. These digital replicas of a cities system will (a) enhance day-to-day city management by helping city managers react quickly to real-time events through rapid experimentation of different decision impacts, and (b) ensure longer term policy decisions are more effective and trusted by enabling city managers from different units, citizens and businesses to explore the issues in a visual, easy-to-digest way via a common view. Thanks to the 3D interface public administrations will, for the first time, more easily harness the collective intelligence of ALL policy stakeholders to tackle complex, systemic policy problems that require innovative thinking to develop transformative solutions.

1.1. Objectives

The transformation of traditional policy making is long overdue. The explosion of data along with enabling technologies such as blockchain, artificial intelligence and cognitive computing is already driving a paradigm shift in the way cities and regions are governed. Today, however, many cities are still at the start of the transformation journey and progress has been slow. A recent Forrester report found that only 12% of city data is analysed and used for decision-making and management, currently leaving 88% untouched.[2] It follows that whilst cities are data-rich environments, and that much investment has been made in Europe to raise both digital and data-based skills, cities cannot truly make advances as they lack:

1) An understanding of the data, what types are available, how they can be harnessed and how they can be used for enhancing policy and operations
2) The computing power needed for advanced analytics which can unlock the intelligence hidden within vast amounts of data, and;
3) The principles and protocols to navigate complex multi-level (EU and National) laws and regulations to embrace ethical decision-making processes which do not end with negative legal repercussions.

Recognising these challenges DUET sets out to provide public administrations not just with advanced tools for open evidence-based policy-making using Digital Twins, but also with a broader understanding of the methodology and implications of how to use data to enhance the democratic value of policies. To achieve its aims DUET has three complementary objectives, each with a set of sub-objectives:

Objective	Measurement	Success Criteria	Milestone
1. Create a cloud and HPC enabled Digital Twin approach for collaborative policy making			
1.1. Pinpoint, understand and review ethical challenges for using and sharing big/open data using Cloud based tools for evidence-based decisions	• No. expert contributions • Understanding of ethics • Understanding of legalities • Publication of findings • Dissemination of results	• Feedback from 20 experts • Increased ethical awareness • Compliance through legal guide • Ethics white paper published • Recommendations to EC Cloud	MS1
1.2. Use above findings to advance progress towards real-time policy experiments using HPC to add new value to existing data models through complex scenario simulations	• No. real time data sets used • No. existing data models migrated • No. data types shown & combined • Levels of drill down • Time saved on modelling • Cost saving thanks to cloud modelling	• 20 real time data sets used • 10 data models brought to cloud • 5 data types on one interface • Ability to drill to sensor level • From days to seconds • From thousands of Euros to few Euros per experiment	MS2

[1] https://www.researchgate.net/figure/260579927_fig1_Fig-1-Policy-Analysis-Cycle-Patton-and-Sawicki-1993
[2] http://datasmart.ash.harvard.edu/news/article/analytics-excellence-roadmap-866

1.3. Develop web-based 2D and 3D Digital Twins to showcase systemic impacts of the scenarios and make policy making easier to understand and more collaborative	• No. Digital Twins • No. predictive simulations • No. policy scenarios • User ability to understand • User experience • Practical usability	• 3 Digital Twins in operation • Min 5 simulations each pilot • 15 different policy scenarios • 80% • 80% • 80%	MS3
2. Test Digital Twin approach for more effective policy experimentation			
2.1. Provide real-world conditions in three pilots for citizens, businesses and policymakers to test and validate policy making (real-time and long term) using DUET Digital Twin platforms	• No. Pilots • Acceptance of the Twins • Satisfaction of the Twins • No. stakeholders collaborating • No. co-creation sessions run • No. policy options explored • No. policy decisions made	• 3 pilots • 90% user acceptance • 80% min satisfaction • 100 collaborators • 30 co-creation sessions • 30 options explored • 12 policy decisions	MS4
2.2 Inform regional/national/EU policies by exchanging findings from Digital Twins in sister cities who are exploring common challenges.	• Transferability of data models • Scalability of data models • Exchange of experiences • Impact on policies • Inclusion of outside cities	• 3 data models exchanges • City models tested in region • Pilot roundtable event • 3 Papers on policy results • 4 similar project clustering	MS5
2.3 Refine DUET Twins and policy making processes from validation trials and feedback	• No. test cycles • No. platform releases • Adherence to user requirements	• 1 internal and 3 pilot test cycles • 2 internal + 2 official releases • Meets user requirements	MS3 MS4 MS5
3. Ensure wider sustainability and impact through the scalability and transferability of outcomes			
3.1. Develop and disseminate success stories from the Digital Twin pilots which highlight the benefits of adopting the approach and provide inspiration	• No. case studies created • No. speeches/publications • No. social media campaigns • No. cities targeted • Positive feedback from cities	• 6 case studies delivered • 30 speeches/5 publications • 4 social media campaigns • 300 new cities contacted • Quotes from 10 cities	MS6
3.2. Create exploitation models and commercialisation approaches for DUET, promote, showcase, encourage adoption across Europe	• Realism of business model • Ease of replication • Feedback from business experts • No. cities interested in adopting • No. countries targeted • Easy deployment/install base of a basic Twin	• Based on real evidence • Digital Twin Starter kit created • Reviewed by 3 experts • 5 new cities interested in Twins • All member states contacted • Easy replicable install base in each of the 3 pilots	MS6
3.3 Create recommendations for a European Cloud Infra which address ethical and legal aspects for sharing policy ready data	• Responsiveness to state-of-art • Evidence based feedback • Quality of recommendations • Relevance of distribution list • Launch impact	• Advances current thinking • Inclusion of validation results • Drafted by lawyers and cities • Sent to EC cloud infra experts • Presented at final project event	MS6

1.2. Relation to the Work Programme

DUET has been specifically designed, leveraging lessons from past projects, to address the Call DT-GOVERNANCE-12-2019-2020 and more specifically the topic**:** Pilot on using the European cloud infrastructure for public administrations. It aligns with the call scope as follows:

Call Requirement	Proposal Alignment
Proposals should develop new ways and methods and ethical aspects of using the cloud infrastructure by public administrations for policy modelling, policy making and policy implementation.	• DUET uses cloud infrastructure to develop an innovative **Digital Twin** approach for more effective, transparent, trusted and collaborative policy making • The Digital Twin concept contributes to ethical policy making by: ➢ Providing a common digital view (replica) of the city so all stakeholders use the same baseline for policy experimentation and impact exploration ➢ Aggregating data from different units so teams can plan policy and decisions understanding the systemic impacts on other elements of city management ➢ Encouraging collaboration of all kinds of stakeholders at every stage of the policy cycle through shared visualisation experiences (incl. 3D) ➢ Creating simple intuitive interfaces for the visualisations so anyone, no matter their tech, academic background can contribute to policy issues ➢ Reducing the need for multiple costly, siloed, real-life pilot experiments as impacts can be visualised digitally and save the city money ➢ Ensuring all cities have access to same Digital Twin (HPC-cloud-enabled) capabilities for effective data-based policy making, i.e. **Policy Ready Data-as-a-Service**
The availability of open and big data, in particular as facilitated by high-performance computing **(HPC) capabilities** offered by the European Cloud Initiative, would provide an infrastructure with data and analytical power for the public administration	• DUET builds on lessons from the European Science Cloud and European Data Initiative to design an interoperable, compatible infrastructure for policy making • DUET uses Digital Twins to fuse different (conventional and non-conventional) data sources to extract information that is hard to achieve by traditional means • Digital Twins overcome fragmented approaches to policy making using of a common interface for brokering different data models to add greater value to open/big data • DUET harnesses HPC capabilities for heavy algorithm execution (e.g. for predictions) to advance the state-of-art for data-driven policy making • DUET Digital Twins bring consistency and alignment to a cities policy landscape ensuring policies from different units support each other • DUET delivers legal guidelines and technical standards for the ethical delivery of Policy-as-a-Service and recommendations to the European Cloud Initiative
Create reusable models that allow for a better, more accurate and more efficient development and management of policies related to health, emergency responses, weather warning etc.	• DUETs approach can be utilised for any area of city decision and policy making, in the pilot case this will focus on Transport and Environment related challenges • DUET enable cities to make more accurate and effective real-time decisions. thanks to faster predictions/visual explorations, which align with wider policy goals • DUETs Digital Twins enable the re-use, sharing and combining of both existing and new data models to increase effectiveness of current policy tools • Reusable models include standards for Digital Twin use for brokering & fusing data, for publishing authentic data sources, and ethical policy experimentation
Proposals should demonstrate the interoperability, reusability or scalability of the models and analytical tools.	• DUET demonstrates interoperability by taking existing data models and data from different parts of city management and integrating them in Digital Twins • DUET demonstrates reusability by operating Digital Twins for policy making in 3 pilot locations with different characteristics and needs • DUET demonstrates scalability by piloting at both a city level (Athens, Pilsen) and a regional/network of city levels (Flanders)
Develop a solid and realistic business plan to ensure the long-term sustainability and take-up of the results and consider legal and security aspects.	• DUET uses a Value Network Analysis (VNA) approach to develop a new business model for Policy-as-a-Service with attention on data-ownership, rights, responsibilities etc. • DUET builds a strong case for the added value of a HPC-enabled data-driven approach to increase the effectiveness and efficiency of current policy tools • DUET standardises models, approaches and a compliance framework to make it easier for other cities to adopt the approach and quickly realise the benefits • DUET explores use of standard ontologies, access rights, data licence management to ensure Digital Twin solution is secure and trusted (technically, legally & organisationally)
They should also consider how communities can be effectively involved in	• DUET enables citizens and businesses to contribute data to the Digital Twin by creating an experimentation environment that doesn't breach privacy or security ○ Lay stakeholders can easily view and understand Digital Twin data, thanks to intuitive interfaces and also provide feedback, and contribute data

co-creation of data management and analysis.	○ More technically advanced stakeholders (academic/business) can use data subject to various constraints and run their own analysis using own tools ● DUET will build its Digital Twins using design thinking with stakeholders to ensure its look, feel, usability and processes are ethical and meet end-user requirements ● DUET will use both 2D and 3D digital twins for participatory art methods of inclusion[3], facilitating co-creation around policy design, implementation & evaluation
Involve a multidisciplinary, cross-sector teams to explore complexity, including the problems raised by big data and consideration of precautionary approaches to problems.	● DUET is designed to overcome big data use barriers - from quality of data, to access of needed computing power, to data understanding skills and ethical governance issues ● DUET enables multi-disciplinary, cross-sectoral teams to work together on a long-term future city vision enabling complementary decisions to be made in the short-term ● DUET overcomes 'double data divide' for cities - 1) all cities have access to HPC for policy, and 2) all citizens have an opportunity to understand data via the Twins ● DUETs agile approach to delivery enables precautionary techniques to be tested and refined continuously via 8-week sprint cycles (i.e. open algorithms) ● DUET brings together social scientists, co-creation experts, legal experts incl. ethics, visualisation experts, data experts, AI experts, semantic web experts, and policy experts

1.3. Concept and Methodology

1.3.1. Opportunity

The volume of data in the world is massive and growing exponentially. Every day studies tells us we are in the midst of a 4th revolution, the data revolution. 90% of the data generated worldwide since the beginning of time has been generated in the last 2 years. Recent forecasts state that we will reach 163 zettabytes of data by 2025[4]. Whilst the transformational potential of data is not disputed, cities still have a long way to go to fully leverage the power of this data for more responsive and effective city management. The emergence of a) the ***Internet-of-Things*** generating useful data from city sensors, and b) ***Cloud storage and computing***, has created new opportunities for harnessing city data, generating new tools, techniques and businesses focused on enhancing city understanding and the city experience. Surprisingly, despite these new capabilities, only 2% of all the data in the world is effectively utilised, with just 12% of city data used for policy making[5].

As expected, the private sector is ahead of the game, and own much of the richer, more useful data that is generated daily by the city. For example, they own mobility data from people's smartphones, commerce data from store and credit cards, data from privately owned sensors and more, using it to increase the quality of their services and revenue potential. Government, despite the move towards Open Data in the last ten years, are being left behind. Whilst thousands of open data sets are available for reuse across Europe, take-up remains low. European, National and Local open data portals have poor name recognition and a smaller number of datasets are downloaded than expected. Europe is not reaching its full potential, with an overall maturity score of 65% in 2018's EU Open Data Maturity Report[6]. This data has not turned out to be the 'new oil' many predicted.

The reason for struggling impact is due to many factors including: the ***lack of data quality*** in all dimensions: consistency, accuracy, coverage, freshness, and completeness; the ***lack of data interoperability*** to ensure mobility of services keeps up with the mobility of the users; the ***lack of data understanding (data literacy)*** to enable meaningful interpretation of data in the form of information, and; the ***lack of useful real-time data sources*** which have the potential to deliver the most impact.

Aside from the data itself, an overreliance on traditional analytics techniques, and ***lack of an infrastructure with the needed processing power to analyse the volume and variety of city data fast enough*** has also hampered progress. Despite the economics of sharing hardware and software, in reality the costs for sending data to and retrieving it from the cloud is often more expensive than in-house storage.

[3] http://sateenvarjolla.blogspot.com/2013/07/games-in-planning-pop-up-pest.html
[4] IDC Whitepaper - https://www.seagate.com/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf
[5] http://datasmart.ash.harvard.edu/news/article/analytics-excellence-roadmap-866
[6] Open Data Maturity in Europe 2018 https://www.europeandataportal.eu/sites/default/files/edp_landscaping_insight_report_n4_2018.pdf

Data sharing and reuse also amplifies subtle and ***complex questions of interpretation, transparency, collaboration and trust*** that form a number of ***data ethics concerns***, along with confusion around balancing the principles of 'openness' and 'privacy'. Use of data must meet wider ethical requirements including; A clear public benefit; Use only to the extent proportionate to the need; Recognition of the limitations of the data used (including the risks of taking decisions on incomplete or inaccurate data) and; A precautionary approach, with transparency and accountability in the acquisition, processing, storage and use of data, i.e. ensuring that the algorithms driving HPC analytics are open and fair.

Whilst there is a big movement towards open government[7], it's not correct for administrations to automatically assume that 'open,' 'shared' and 'public' are synonymous with the principle of public good. Many who are reluctant to make data public often have concerns about how it is reused, after all research has shown several examples of surprising correlations which can unintentionally disclose sensitive information about persons in public datasets[8].

Even if personal privacy is protected, Administrations must consider if the citizens providing the data would support the way that their data is being used, and would they have provided it if they had known how it would be used? This is not a straightforward process which requires policy and regulations to be developed with stakeholders and social partners, as it cannot be left to the technologists alone (a 2018 survey by StackOverflow[9] found that 80% of developers wanted to know what their code would be used for, however 40% wouldn't rule out writing unethical code, and 80% did not feel responsible for the use of their unethical code).

Together, all the issues above combine to put cities off publishing and sharing data, meaning many notable European open data projects focused on empowering and upskilling citizens in using data and enhancing city decision-making, never achieve their true potential for collaboration and innovation. Public administrations seem destined to remain stuck in a world of pilots, with data literacy capacity remaining low, so their results rarely hit the mainstream the same way as private sector offerings do.

Imagine if cities could overcome these challenges and utilise lessons from the private sector that help to move beyond the 12%, using fresh approaches to bring together existing and new data sources (structured and unstructured) via an underpinning infrastructure which creatively aggregates them in a way that makes the data more valuable both in its quality and usefulness. ***A new Cloud enabled approach for the public sector that will aggregate city data adhering to legal and ethical principles, and intuitively make it easy to understand by all.*** An approach that removes concerns around ethics and skills and unlocks the real potential in open data for ***driving future decisions*** for cities whilst simultaneously ***enhancing today's city experience*** for all.

To take advantage of the increasing opportunities presented by vast amounts of city data for improving policy making three major barriers must be overcome:

1. **Lack of Access to Computing Power:** Cities need cost-effective access to high levels of computing power to creatively unlock tangible benefits from large quantities of different data, and enable real-time decision making.
2. **Lack of Data Literacy:** City data needs to be easier to understand for all through simple interfaces that enable everyone to understand the issue being addressed, and to be able to contribute ideas, thoughts, own data and feedback towards creating a more sustainable future
3. **Lack of Data Ethics:** As policymakers move towards using data from multiple sources, using new and creative data models, and advanced analytical techniques and easy to use tools, it is increasingly crucial to ensure that the way the data is collected and used conforms not only to the requirements of the privacy of personal data but also to the wider ethical principles of public benefit, proportionality, a precautionary approach and transparency.

1.3.2. Solution

DUET tackles the challenges outlined above to leverage the European Cloud Infrastructure to bring new opportunities to policy-making as follows:

[7] https://www.opengovpartnership.org/
[8] https://www.accenture.com/t20161110T001618Z__w__/ca-en/_acnmedia/PDF-35/Accenture-The-Ethics-of-Data-Sharing.pdf
[9] https://insights.stackoverflow.com/survey/2018/#ethics

1: Providing access to needed computing power: Real-time city management needs algorithms and computing power that can scale to distil oceans of open data, deliver insights and maintain efficiency. Cloud computing offers the ability for cities to access highly scalable hardware and software resources for the overwhelming majority of IT use cases. However, for future scenario predictions for policy modelling, cities need to execute heavy algorithms and leverage near real-time deployment and processing require the use of high-performance computing (HPC).

Cloud computing has not been used for high performance computing (HPC) to the same degree as other use cases for several reasons, namely cost, but DUET will advance this area by providing a new shared approach for its use in policy making and city management – using a **Digital Twin.**

A "Digital Twin" is a new concept consisting of a continuously learning digital copy of real-world assets, systems and processes that can be queried for specific outcomes. DUETs Digital Twins will consume Open Data and Data models from different sources in the city and integrate them with new technology capabilities including HPC, Artificial Intelligence and Advanced Analytics in order to provide a replica city environment where policy experimentation can safely take place. By predicting asset behaviour and capacity to deliver on specific outcomes within given parameters and cost constraints, the Digital Twin provides a risk-free experimentation environment to inform stakeholders what they need to do with the assets in the real-word in order to both achieve the most effective long-term policy outcomes, and short-term operational decisions.

2: Making data easier to understand: Easy to understand visualisations are a critical factor for driving trust in using data for democratic decision making. However, most visualisation platforms still need a degree of geo-expertise to truly use them to extract intelligence. DUET is different as it can provide a ***3D interface for its Digital Twins*** alongside a 2D offering. Users, regardless of their technical or academic background, will be able to walk through DUET's virtual 3D city neighbourhoods, and directly see dynamic data readings from multiple sources in a familiar context that makes them easy to understand. For example, users may see air quality through colours, traffic congestion as lines, incident sites as icons and so on. This simple, relatable way of viewing the city through ***multiple integrated data sources*** brings to life the tangible, systemic impacts of policy options, fueling 'what if' experimentation that unleashes creative and innovative qualities of all participants. This levelling of the field means that policy makers, administrative workers, emergency services, entrepreneurs, businesses and citizens can all participate in co-creation and consultation exercises as part of the traditional policy making cycle.

3: *Establishing Ethical Principles for Data-Driven Decisions:* The game-changing, cloud based, Digital Twin infrastructure with its deep-dive visualisation platform for policy experimentation will boost collaboration and policy innovation and bring new discoveries and intelligence through novel views of the data. Using visualisation tools, analysis of problems can have greater depth as many multi-disciplinary and multi-sectoral layers of data relating to the physical and social world can be considered together. ***Using a Digital Twin users can explore policy impacts across a whole city, rather than just one or two small localities***. Instead of providing complicated graphs and multiple versions of maps from different industries to illustrate the impacts of, for example road routing decisions on mobility, air quality and health, the Digital Twin provides **one version/replica of the city** for all to use as a ***trusted baseline*** for exploring systemic impact of decisions. Visualising multiple data sources through the Digital Twin make relationships more apparent, dependencies and interactions more clearly viewed and the trade-off between a variety of possible solutions can be modelled and evaluated. ***For the first time complex policy will be open for all to easily explore and understand the situation that needs to be improved, experiment with ideas, cocreate potential solutions, and contribute to its formalisation.***

1.3.3. Offering

DUET is designed to advance policy development in the age of big data and cloud, to deliver a trusted, scalable and transferable ***Digital Twin*** solution for accelerating the adoption of data-driven, collaborative decision making and policy-making. It is designed to stimulate the creation of collaborative and innovative solutions to multi-disciplinary and multi-sectoral societal challenges by making it easier for policy makers and their stakeholders to access, visualise and use a wide variety of big geo-data sources to explore and co-create policy in the key Horizon 2020 target areas of ***transportation, environment and health***.

Using DUETs Digital Twin approach means policy-making no longer needs to be based upon static models of consultation and closed planning over a timeframe of a year or more. Traditional ways of decision making are often siloed and slow, with thinking and solutions out-of-date by the time policy is ready to be implemented. Yet

the world has changed; technology has changed the way we work, live and communicate, so solving society's problems in old ways no longer works. Whilst many administrations are utilising a number of innovative solutions to combat multi-disciplinary urban challenges (e.g. variable congestion charging to reduce traffic jams, improve air quality and reduce air-related disease) **no-one is yet harnessing the full disruptive power provided by combining big data and HPC advanced analytics** to develop solutions that enable the collaborative exploration of the systemic impacts of city decisions, utilising the knowledge and experience of a range of urban stakeholders.

DUETs use of Cloud truly changes the game, disrupting the field of Smart Cities and transitioning to a new age of **Responsive Cities**. With Responsive Cities, solutions are not designed around citizens, they are designed with the citizen placed firmly at the centre of the action. Where Smart Cities are technology driven and produce large amounts of data from fixed or centrally controlled sensors, Responsive Cities recognise that citizens are also a major player in data generation which helps to shape real-time city decisions.

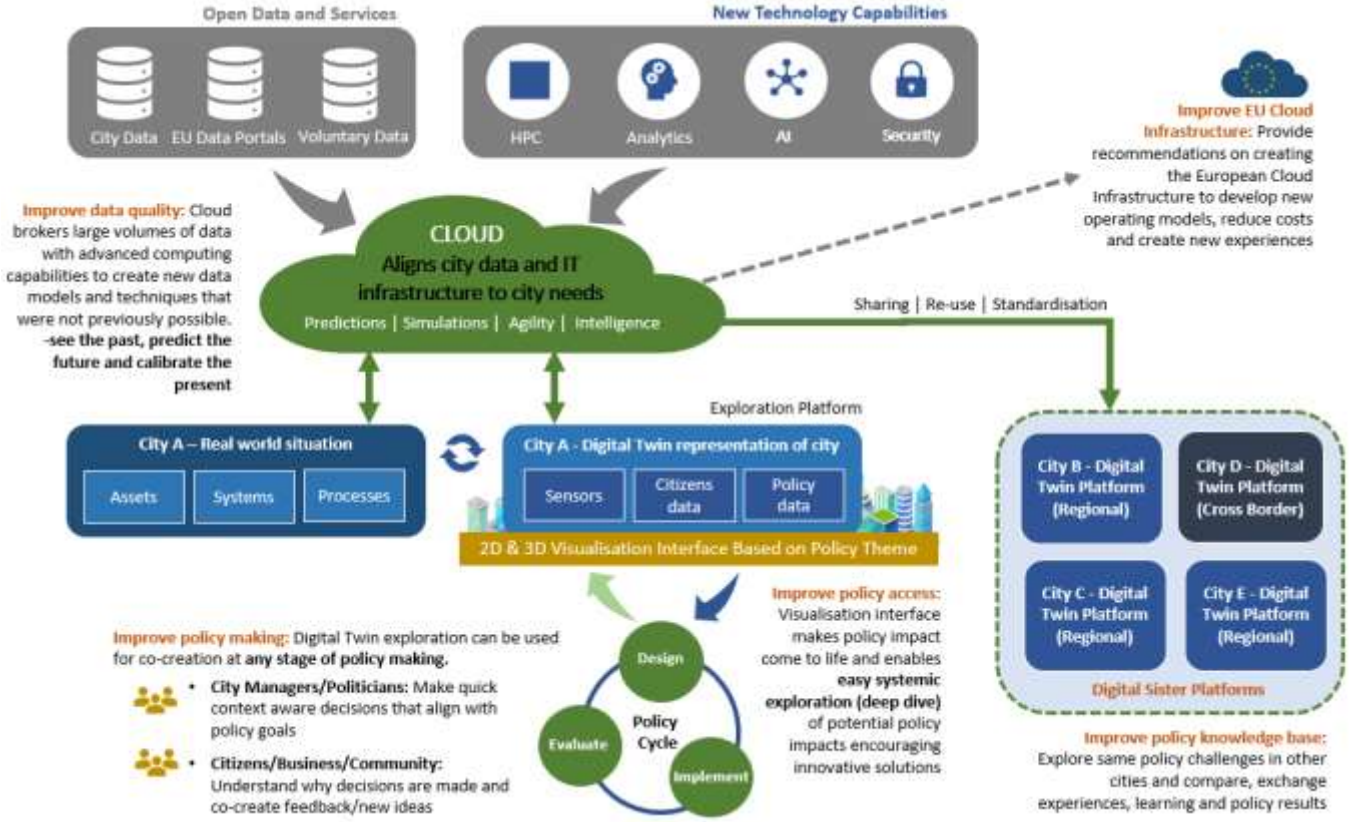


Figure 1: DUETS Digital Twin for Policy Making Concept

Embracing the Responsive City concept, DUETs Digital Twin infrastructure uses HPC, AI and other advanced analytics to utilise raw data and simulate policy impacts via its 3D and 2D interfaces. This enables users (e.g. policy makers, administrative workers, emergency services, charities, entrepreneurs, corporates and citizens) to explore the knock-on effects of decisions on other areas of the city and other sectors (e.g. planning, fire and public safety, transport, social care, waste management etc). These visual interfaces can be explored individually on a user's chosen device, or blown-up on life-size screens and used for immersive co-creation purposes which bring to life the tangible, systemic impacts of different policy options on the city experience. These fuel 'what if' experimentation that unleashes the creative and innovative qualities of all participants and brings a whole new dimension to stakeholder engagement and consultation.

Figure 2: Examples of 3D Interfaces from DUET Partner, virtualcitySYSTEMS

Disrupting Traditional Policy Making

Using a digital replica of a city for decision modelling transforms the traditional three stage policy making cycle (Design, Implementation, Evaluation) from the solid process wheel, into one of continuous policy experimentation and adaptation. Utilising a 'big-data for policy making framework' developed by an existing H2020 project called PoliVisu along with the Evidence Based Policy (EBP) concept (Shaxson[10]) DUET advances the state-of-the-art by amplifying the opportunities for collaboration and co-creation of solutions through an easy-to-understand, common baseline for exploration; and accelerates the speed of policy design through digital pilot modelling. Following the concept of evidence-based policy DUET augments the traditional process of policy making with more evidence-based approaches and injects transparency as a new policy value.

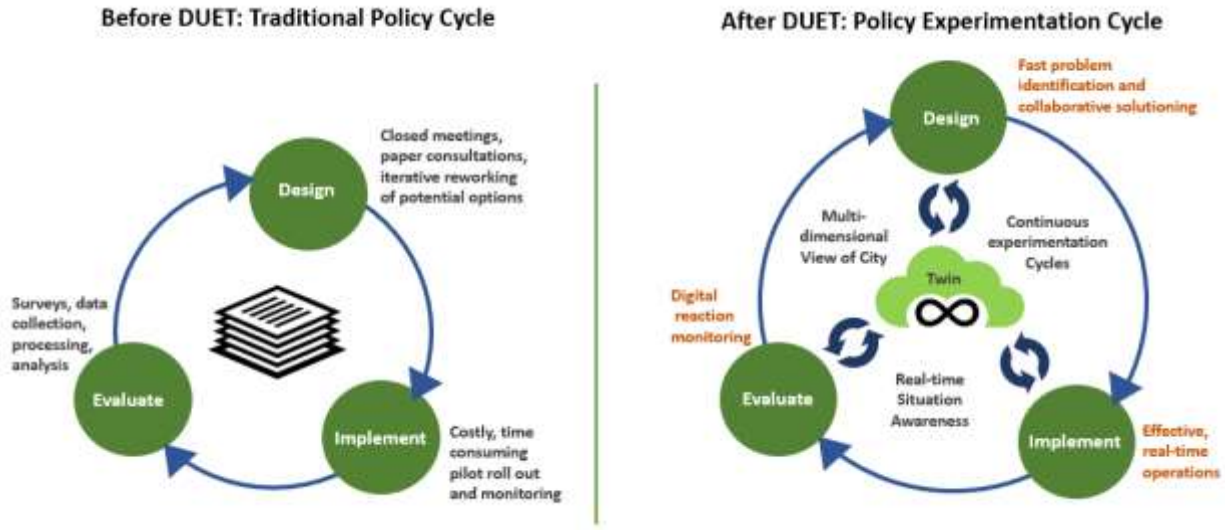


Figure 3: How DUET Evolves the Policy Making Cycle

Specifically, for each level DUET will:

- **Design Stage:** Integrate the available body of data into the Digital Twin and use to either help identify an issue or understand whether a belief/assumption/proposition is true or valid. Predict and explore systemic impact of different policy options and deliver more collaborative consultation events with stakeholders
- **Implementation Stage:** Use Digital Twins to tweak and adapt city operations based upon real-time data, and/or the addition of new directly or indirectly related policy.
- **Evaluation Stage:** Monitoring the real-time results of the actions, bring in new data such as sentiment analysis to understand people's feelings about the results, and assess effectiveness against identified policy objectives

[10] Shaxson L (2005) Is your evidence robust enough? Questions for policy makers and practitioners' Evidence and Policy: A Journal of Research, Debate and Practice, Vol. 1, No. 1, pp.101-111.

Not only will DUET help stakeholders across the board in a city to better understand and contribute to city-based policy making, the solution can also scale to cover regions, and/or enables different cities who have also adopted Digital Twins (referred to in this bid as Digital Sister Platforms) to exchange data models and scenario simulations to see if an innovative policy solution created in one city, would work in another. These findings can lead to more cohesive regional and national policies.

Features and Benefits

Specific features and capabilities of the DUET Digital Twins will be developed in design thinking innovation workshops with end-users. However, the architecture (see next section) has already been developed to include at a minimum the functions and benefits shown in the diagram below:

Figure 4: Key Features and Benefits of DUETs Digital Twins

Overall the DUET Digital Twin approach provides both an efficient city management tool and a clear, effective visual communication tool that will ensure ALL stakeholders are better informed about policy decisions, are able to easily have a constructive opinion on policy options and feel included in the democratic process.

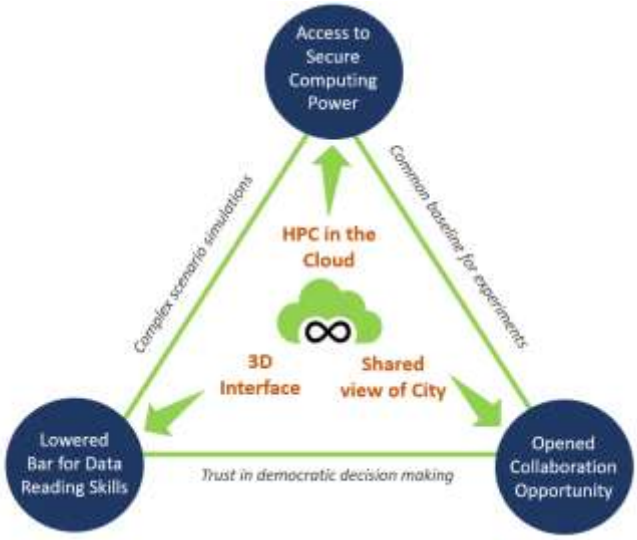


Figure 5: How DUET Address Core Challenges

1.3.4. Project Positioning and Technical Readiness

The DUET implementation phase involves a series of steps to develop, extend and customize existing technological assets in accordance with an agile development philosophy to constantly build and update a Digital Twin platform based on feedback received from the users. The objective is to develop a truly innovative system to support existing policy making processes which meet the requirements of the users in a cost-effective and time-efficient manner. Developments are interleaved with releases of mock-ups and prototypes to create a shared understanding of the functionalities of system modules and features that will be gradually released to coincide with the familiarisation process of the users of the different pilots. In total two major releases of the platform are envisaged for official deliverable purposes, however in reality these will cover multiple sprint development cycles.

Architecture: DUET will set up the necessary processes, infrastructures and tools based on existing best practices (e.g. BDVA[11]) adopted by its partners, with a view to optimizing the platform development, deployment, integration, testing and maintenance. The figure below presents a high-level architecture of the DUET platform.

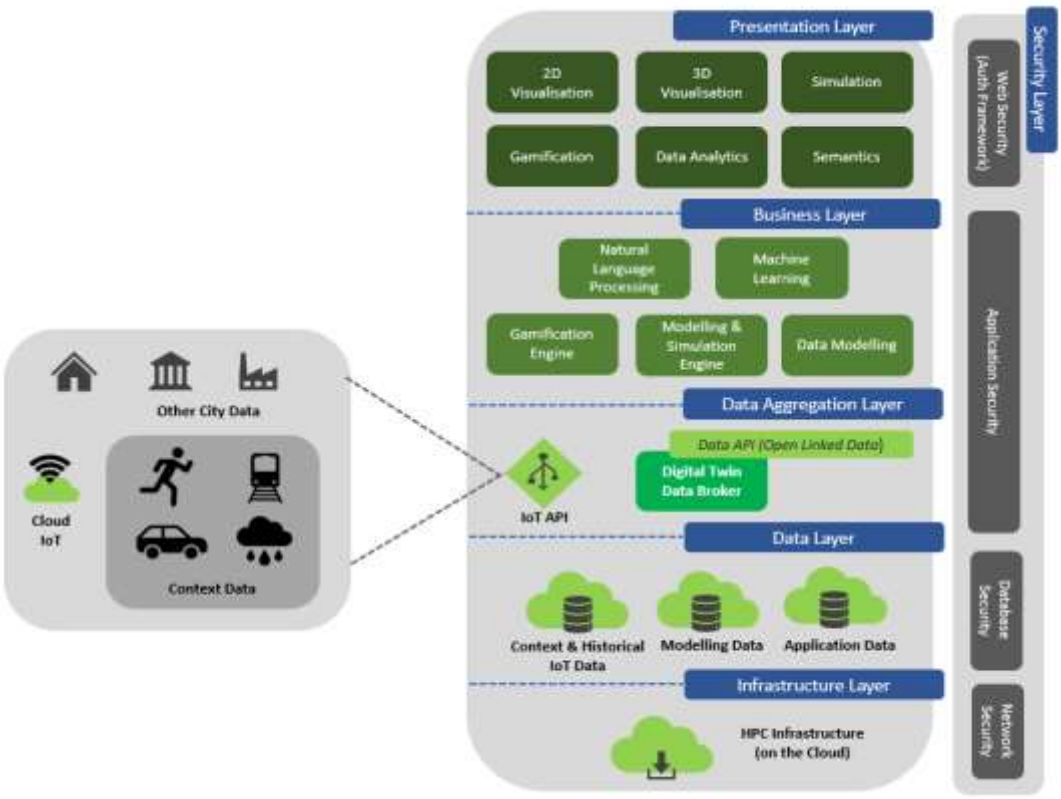


Figure 6: DUETS High Level Systems Architecture

The DUET Digital Twin platform encapsulates components for data analytics, visualisations, interaction design, and simulation. As depicted the DUET high-level architecture follows the layered architectural pattern where each layer corresponds to a particular level of abstraction. By following the layered pattern the separation of concerns is implicitly applied, thus no logic related to one layer's concern is placed in another layer, as well as the isolation concept, thus changes made in one layer does not impact components in another layer. Specifically:

1. The ***Infrastructure layer*** corresponds to a cloud-based infrastructure with support for the High Performance Computing (HPC) workloads of the platform. The platform will be designed to be agnostic of the backed cloud provider.
2. The ***Data Layer*** refers to the repositories/databases of the platform where each database is deployed in a distributed mode that spans multiple nodes in the cloud cluster for enhanced scalability, availability and performance.

[11] Big Data Value Reference Model: http://www.bdva.eu/sites/default/files/BDVA_SRIA_v4_Ed1.1.pdf

3. The Digital Twin Data Broker is in the heart of the ***Data Aggregation/Access layer*** that serves 2 purposes: it is responsible to not only aggregate data from the various external data sources but also to expose a unified data API for all open linked data in the repository. The IoT API component facilitates the ingestion of new data pipelines from sensors and other sources.
4. The ***Business layer*** corresponds to the processing components that implement the business requirements of the platform. All components in that layer will expose a REST API to be consumed by the visualization/UI components of:
5. The ***Presentation layer***, relying thus on a service-oriented architecture. This layer provides the interfaces between the systems and the user.
6. The ***Security layer*** is applied to the whole architecture as a crosscutting concept and it affects different aspects of the architecture (web, database, network etc).

The key architectural components and their readiness are highlighted in the table below. DUET will build its Digital Twins by looking at all the components and finding a way to link them in a process that realises the projects ambitious goals.

Component	Product Description/Purpose	Partner	TRL
Presentation Layer			
2D and 3D Visualisation	The 2D and 3D visualisations provide the user interface to the DUET Digital Twin for policy makers and their stakeholders. Components include: **VirtualcitySUITE**[12] comprising different software components: ● *virtualcityDATABASE* – A data storage and maintenance solution for CityGML-based 3D city models. ● *virtualcityWAREHOUSE* – A data distribution solution for extract/load/transformation processes that allows for extracting CityGML data from the virtualcityDATABASE into various industry GIS/CAD formats (e.g., ESRI mulitpatch, Sketchup, DWG, KML/COLLADA). ● *virtualcityPUBLISHER* – A publishing component for the web-based 3D visualization of CityGML- based 3D city models. All components use open standards for 3D visualisation and support advanced OGC CityGML models in a web browser environment. The suite allows combining WM(T)S services to link with standardised GIS layers to add additional data on the map. The solution has the potential as a map solution for an entire 2D and 3D digital twin and was already used for climate and energy visualisation in the city of Helsinki.	VCS	TRL9
	WebGLayer[13] is an open source JavaScript library focused on fast interactive visualization of big multidimensional spatial data through linked views. The technology provides interactive visual analytics that allows to identify patterns and risky areas from the large data (up to hundreds of thousands of features with several attributes) through heatmap, points or shapes on top of the map. WebGLayer is based on WebGL and uses GPU on the client device for high-speed rendering and filtering. The WebGLayer module provides components for advanced visualisations in the form of multiple linked views, filters through interactive graphs, parallel coordinates relationship analysis, map-screen extent filters, and area selection.	P4All	TRL9

12 https://www.virtualcitysystems.de/en/

13 http://webglayer.org/

Simulation	Simulations are predictions of policy impacts provided from the modelling and simulation engine in the Business Layer. In DUET the Air and Noise Pollution calculations will be driven by Traffic Volume on the road network. The Traffic Volumes are calculated using OD-matrices (Origin-Destination) describing 'Trips' going from A to B. With help of a global cost function, routes with lowest cost will be selected. Realtime data will be used to calibrate the OD-matrices, resulting in better prediction of the Traffic Volumes in the (near) future. For Air and Noise Pollution, emissions are calculated based on the Traffic Volume. Other (real time) data such as wind speed & wind direction will also be input for these environmental models. For an average city size 500.000 till 1.000.000 calculation points will be placed on the map for the area of interest. With DUET these calculations will benefit from the HPC cloud, because results will change based on the real time data feed. The results will be interpolated in real time producing bitmap (.png) tiles for display on 2D and 3D interfaces.	TNO	TRL7
Data Analytics	DUETs Big Data Analytics system will combine and analyze data from a variety of sources (databases, log files, web services, data streams, IoT networks). Some of the sources need to be processed in real-time, whereas for some other an ETL process is required. This process will bring all data into a common destination system and in a format suitable for further analysis. Big Data will be stored in special-purpose database systems that are able to store large amounts of data and can quickly and efficiently execute queries against them. Both proprietary (Redshift, Snowflake, BigQuery, Azure) and open source (Presto) solutions are available. For time-series data specialized tools (Prometheus) can be used in order to process the data and generate graphs, tables and alerts. Visualization tools, like Grafana, allow the creation of advanced and beautiful dashboards for analyzing and monitoring time-series data. In some domains the results of the analysis and selected visualizations need to be make publicly available. A policy maker would need to publish analysis results, tables and graphs in order to inform the public. In this case specialized development and custom tools are necessary.	ATC	TRL7
Semantics	DUET will leverage the OSLO[14] interoperability framework responsible to initiate and govern data standards applicable to the complete Flemish Government. OSLO provides in the tools, processes, guidelines and means to create and publish data standards. The OSLO standards are based on a strict interpretation of the ISA, Inspire and W3C/OGC standards All this happens in full transparency, accessible to all potential stakeholders. To further enhance the interoperability OSLO is almost entirely based on a Tim Berners Lee 5 stars Linked open Data approach. This approach is essential to ensure interoperability between cross border Digital Twins.	AIV	TRL8
Gamification	Gamification is the process of improving systems and people's experience using lessons, techniques and elements taken from games. Done well it increases engagement, motivation, retention and activity. In DUET gamification techniques will be explored like interactive voting and storytelling with the pilots to see if they can bolster participation of stakeholders in the policy design process. Selected approaches will be coded into the digital twin interface to be integrated in the 3D and 2D interfaces.	ATC	TRL3
Business Layer			
Natural Language Processing	A language detection module will be configured for a number of supported languages and a topics generator (based on LDA algorithm or its variants) that will take the number of topics as a parameter. More complicated machine learning techniques can be applied based on the output of these modules.	ATC	TRL7
Machine Learning	Social media content will be grouped into sentiment categories so policy makers can focus on certain factors (named entities) and assess their importance. For each detected entity, the positive and negative references will be available. The implementation will be based on a classifier that will use a feature vector to categorize the text. If sufficient training data is available, deep learning techniques could be also applied.	ATC	TRL7

14 https://joinup.ec.europa.eu/solution/oslo-open-standards-local-administrations-flanders

Gamification Engine	Coding based on co-creation e.g. voting mechanisms and storytelling with data. The storytelling component will guide users step by step through a data visualisation to get a better insight. A voting mechanism will allow users to compare different policy measures, options and strategies.	ATC	TRL7
Modelling & Simulation Engine	In order to connect (real-time) data to models and analytics a messaging framework (TNO IMB) is used to interconnect them on a 'publish/subscribe' basis. (Real-time) data is published to the framework using gateway modules. The gateway modules are able to connect to various data sources (IoT, CoT, etc.) and publish their data to the model connection framework (publishing). The models use the framework to acquire relevant data elements (subscribe) which trigger (re)calculation of the results	KUL	TRL4
Data Modelling	Initial modelling components include: ● **Traffic Modeller**[15] is an open source server-based solution for city and regional traffic modeling that allows city and transport planners to visualise traffic flow in near real time based on several parameters. The tool combining IT and GIS expertise can be fully implemented in a server environment with an application programming interface (API) for mobile and web applications. This creates an opportunity for a city or a region to test various traffic scenarios (e.g. road or lane closures, traffic accidents, planned roads) within seconds and without a need to install and learn how to use desktop traffic modelling software.	P4All	TRL5
Data Modelling	● **Urban Strategy Tile generator:** Environmental calculations mostly generate there results on top of the map. The Urban Strategy Tile generator is capable of (re)generating tiles at requested zoom levels for changing data. When environmental calculations are driven by real-time data, the changing results should be reflected on top of the map when available. The generator makes use of a multi-threaded, multi-core environment being able to process different data-layer in parallel. Results are standard .png images for easy inclusion in web based front ends. ● **MatlabTrafficToolbox**[16]This Matlab package provides access to open source library of codes to run and visualise dynamic traffic models. More specifically it presents tutorials and insights into the Link Transmission Model (LTM) a state-of-the-art dynamic network loading procedure and related dynamic equilibrium route assignment procedures.	TNO KUL	TRL7 TRL4
Data Aggregation/Access Layer			
Digital Twin Data Broker	The data broker is the heart of the digital twin. It aggregates data for modelling, simulation and visualization purposes and exposes a secure API for modules to use as they see fit. As the name suggests, the data broker itself does not contain any specific modelling, simulation or visualization logic. An authentication and authorization framework enables secure access to the data and facilitates collaboration through data sharing.	IMEC	TRL5
Data API	Facilitates and regulates access to different data sources. It's main purpose is to provide a unified way of working with different kinds of data. It shields the data from unauthorized access and presents the users with efficient ways of finding and retrieving the data.	IMEC	TRL5
IoT API	The IoT API is very important in ensuring that the system built is a Digital Twin and reflects the real-world and is not just a process of digitisation. Smart cities use numerous resources such as sensors, cameras, mobile devices, etc. to collect data, route them through gateways and networks and eventually story them in a database. The DUET architecture relies on the ability of these IoT stacks to deliver sensor data in an open format. DUET uses the Fiware open source platform and extended concepts because they use open standards and because they embrace the concept of linked open data in	IMEC	TRL9

[15] https://github.com/kolovsky/spark-traffic-modeler/wiki
[16] www.itscrealab.be

	order to deliver true open smart city platforms. The city of things competence center of IMEC has realized several IoT solutions for smart cities and digital twins. DUET will leverage some of the existing IoT solutions and new ones as well to collect smart city data. The IoT stacks will be designed to deliver the necessary data to DUET's data aggregator. **Senslog**[17] is a web-based sensor data management system suitable for static in-situ and mobile devices with live tracking ability. It enables reception of sensor data directly from sensor devices or indirectly from any front-end elements, storing sensor data in the SensLog data model implemented in RDBMS, pre-processing of data for easy querying and analysing, and publishing data through the system of web-services to other front-end elements or other applications. SensLog provides a system of web-services with the JSON encoding or provides standardised services using core methods of the OGC SOS version 1.0.0. The latest version of the REST API is following the CRUD schema. SensLog is available as a cloud solution, written in JAVA 8 with utilisation of the Spring framework.	P4All/ UWB	TRL9
Data Layer			
Context & Historical IoT Data	Sensor data typically comes in two forms. The historical data set is a large volume of data typically indexed according to time and geographical dimensions. The historical data is mainly used to train digital twin models and visualize the past. The context data contains values as currently measured by the different devices. The context data is used as input for simulations and to visualize the present.	IMEC	TRL9
Modelling Data	The modelling data contains all data related to models and interactions (incl the (1) Structured data; (2) Time series data; (3) Geospatial data; (4) Media, Image, Video and Audio data; (5) Text data, including Natural Language Processing data and Genomics representations; and (6) Graph data, Network/Web data and Metadata.). A number of existing data models will be integrated into the Digital Twin, these are described below this table. New data models will also be created based upon city/policy need.	TNO	TRL7
Application Data	Application data is needed to regulate access to and management of the digital twin data. This includes user data, user rights management, model management data, data catalog management (metadata catalogue), subscriptions to data sources, etc. This repository contains data related to the user management needs as well as data related to the role-based access control mechanisms of the platform. Moreover, it enables integration layer to store data related to the synchronization and integration needs of the various workflows of the platform.	ATC	TRL7
Infrastructure Layer			
HPC	The Flemish Supercomputer Centre (VSC) is a virtual centre making supercomputer infrastructure available for both the academic and industrial world. The KUL has premium access and reduced fees for the usage of HPC within European projects. VSC also has support in setting up and converting software for HPC usage.	KUL	TRL9
Cloud	DUET Digital Twin is cloud provider independent and agnostic to ensure re-usability but will be based on the DUET principles regarding ethics, security, functional and non-functional requirements (digital Twin Blueprint). One of the important needs will be the needless cooperation between the cloud-based solution and the use of HPC modelling.	IMEC	TRL4
Security Layer			
Web Application Database	The security layer is a collection of mechanisms that will enforce privacy-preserving security policies on all the platform layers. A major part of it will be the Access Control and Identity Management mechanism to retain authorized access across all components. Moreover, the use of AEGIS' Advanced Visualisation Toolkit will offer analysis and	AEG	TRL6

17 http://www.senslog.org/

Network	situational awareness to the end users of the platform, facilitating data process auditing and investigation of security alerts and actions that might result to data breaches or other security incidents.		

Starting Point: Existing Data Models

For DUET the importance of using open data models and adopt open standards cannot be underestimated. If the semantics of digital twin data is unclear, its usability becomes limited. One of the key aspects of a digital twin is the ability to combine different data sets in order to discover and monitor correlations. This can be better achieved if metadata is stored in a uniform and standard manner. The data aggregation layer accumulates data from different sources. Either by accessing them directly upon request or by storing it in a uniform way inside the digital twin broker. The latter can be done in several ways, for instance (a) by importing raw (historical) data, (b) by subscribing to external events and recording the data from these events. Event data can be stored as historical data or to update the state of the context. An overview of the existing models that DUET will initially integrate for environmental, health and mobility policy include the following. All the models rely heavily on the availability of GPU hardware and/or cloud infrastructure because of the compute intensive nature of the calculations.

- **Air quality model visualisation** (IMEC/TNO): The Air quality model will calculate the dispersion of air pollution caused by traffic for a grid of geospatial placed calculation points. The results will be converted to map images using interpolation or heatmap technology and placed on top of a map. Calculations are done for several compounds (NOx, PM10, PM2.5, EC, etc.), based on weather information (wind direction, wind speed) and spatial conditions (street canyons, shielding, etc.).
- **Noise model visualisation** (IMEC/TNO, P4All): The Noise model will calculate the propagation of sound caused by traffic for a grid of geospatial placed calculation points. Given the distribution of type of vehicles, noise levels per road link are calculated in an eight band frequency spectrum. The results will be converted to map images using interpolation or heatmap technology and placed on top of a map. Calculations are done for noise levels in an eight band frequency spectrum.
- **Traffic model visualization** (IMEC,TNO, P4All): The Traffic model uses OD-matrices (origin, destination matrices) to assign executed trips to routes in the road network. The Traffic model assigns amount of vehicles on roads using a 'route cost function' to determine the route having the lowest cost. Information from real-time traffic counts will be used to calibrate the traffic model predictions.Visualization on the map is done by drawing colored bands beside the road. The width of the band is modulated by the amount of vehicles, the color of the bands can have various meanings. By calculating the ratio between intensity and capacity, the color can represent the change for congestion

Data Sources for New Models

In addition to working with existing data models DUET and its Data Broker will create new models based on pilot needs. To do this the system needs context data associated to a certain location and a point in time. Examples include data coming from sensors such as traffic intensity, air quality, etc. But non-sensor data can also be collected, such as manually recorded events by police (traffic violations, accidents, etc.) can be recorded. Every time the context is updated, a snapshot of the data can be stored in the historical data, leaving a historical trace of data (time series). Other relevant data includes planned road closings, social events, company locations, public transportation schedules and anything else that may be useful for modelling, simulation or visualization may be included into the data broker. It is important to categorize and standardize such metadata. Specific datasets to be used by the pilots will be outlined in the pilot descriptions.

1.3.5. Assumptions

DUET will operate under the following assumptions:

- DUET operates per the principles of Open Government - transparency and accountability
- DUET uses open source components wherever possible
- DUET focuses on the experimental dimensions of policies
- DUET approach will be tested with data already available in the pilot cities and the consortium
- DUET is open to participation/adoption from stakeholders across Europe and beyond
- DUET will contribute results to broader network discussions around open policy making standards
- DUET partners are fully committed to delivering deliverables and achieving the goals of the project and will all sign a consortium agreement

1.2.6. Interdisciplinary Considerations

Tools: The potential for interdisciplinary working with DUET tools are unprecedented. Mobility, health and environment intersect and their impacts crossover many different domains, so data between domains can be combined usefully (if it has a geolocation component) for intelligence extraction. For example, DUET could map pollution data, such as CO2 measurements, against road use, and with public health data, such as location of cancer-related deaths, and census data. Such integration of data in a 3D Digital Twin format, could help facilitate advanced research to uncover specifically where and when in a city pollution is causing specific health effects and in what demographic of population. The 3D interface helps determine factors that cannot be seen on a traditional 2D map, thereby unlocking new insights and ideas for mitigation.

People: DUET provides an easy to understand common interface/shared real-time baseline for policy modelling with people from different sectors and backgrounds. This 360-degree view of a city and its issues helps with cross-sector and cross-interest discussions and solutioning to come up with solutions that are at a maximum, mutually beneficial, and at a minimum, at least understood, by all.

Ethics and Standards: In addition, the ethical, legal and technical standards for sharing and processing 'policy ready data' using Cloud and HPC technology will be useful for many other domains.

1.2.7. Use of Stakeholder Knowledge

DUET is specifically designed to utilise stakeholder knowledge and volunteered data by creating a more collaborative policy making process. By harnessing advanced analytics, Cloud and immersive 3D visualisation technologies, DUET begins to close data gaps that have long impeded effective policy making. As problems are illuminated, policy-making can become more targeted, with attention appropriately and efficiently directed; more tailored, so that responses fit divergent needs; more nimble, able to adjust quickly to changing circumstances; and more experimental, with real-time testing of how problems respond to different strategies. Building such a data-driven government will require sustained leadership and investment, but it is now within our reach.

1.2.8. National and International Research and Innovation Activities

The need for DUET's approach came from direct discussion with cities and an analysis of existing projects, research and literature. It is widely accepted that the use of ICT for decision making can help resolve collective problems in a participatory and cost-effective manner. In the work of Berkhout and Hertin (2004) individuals used websites to calculate personal carbon emissions Later, Kaschesky et al. (2011) later reflected on the requirements for opinion mining in social media and the blogosphere, and Rodríguez et al. (2007) established their own social software system for collective decision-making – the *Smartocracy* model (see also Evangelopoulos & Visinescu, 2012).

With regards to data, over the last seven years much of the research that scrutinizes methodologies for online data-based policy-making is based on the future-oriented technology analysis work by Haegeman et al. (2010) who reviewed methods for policy and decision-making that best suited the data-based co-creation paradigm of governance. The Importance of Visualisation to enrich the use of Open Data is advocated by Graves & Hendler (2013), whose own works includes survey data supporting this hypothesis.

More recently several contributions evolved from a holistic analysis of the three branched nature of IT-enabled policy analysis. From that angle, Puron-Cid et al. (2012) scrutinized the policy-cycle from an integrative view in which data, app interfaces and governance structures are captured in a single framework.

Beside the necessity of Data-Driven Policy Making initiatives based on visualising open and big data, standard-based initiatives were taken to bring vast amounts of data to the users without the need of possessing all the data. The open science cloud is an interesting example of how cloud data can be used in science processes via advanced search and retrieval mechanisms. The same approach can be applicable to decision-making models in a scalable urban digital Twin as part of the European data cloud concept where scientific and policy data comes closer together and are using the same techniques.

Initiative	Objective/Principles	Relevance to DUET
Data Driven Policy Making		
PoliVisu	PoliVisu enhances public involvement and support in urban policy making, by equipping decision makers with the skills and tools to use big data for collaborative policy making.	DUET will leverage the evidence-based Policy Making model from PoliVisu as a starting point for policy co-creation and citizen involvement in the entire policy making cycle. DUET will also contribute case studies to PoliVisu's open repository of data driven policy stories.
Big Policy Canvass	Big Policy Canvas fosters collaboration amongst relevant stakeholders towards building a more effective, efficient, precise and evidence-based public sector	DUET will leverage BPC's findings to date on barriers and policy making practices using data and include them in building user requirements. DUET will also contribute tools to the Big Policy Canvass roadmap and toolbox.
Policy Lab	Brings together a community to explore the use of new digital tools such as the advanced analytics of large unstructured data, and adopting rapid prototyping and iterative development in policy.	Aligns with DUET s practical experimentation approach to policy. DUET will feed results into the Policy Lab to ensure findings are widely disseminated and will stimulate debate with other Policy Lab members to improve the DUET offerings
Data4policy.eu	A study of big data and other innovative data-driven approaches for evidence-informed policy making.	The project finished in 2016 but provides useful research, policy models and case studies to support DUETs design thinking approach to solutioning.
Symphony	SYMPHONY developed a framework of designing and testing policies & regulatory measures	DUET will use the visualisation and data presentation techniques for policy making. Social Media analytics components can be also used in the context of DUET
City of Things	Developed a digital twin for Antwerp with real time data of traffic, air quality and noise to simulate events and the impact on those parameters	DUET will build upon the knowledge and lessons gained during that project and advance Digital Twin use with an innovative Policy-Ready-Data-as-a-Service approach for other cities. And will create and use new data models.
Urban Strategy	An interactive, integral tool for spatial planning to help decision makers of the (smart) city. Areas covered, Traffic analysis, Air pollution, Noise pollution, Safety, Energy, Solar Potential, Heat.	Urban Strategy uses state-of-the-art distributed, cloud and HPC technology to speed up model calculations and cross domain interconnection. DUET will be able to use TNO's experience in the field of Smart Cities and Digital Twin solutions.
European Cloud Use		
European Data Initiative (EUDAT)	Federation of a pan-European data infrastructure featuring a cross-disciplinary suite of research data and management services.	DUET will help raise awareness of the EUDAT and its activities and will feed in underpinning recommendations that will help bolster, support and realise the European Cloud initiative.
European Cloud Initiative (ECI)	Entails plans for a European Open Science Cloud supported by the EUDAT and represents a vision to ultimately strengthen the EU's competitiveness in digital technologies and in innovation and to enable users and society at large to reap the benefits of data driven science.	DUET will leverage lessons and principles and align its vision with the European Cloud Initiative. It contributes a new business model and approach for Government to easily access Policy Ready Data-as-a-Service through Digital Twin use which will improve the speed and effectiveness of policy making, enabling wider collaboration and understanding of decisions.
Helix-Nebula Science Cloud	The Helix Nebula Initiative is a partnership between industry, space and science to establish a dynamic ecosystem, benefiting from open cloud services for the seamless integration of science into a business environment.	The Helix PCP project has come to a close and is publishing results and lessons learned about how it has built an ecosystem of use around its open cloud. DUET will take and build on these lessons in its own practices in the policy realm thereby helping to advance the first results from the ECI.

Private **Sector Services Using Cloud platforms**	These include Initiatives like WAZE which are cloud platforms with community input.	Explore business models, data use, and extrapolate principles and take the lessons learned into DUET design and sustainability.
Open/ Big Data		
European Open Data Portal	(EU ODP) gives access to open data published by EU institutions and bodies, free to use and reuse for commercial or non-commercial purposes.	DUET will leverage data for the EU ODP and use its Digital Twins to integrate it with other data and make it more useful creating Policy-Ready-Data-as-as-Service for city decision making.
INSPIRE	INSPIRE works to create a European Union spatial data infrastructure to share environmental spatial information among public sector organizations and better facilitate public access across Europe	DUET will use INSPIRE standards with its geospatial visualisations helping spread use and knowledge of these standards across Europe to help promote interoperability between countries spatial data infrastructures. Will help advance standards through addition of sensor networks.
European Sensor Systems Cluster	The main objective is to avoid defragmentation and to promote synergies with industrial leadership and European cooperation in the field of research and innovation of sensor-systems applications.	DUET will consider ESSC standards when looking at data ethics and contribute project findings/city needs to its workstreams on environmental sensors (air quality) and integration, business modelling and commercialisation streams.
GISCO	Produce maps, spatial analysis. Promote geo-referencing of statistics. Provide user support for Commission users of GIS	DUET will support the work of the Commissions group by promoting GIS and data dissemination in the EU.
Open Geospatial Consortium (OGC)	Standards body developing publicly available interface standards for geospatial data use across the globe.	DUET will advance the research of an existing working group working towards harmonization of spatial information across the EU and will steer the Metadata and Catalogue DWG. Use and cooperation to the further development of services as WCS, SOS.
Synchronicity	Consortium of smart cities who have adopted interoperability technologies to integrate reference zones in Europe in order to share data, services and solutions.	DUET will build taking into account existing interoperability mechanisms that have been adopted by cities globally to ensure replicability of the solution across cities.
Big Data Value Association	The mission of the BDVA is to develop the Innovation Ecosystem that will enable the data and AI-driven digital transformation in Europe delivering maximum economic and societal benefit, and, achieving and sustaining Europe's leadership on Big Data Value creation and Artificial Intelligence.	DUET will build on the BDVA reference model for big data technologies as meta model of the DUET architecture, interoperable also with the ISO JTC1 WG9 Big Data Reference Architecture standard. DUET will collaborate with other flagship projects and initiatives under the umbrella of the BDVA.

DUET will also support the goals and priorities of national governments in each of the countries where pilot sites are to be deployed. The following table summarises the impact of DUET on national policies, programmes and initiatives that help encourage the adoption of cloud-based data practices:

Initiative	Objective/Principles	Relevance to DUET
Flanders Region, Belgium		

Smart Flanders programme	Focuses on real-time open data and shared standards. It seeks to stimulate the collaboration between cities and other actors such as research and private organisations.	Provides the necessary scale for testing the creation of DUETs Digital Twin solution. Helps roll out products that rely on standards and semantics; Promotes smart use of smart city-related datasets in Flanders and the major Flemish cities network for dissemination.
The Flanders Crossroadbank	The core modular digital platform fulfils three essential functions: 1) Making data easily accessible in the form that best suits everyone's needs by using standard API's; 2) Ensuring data quality (OSLO, Inspire;) 3) Ensuring data integrity (inc. personal data)	Using standardised and easily accessible API's that connects data stored in a cloud environment qualitatively and safely. Making data easily accessible while ensuring data integrity. The Crossroadbank is a vital link between the stored data and the use of the data for representation in a digital Twin.
OSLO - Open Standards for Linked Organisations	OSLO is the interoperability program of Flanders. Its mission is to establish data and technical standards to smoothen the information flows within the government, but also with its external partners.	Sharing the OSLO process, tools and experiences on creating data models. Provide ability to initiate immediate impact on actual data streams in Flanders Testing the OSLO principles as a concept for an Interoperable European Public Data cloud.
Athens City, Greece		
Athens Digital Transformation Strategy	Creation of digital Athens operating in three levels: internally within the public administration of the Municipality, externally through city-services, and in a wider scope of a smart city through initiatives deriving from cooperation and synergies mobilizing the complete ecosystem of the City of Athens.	Use DUET to help ensure city data is dynamically updated, open, robust and usable. Merge all the city's digital sources. Enhance citizen engagement and capacity building in collaboration and co-creation. And advance the city's objectives in the field of entrepreneurship by creating open pools of data accessible by citizens initiatives.
Athens Resilience Strategy	Creation of an Open City, a green city, a proactive city, a vibrant city. The pillar referring to the open city, focuses on an effective and efficient governance by fostering data driven policy making and accountability.	Help be accountable, to win back the trust of citizens. The city is in the process of becoming more open and transparent through opening channels of communication, its data and its procedures and within DUET new paths will be created to advance this dimension.
Pilsen, Czech Republic		
Regional Development Strategy of the Czech Republic	Strategic framework for regional development aligned with the Strategic Framework Czech Republic 2030.	Pilsen is one of the 8 areas included in this strategy. The strategy includes urban policy development framework aiming at human-centred, transparent, knowledge and skill-based policy making mechanisms, which should be a foundation to DUET.
Smart City Pilsen	Pilsen is developing a strategy for adopting the Smart City concept involving citizens and businesses	DUET helps advance availability of vast quantities of open data driving innovations related to mobility, business and environment
GeoInfoStrategy	Strategy for Development of Infrastructure for Spatial Information in the Czech Republic to 2020. A framework for creating an interoperable national spatial data infrastructure across different sectors and policy domains.	Data and services coming from different data and service providers need to be harmonised and made interoperable, including rights, restrictions and responsibilities (RRR) to land and properties. This is crucial for DUET and its innovations built on such data and services.

1.3. Methodology

1.3.1. General Approach

The DUET approach is broken down into three continuous, interactive workstreams: A) Design, B) Innovation and C) Validation. The processes within and the outputs of each stream will be **governed by a panel of eminent experts in the fields of cloud computing, data sharing and policy making/modelling**. These experts not only provide academic rigor and scrutiny to the approach of DUET, they also act as a sounding board and a dissemination channel who can help steer the project to success. The key techniques to be used are as described in this section. A further breakdown into logical chunks of work for delivery is provided in the work plan.

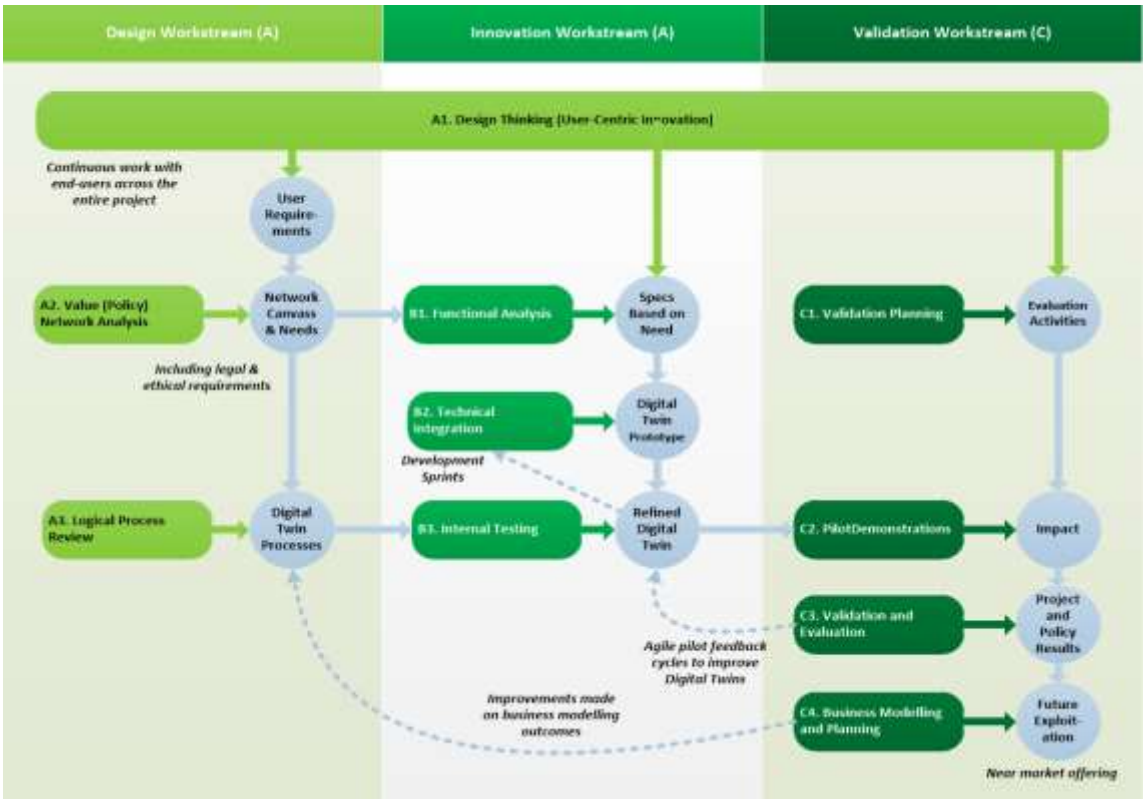


Figure X: High Level Overview of the DUET Methodology

A) Design Stream

A1. Design Thinking: DUET adopts Design Thinking, an interactive design methodology that provides a solution-based approach to solving problems and uses it to design the Digital Twin solution (both software and processes). This methodology is particularly useful for ensuring the innovative new product is fit-for-purpose as it frames the challenge in a human-centric way, and enables it to be explored through brainstorming, hands-on prototyping and testing. The stages of delivery include (1) Empathise, (2) Define, (3) Ideate, (4) Prototype and (5) Test. Whilst these steps are not necessarily linear, for methodology planning they have been broken down to input into the different workstreams.

1) Empathise: The first step involves ensuring the whole DUET Consortium has an empathetic understanding of the end-users and the problems they face in policy making. Empathy is crucial to a human-centered design process and will allow the developers to set aside their own assumptions about the world and gain insight into user's real challenges and needs. The whole Consortium will be invited to meet policy makers and city managers (as these are the users who will be expected to adopt the solution) in at least one of the pilot sites and through an interactive session start to understand their daily processes, what works well for them, what doesn't, barriers they face etc. This will include a first review of the specific policy challenges/scenarios that will be tackled by the DUET solution.

2) Define: The policy-making problems identified at the first stage are analysed and a core problem statement for DUET is defined. Then in collaborative workshops in each pilot site DUETs designers and product owner

ideas are stimulated around how the Digital Twin will work to enhance policy making, using the identified policy scenarios, to come up with ideas for features, functions, and other elements.

3) Ideate: Involves working with end-users and the Consortium to undertake a range of brainstorming type activities to unleash creativity and start to think outside the box as to how the proposed features could work together

4) Prototype: Help prototype the processes, flows between features, and the look, feel, usability of the Digital Twin interfaces. Use journey maps to explore touch points between users and the Twins and wireframes to mock-up user experiences.

4) Test: Trial the new developments at the end of each sprint cycle and validate the prototypes in both closed and real-world settings, provide feedback through diaries, surveys, shadowing, user groups, interviews etc.

Please note the design thinking approach will also be leveraged in the co-creation activities with stakeholders using the Digital Twins around the specific policies being explored.

Outputs - *End-User requirements for the Digital Twins which meet the needs of the end-users (e.g. future adopters of the solution), along with policy scenario drafts. Prototype ideas for the innovation workstream and testing for the Validation stream.*

A2. Value Network Analysis: Complementing the Design Thinking process will be a simultaneous Value Network Analysis (from herein known as the Policy Network Analysis) exploring the links between individuals, governments, policy communities and other non-government actors in the existing policy making lifecycle of each pilot city and the information flow between them. It enables DUET s designers to illustrate the functioning of complex systems, identify any problems with information flows, and begin to map the processes into both an information flow map, and a technical architecture for each Digital Twin.

This network analysis will help not only identify flows of info, but also obstacles in the current methods of policy making, and the most important actors influencing government decision-making. Using different techniques (e.g. interviews, focus groups), project partners will be able to "paint" a Policy Network Canvas for each pilot city, showing on it the main stakeholders, relationships between them and points where bottlenecks tend to occur most frequently. This will help inform the user requirements which impact the technical design and subsequent business modelling activities. The techniques DUET will use to paint the canvas and assess DUET's impact on stakeholder interaction and assess the bottlenecks within it include Expert Interviews and Focus Groups.

Expert Interviews: Expert Interviews will be performed with selected end-users from the pilot sites in every major phase of the project (policy design, implementation and evaluation). Input from the first round of interviews will be used to draw up a Policy Network Canvas for every pilot city, while subsequent rounds will serve as a means to update the canvas with any new information and to assess DUET's role in reducing existing bottlenecks in the relevant policy networks that may be impeding important policy reforms. Owing to the multi-actor nature of the phenomenon to be investigated, interviews will focus not only on policy makers and city managers, but also on non-governmental actors such as private companies and research bodies working with city data so all elements relating to ethical and legal considerations are also captured.

Collaboration Focus Groups: DUET will leverage the Design Thinking workshops detailed above to also gather information that will help "paint" and update the Policy Network Canvas and then to update its content and assess DUETs role in overcoming challenges in using data for policy making. Steps that will be used in Expert Lens Interviews as regards participant identification, research ethics, data transcription and coding will also be used to organise, run and manage focus groups.

Outputs *– Policy Network Canvas depicting (a) key stakeholders that affect data driven policymaking, (b) relationships between them and (c) points where challenges occur. Used to refine the User Requirements document (including legal and ethical issues) ready for translation into functional requirements and input into business modelling work.*

A3. Logic Modelling: A Logical Process Review will take the outcomes from the Policy Network Analysis steps to ensure the Digital Twin delivers solutions for the identified barriers to help facilitate data-driven decision making.

Logic models provide graphic representations of the essential elements of a programme or process, in terms of inputs, activities, outputs and outcomes. They encourage systematic thinking about a project, external influences

impacting on it and its underlying assumptions, and make them explicit. Logic modelling is useful in emphasizing causality and gaps between components of a programme. Similarly, to the Theory of Change (ToC), a logic model provides a strategic picture of the resources and interventions required to produce outcomes (short- medium- or long-term) needed to reach an ultimate goal. A logic model-cum-ToC will be used by each pilot to address a specific policy challenge (ultimate goal) using different data, tools, financial and human resources as well as networks of partners sharing the same cause. A standard logic model for a pilot city will look as follows

Inputs	Activities	Outputs	Outcomes: Short to Long term
• Financial Management (e.g. municipality, public authority) • Experts (e.g. GIS, ICT) • Data (e.g. crowdsourced, open) • Technologies (e.g. HPC, AI, NLP etc.) • Collaborative action (e.g. MoU) • Current standards	• Expert Lens Interviews • Focus Groups • Co-creation / design thinking workshops • Functional analysis • Systems integration • Testing • Validation	• 3D Interface • Interactive simulations • Apps (mobile) • Apps (web-based) • Predictive analytics (e.g. algorithm) • Legal and ethical principles and recommendations	• Efficient coordination of operations in the city • Better use of advanced technologies in city management • Better integration of transport, environment and land use policy planning • Better public services and facilities • Recommendations for European Cloud Infra

Process mapping is a workflow diagram that is used to bring forth a clearer understanding of a process or series of parallel processes. The drafting of the process map relies on an iterative process of drafting and revising, using a combination of methods to gather the relevant evidence. Document reviews can be used to reach a preliminary understanding of the science and technology assessment process, supplemented by key informant interviews to get access to further documentation and to validate the initial findings. Process maps can often lend themselves to being used to identify the capacity (that is, the availability of relevant skills and resources) needed to deliver the intended outcomes and to manage the risks incurred.

Outputs *– A Digital Twin framework for policy making based on user needs. The framework is expected to include guidance on how to utilise existing city data into a decision-making process. while avoiding external and internal bottlenecks. Another output includes a logic flow diagram for every pilot outlining detailed, realistic and measurable inputs, activities, outputs and outcomes.*

B) Innovation Stream

The innovation stream includes all the adaptation and integration work to create the cloud enabled DUET Digital Twin with its advanced predictive analytics and visualisation tools that policymakers can use to influence policy decisions in the short and medium term. Key activities and models include:

B1. Functional Analysis: Based on the requirements derived from the policy network analysis and end user requirements, along with the prototyping results, a functional analysis will be performed to describe what software and information will be used for creating the Digital Twin, including cloud spec, which data models are required to generate needed information and how will it be visualised (2D/3D etc.). Basically, it transfers the soft requirements into technical ones that can be used to create a solution architecture. The analysis consists of two parts. One part describes the set up and architecture for a generic, reusable Digital Twin and the second part describes how the Twin is populated and personalised with collected city data and how it will be integrated in existing processes and ICT systems within the pilots.

Outputs *– Functional Requirements Specification and Technical Architecture for DUETs Digital Twins*

B2. Technical Integration: Starting from the functional requirements specification (B1), the overall architecture and technical requirements will be distilled and the gaps with the existing tools and solutions will be documented. Next, the technical partners will devise concrete plans to create, extend, adapt and enhance the necessary components required to meet the business challenges formulated by the pilot cities. The actual implementation of required adaptations will follow an agile approach where incremental software capabilities are delivered in consecutive iterations called sprints. At the end of each development sprint the results of previous deliverables will be validated in close cooperation with the pilot cities (system users). Feedback and new insights will be considered

to ensure a maximum alignment between the Digital Twin policy experimentation approach, the pilot requirements and experience and the technical implementation plans. The component integration will focus on how we will integrate the functional components to support the policy process. With integration DUET will focus on a smooth data exchange between components. Focus on replicability will be strong with the ambitious aim of creating a system where any city can set-up a basic Digital Twin at the touch of a button, then customise it with own data models, desired interface etc.

Outputs *– Digital Twin Prototype with populated versions for each pilot city/region*

B3. Testing: Initial testing will contain a combination of dynamic testing, during the development process of individual components and static testing by reviewing the result based on the requirements and functionalities. The dynamic testing will be done by the pilot partners and the partner responsible for the functional analysis. Once the Digital Twin reaches a beta level that the pilot cities are happy with they will be released into the Validation workstream for agile user testing via a living lab methodology organized by the pilots in cooperation with OASC and the technical coordinator ATC.

Outputs *– Three city Digital Twins ready for validation in a real-world setting*

C) Validation Stream

The validation stream contains a set of techniques relevant to demonstrating and refining DUETs Digital Twin solution and process and ensuring its future sustainability. In order to maximise the effectiveness of these outputs, it is important that project partners use consistent assessment and validation methods throughout the project. A formal assessment of DUET's technical and non-technical components is therefore needed to ensure that they meet performance specifications and have the same impact as desired by end users.

C1. Validation Planning: DUET validation activities will be performed in accordance with the Validation Plan, a draft version of which will be created in the early months of the project and updated with inputs from the design and innovation streams as soon as they become available. The plan will guide project partners through the subsequent stages of design and innovation and will provide descriptions / definitions of the following: DUETs solution architecture, expected outcomes, assessment objectives, user groups to be involved in validation and methods of validation, among others.

Design Stream	Innovation Stream	Validation Stream
• Policy network actors • Bottlenecks impeding Data driven decision making • Pilot inputs, activities, outputs and expected outcomes as depicted in a logic model • Other	• Policy data visualisation requirements as described in the functional analysis • Technical tools to be integrated and used by pilots • Other	• Definition of DUET architecture • DUETs expected outcomes • Success indicators (KPIs) • Assessment objectives • User groups for validation • Methods of validation • Other

A key focal point of validation activities will be impact, and policy changes brought about by DUETs work and outputs. Expected impacts are of crucial importance because how precisely (or imprecisely) they are described will affect the design and accuracy of validation methods, which in turn will affect the degree of project's success. Equally, it is important to define precisely the different groups of users that are likely to be affected by DUET**.** Are these people connected to the project or are they completely independent of it? Do the users have similar or different skills, backgrounds, data literacy levels and visualisation needs? These are just some distinctions that must be kept in mind because impacts may differ from one group to another in both type and scale, and because any perceptions of benefits (or lack thereof) are also likely to vary between groups.

Output *– Validation plan to guide user acceptance testing and refine the solution*

C2. Pilot Demonstrations: The European Commission defines demonstration as a "stage of validation [which] will use a sufficiently large sample of users in a real-life situation to provide information on cost-effectiveness, user friendliness and similar issues, as well as testing the feasibility of the system when used on a large scale[18]." With this in mind, DUET has defined its demonstration stages as a series of cycles concentrated on testing the

[18] *European Commission - DG XIII (1994b). Telematics Applications Programme (1994 - 1998)*

functioning, accuracy and effectiveness of technical and non-technical outputs with different user groups e.g. people with different skills, backgrounds and needs, people that are in one way or another associated with the project and people outside the consortium circle who are new to it. Validation methods that will be used at demonstration stages will vary depending on output type. Qualitative outputs like the Policy Network Canvas will be validated during new focus groups and interview rounds with external experts. By contrast, technical outputs of the Digital Twin components will be tested during scenario-based activities in which both external users and people close to the project will be involved, although not always at the same time.

The DUET pilots, with the support of WP2 team, will use the different scenarios identified in A1 to begin testing the technical outputs of the project in conjunction with the development sprints, first in a closed in-house cycle where it is easier to shadow users and collect valuable feedback, and then with external users in an open phase. The citizen and business stakeholders for the latter will be recruited using online and offline communication channels in a manner that attracts people with an interest in the policy issue being modelled, (inter-disciplinary knowledge will be a target) and participants may be offered an incentive (e.g. Amazon vouchers) as a token of appreciation for their time and effort. In developing policy scenarios/simulations using the Digital Twins, project partners will utilise the results of work carried out in previous streams (design and innovation) and may supplement any gaps with new information collected through additional activities. The aim of this task is to ensure the front end of the Digital Twin for use by each pilot during hands-on testing sessions, and the policy models/predictive scenarios themselves being explored are designed to be easy to read and will stimulate testers' thought processes during the validation activities.

Output *– Hands on co-creation sessions with users in closed user groups and an open user group that will assess the effectiveness of DUETs Digital Twins and feed back into continuous cycles of improvement*

C3: Validation: An indicator is the main criteria of quantitative or qualitative assessment. It is a parameter indicating the performance or impacts of technical and non-technical outputs. Quantitative assessment is often referred to as 'hard' because it relies on a physical measurement to evaluate the results. Use of indicators for qualitative assessment is more problematic because measurement is replaced by personal judgement. This may mean that qualitative assessment is more applicable to measuring user perception (of the effectiveness of DUETs Digital Twin tools) than carrying out impact analysis.

Methods of quantitative assessment often include questionnaire surveys while qualitative ones tend to include interviews, focus groups, expert opinions and other less structured way of obtaining information. In using qualitative assessment, it is desirable to be transparent in explaining how the validation results were obtained - for example, who was consulted and how – because of the less structured nature of the approach. A greater degree of doubt must also accompany any assessment of validation results by qualitative assessment for the same reason. A precise definition of indicators for testing physical functioning of DUET Digital Twins and user perceptions / acceptance will probably have to await the completion of a functional requirements phase, in which case any indicators defined not precisely enough in the draft validation plan will have to be defined precisely in a revised version later on.

The performance and impacts of interventions are usually compared against past or existing practices in order to show their added value. Thus 'Before and After' studies are a useful way of showing progress, assessing user perceptions and measuring the impact of a solution. Such evaluations, however, require reference cases that can vary with category of assessment objectives and may be required for individual indicators or be the same across a group of indicators or assessment objectives.

Equally important to the evaluation process is the definition of success, which defines expectations of performance and impacts of the evaluated solution. The success or failure of validation results are tested against the defined criteria and it is therefore vital to have it specified in the validation methodology. All the foregoing considerations – definition of indicators, definition of success, reference cases, methods of quantitative and qualitative assessment and occasions on which both will be used – will be presented in the draft version of validation plan. The draft itself will be continuously updated until the final version is released following the completion of functional requirements phase.

Output *– User accepted, viable, near-market solution*

C4. Business Modelling: The outcomes of the validation activities, including the impact on the Policy Network Analysis will inform a process of business modelling looking at new ways of making access to the cloud-based Digital Twin capabilities sustainable beyond the context of the project. To achieve this, a business model matrix is used to highlight key points of attention when considering the sustainability of such a complex network. Additionally, this matrix includes parameters that come into play when a public entity contributes value to the business model. The matrix is represented in the figure below.

Business design parameters	Value Network	Technical Architecture	Financial Architecture	Value Proposition
	Control Parameters		Value Parameters	
	Control over assets	Modularity	Investment structure	User involvement
	Ownership vs Consortium Exclusive vs other Influence	Modular vs integrated	Concentrated vs distributed	Enabled, encouraged, dissuaded or blocked
	Vertical integration	Distribution of intelligence	Revenue Model	Intended value
	Integrated vs disintegrated	Centralised vs distributed	Direct vs indirect	Price/quality Lock-in effects
	Control over customers	Interoperability	Revenue sharing	Positioning
	Direct vs mediated Profile & identity management	Enabled, encouraged, dissuaded or blocked	Yes or No	Complements vs substitutes Branding
Public design parameters Policy goals Organisational	Public Governance Parameters		Public Value Parameters	
	Good governance	Technology governance	ROPI	Public value creation
	Harmonising existing policy goals & regulation Accountability & trust	Inclusive vs exclusive Open vs closed data	Expectations on financial returns Multiplier effects	Public value justification Market failure motivation
	Stakeholder selection	Public data ownership	Public partnership model	Public value evaluation
	Choices in (public) stakeholder involvement	Definition of conditions under which and with whom data is shared	PPP, PFI, PC...	Yes or No Public value testing

Figure 7: Expanded Business Model Matrix (Walravens, 2016)

For each of the parameters different scenarios are explored together with the project partners and an assessment is made towards their feasibility. As such, this business model matrix will be used to develop potential scenarios for the future exploitation of the DUET solution.

Output *– Business model scenarios and plan for future sustainability*

1.3.2. Pilot Descriptions

The three DUET pilots cover a range of scales to testing different scenarios related to the field of mobility, health and environment. These policy domains were chosen for testing purposes due to immediate policy needs in all areas and the fact that these issues often intersect and impact each other, providing a perfect opportunity for robustly testing the Digital Twins with multidisciplinary input and multi-sectoral output.

Starting from a similar data cloud concept, three pilots - each committed to digital transformation - have been chosen to cover different geographical scopes, spatial challenges, and policy needs and will be rolled out in a cascading order to (a) have more efficient use of resources (b) demonstrate transferability towards other cities and regions, (c) ensure lessons learned are captured and used during the project. The piloting will end with the cities using each others data/models/APIs to demonstrate interoperability and potential for Policy Ready Data-as-a-Service.

Pilot	Flanders	Athens	Pilsen

Scope	Regional Area	Large Metropolitan City	Smaller Sized City
Policy Goal	Improve air quality impact measurement, congestion impact prediction, management of road planning, supporting land-use planning, impact study using the modelling of impact on air, mobility and noise. Impact of new city developments (including link with water levels). Improving the information driven policy making process by public co-creation	Improve understanding of city pollution causes and use Digital Twin to predict the impact of different measures from different sectors (wood burning controls, smoking fines, diesel bans etc.) At the same time contribute to the city's digitalisation and move to citizen involvement in co-creation of city services.	Improve environmental and mobility policy for the city by visualising and analysing disconnected data sources to see correlations and make predictions on the impact of different policy actions.
Policy Sectors Involved	Urban planning, mobility planning, environment, and health and emergency.	Urban transport and mobility, city planning, pollution reduction.	Noise pollution, air quality, urban mobility.
Expected Outcome	Improved effectiveness and speed of operational and policy decisions based on drilling down and investigating real data-based evidence. Improved decision acceptance by all stakeholders. Establishing Digital Twins as a key method for policy making.	City data bought together in a way that's easy to explore through 3D models and scenario predictions, making it easier for citizens to ask questions on mobility and enviro policy and provide new innovative ways of looking at policy situations.	Data connected across the city for smarter, better aligned decisions. Citizens have access to huge amounts of data and are empowered to contribute to the decision-making process.
Stake-holders Involved	Quadruple Helix stakeholders (General public, Government departments and Private Companies, Community groups, charities and NGOs)	Municipality of Athens within its Agencies and initiatives Citizens groups, Startups/Businesses NGOs.	Anyone with an interest in the policies being experimented on, and the city data itself.
Data sources	Wide range of EU and Regional data together with local data & citizen (science) data	National and Regional open data combined with local transport data and citizen data.	Existing traffic models, city open data, citizen data from mobile phones and collaboration exercises.

1.3.2.1. Flanders Pilot (BE)

Intro: Flanders is an urbanised region with a network of close related cities surrounded by urbanised municipalities, considered as one single smart region of 6 million people. The Smart Flanders network brings together 13 major Flemish cities and the Flanders region as a learning network and has the ambition to create the necessary scale at Regional and National level for smart city solution- and data providers. A Flanders Digital Twin will play a crucial role to open and democratise available Smart City data to citizens, companies and service providers and to use the available (government) data for co-creative policymaking.

Pilot Goals: Flanders together with Smart Flanders network has a number of common goals for Digital Twin use:

- Creating a Smart Region where all involved players can access available services and data;
- Support cross-silo cooperation between sectors;
- Involve citizens and companies active in policy-making processes to improve the quality of decision making and acceptance of the outcomes;
- Setting up transferable services and data standards to maximise efficiency and open the market.

Pilot Policy Scenario: The Flanders DUET Digital Twin will concentrate on the design of new measures, implementation of actions and evaluation of the success of actions as foreseen in for example ***Flanders Regional Mobility Plan***[19], and the ***Flanders Environment Plan***[20] which aims both for smoother mobility through actions

19 https://www.mobielvlaanderen.be/overheden//mobplan.php?a=25&nav=7

20 https://www.lne.be/vlaams-milieubeleidsplan

that are kinder to the environment and reduces the impact on human health. These regional plans are translated to specific measures on the local level that can be part of a DUET Digital Twin simulation. Currently Flanders is a European hot spot for air pollution, alternatives to car transport have been put in place to increase the daily level of physical activity (PA) among the population and reduce air pollution and global warming. To evaluate the impact of existing measures and to help create new ones Flanders will use the Digital Twin to ingest and use vast amounts of data to help the city and its stakeholders explore correlations between the mobility, health and air data.

Expected outcome: Flanders and Informatie Vlaanderen, have more than 20 years of experience in building e-Gov and geospatial services to support (web-based) processes based on open standards. Realising a Smart Digital Twin will integrate new and existing silo over-arching services and solutions on a demand-driven way and will deliver:

- **A Smart City Cloud for Flanders** combining big data sources as a basis for creating a smart region based on regionally available (open) and (big) data sources.
- **A Smart and Transferable Digital Twin.** By focusing on well-defined cross-silo topics, the Flanders pilot will scrutinise how transferability can be achieved by using a combination of International, National and Regional datasets together with standardised local datasets using the EU based OSLO semantic standards. These standards are key to ensure sustainability between all partners. The Flanders pilot has the ambition to create transferable Digital Twins useful for the 13 Flemish cities based on regional and National sensor networks based on International Open Standards and a vendor agnostic and scalable API based knowledge graph.
- **Integrated Policymaking, Co-creation and Public Involvement**. The way the Flanders Digital Twin will become available to professional users, and the public will be part of a co-creation process. Flanders will test the use of a Digital Twin for ***co-creating new policies with citizens and businesses***.
- **Cross Sector Working (Smart City Market).** An open Digital Twin platform must lead to an innovative cross-silo and cross-sector smart city approach in Flanders. An open and secure accessible infrastructure combining datasets, data services, HPC/AI models must allow third parties to link initiatives to the Digital Twin and make them available for the Flemish market and beyond.
- **Effective policies and Happier Stakeholders:** Services and policies will be more open and transparent. People will be able to understand why decisions were made. Progress towards delivering the Regional Mobility Plan will be enhanced through more systemic, cross-party/sector decisions.

Stakeholders involved:

- Government (AIV, Mobility Department - MOW; VMM - Flanders Environment Agency);
- Cities of Aalst, Antwerpen, Brugge, Genk, Gent, Hasselt, Kortrijk, Leuven, Mechelen, Oostende, Roeselare, Sint-Niklaas and Turnhout;
- Citizens, companies and smart city service providers.

Data sources: Information Flanders and the Smart Flanders network has access to many useful data sources to start building its Digital Twin:

- Traffic model data - static and dynamic (public sector data);
- Web Service of planned and ongoing road works and events with mobility impact (public data);
- Anonymized and hashed ANPR (Automated Number Plate Recognition) data (public sector data);
- Floating car data (private market);
- Traffic lights regimes on regional roads (public sector data);
- Socio/demographic statistical data (public open data);
- 3D LRD (Large Reference scale Database) base map of the Flanders region (public open data);
- Land-use data - Corine land cover (public open data);
- Location of companies & industrial zones (public open data);
- Air quality sensor data (public open data);
- Parking data (mixed public and private data);
- Citizen science project data (leuvenAir project, Curieuzeneuzen project,...) (public and private open data);
- Weather sensor information (public sector data);
- Detailed water level information (public sector data) ;
- Social media data.

1.3.2.2. Athens Pilot (GR)

Intro: Athens has the benefit and privilege of being a metropolitan European city with the largest population in Greece, combined with large surges of tourist and visitors' traffic. There is a growing need to transform the city into a hub for potential economic growth and social convergence. The recent economic crisis is being tackled through an ongoing social and digital transformation focusing mainly on improving the service of the citizens. The latter has already established important policies and innovations for the city's digitalisation.

The current challenge for Athens is to create an interactive pool of city data that will be dynamically updated, open, robust and usable for evidence-based decision making to enhance the Athens livability experience for all. Hence, the need for an integrated Digital Twin with the capacity to merge all the city's digital sources and make it easily accessible and useful for exploration and experimentation.

Pilot Goals: Athens sees data-driven decision making as a key pillar for city and business transformation. In an era of exponential and constant change, Athens wishes to embrace Digital Twin use to:

- Understand city relationships and overcome engagement barriers with stakeholders;
- Create new business value based on data-driven insights;
- Co-create digital services with the active engagement and participation of citizens;
- Generate decision making approach using common standards for greater interoperability of digital tools;
- Improve effectiveness of policy design and implementation.

Pilot Policy Scenario: Athens is cracking down on air quality, around six per cent of all deaths in Greece are linked to air pollution, towards which diesel engines are acknowledged as a leading contributor, along with a high smoking percentage of the population. With nearly 30 percent of Greece's population living in the capital, having government departments working on transport, health and environmental policies to tackle the issue together seems eminently sensible. Therefore, the Athens DUET Digital Twin will concentrate on predicting and modelling the impact of existing policies (e.g. diesel bans, no-smoking enforcement) and the co-creation and exploration with citizens on creative new policies (for example using gamification to drive behaviour nudges) which could accelerate impact.

Expected outcome: By addressing the challenges mentioned above, the expected outcomes for Athens in building and adopting a Digital Twin mainly refer to the creation of policies that accelerate the growth of a healthy population and data-driven local economy:

- Transforming the city's services and infrastructure on transportation to be more environmentally friendly;
- Integrating data from citizens, businesses and the city to create augmented services for enhancing urban mobility and monitoring, reacting and improving services related to citizen health;
- Enhancing and boosting entrepreneurship by citizens and for citizens through the exploitation of data experimentation tools of DUET.

Stakeholders involved:

- Municipality of Athens;
- Chief Digital Officer;
- Athens Resilience Agency;
- Health and Well-being agencies;
- Citizens and Business/Startups;
- NGOs.

Data sources: Athens will start with the following data sources:

- National Data from data.gov.gr (the official repository of open data for the Greek public administration.);
- Data on transportation from geodata.gov.gr;
- Data from the Athens Urban Transport Organisation.

1.3.2.3. Pilsen Pilot (CZ)

Intro: Pilsen is a mid-sized city with a population of 165+ thousand people located in the western part of the Czech Republic. Pilsen is a hub for commuters, retail, entertainment and tourism/visiting. Pilsen is, therefore, facing many challenges in terms of transport planning and the city design itself. The Pilsen case is a good example for many smaller/medium sized cities and hence the Digital Twin developed within this pilot will be of high importance elsewhere.

The City of Pilsen is developing and implementing the Smart City concept in different areas including mobility, security, business support, environment, ICT and public participation. However, there is still a lack of complex and data-based planning across different sectors and policy areas that influence each other.

Pilot Goals: The Pilsen pilot will focus on the interrelation between transport and noise pollution in a 3D environment. Noise pollution in the city environment is influenced by many factors. One of the factors is the local road transport - especially the traffic volumes that pass by the built-up environment, types of vehicles and traffic conditions such as speed limits. The other factors that play a crucial role in the city ecosystem is urban design, urban morphology, land use, street distribution, street environment and green infrastructure.

Pilot Policy Scenario: Pilsen will demonstrate the DUET Digital Twin concept across transport and mobility, urban planning and environment and wellbeing by focusing on two related policy areas (1) ***Environmental Noise Directive (2002/49/EC)*** which recognises the need to protect quiet areas in cities and towns as sites of value to the local community. Plants and specific land use can play a role in this by softening the urban environment and reducing noise, and; (2) the development of Pilsen's ***sustainable mobility plan***[21]. Stress will be made on the interrelation of these policy areas, breaking the silo-based traditional approaches in decision making.

The pilot will be based upon existing traffic and modelling scenarios and tools developed and tested during previous H2020 projects, OpenTransportNet and PoliVisu. Leveraging these models in the Digital Twin, integrated with new air quality and noise pollution models and exposing the results via the 3D interface. Pilsen will be able to benefit from the HPC Cloud capabilities to simulate impacts of different urban design scenarios such as new road construction or road closure and its effect on the neighbourhood, the environment and well-being of local citizens.

Public participation and co-creation approaches will be designed and applied to involve citizens in the planning processes. Crowdsourced data from mobile phones and dedicated fora will also be analysed to provide additional input for policy design. Using

Expected Outcome: The expected outcomes of the Pilsen pilot include a replicable DUET Digital Twin and positive impact on city policy making. Key outcomes include:

- A set of tools dedicated for policy support in urban design including traffic and noise pollution modelling tools, visualisation tool, sensor data orchestrator and social media analytical tool;
- Visual insights providing data-based evidence for policy making across the targeted policy areas;
- A virtual space for entrepreneurs, start-ups and spin-offs that can boost their innovations on top of the Twin visual insights.

Stakeholders involved:

- City of Pilsen - A policy making authority on the city level, PLZ is affiliated partner of the City of Pilsen;
- Urban Planning and Development Institute of the City of Pilsen - Urban planning specialist providing supporting data-based evidence for policy making by the City of Pilsen;
- Pilsen Region - A policy making authority at regional level including transport, environment and spatial planning departments;
- University of West Bohemia - A key innovator and technological partner from the research point of view;
- Entrepreneurs, start-ups, spin-offs and general public.

Data sources: Pilsen is curating many datasets openly available via its open data portal[22]. This portal is one of the primary data sources to be used in the pilot. In addition to key-reference data such as Open Land Use Map, Smart Points of Interest, Open Transport Map, cadastre data, hydrography and orthophoto maps, the following thematic datasets will be utilised: real-time road sensor data, air quality data, 3D building model, spatial plan, road infrastructure, green infrastructure, protected zones and digital terrain model. The Pilsen pilot will also rely on the historical and real-time road sensor data (from more than 1000 road sensors) and crowdsourced traffic data from Waze which will be used to calibrate and refine the existing traffic model of the city. Other available data that might be used is the real-time GPS position of public transport vehicles (trams, buses, trolleybuses).

21 http://www.mobilita-plzen.cz/

22 *https://opendata.plzen.eu/*

1.3.3. Sex and Gender Considerations

Policy is often made as a 'one size fits all' approach and doesn't take into consideration differences between genders. For example, with mobility policy, women and men tend to have different transportation needs, travel behaviour and levels of access to transport services and infrastructure. Women for example usually travel shorter distances, walk more, drive less and are the main users of public transport, which often has a positive knock on effect on both health and the environment. Women tend to be more sensitive to safety concerns and tend to limit their movements and activities because of the heightened perception of risk. In terms of employment, the transport sector has more male workers than female workers, including in positions with decision-making powers. Consequently, these factors have an impact on how related policies are understood, designed and managed, and how gender-balanced they are.[23]

Acknowledging the importance of sex and gender considerations in policy making, DUET will integrate gender perspectives into its work in accordance with guidelines specified in Gendered Innovations[24], GenderSTE[25] and RRI Tools.[4] On the implementation level, this means that project's teams will be managed by teams with a balanced male to female ratio; in data insight exploration the use of demographic information will be used where possible to explore needs and differences; in co-design activities like workshops female representatives will be given as much voice as men; when disseminating project results women will be one of the key target audiences to learn about DUET achievements and developments; and when providing recommendations to decision-makers gender perspectives will be fully highlighted to ensure policy outcomes benefit both sexes in equal measure. On the project management level, female partners will occupy a central role in the decision-making process. They will drive the overall gender agenda to make sure that all project activities in the field and within the consortium comply fully with responsible research and innovation practices.

1.4. Ambition

Before configuring the pilot demonstrations for DUET, the Consortium undertook a high-level review of the state-of-the-art in: (A) Data driven decision making in the public sector, (B) The use of Digital Twins for managing operational decisions in the public sector, and (C) The European Cloud Infrastructure. Initial findings are highlighted in the section below, show how DUET goes beyond the state-of-the-art in all these areas to deliver an original innovative solution leveraging the power of the cloud for smarter decision making.

(A) Advancing Data Driven Decision Making

Whilst not as prolific as in the private sector, Government has started to utilise their data to react to citizen demands and concerns, and to even proactively anticipate an issue before it develops into a crisis. Examples of advanced data-driven decision-making happening right now within public agencies across the globe include:

Transportation: West Virginia's Department of Transportation[26] continuously tracks traffic at 2,500 spots around the state to understand a variety of components such as average daily traffic, vehicle type information, intersection turning movement information, and annual vehicle miles. The information is used by the planning team to plan infrastructure enhancements and prioritize new construction projects.

Citizen Complaints: The Hong Kong government's Efficiency Unit[27] acts as single point of contact for many government departments to handle citizen complaints and suggestions. Each year, the unit receives 2.65 million calls and 98,000 emails. The office partnered with a text mining firm to build a complaint intelligence system to analyse all the data and uncover patterns to help establish the root causes of many problems. Report generation is shortened from one week to one click, and the responsible department is immediately informed of issues.

Utilities and Energy: Eastern Denmark used to work with 16 partners to balance electricity supply on a daily basis in order to anticipate the right amount of power consumption and production needed. After partnering with

[23] *http://www.genderste.eu/i_transport01.html*
[24] http://genderedinnovations.stanford.edu/
[25] https://www.rri-tools.eu/gender-equality
[26] http://www.eu.gov.hk/en/index.html
[27] http://www.transportation.wv.gov/highways/programplanning/plan_conf/Documents/2011PC/GTI__Section.pdf

Copenhagen Energy, which drove the use of data driven decision making, consumption can now be predicted on an hourly basis to minimize production waste[28].

Going a step further and actually using the data for official policy making is still largely confined to theoretical concepts or only specific types of data rather than a sufficiently large combination thereof. Previous projects financed through Horizon 2020 and FP7 funding as shown below have made great strides in pushing forward open and linked data on a more technological level in public administrations but take up has been low. Additional projects include:

PoliVisu[29] is a research project designed to help government use big data in its policy making processes. The project has designed a big data policy making framework, along with a Toolbox that provides access to the framework along with helpful data-driven decision-making cases studies, visulisation software and technique information.

ASK[30] is an innovative concept providing a 'data broker' model to connect policy makers and young people over Twitter. The data broker dashboard is specifically designed to reformulate dry policy texts into more engaging material that will spark reaction from both young people and policy makers fueling debate and insights that close the gap between what policymakers think young people care about and the actual needs/concerns of youth.

Puzzled by Policy[31]**:** Puzzled, designed by DUET partner 21c, used algorithms and apps to create a tool that after a short, fun, interactive quiz plotted a user (citizen) on a political dimension map so they could see other groups/communities/organisations that shared their viewpoints. Policymakers benefited from the analysis of the data seeing where general consensus lay for specific issues around immigration.

WeGov[32] provided social networking technology to deliver new opportunities for policy makers (eGovernment) to engage with the community (eSociety). The project delivered a toolkit for policy makers helping them to take advantage of new (at the time) channels such as Facebook and Twitter.

OCOPOMO[33] (Open Collaboration in Policy Making) addressed two levels of scientific and technological advancements: 1) Socio-political: to formulate, model, evaluate and monitor social and economic policies of governments, which are supported by 2) Scientific and technological innovations.

DUET goes beyond the state-of-the-art in data driven decision making *in the public sector by (1) creating advanced data rich interactive interfaces - enabling and integrating data sets on a much larger scale than before, with a wider variety of data (structured and unstructured- i.e. video, photos) on an easy to understand 3D interface. (2) Enabling users to explore future scenario predictions - using the power of HPC Cloud to speed processing and undertake more complex correlation analysis and impact prediction for collaborative interpretation and discussion. And (3) focusing on ethical principles for data use.*

(B) Advancing Use of Digital Twins

The digital twin concept has been around since 2002. And in 2017 first made the list as one of Gartner's Top Ten Strategic Technology Trends[34]. Their use was first documented by NASA who used IT environment replicas to test repairs to spacecraft, assessing risks and impacts, before asking astronauts to undertake the fixes in real-life. Since then the use of Digital Twins grew in the field of manufacturing, until recently when other industries started to notice the benefits.

Automotive: It's predicted that by 2020 there will be 10 million self-driving cars on the road. The emergence of autonomous vehicles means a proliferation of new, interconnected things. Automotive manufacturers can create a digital twin of every single autonomous vehicle it sells, enabling them to analyze how a car performs in its physical environment, and track the vehicle from creation to the day it goes to the junkyard. Much of the sensor infrastructure is already in place in newly released vehicles that are constantly controlling a car's critical systems.

[28] http://cleancluster.dk/wp-content/uploads/2015/05/Co-creating-the-cities-of-tomorrow.pdf
[29] https://www.polivisu.eu
[30] www.ask-project.eu
[31] www.puzzledbypolicy.eu
[32] http://www.wegov-project.eu/
[33] http://www.ocopomo.eu/results/presentations/crossroad-ws-ifip-egov-2010/files/ocopomo.pdf
[34] https://www.gartner.com/en/newsroom/press-releases/2017-10-04-gartner-identifies-the-top-10-strategic-technology-trends-for-2018

When you go to the auto shop and a mechanic runs diagnostics, it is this sensor data that tells them what needs to be repaired. The next step is setting up systems for that data to automatically be transmitted back to the manufacturer, analyzing that data and performing predictive analysis that can help make driving experiences smarter and safer for car owners.

Health Care: GE are building sensors for bandages that monitor patients' blood pressure, heart rate, oxygen level, sleep patterns etc. The data is then integrated into a Digital Twin for the patient's body. This exact model of an individual person can help doctors explore reactions to different types of treatment and predict anomalies in recovery. It is anticipated that the Twins could provide Doctors with increased visibility into their patient's well-being when they are not at hospital.

In terms of public sector use this a pioneering concept that cities are just starting to understand and think about:

Amaravati[35]: the new capital of the Indian state of Andhra Pradesh, is reported to be the first entire city born with a digital twin. The initial 3D prototype of the greenfield city was unveiled at the World Economic Forum's annual general meeting in Davos in January 2019. Its aim is to provide real-time construction progress monitoring, environmental and wellness monitoring, et al via ubiquitous, multi-nodal Internet of Things (IoT) sensors to advanced mobility and traffic monitoring and simulations, advance microclimate and climate change monitoring and simulations, and use for digital zoning.

Antwerp: has recently built a digital 3D replica of the city combines noise pollution data with real-time sensor information from air quality and traffic, and computer models. It aims to bridges the digital and physical worlds and supports policymakers and area developers in making complex decisions about urban quality of life. The effects of certain scenarios on traffic, noise and air quality can be predicted in advance. The availability of more and up-to-date data from various sensors in the city makes future forecasts even more accurate and enables planners to make the best decisions for short-term measures based on multiple simulation scenarios.

UK Digital Framework Task Group (DFTG): The task force has launched the Gemini Principles[36], bringing together key voices from government, academia and industry to provide the sector with foundational definitions and values to guide the development of the National Digital Twin (NDT). This NDT will be an ecosystem of digital twins that are connected by securely shared data. It starts to address the key recommendations in the National Infrastructure Commission (NIC)'s 2017 report Data for the public good[37]. This work forms part of Centre for Digital Built Britain's remit as the national focus for the digital transformation of the built environment.

DUET goes beyond the state-of-the-art in public sector digital twin development *in the public sector by (1) leveraging the lessons learned from the Antwerp Digital Twin experience to create a cloud agnostic, scalable, replicable and cost-effective Digital Twin than can be set-up easily via a generic Digital Twin install base. The Digital Twin offering will be not only tested at city level, but also at regional level (networks of cities), (2) develops a new concept of Policy-Ready-Data-as-a-Service with new business models to make it easier for cities to share policy simulation models and (3) creating a Digital Twin Starter Kit and accompanying business book that will rapidly inform and upskill any city exploring the potential of Digital Twins. This starter kit will also describe how city initiatives and private sector initiatives can cooperate with the Digital Twin on a regional and local level.*

(C) Advancing the European Cloud Infrastructure

Just 26% of European enterprises are using the cloud[38], mainly for hosting email or running accounting packages. In the public sector this figure is far lower and hard to pinpoint. The European Commission has taken great steps to help accelerate cloud adoption through a European Cloud Infrastructure initiative which includes:

The European Open Science Cloud[39] (EOSC) an infrastructure which is making progress in connecting Europe's 1.7 million researchers and 70 million science and technology professionals through a virtual environment to store, share and re-use the large volumes of information generated by the big data revolution[40].

[35] https://www.smartcitiesworld.net/news/news/digital-twin-created-for-new-indian-smart-city-3674
[36] https://www.cdbb.cam.ac.uk/news/2018GeminiPrinciples
[37] https://www.nic.org.uk/wp-content/uploads/Data-for-the-Public-Good-NIC-Report.pdf
[38] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cloud_computing_-_statistics_on_the_use_by_enterprises#Use_of_cloud_computing:_highlights
[39] https://ec.europa.eu/digital-single-market/en/european-open-science-cloud
[40] https://ec.europa.eu/digital-single-market/en/%20european-cloud-initiative

The European Data Infrastructure[41] (EDI), focused on deploying the high-bandwidth networks and the supercomputing capacity necessary to effectively access and process large datasets stored in the Cloud. Focusing initially on the scientific community as above, the user base will be enlarged to the public sector and industry.

DUET helps to advance the state-of-the-art for European Cloud Infrastructure *by (1) proposing recommendations for a European Cloud Infrastructure which is interoperable with the European Open Science Cloud and supports ethical and legal policymaking, based on anonymised privacy sensitive big datasets. (2) DUET will go a step further than the combination of cloud-stored data, HPC modelling and scientific reporting by covering the whole integrated process from data, to information to (policy)knowledge. The DUET Digital Twins will help accelerate the use of this data for knowledge processes to realise smarter and more responsive cities where people are involved in cloud data-based decision processes. (3) DUET contributes a new business model and approach for Government to easily access Policy Ready Data-as-a-Service through Digital Twin use which will improve the speed and effectiveness of policy making, enabling more extensive collaboration and understanding of decisions.*

2. Impact

2.1. Expected Impact

The table below highlights how DUET will deliver the impact expected by the call.

Expected Impact	DUETs Alignment	Objectives
Create analytical tools that enable administrations to reuse common infrastructures and data sets for the development of better targeted and more effective evidence-based policies	**DUET delivers effective evidence-based policy by:** ● Creating Digital Twins to bridge the virtual and physical worlds to inform decision making, reduce risk and increase citizen engagement ● Harnessing Cloud and HPC power to provide faster, complex analytic analysis focused on systemic impacts of specific policies on multi-areas ● Reusing and connecting existing data models to unlock greater opportunities for predictive simulations and intelligence extraction ● Delivering a solution that can be used at any stage of the traditional policy making cycle to design new policies or evaluate and improve existing ones ● Ensuring decisions are more sustainable by considering the impact on multi-facets of a city - health, mobility and the environment ● Empowering all cities in Europe to benefit from Digital Twins through DUETs Digital Twin Starter Kit and Policy-Ready-Data-as-a-Service ● Extending the European Cloud Infrastructure with recommendations for a European Policy Cloud	● 1.1 ● 1.2 ● 1.3
Engage citizens and businesses in the co-creation of the tools	**DUET enhances collaboration and co-creation by:** ● Harnessing the levelling power of 3D visualisations to facilitate easier inclusion of non-government players in decision-making process e.g. citizens, businesses, civil society and so on. ● Enabling people from different city departments and their stakeholders to collaborate on common goals using a common view/baseline of the city ● Integrating multiple data sources on one interface to help identify correlations and patterns of impact which can inform policy ● Allowing citizens and businesses to enrich the Digital Twin experience and knowledge by uploading own data sources ● Providing business with interoperable data and computing power (Cloud HPC) for new services and product innovation that meet city/people's needs	● 2.1 ● 2.2 ● 2.3
Enhancing trust and boosting the perceived legitimacy of authorities.	**DUET makes policy making more democratic by:** ● Focusing on building in legal compliance and creating ethical processes for using Digital Twins and data in evidence-based decision making ● Delivering transparency by clearly showing predicted impact of policies in an easy to understand manner - 3D and 2D visuals - for all users	● 3.1 ● 3.2 ● 3.3

[41] https://www.eudat.eu/

	• Increasing trust in decision making by using data to present a common version of the truth for all stakeholders to openly and collaboratively work with • Amplifying perceived legitimacy of government by responding to citizens' concerns through co-created policy solutions resulting in improved effectiveness of outcomes	

The adoption of DUET ensures policy teams receive the support they need to enhance the effectiveness of their policy making processes, and citizens and other stakeholders are given the opportunity to become valuable policy influencers and solution co-creators. The ability to quickly experiment and understand the impact of a variety of policy solutions will result in saved time and costs. Impact will be demonstrated and extrapolated from the pilot sites who will use the DUET Digital Twin approach for real life policy scenarios, enabling measurement of both quantifiable and qualitative impact measures on their internal processes and to their policy outcomes. The results will be transferred across Europe through events, communication campaigns and a business book.

2.2. Measures to Maximise Impact

The Consortium understands that DUET cannot achieve true success unless the results and outcomes scale beyond the project to provide wider market and technological impact. To ensure maximum impact is achieved, the Consortium will develop an **Enhanced Communication, Dissemination and Exploitation roadmap (ECDER)**. This coherent, easy to follow document will outline three strands of activities (i) General Dissemination, (ii) Specific Communication, and (iii) Targeted Exploitation. Including all these activities within one Roadmap will ensure that the projects innovative promotional strategies and tactics within each of these streams will be complementary, working efficiently together to achieve future sustainability and long-term success.

2.2.1 Dissemination and Exploitation of Results

Work package 7 is dedicated to the dissemination, communication and exploitation of the project's results. The end goal being the creation of exploitation opportunities for DUETs Digital Twins across Europe in order to multiply its impact and deliver sustainability. Specifically, the main objectives will be: (1) identifying the most appropriate business model and putting it into action, and (2) reaching the widest audience of stakeholders in the sector as well as strengthening collaboration links with partners, in order to establish a wide network with potential administrations interested in adopting DUET outcomes. A full analysis matrix of stakeholders and areas of interest will be created as part of the Impact Enhancement Roadmap to ensure DUET engages specific audiences with tailored messages at the right time through the most appropriate channels.

2.2.1.1 Exploitation Strategy Approach

DUET aims to transform policy identification, production and delivery in Europe by giving Public administrations and their stakeholders the tools to develop advanced, flexible, policy options that keep pace with rapidly changing citizen expectations. DUETs unique Digital Twin tools provides as 'Policy Ready Data-as-a-service' making it faster, easier, and cheaper for even the smallest public administrations providers to use cloud computing HPC for simulating, visualising and communication policy impact. In order to deliver this ambitious vision, the Consortium will start with a rigorous programme of design thinking to identify current challenges and trends cities face in using big data for policy making, as well as analysis of the Digital Single Market strategy that DUET will need to take into account for future positioning. The outcomes of which will help to tailor DUET outputs to the precise needs of a rapidly changing and budget-conscious government market bound by public procurement rules. The following strategy, executed over the lifetime of the project, will deliver a near-market-ready solution by mid- Y3 of DUETs development cycle and ensure a viable and sustainable customer base before the end of European financing. To deliver the Sustainability Model, exploitation of DUET will take the form of 3 distinct 'waves': Wave 1: Exploration; Wave 2: Implementation; Wave 3: Acceleration.

WAVE 1: EXPLORATION - At an early stage in the project, the DUET exploitation team will conduct market research including a Value Network analysis (also part of the design stream) and collaborative Business Model Clinic with the full range of stakeholders. The outcomes of which will help partners in WP7 create a clear picture for the exploitation of project results as part of the design, development, and implementation of the use cases. Through this integration of business parameters from the very start to the end, DUET achieves 'impact by design' for the pilot locations, thus ensuring sustained post-project exploitation. Value Network Analyses (VNAs) are

qualitative in nature and are useful whenever sustainability modelling rises above a single organisation level. VNAs aim to take into account the differing and sometimes-conflicting interests and motives of stakeholders from a variety of industrial or public fields. The value networks are developed using qualitative data gathered from a blend of desk research, in-person interviews and public workshops.

Running concurrently with the VNAs, the Business Model Clinics (BMCs) will focus on the development of suitable business models for the exploitation of the DUET tools. DUET's BMCs will take into account the needs of all stakeholders who could be potential competitors, customers or consumers of DUET s services to generate a 360° of the business landscape. BMCs will factor in social, technological and economic performance under an evolutionary perspective in order to assess the desirability of the different business models from different stakeholder perspectives and arrive at a balanced approach that maximises both stakeholder value and commercial viability. This business modelling technique is based on a multi-criteria approach which will use different data sources including in-field investigation, opinion leader interviews, living lab consultation groups and social-network short-form surveys and virtual business simulation to arrive at an optimal result. By analysing the results from both the VNA and BMC's, DUET will arrive at an optimal value model/common approach for the developed technologies within the dynamics of the current market place. The outcomes will serve as a blueprint for further exploitation scenarios in Wave 2 and Wave 3.

WAVE 2: IMPLEMENTATION - In this stage, the impact activities of the project take on a much more pronounced (and targeted) communication role on top of the exploitation activities. Here DUET will organise, based on the previous work in Wave 1, collaborative Business Modelling Workshops with the pilot countries. This activity constitutes all countries of partners in the consortium. In these workshops, partners will explore with local stakeholders the business models for adoption of the DUET Digital Twins in their value networks. These workshops will lead to grounded and granular individual exploitation plans – started in the table below - (including value models and business rules) for all partners in the project, and a clear way forward for rolling out a commercial version of DUET nationwide in the respective countries. Supporting the workshops will be the touch-screen lightweight business model simulator BEMES, which was developed by the Future Internet Programme (FI- PPP). By organising the workshops iteratively and starting relatively early on in the project, we expect to have additional 'stand-alone' exploitation scenarios with measurable results by the final review of the project. The workshops will also entail the education of local stakeholders through dissemination activities to ensure understanding of the potential of DUET.

Partner Exploitation Plan	Sector	Route
AIV: Awareness raising of the importance of Digital Twins for effective city operations.	National and Regional government in Belgium	Promote DUET results across Flanders through meetings, speaking opportunities at regional workshops and conferences. Sharing news and findings through official government communication channels. Targeting local administrations directly within DUET newsletters.
IMEC: Create awareness of data driven policies and the potential of interoperable simulation of multiple parameters for policy makers.	National and Regional government International	Showcase DUET results on conferences and regional workshops. Promote the project to different local and national policy makers. Communicate the project progress and results on the different IMEC communication channels.
KUL: Advance and develop dynamic traffic models based on observed (open) data for a large region using High Performance Computing (HPC).	Public and private market via education and scientific publications	Present DUET results at conferences and regional workshops attended by both researchers as practitioners e.g. Annual Meeting of the Transportation Research Board; international conference on Models and Technologies for ITS; symposium of the European Association for Research in Transportation.
ATC: Embed results into ATC's content analysis and social media monitoring portfolio of products to cover the policy-making domain.	Global markets both public and private	Use new case studies and business case to promote ATC's data and social media portfolio of products to a wider market.

21c: Enhance existing consultancy offering and potentially be involved in rolling out new DUET Digital Twin deployments commercially with other partners.	National and Local Government, UK, Lithuania	Promote DUET at conferences and via its position on working groups (e.g. UN, Arab Digital Strategy). Offer services via usual tender channels. Add to UK G-Cloud for easier procurement.
AEG: Understand the real-world needs from a cyber-security service and enhance its overall offering.	Public and private markets	Offer training, consultation and cyber-security digital investigation services that are highly needed for the critical infrastructures owned by public administrations.
OASC: Promoting Digital Twin benefits among the international OASC network of member cities to stimulate awareness.	Global City Market	Promoting DUET through the networks communication channels and annual event (Connected Smart Cities Conference).
GSL: Expand the knowledge on Digital Twin solutions and ensure the project and the solutions are GDPR compliant.	EU, Local Government, policy makers	Promote the DUET results and offer consulting services on the GDPR compliant solutions of Digital Twin.
DAEM: Lead to a new services to be offered to citizens and innovative city strategies conceived, through HPC.	National and Local Gov, private markets	Leverage the company business opportunities to improve market positioning and to offer credible services.
VCS: Enhance existing products, solutions and consultancy offering by rolling out new DUET Digital Twin deployments commercially with other partners.	Global markets both public and private	Showcase the DUET results at conferences and regional workshops. Promote the project to different local and national policy makers. Communicate the project progress and results on the different VCS communication channels.
TNO: Enhancing the Urban Strategy instrument to support and adapt the standard set by DUET for Digital Twin solutions.	Local Dutch government, Municipalities	Use of TNO knowledge to realize the DUET ambitions. Insights will be used in further development of the Urban Strategy instrument to assist (Dutch) cities in the pathway towards a 'smarter' decision making process.
P4ALL: Expand the P4ALL network and exploit the Digital Twin deployments.	Public and private sector	Offering consultancy services in cooperation with all Plan4all members.
PLZ: Support and adapt the use the DUET Digital Twin deployments.	Local, Regional and National	Promote DUET to local and regional sector to stimulate new opportunities for business.
ISP: Business development for the DUET Digital Twin.	Public/private markets	Building new commercial relationships, leveraging existing partnerships, identifying new market opportunities.
GFO: Promote the DUET Digital Twin deployments and stimulate awareness.	National and Local Gov Public market	Promoting DUET to the Universities and Research Centers that are GFOSS shareholders.

Looking at individual exploitation aims, and plans will help DUET create an exploitation strategy/plan for the non-commercial results of the project, which will be used to support commercial endeavours. The findings will be used to update the Impact Enhancement Roadmap.

WAVE 3: ACCELERATION - In this stage, the strategy focuses on both (1) depth and (2) breadth of the project outcomes to ensure uptake, impact, and post-project sustainability. The depth strategy focuses on technological integration, whilst the breadth strategy focuses on broad uptake by stakeholders. In terms of **depth**, DUET will reach into its own and affiliated networks with the GI community such as Plan4All association members and their networks, pilot channels. Via various ongoing working relationships with these networks, DUET's solution will be

positioned to be superior to existing alternatives so it can be positioned as THE standard for data-driven policy making. In terms of **breadth,** DUET will focus on capacity building of public administrations across Europe by offering free books/guides on data driven decisions through affiliated general networks such as LOLA (Linked Organisation of Local Authorities), Eurocities (AIV is a member), SmartCitiesCouncil, amongst others. The Consortium will use the business guides to encourage public administrations to embed the DUET approach in their operations and offer commercial incentives to use its tools.

2.2.1.2 First Draft Business Plan

a) Vision Statement: The DUET vision is to make policy experimentation using Digital Twins for systemic impact exploration the de facto way that public administration teams work together with stakeholders to deliver data-driven policy making across Europe. Any city should be able to create its own Digital Twin using the DUET Digital Twin Starter Kit.

b) Mission Statement/Value Proposition: DUET transforms European policy design, implementation and evaluation by giving Public administration Policy Teams everything they need from ethical and legal principles, co-creation techniques and processes to advanced technology tools (Digital Twins - processing, analytics, predictions, 3D visualisations) to create and deliver innovative, effective policy solutions. Harnessing available city data – open, private, social – into a trusted Digital Twin that replicates the real-life city environment, DUET removes traditional technological and data literacy barriers and enables public administrations and their stakeholders to collaborate using the same levels of advanced visualisations, that large consultancies would provide, at a fraction of the cost. Thanks to DUET, 'Policy Ready Data-as-a-Service' redefines the way public policy teams collaborate and operat**e.**

c) Target Market: Public sector in Europe, namely (but not only) on municipal and regional level, targeting Policy Makers – Mayors, Council Leaders, Cabinet Members and Overview and scrutiny committees - Overview and scrutiny is at the heart of city accountability. It is the principal, democratic means, between elections, of ensuring that decisions made by the council and its partners are held to account.

d) Sustainability: DUET ensures sustainability of the project results by ensuring all the outputs of the project – Digital Twin architecture, data models and processes, support material, communication collateral, white papers etc - are openly available on the DUET website, with relevant material published on partner and network sites and passed to additional research initiatives that can utilise the results. By the end of the project DUET will create a Digital Twin Starter Kit and book that will support new cities and regions in setting up their own Digital Twins in an ethical and legally complaint way. Project partners will promote the results and outputs in their everyday activities, from speaking engagements, direct sales contacts via their business networks, to social media sharing. Many of the technical components of DUET will be freely available for adoption, and project adaptations of the tools will be published in GitHub.

e) Business Model: DUET Partners will work together in various configurations to offer commercial consultancy, advanced data analysis & tools, customisation of the Digital Twins, and technical support at an affordable cost to cities. The mechanism for these partnerships will be decided during the Exploration WAVE activities. One option, which already has been proved by business reality in other EU projects, i.e. OpenTransportNet, is a loose partnership arrangement, within a not-for-profit association like Plan4All. In this model consortium members agree to share revenues from new business while individually bearing the costs of working on an engagement, either alone or as a group. Revenue sharing triggers will be tied to the amount of work the partner will be able to carry out or commit to. If the partner can deliver the project alone, and assuming the partner onboarded the client directly, not through referrals or other intermediaries, then no revenue sharing with other partners shall be triggered. If the partner lacks skills to deliver the project alone, or if the partner decides that it would be more efficient to work in a group, then a percentage of new revenue will be shared between the partners involved. If the partner finds a customer but has no skills relevant to the project, or if the partner decides that it is more beneficial, commercially or otherwise, to focus more on new business development (NBD) and less on project delivery, a fixed commission for NBD is in order. The customer will then be handed over to a partner, or a group of partners, that agrees to take charge of the project. A small share of the revenue for the 'umbrella' non-profit organisation may also be considered to cover costs for IT infrastructure maintenance and engagement activities.

f) Market: The core enabler of DUET's technical solution is the ability of its twins to use and visualise data in a geospatial manner. Therefore, it is likely DUET will sit in the geospatial industry space offering services to

enhance policy and governance operations. The geospatial industry in Europe is composed of several sectors – hardware, software, consulting, solutions and services – of which the latter is the greatest in terms of market share (hardware's is the smallest)[42]. In recent years, however, there has been a clear trend towards a 'solutions approach,' whereby businesses combine technologies from hardware and software to provide an optimal offering to customers. This approach is in line with DUET's ambition for combinatory, multi-disciplinary, experimentation, which seeks to mix and match different data sources, tools and services to create a unique solution for policymakers in Europe.

Based on information available from open sources, the size of GIS market globally was estimated to be $10.6 billion in 2015[43], while Europe's was projected to reach $3.3 billion by the end of 2016. To the extent that these figures are accurate, Europe was accounting for a third of the worldwide GIS market in 2015-16. However, within a specific niche – geospatial analytics - Europe accounted for the largest share in the global in 2015. A large part of geospatial services offered by the European companies, as to be expected, is in one way or another related to data. The most common type of service on offer is data processing, which is followed closely by data acquisition, analysis and management. Data, it seems, is at the core of geospatial industry, driving its revenues and creating opportunities for specific sectors, like data analytics, to flourish.

In terms of revenue sources, in Europe they are split almost equally between private (56%) and public (44%) sectors[44]. The share of private sector is likely to continue to grow given the continued proliferation of data and its use by industries such as banking, telecom, insurance, logistics, gaming and retail. Public sector, for its part, makes its contribution particularly visible in areas like infrastructure, environment and climate change, disaster management, land use, utilities, public safety and homeland security. Within public sector, government is going to be a major contributor to the industry's growth as it continues to seek customized, integrated, enterprise level GIS solutions that can enhance public services, national infrastructure and security.

DUET enters the market at a time of high demand for GIS related services. Thanks to its unique expertise, approach to data visualisation, collection of tools and methodological framework the project is well-placed to meet this demand in public sector and even to go beyond that by offering new perspectives on policy-making through the use of big data.

g) Route to Market: To ensure that DUET delivers on its Mission Statement, the team has thoroughly considered in advance the best route to market and devised an initial marketing strategy for growth:

1. *Marketing Objectives:*
   - To position the use of Digital Twins as a transformational solution enabling Policy Makers to create innovative, responsive policy solutions that produce efficiencies and cost savings
   - To demonstrate the financial, technical and operational advantages of using DUET Digital Twins
   - To establish DUET as the standard for open and data-driven policy making
   - To create a strong ecosystem of cities/policy makers around the DUET Digital Twins who can support each other and continue to enhance and refine the technical solution and processes

2. *Marketing Messages.* DUET will focus marketing material around the following core messages:
   - DUET helps Policy Makers across Europe use their city data to unlock innovation and become a responsive city using Digital Twins to make real-time decisions and deliver effective policies
   - DUET Digital Twins provide an ethical framework for delivering trusted data-driven-decisions
   - A DUET Digital Twin can be set up at the touch of a button providing Policy-Ready-Data-as-a-Service

Marketing Tactics: DUET will be promoted across Europe by core members of the project team – all of whom know the solution and the project results intimately and have direct access to actors who will assist in the promotion of the solution through their cities and networks. Thus, rather than commissioned salespersons (who often have limited product knowledge and direct access to purchasers), DUET will leverage the extensive collective expertise and professional networks of the consortium to drive adoption. An offering of free business

[42] http://geospatialmedia.net/european-geospatial-business-scenario.html
[43] *https://www.gislounge.com/gis-industry-trends/*
[44] *ibid*

guides/books around using Digital Twins, alongside hands-on workshops showcasing the power of Digital Twins, will be used as an incentive to hook administrations into understanding the benefits of data-driven policy experimentation which not only builds capacity for the policy makers but also provides a potential chance to sell DUET consultancy to create bespoke visualisation models. The pilot leads will act as DUET champions and will be featured in case studies and other exploitation materials as well as continue to act as demonstration sites for potential adopters to visit or use to speak to peers. DUET will rely heavily on online marketing, but also use regular appearances at major industry events and showcases. In addition, as DUET's network of other similar projects grows, the team will pursue a tie-in promotional model to harness their networks to our advantage through joint promotional campaigns.

2.2.1.3 Dissemination Plan

The general dissemination of DUET results will differ in intensity based on the evolution of the project. The dissemination activities will be carried out in three main phases coinciding with the workstreams, spanning throughout the project duration and extending beyond it, with increasing level of intensity, starting from the creation of general awareness and concluding with attracting through workshops potential supporters and adopters of DUET results. The three phases are presented as follows:

Phase I covers the first 12 months of the project duration. The main purpose of this phase is to create general awareness about project objectives and expected results. The first task will be the creation of the project brand through an attractive and compelling DUET logo and clear messaging. The brand will then be used across a range of communication tools and materials including the project website, main social media channels (Twitter, LinkedIn and Facebook), presentations and flyers which should be able to be understood by any layperson across Europe. By month 3 of the project all general dissemination materials should be in place. The project will be presented to a broad audience through a range of social media messaging and presentation at European and national conferences and workshops with streams related to policy making and city data use. The partners in DUET were chosen not just for their expertise, but also for their geographic coverage of Europe: Western (Germany, Netherlands, UK), Southern (Italy, Greece), Central (Belgium) and Eastern (Czech Republic) ensuring dissemination activities are spread widely. In addition, partners OASC and Plan4All provides its own network of members across Europe.

Phase II will be executed during the second year of the project (months 13-24). The dissemination activities during this phase will aim at attracting potential users & early adopters for DUETs Digital Twins. The main output to be disseminated will consist of the project's concrete results and success stories. The project results will be disseminated via more focused dissemination activities, including press-releases, social media postings, presentations, workshops, training, publications and participation in relevant conferences, exhibitions and videos.

Phase III will be during the last year of the project when the main focus will be to leverage the exploitation of the DUET outcomes promoting the benefits of using the Digital Twins to appropriate public and professional media channels and will provide lessons, guidance and recommendations to relevant parts of the Commission for the advancement of the European Cloud Infrastructure. The aforementioned are summarised in the following table:

Phase	Month	Type of Info	Broad Audience	Key Channels
Phase I	1-12	Approach-oriented content; project presentation; objectives; expected results.	• Standards bodies • Gov policy makers • Businesses • Research Institutions	Project Website & SM, Leaflet & Brochures, Publications/presentations at Conferences and Workshops
Phase II	13-24	Result-oriented content; project intermediate and final results	• Standards bodies • Gov policy makers • Businesses • Research Institutions	Project Website & SM, Workshops, Focused publications, Conferences, press releases; promotional videos;
Phase III	24+	Result-oriented content; project final results; Proven PRDaaS platform, pilot showcases, and lessons learnt.	• Standards bodies • Gov policy makers • Businesses • Research Institutions • Investors	Project Website & SM, Conferences, Targeted Policy Workshops, Focused publication, , Business book, Guidelines, press releases promotional videos; Publicity through TV & radio

The DUET Consortium is also planning to organize workshops in each pilot region targeted to the policy teams who can benefit from the DUET solution as well as additional organisations (who can provide support and influence). It should be worth noting that whilst citizens have not been considered as a direct audience segment for dissemination, they are a direct target for communication activities (detailed at end of this chapter) and all material will be accessible to anyone who has an interest in data driven policy making.

Dissemination Activities Focus: All project partners will perform dissemination activities, but they will differ according to partner type and area of specialisation. The technical partners will approach their networks in order to raise industry level awareness about the ability of DUET's services, while the business and SME partners will focus on disseminating the project results towards city policy makers to encourage take-up and adoption of the Digital Twin approach, at the same time research partners will target research institutes and universities across the enlarged Europe aiming to showcase DUET's results for influencing and informing further studies in this area.

2.2.1.4 Knowledge Management and IPR

Whilst the DUET Consortium are working to principles of Open Government, Open Access and Open Innovation, choosing technical components, where possible, that are Open Source to ensure project results are freely available to all, the consortium also recognises that formal management of knowledge and intellectual property rights (IPR) is fundamental for the effective cooperation within the project lifetime and the successful exploitation of the DUET Digital Twin solution within and after the end of the project. Through knowledge management and the protection of partners' individual interests, we will avoid information bottlenecks related to confidentiality or competitiveness among the Consortium members, thus the chances for the market visibility and the exploitation potential of project results are maximised. Management of knowledge and IPR issues will be carefully integrated within the framework of the Consortium Agreement (CA), drawn to be aligned with the policies and context for EC funded projects under the ICT programme of the Horizon 2020. The Consortium agreement will specify how and under which terms and conditions partners access existing knowledge or knowledge generated by other parties. It will also elaborate on the terms and conditions of access to such IP in the case of exploitation beyond the scope and duration of the project. The Consortium Agreement will carefully identify the Foreground and Background Knowledge and will address: confidentiality, i.e. issues related to the disclosure of confidential information in accordance to applicable laws and EU regulations; ownership of knowledge; legal protection of results; access rights to Foreground and Background; obligation for use specifying the responsibilities of the partners to meet the EC Model Contract; dissemination of knowledge according to regulations governing IPR and reflecting the EC Model Contract. The enforcement of the agreement is a task of the management structural organisation. This is not obligated to start a legal process.

2.2.1.5 Standardisation Activities

Policy Making: In addition to working with International research initiatives (identified in chapter 1.3.1.7 such as the Policy Lab who are gather ideas, research outcomes and new methodologies on how to use data for decision making) and PoliVisu who are creating a framework for using Big Data in the traditional policy making cycle, DUET will also consider how to contribute ethical input into IEC and ISO International Standards for policy making. These International Standards developed by the IEC and ISO are voluntary. And while they do not seek to establish, drive or motivate public policy, regulations, or social or political agendas, they do provide valuable support to the implementation of public policy. DUET envisions embedding the ISO principles in its processes, submitting the results as a reference case for other policy makers, as well as getting directly involved in the International Standards development process, potentially suggesting a new working group to explore data-driven policy making.

ICT Standardisation: The Open Geospatial Consortium (OGC) provides a key expert to the DUET expert panel. During a previous GI project, DUET's Coordinator AIV, organised the creation of a new OGC DCAT Geospatial working group to focus on best practices in the field of cross-domain metadata standards. DUET will continue to deliver value to that group by describing how metadata about live (big) datasets and sensor data can be added to the existing DCAT standard by formulating and testing specific extensions. The advantage of such an extension is that every dataset uses the same basic and easy to understand information, and that extra valuable and more accurate information can be added in a standardised way. This approach is in line with the W3C, OGC and JRC approach on DCAT and GEO-DCAT (AP). Whilst seeming very technical, this standard work helps to advance the field of big data use, making it ever easier for cities to used data in an interoperable manner. DUET will also add additional value by contributing to other OGC initiatives on sensor data like the SWE standard (Sensor Web

Enablement) and SOS (Sensor Observation Service) standard by using the appropriate sensor standards and communicating our findings to the OGC and ITS community.

2.2.1.6 Management of Data

Whilst DUET is an Innovation project and therefore focuses most of its activities on design and development, any research data generated and/or collected during the project will be carried out following a Data Management Plan that will be included in the overall Project Management Plan. This will include guidelines for collecting, storing, handling and making accessible the data produced during the research and validation work streams. The plan will be constantly updated to fine-tune it to the data generated and the uses identified by the consortium during the research.

DUET will follow the Open Access mandate for its publications and will participate in the Open Research Data pilot, so publications must be published in Open Access (free online access). Following the list of deliverables, the consortium will determine the appropriate digital objects that will apply to the Data Management Plan. Each digital object, including associated metadata, will be deposited in a designated institutional repository (University of Leuven to decide), with an objective to increase visibility and make it accessible and preservable. This reflects the commitment of the Consortium within the framework of the *Initiative for the Budapest Open Access*, with the movement of open access to knowledge gained from joining the *Berlin Declaration* and Institutional Policy on Open Access. The Data Management Plan will contain an Ethical Protocol with precise indications for fulfilling the following tasks:

- How to ensure the privacy of all pilot participants; how to manage, store and destroy sensitive data; how to anonymise data which will be made public and openly accessible;
- How to ensure a constant quality control for the collected data;
- How to use the data collected and/or produced during the project, respecting the privacy of all participants, the intellectual property and the exploitation in further research of the collected findings.

The data collection and storage will be defined in order to guarantee the quality of data and its correct use during the evaluation. A special effort will be made to collect as little restricted and personal data as possible. The collection, storage, management and evaluation of the data will be mainly oriented to evaluate the service. All the personal data added to the central database will be anonymised.

Furthermore, all this data will be handled only by qualified members of the Consortium under strict confidentiality agreements, who will ensure that data access, data protection and privacy standards are in compliance with national and European regulations. All the users included in the different trials will sign an informed consent in which they will be duly informed about how their personal data will be treated. Should any sensitive data be obtained during the project, the project will see to it that it be made anonymous and rigorously protected for the duration of the action and destroyed at the conclusion. When processing personal data, the consortium will comply with the Data Protection principles which are set out in the Directive 95/46/EC and its revision (European Parliament legislative resolution of 12 March 2014 on the proposal for a regulation of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation)**.**

2.2.1.7 Communication Activities

In addition to a general dissemination approach, more focused communication activities for specific audiences will be framed around two central objectives: (1) development of incentives to help engage specific stakeholders (relevant to the mobility challenge being explored) in the pilot sites to participate in the experimentation (development and testing) of new policies, (2) creation of the DUET Business Case based upon the pilot results and use to attract new users/adopters. At the outset of the project, DUET will elaborate upon these objectives to create a communication approach that will include the following tasks:

- Build on the project brand and identity to create communication messages for targeted audiences;
- Generate positive media coverage for the project at local, national, European and international level;
- Communicate project results and achievements to specific stakeholder groups at targeted local events;
- Contribute to and help sustain active communities of interest around data-driven policy making;
- Develop a tailored methodology to monitor and measure the impact of the communication strategy.

DUET will address the following target groups: (a) Governance: Policymakers who have an interest in improving policy impact using data (b) Stakeholders: Communities, organisations and individuals who will co-create policy with the policymakers, and (c) Influencers: Media, standards bodies & research institutions who are interested in DUET results (3 letters of support already included in Annex 1 – Part 4-5 of the bid).

DUET will achieve the above objectives by using a multi-platform, multi-channel communication strategy to carry out diverse and novel activities in order to create compelling content and events that live-up to the scope of the project and the challenging environment of data driven decision making. Key elements include:

Enhanced Multi-Media Website
Create a general dissemination website with additional pages and material for specific audience groups. Update it with results and achievements, including access to the interactive DUET Digital Twin simulations, during the entire project period. Complement information with interwoven tools such as social media, newsletters, RSS feeds, project results as well as presentations and other audience videos and specific publications. **Audience:** Policy makers, Researchers, Stakeholders, Standards Bodies, Media, General Public **KPIs:** Quantified and qualified web traffic analysis, trackbacks, mentions
Specialised Social Media
In addition to managing the main social media channels (Twitter, LinkedIn and Facebook) DUET will set up and maintain other more specialised social media channels for specific audiences (Google Scholar, Tumblr, Listgeeks, Xing etc.) and will connect to and influence ongoing conversations in particular areas of big data, linked data, open data, geospatial data and policy discussions related to transport and mobility. Where possible the social channel will be linked with the project website **Audience:** Policy makers, Researchers, Stakeholders, Standards Bodies, Media, Public **KPIs:** Quantified and qualified social media analysis, number of retweets/shares, mentions, listings
Targeted Conferences/Workshops
Includes events created by the consortium streamlined towards the various mobility policy areas in DUET as well as a wide range of fairs, conferences and workshops within the academic, industry and standards world e.g. Global Forum, NetFutures, DataCloud Europe, Data for Policy Making, Smart City Expo and World Congress, etc. **Audience:** Policy makers, Industry players, Researchers, Standards Bodies **KPIs:** Number of presentations given and papers/workshop/poster proposals accepted, attendees
Policy Data Jams
DUET may organise Data Jams within the pilot locations to showcase the use of the DUET Twins and provide a supportive co-creative space for the first hands-on experimentation of specific policy challenges. The Jams will enable the novel creation of practical solutions concerning on these challenges. The results of these events will be used to further promote DUET across traditional and new media. **Audience:** Policy makers, Stakeholders, Media, **KPIs:** Number of attendees/platform sign-ups, evaluation of concepts, policy scenarios created,
Paper Publications
With regards to the academic community the respective DUET research partners (KUL,IMec) intend to disseminate the results of the project via the publication of articles and submission of technical papers in specialized press (e.g. Journal of Policy Making) magazines and/or newspapers also on-line (e.g. TechCrunch, EurActiv), audio or video media, at international, European, national, regional or local level in order to reach the widest audience possible. Additionally, these papers will be further promoted via DUET's regularly updated newsletter **Audience:** Policy makers, Researchers, Standards Bodies, Media **KPIs:** Number of papers, publication types, countries covered, audience reac
Clustering
Sharing lessons learned and even resources with other related projects and initiatives in the ICT/Data Policy Making world will ensure DUET doesn't reinvent the wheel but rather it builds upon the results of others in the field. Clusters will include cross-project activities with other EU funded initiatives such as PoliVisu, Open4Cities, WeLive and Smarticipate; as well as networking with European associations and networks such as OASC (Partner) EuroCities, LOLA, VICTOR, FutureCities catapults, etc. These clusters will be useful in creating DUET final dissemination event, which will be held in conjunction with a major event (Policy Making, Smart Cities, Horizon2020 related) to showcase the Twins **Audience:** European Projects, Policy Networks, Mobility Networks, Standards Bodies, Researchers **KPIs:** Number of networks/projects, lessons shared, meetings/events, impact on DUET

Audio Visuals
The production of a professional animated DUET video for informing and engaging users will be placed on the website and used at conference exhibitions, training workshops and event presentations and the like. The core aim of the video is to explain the somewhat complex undertakings to the widest possible audience. This professional video will be supplemented with short Vox pops and consortium made films to support more specific exploitation opportunities. **Audience:** Policy makers, Researchers, Stakeholders, Standards Bodies, Media, Public **KPIs:** No. of views, number of shares, mentions, listings

As with the general dissemination approach, more specialized communication outreach will be carried out by individual partners to the audiences they identify with and have access to. This approach is intended to build on established trusted relationships to significantly increase the chances of encouraging the adoption of DUET solution by end users.

3. Implementation

3.1. Work Plan

The work plan for DUET is broken down into logical tranches using the Work Breakdown Structure (WBS) approach. The diagram below highlights how the interconnected and dependent work packages work together and where they fit in the overall workstreams (see Methodology chapter).

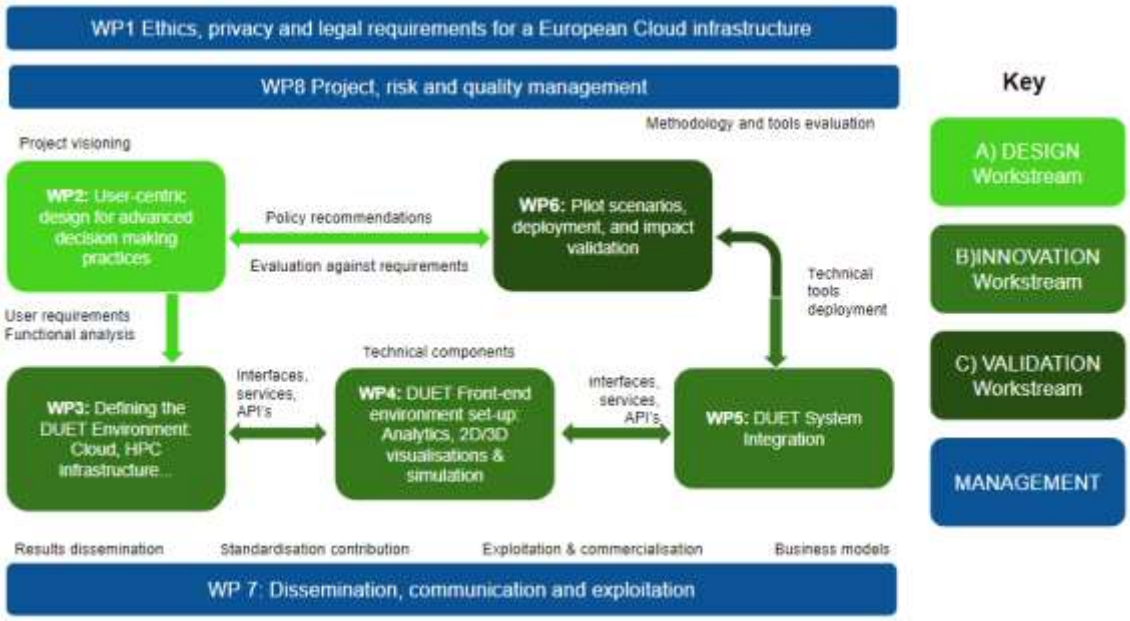


Figure 8: High level relationship between DUET work packages

WP	Title + Description	Lead
1	**Ethics, privacy and legal requirements for a European Cloud infrastructure** addresses questions on how to use cloud for sharing and re-using data between different stakeholders. Also, examines ethical aspects of using data in decision-making processes to create trust in decision making.	GSL
2	**User-centric design for advanced decision-making practices** uses Design Thinking to extract end-user requirements from multi-disciplinary and multi-sectoral stakeholders to ensure the Digital Twins will meet their needs from look and feel, to features and underlying business models.	IMEC (SMIT)
3	**Defining the DUET Environment: Cloud design, HPC infrastructure, security, modeling, semantics & standardisation** covers Cloud design, HPC infrastructure, security, modeling, semantics & standardisation to create a Digital Twin architectural Blueprint based on functional and technical requirements to enable complex data modelling, simulations and impact predictions for evidence-based policy making.	IMEC (COT)

4	**DUET Front-end environment set-up: Analytics, 2D/3D visualisations & simulation** creates a Digital Twin front-end using analytics, 2D/3D visualisations & simulation to present results to multiple stakeholders (citizens, policy makers, city managers). This front-end will display the results of the HPC modelling and simulations in 2D, 3D and in an advanced (dashboard) data presentation allowing for gamification and advanced data filtering.	VCS
5	**DUET System Integration** undertakes the integration of the different architecture layers (Infrastructure, Data, Business, Presentation and Security). The WP will take care of building a reliable and manageable core system that is replicable and extendable.	ATC
6	**Pilot scenarios, deployment, and impact validation** deploys, tests and validates the DUET tools through real-life proof-of-concepts in three different cities & regions (Flanders, Athens, Pilsen) the results of which will be analysed and used to refine the offering, so it is easily transferable and replicable in other cities.	OASC
7	**Dissemination, ecosystem management and exploitation** builds on the results of previous WPs, deploying outreach strategies to ensure general awareness raising of DUET and targeting of its results to specific stakeholders. The WP will package DUET into an exploitable offering for adoption by new cities.	21C
8	**Project, risk and quality management** is an 'umbrella' work package defining the project vision, quality procedures and management actions for resource-efficient and timely management of DUET. WP8 will produce regular financial and operation reports on the project progress.	AIV

3.1.1. Gantt Chart

DUET Gantt Chart

WP	Task	Lead	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
			Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
									MS1					MS2						MS3						MS4						MS5						MS6
WP1	Ethics, privacy and legal requirements for a European Cloud infrastructure	GSL																																				
	T1.1 Identification of legal and ethical considerations	GSL				D1.1																																
	T1.2 Ensuring legal compliance	GSL										D1.2										D1.3										D1.4						
	T1.3 Exploring ethical responses	AIV															D1.5																					D1.6
	T1.4 Providing recommendations to the European Cloud Infrastructure progran	GRI																																D1.7				
WP2	User-centric design for advanced decision making practices	IMEC																																				
	T2.1 Policy (Value) Network Analysis	IMEC				D2.1																										D2.5						
	T2.2 Scenario specifications of the DUET solution	IMEC					D2.2																															
	T2.3 Co-creation of the Digital Twin concept	IMEC							D2.3																														
	T2.4 Cloud based Business Models	IMEC																		D2.4																			
WP3	Defining the DUET Environment: Cloud design, HPC infrastructure, secur	IMEC																																				
	T3.1 IoT stack and data API design	IMEC									D3.1									D3.2																			
	T3.2 Smart City domains, models, interaction frameworks	KUL						D3.3																		D3.4													
	T3.3 HPC and cloud design for model calibration and simulation	TNO												D3.5																								
	T3.4 Generic data standards and specific Standards for Open and Linked Orga	AIV																		D3.6															D3.7				
	T3.5 Digital Twin Broker and API design	IMEC												D3.8												D3.9												
	T3.6 Security and Privacy model	AEGIS												D3.10												D3.11												
WP4	DUET Front-end environment set-up: Analytics, 2D/3D visualisations & si	VCS												RelA						RelCB						RelOB						RelC						
	T4.1 Model Visualisation	TNO																		D4.3																		
	T4.2 2D and 3D Visualisation	VCS									D4.1									D4.4												D4.7						
	T4.3 UX/UI design, dashboarding and interaction support	VCS																		D4.6																		
	T4.4 Data analysis & Visualisations	TNO												D4.2						D4.5																		
	T4.5 Information integration	VCS																																				
WP5	DUET System Integration	ATC												RelA						RelCB						RelOB						RelC						
	T5.1 System Architecture	ATC												D5.1																								
	T5.2 Platform Integration	ATC																		D5.2																		
	T5.3 Technical Assessment & Testing	ATC																																				
	T5.4 Maintenance, Operation & Updates	ATC																																	D5.3				D5.4
WP6	Pilot scenarios, deployment, and impact validation	OASC																	Internal testing					CUG						OUG						SUG		
	T6.1 Pilot Operation Planning	OASC												D6.1																								
	T6.2 Personalising the Digital Twins	ATC																		D6.2																		
	T6.3 Pilot Testing Cycles	OASC																						D6.3						D6.4						D6.5		
	T6.4 Evaluation and Validation	IMEC																																			D6.6	
WP7	Dissemination, ecosystem management and exploitation	21c																																				
	T7.1 Development of Impact Realisation Roadmap	21c			D7.1																																	
	T7.2 Dissemination Kits for Partners	21c			D7.2											D7.3									D7.4										D7.5				
	T7.3 Ecosystem Engagement, Growth and Management	21c																																				D7.9
	T7.4 Sustainability Through Exploitation and Commercialisation	IMEC																		D7.6												D7.7			D7.8			
WP8	Project, risk and quality management	AIV																																				
	T8.1 Project Visioning and Strategic Direction	AIV	D8.1											D8.1												D8.1												D8.1
	T8.2 Project Planning and Daily Administration	ISP		D8.2																																		
	T8.3 Data Management Plans	AIV						D8.3						D8.3												D8.3												D8.3
	T8.4 Expert Panel Engagement and Management	AIV																																				
	T8.5 Interim Progress Reporting and Reviews	ISP													PR																								PR
									MS1					MS2						MS3						MS4						MS5						MS6
			Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
			M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36

RelA RelCB RelOB RelC platform development and integration cycles 1-3 (releases alfa, closed beta, open beta, candidate)

Internal CUG OUG SUG pilot testing cycles (internal, closed, open and sister user groups)

3.2. Management Structures, Milestones and Procedures

DUET is an ambitious innovation project with the key objective to leverage the power of Cloud to deliver policy innovation in today's smart cities, regions and related sectors, as well as to encourage fast adoption of Cloud solutions across Europe. The consortium will use a proven project management methodology - Prince2 - to ensure everyone understands each-others roles, responsibilities and deadlines, ensuring all work undertaken contributes to achieving the DUET vision and associated KPIs. This strong leadership will ensure the successful delivery of high-quality outputs and outcomes as well as the protection and effective utilisation of the knowledge that is generated. DUET has incorporated qualified programme and project managers within its team, and for effective solution building centred around end-user needs DUET appoints a scrum manager to lead an agile development process, with sprint cycles between 2 to 8 weeks.

3.2.1. Organisational Structure

The organisational structure of DUET incorporates traditional project management workflows and roles with more modern development practices. The diagram below illustrates the proposed framework for the roles within the project. This structure will be finalised with the signing of the Consortium Agreement by all partners. Besides this, although key partners have been identified for each role, the complete structure will be finalised and implemented within the Project Management Handbook and Quality Plan, which will be delivered in the early months of the project.

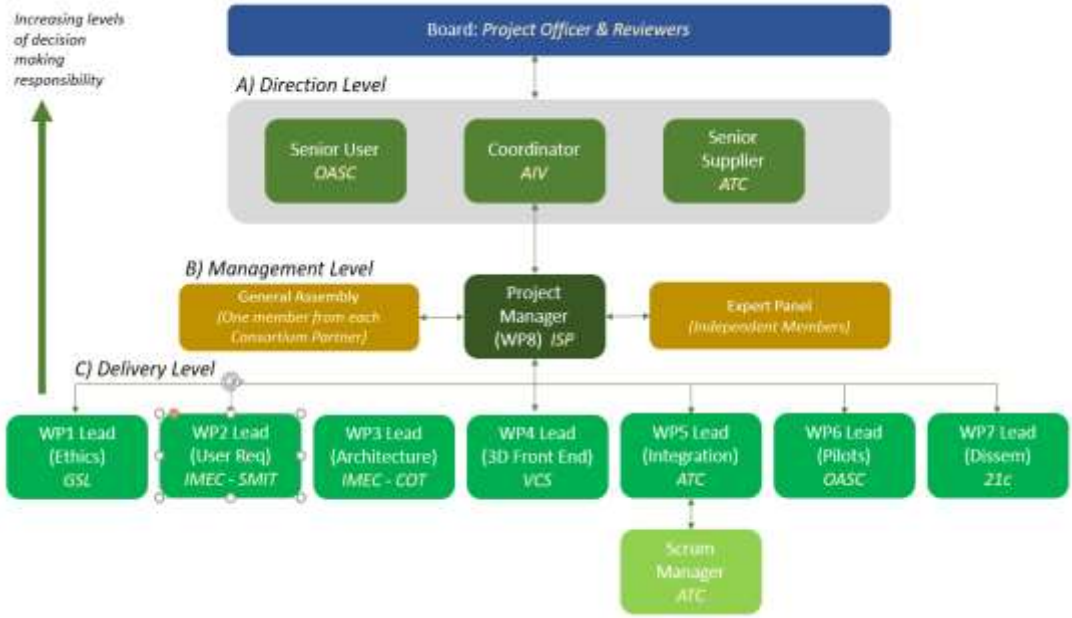


Figure 9: Project Organisation Structure Using PRINCE2 Project Management Standards

The Key roles within the DUET project are as follows:

A) Direction Level

Programme Management Board: Composed of the European Commission's Project Officer and supported by 2 to 3 external reviewers, the Programme Management Board gives the go-ahead for the project to proceed, sets the tolerances for the project, receives all the outputs and results for quality assurance, and provides strategic steering advice to the Consortium.

Project coordinator: The Coordinator (AIV, represented by Lieven Raes) is ultimately responsible for the vision, ethics and strategic management of the project and is ultimately accountable for its direction and success. The Coordinator will work with the Senior User and Senior Supplier to ensure the DUET Digital Twins are built and piloted in a manner that meets both the needs of the end-user (usable solution) and the suppliers (commercial product). The Coordinator provides strategic guidance and support to the Project Manager, chairing General

Assembly meetings, reviewing risk logs, undertaking quality assurance, and has the casting decision in any group vote or decision around change control. The Coordinator is responsible for the allocation and distribution of the overall budget and is the projects direct point of contact with the Programme Board. Note, the Coordinator is not delegating any of the tasks listed in art 4.1.2 of the GA to the Project Manager.

Senior User: The Senior User (Open & Agile Smart Cities, represented by Davor Meersman) is responsible for specifying the needs (requirements) of the users that will use the DUET Digital Twins. He effectively provides the liaison between the project management team and the users and ensures the solution meets end user needs especially in terms of quality and adherence to requirements, to ensure expected benefits are realised.

Senior Supplier: The Senior Supplier Role (ATC, represented by Anna Triantafilou) represents the interests of those designing, developing, facilitating, integrating and implementing the DUET Digital Twins. She ensures the Consortium provides appropriate technical resources to the project and ensures that the right people, tools, equipment and knowledge are in place, and that the Digital Twins will meet the expected criteria, including quality criteria.

A) Management Level

Project Manager: The Project Manager (ISP, represented by Hugo Kerschot) is responsible for day-to-day operations of the project. He manages the project on behalf of the Project Coordinator and is the main link between the Coordinator, WP Leads and the Partner Leads on the General Assembly. Specific responsibilities include: owning and updating the project plan, risk register and quality log, motivating and managing the team, closely monitoring the progress of the project, orchestrating the peer-based quality assurance process for outputs and deliverables (all members of the Consortium are quality assurance reviewers for multiple documents), official reporting coordination and reporting of issues to the Coordinator, and configuration management of all outputs and documents.

General Assembly (GA): The GA consists of official delegates assigned by the project partners, and is chaired by the Coordinator. The representatives will have the authority to make decisions (vote) on behalf of their respective organizations in terms of overall project strategy, proposals for changes to the Description of Action, resources allocated to the project, and any other contractual and financial matters. For the avoidance of doubt, any change to the Consortium Agreement or any budget-related change to Annex 1 to the Grant Agreement shall only be legally binding between the Parties if agreed in writing and executed by the duly authorised signatories of each Party.
The GA will vote on all important decisions related to the contractual execution such as changes to the consortium configuration, reallocation of responsibilities and effort among partners, settlement of disputes, or differences between partners. If necessary, the GA can create ad-hoc Task Forces, composed of experts, chosen from the project participants, that will work together to solve well-defined problems in a limited period. A face-to-face GA meeting will be organised at least once a year, but in practice will convene at the end of each project meeting. Conference calls may be organised on ad hoc basis. The GA's role, responsibilities, rules, and decision-making procedures will be detailed in the Consortium Agreement (CA).

Expert Panel: To provide the role of a critical friend to the project, with insights, knowledge and advice on deliverable outputs DUET has appointed an external panel of eminent policy experts (see 3.3). The experts will receive copies of deliverables for quality assurance review and will be invited to attend selected project meetings to view progress first hand and provide feedback and opinion.

C) Delivery Level

Work package Leads: The WP Leaders prime responsibility is to ensure production of the products and outputs in their Work Package, under the control of the Project Manager, to an appropriate quality in the expected timeframe and cost outlined in the Description of Action and the Grant Agreement. They direct motivate, plan and monitor the delivery work, advise the Project Manager of any deviations to the plan; ensure all project issues are properly reported; and ensure quality control of the working teams are performed and planned correctly.

Scrum Manager: The Scrum Manager sits under Work Package 5 and is responsible for the agile integration of the DUET Digital Twins ready for piloting. They are responsible for ensuring the development team follow agile values, principles and processes. Responsibilities include breaking down work into sprints, clearing obstacles for development and establishing an environment where the team can be effective. They ensure the Digital Twin solutions meet the requirements of the Senior User and Senior Supplier who are in effect the products owners.

3.2.2. Management Procedures

3.2.2.1. Change management

Change management is a process for requesting, reviewing, approving, carrying out and controlling changes to a projects direction or core deliverables that will affect the end result, whether its impact, budget or timeframe. At the start of the project in a Project Management Handbook, the Consortium will agree a well-defined process for change control based upon that will detail responsibilities, tolerances for change at different project levels, and tools to be used to manage the change process. Any participant in DUET may raise a Request for Change (RFC). The Project Manager and Coordinator will then ensure it is captured and proactively managed to conclusion. An initial review should be made to examine the need for the change, how it could be achieved and what the consequences would be. The most appropriate member of the Consortium would normally perform this review. Based on those conclusions, a recommended action would be proposed which would be one of three possible courses: (1) Minor changes within scope can be approved by the Project Manager. (2) Change affecting deadline or deliverable or outcome would need to be reviewed by the Coordinator and shared with the General Assembly to agree the necessary revisions to get the project back on course. (3) Larger changes of scope and grant agreement revisions would require the approval of the European Commission. The diagram below highlights DUET approach to change control.

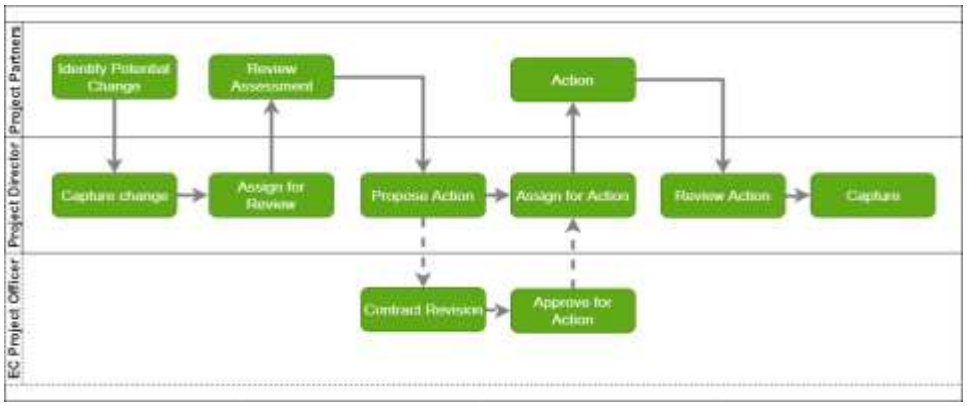


Figure 10: DUET Change Control Process

3.2.2.2. Quality Control and Management

Quality control: Before the project begins, the Consortium members will sign a formal Consortium Agreement in which roles, responsibilities and mutual obligations will be defined. The Consortium Agreement will include: Internal organisation of the Consortium, its governance structure, decision making processes, reporting mechanisms, controls, penalties and management arrangements. Mitigation processes and provisions for the settlement of Partnership disputes. Specific arrangements concerning ownership and intellectual property rights to be applied among participants. Management of knowledge generated by the project and rules for knowledge transfer. Rules for Partners joining and leaving the Consortium.

Quality management: On the other hand, quality management will be carried out to ensure that the quality expected by the EC is achieved. Progress of the work within the project will be monitored against the milestones and the defined objectives and performance indicators (the impact framework including indicators will be developed as part of the ECDER and will also include the communication indicators: e.g. hits on the website, social media uptake, etc.). These success criteria, based on the EC's expectations for the project, will be defined at the beginning of the project to ensure that all work is carried out in reference to them. To help ensure the project meets its objectives, all the quality procedures to be implemented during the project life cycle will be formalised in

the Project Management Handbook issued at the start of the project in WP8. The plan will define the techniques and standards to be used in the project. These techniques and standards will include a set of rules for the organisation of the day-to-day work, the procedures and reporting mechanisms to be used, the organisation of meetings and the preparation of Deliverable documentation for submission to the EC.

The Coordinator (AIV) will head the Project and Quality Assurance role for DUET. The specific responsibilities of these roles will be defined in the Quality Assurance section of the D8.2 Project Management Handbook, but the main role will be to review and approve plans created for each stage of the project and ensuring that quality checking arrangements for the deliverables in these plans are satisfactory.

In addition, the Project Manager will perform a Quality Control role for the project. This will involve a structured internal peer-review of each deliverable produced in a planned, documented and organised fashion. Once the deliverable has been reviewed, the Project Manager will either give 'sign off' to the deliverable to assert that it has passed the quality review and is able to be sent to the EC, or they will assert that the deliverable is not 'fit for purpose'. In this circumstance, the deliverable will be sent back with comments to its producer. If the producer is unable to resolve the problems, this will be taken to the General Assembly to decide on the appropriate action.

Document Quality Management: By using regular management conference calls, meetings and mailing lists, the project partners will be regularly informed about the project status, planning and any other issues relevant for the partners in order to obtain maximum transparency and awareness. Documents shall be transmitted and published via the web page, where appropriate. In addition, a cloud document repository will be managed by the project manager for the consortium to have access to all project documentation. A template for the deliverables will be elaborated so that all the project deliverables comply with the same form and structure.

3.2.2.3. Communication Flows

The main vehicle for information exchange within the project will be through online cloud-based collaborative management software which will be customised to the needs of DUET. Hence, the DUET consortium will have access to project information (e.g. working papers, deliverables, minutes, calendar, timelines, etc.) wherever they may be, no matter what device they are using. Deliverables and reports will be worked on in a collaborative way through shared documents so multiple people can work and contribute to the outputs at the same time. Email is the preferred means for formal communication and information exchange between the partners. However daily working cooperation exchanges should be through online messenger systems like Skype, Slack or Google Hangout so as to not clog people's inboxes. Project conference calls will be on Webex which can record important discussions. The full suite of management tools, file formats and configuration management used for project communication will be agreed upon at the start of the project and will be outlined in the project handbook.

3.2.3.4. Critical Risk Management

A detailed risk management plan will be created at the start of the project (as a part of the Quality Assurance section of the D8.2 Project Management Handbook) to clearly define how the DUET consortium will identify and manage risks throughout the life of the project. This plan will include the creation of a risk log including an account of actions to mitigate these risks. The risk exposure will be assessed for each of the identified risks, being derived from two variables: impact and probability, as the following table illustrates:

	LIKELIHOOD		
SEVERITY	**High**	**Moderate**	**Low**
High	**HIGH**	**HIGH**	MODERATE
Moderate	**HIGH**	MODERATE	LOW
Low	MODERATE	LOW	LOW

The process to be used is a simple step-by-step checklist summarised as follows:

(1) Identify risks. A risk log will be created whereby the Project Manager will identify risks, in close collaboration with WP leaders. The methodology used to identify the risks will be carried out by a "what-if" analysis. (2) Evaluate probability. (3) Evaluate impact. (4) Document the two variables and devise an action plan to mitigate the risks in advance and take proactive actions. (5) Manage actions. (6) Evaluate results.

As stated above, specific risk mitigation strategies will be put in place and acted upon to reduce the probability of occurrence or impact of a risk. The Project Manager will review each risk (based upon the risks impact and its likelihood) and define a mitigation and/or contingency plan that is aimed at preventing the risk from materialising or taking corrective action if the former fails. The mitigation plan will include the preventive actions to be performed, responsibilities to be assigned, and tentative dates by which the plan will be implemented. A contingency plan will also be defined to counter any risks that eventually materialise further on down the road. **Risk Monitoring:** A mitigation plan for all identified risks will be defined and closely monitored by the project management team. Once a risk is identified, it will be tracked and monitored during the project in order to minimise its potential damage. This will be done via status reports and periodic management reviews of the project. A risk log outlining potential issues and contingency actions will be created at the start of the project. An initial list of key project risks for each WP has been identified and is provided in the Section A.

3.3. Consortium as a Whole

The DUET consortium has been built in order to conform to the following criteria:

(i) Adequate level of manageability.
(ii) Balanced consortium between the public sector, International orgs, research/academia/NGO's and SMEs.
(iii) An International approach.

Consisting of 15 partners from 6 different European countries: Belgium, Czech Republic, Germany, Netherlands, United Kingdom and Greece, the Consortium is led by Informatie Vlaanderen (AIV) who has long standing experience in EU projects and includes ***two global network partners***, Open and Agile Smart Cities (OASC) and Plan4All which helps guarantee wider impact outside of the Consortium.

Carefully constructed around user-needs (see diagram below) the Consortium brings together partners who have complementary skill-sets, experience and expertise. This careful selection favoured the definition of distinct roles and responsibilities in order to deliver good value for the budget.

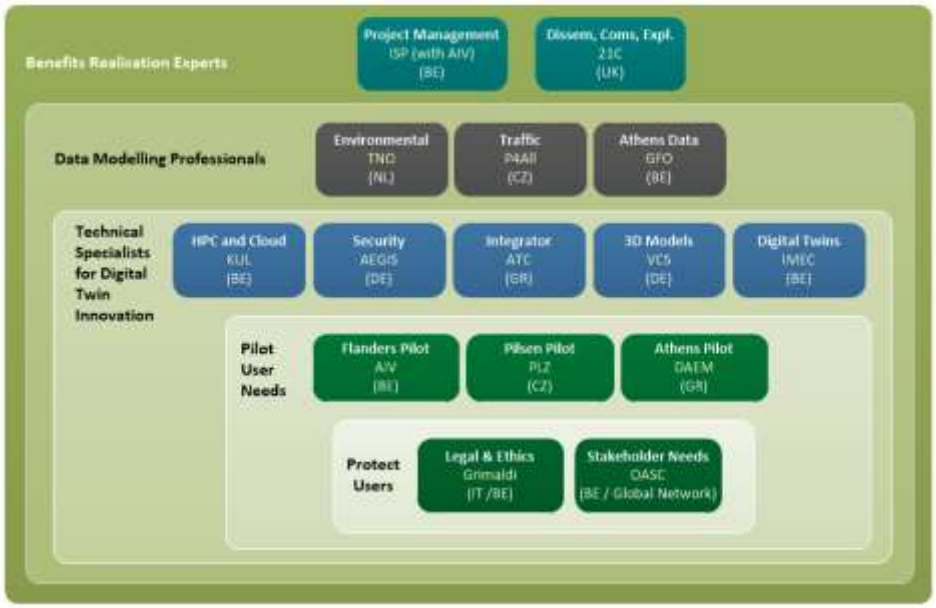


Figure 11: User-Centric Building of the Consortium

From the top down core responsibility are:

Benefits Realisation: DUET will be led by the ***Flemish Information Society (AIV)*** (formerly known as CORVE – Flemish eGovernment Authority). AIV will drive the overall research and innovation effort and ensure rigorous standards of quality are enforced throughout. AIV has an extensive track record as a pioneer in the delivery of innovative Open Data services through coordination of the flagship CIP project Citadel on the Move, the transport data visualisation project OpenTransportNet, and data-driven policy making project PoliVisu. AIV will be

supported in day-to-day project management by ***IS Practice (ISP)*** - A dedicated project management practice with more than 10 years experience of delivering high-quality, high-impact projects for the European Commission, and ***21C*** - a communications and design thinking SME with over 15 years of specialising in open innovation, co-creation techniques and creating campaigns that humanise technology to engage different stakeholder group. Benefits realisation will also be supported by all partners especially *OASC* who will utilise their city network for dissemination, and *iMEC* whose researchers will help with business modelling.

Technical Specialists: The technical lead for DUET is ***Athens Technology Center (ATC)***, a specialist ICT SME who will manage the overall architecture and integration of the Digital Twin components. Components are provided by the innovative ***Virtual City Systems (VCS)***, a company that specialises in the creation, management and distribution of complex 2D and 3D geospatial data who will provide the Digital Twin interface. The HPC and cloud power and services will be provided by the renowned research institution, the ***Catholic University of Leuven (KUL)*** and the Digital Twin data broker and expertise is provided by ***iMEC***, the world-leading R&D and innovation hub in nanoelectronics and digital technology. This expertise is supplemented by the security expertise of ***Aegis (AEG)*** a leading Industrial IT company in developing advanced visualization systems.

Data Modellers: Initial data models to launch the Digital Twins and enable them to explore interrelated transport, environment and health impacts are very important. Tried and tested traffic models will be provided and advanced by specialist Geodata not-for-profit ***Plan4All*** and their subcontractor *University of West Bohemia.* Environmental models will be under the remit of ***TNO*** an independent research organisation based at the University of Delft focusing on social value. Supporting the city of Athens (DUETs least advanced pilot) on their way to opening and reusing city environmental and transport data is ***GFOSS (GFO)*** a non-profit organisation promoting open standards in Greece.

Pilots: As well as being the Project Coordinator ***AIV*** leads the Flanders pilot, representing a network of cities who will all have the opportunity to benefit from DUET. Flanders is in the top 10 cities of public sector cloud use in Europe. The second pilot, ***City of Pilsen (PLZ)*** in the Czech Republic falls just outside the top 10 and is known for its pioneering work on traffic modelling. The third pilot, the ***City of Athens (DAEM)*** lies in the bottom 10 for public sector cloud use and is at an early stage in its journey towards evidence-based policy making. Each pilot has direct links to influential policy makers. The contrasts between the three pilots in terms of size and their point on the digital transformation journey provides a broad test bed for the validation of the DUET solution. Guiding the pilot work will be *OASC* who understand the needs and requirements of cities across Europe and *iMEC* who will provide academic rigour to the user requirement gathering and validation process.

End Users: Whilst the whole consortium will be required to think in a user-centric way, two partners are assigned to ensure the DUET outcomes meets user needs and protects them from unintended consequences. **Grimaldi (GSL)** is a legal firm based in Italy, with branches across Europe, including an office in Belgium, they will ensure the Twins processes comply with EU and national privacy and data regulations and help identify and think through ethical issues for the consortium to solve/mitigate. ***Open and Agile Smart Cities (OASC)*** a membership network for global cities will represent the end user view and provide a conduit for ensuring the project results meet the needs of a much larger audience.

Expert Panel: Finally, the DUET has appointed an external panel of eminent policy experts (who have signed a letter of commitment/acceptance – Annex 2, Part 4-5 of the bid). These experts will help guide the steering of the project and provide a critical friend role in terms of methodology and outputs. The panel will be chaired by the coordinator AIV and includes:

- Policy Modelling Expert: Professor Yannis Charalabidis (University of Aegean)
- Policy and Cloud Expert: Mr. Andrew Stott (former UK Government CIO)
- Geospatial Standards Expert: Bart De Lathouwer (President OGC - Open Geospatial Consortium)
- Environmental Policy Experts: Michiel Van Peteghem & Christophe Stroobants (VMM - Flanders Environmental Agency)

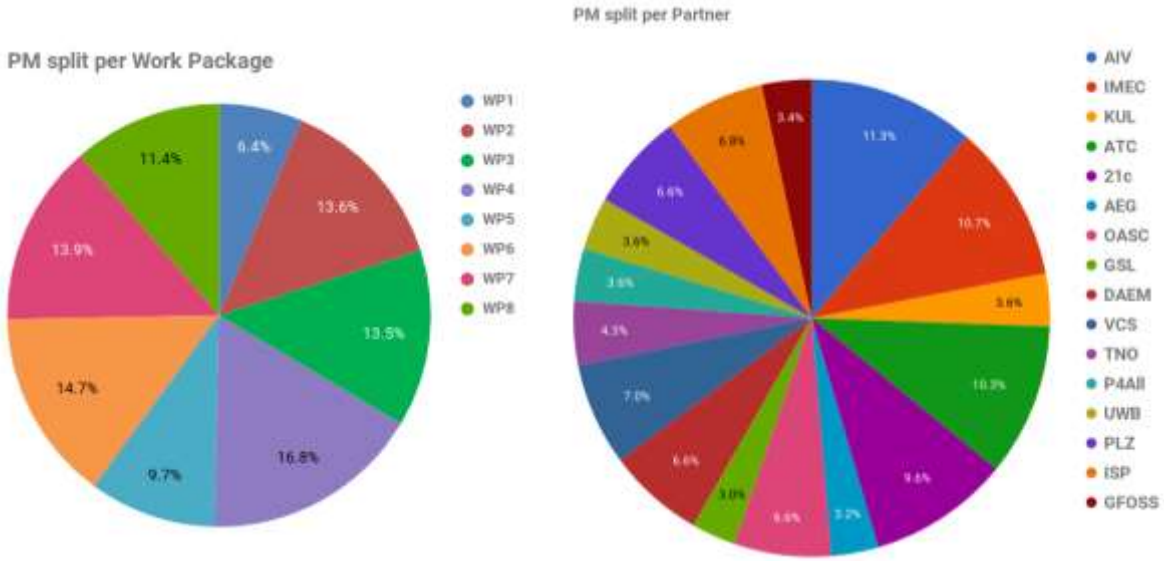
In summary, the breadth and depth of partners expertise ensure all relevant skills and domains are covered by at least two partners to (a) ensure exchange and advance best practices and (b) help manage the risk of the sudden loss of a partner or expert.

Field of expertise	AIV	IMEC	KUL	ATC	21C	AEGIS	OASC	GRI	DAEM	VCS	TNO	PLZ	P4All	UWB	ISP	GFOSS
Policy making, co-creation, Public Involvement																
Policy Development	☑								☑			☑				☑
Living Lab methodology		☑														☑
Design Thinking		☑	☑		☑											☑
Social media analytics				☑			☑									
Visualisation and Front-End																
GeoVisualisation 2D & 3D		☑								☑	☑		☑	☑		
Data dashboards		☑	☑	☑		☑				☑	☑		☑			
Data storytelling and scenarios	☑	☑	☑	☑						☑			☑	☑		
HPC & Modelling																
HPC computing		☑	☑							☑						
Traffic modelling			☑							☑				☑		
Air quality modelling		☑								☑	☑					
Noise quality modelling										☑	☑			☑		
Big data analytics		☑	☑	☑		☑					☑		☑	☑		
Cloud computing & Big Data Management																
Cloud services management	☑		☑	☑						☑			☑	☑		
Big Data Management	☑	☑	☑							☑	☑		☑	☑		
Knowledge graph management	☑	☑								☑						
Ethics, Legal & Privacy																
Ethics and legal aspects of IT		☑						☑								☑
Privacy	☑	☑														
ICT Security & ICT Standardisation																
Security						☑										
Standardisation (IOT, Smart Cities, Metadata, GIS)	☑	☑					☑			☑	☑			☑		
Dissemination, Market Analysis and Business Modelling																
Dissemination and communication	☑	☑	☑	☑	☑	☑	☑			☑			☑	☑	☑	☑
Market analysis		☑			☑	☑	☑								☑	
Business Modelling		☑		☑	☑	☑	☑			☑					☑	
Project management																
Project, risk and quality management	☑	☑	☑	☑											☑	☑
Scrum/Agile development		☑		☑		☑				☑					☑	☑

Figure 12: DUET Consortium Skills Matrix

3.4. Resources to be Committed

3.4.1. Person months



The pie charts above show a fair and balanced distribution of person-months across the key elements and partners of the project. The Innovation Workstream (WP3, WP4 and WP5) has the largest share of effort (40%) as to be expected. This encompasses all the work around Smart Digital Twins design and technical implementation. The Design (WP2) and the Validation (WP6) Workstreams account for 13.6% and 14.7% respectively. Finally, the overarching Management Workstream (WP1, WP7 and WP8) which covers ethics, privacy and legal requirements, project mgmt, dissemination, comms and exploitation account for 31.7% of project PMs.

3.4.2. Personnel costs

DUET 's total budget comes to €4,544,458 with the requested EU contribution of €3,995,532.50. Personnel costs make up majority with the total at €3,209,316. AIV has the largest labour cost because as Coordinator they have direct responsibility for the legal and admin side of the project, as well as the Flanders pilot work and management of the DUET expert panel.

3.4.3. Other Direct costs

The table below highlights the 'other direct costs' for partners whose Other Direct Costs total exceeds 15% of the personnel costs. Every partner has been allocated between €10,000 - €25,000 to cover its expected travel costs and related expenses for project meetings and dissemination events during the project. The dissemination lead (21c) was allocated with additional €10,000 to cover the costs for promotional material printing, banners, website hosting, and book publication. All fall below the 15% threshold apart from AIV and GFOSS. **AIV** has a travel budget of €25,000 to cover travel costs for the Coordinator activities.

Cost Category	Amount (€)	Justification
Travel	25,000.00	Travel and Subsistence costs for the Coordinator activities (travel items that relate to dissemination should be in line with the ECDER)
Goods and services	90,000.00	Costs for the HPC power, Cloud services, obtaining datasets, CFS
Goods and services	15,000.00	Conference booth's & and fees
TOTAL COSTS	**130,000.00**	

GFOSS has been allocated with a smallest travel budget within the Consortium (€10,000) as it is a specialist partner with less promotional responsibility. Nevertheless, due to the relatively lower personnel costs budget resulting from the consortium-lowest PM rate of €3,000, this travel budget corresponds to 18.5% of GFOSS' personnel costs.

Cost Category	Amount (€)	Justification
Travel and Subsistence	10,000.00	Travel costs for the project meetings and disseminations events (travel items that relate to dissemination should be in line with the ECDER)
TOTAL COSTS	**10,000.00**	

3.4.4. Subcontracting

DUET will appoint an external panel of eminent policy experts who will help guide the steering of the project and provide a critical role in terms of methodology and outputs. The experts will be selected within the first 6 months of the project according to the public procurement procedure of AIV and with respect to the principles of best value for money and absence of any conflict of interest.
The panel will be chaired by AIV and it is planned that it will consists of the four following profiles:

- Policy Modelling Expert
- Policy and Tech Expert
- Geospatial Standards Expert
- Environmental Policy Expert

The experts shall deliver an excellent combination of the following skills to observe and steer the DUET activities objectively and critically review the project outcomes.

- Technical implementation
- Standardisation
- Open data and IPR
- Policy Design & modelling
- Co-creation and public involvement
- Thematic knowledge (transport, environment)

Each of the four experts shall have a budget of 15,000.00 EUR during the 3-year project. The experts shall have an assignment of 20 days. An additional €15,000 is allocated to cover the travel and subsistence expenses of the advisory board. The total amount to be subcontracted is 75,000.00 EUR.

General tasks for the experts (6MD per expert): Participation to the project meetings (project management meetings and/or specific meetings). 1 meeting a year, i.e. 3 meetings per project (6 MD per project per expert).

Specific tasks for the experts (14MD per expert): These tasks include expert guidance during specific assigned tasks and document review. To make the input of the experts more valuable for the overall project results, the outcome is formulated as participation to deliverables. Nevertheless, the experts will also follow up the formulated tasks in their domain of expertise since every deliverable is linked to at least one project task. Most of the deliverables will be reviewed by more than one expert. In a project like DUET it is very important that a multidomain approach is followed. This is especially the case when a combination of technical knowledge and social/policy expertise is involved.

Policy Modelling Expert:
WP 2 (D2.2 - D2.4) , WP 3 (D3.1, D3.2, D3.5, D3.8 - D3.11), WP 4 (D4.3, D4.5), WP 5 (D5.1 - 5.4)

Policy and Tech Expert:
WP 1 (D1.5 - D1.7), WP 2 (D2.1 - D2.4), WP 4 (D4.1 - D4.3, D4.5) and WP 6 (D6.1, D6.2, D6.6)

Geospatial Standards Expert:
WP 3 (D3.3, D3.4, D3.6, D3.7), WP 4 (D4.2, D4.4, D4.6, D4.7) and WP 5 (D5.1, D5.2, D5.4)

Environmental Policy Expert:
WP 2 (D2.1 - D2.3, D2.5), WP 3 (D3.1 - D3.5) and WP 6 (D6.1, D6.2, D6.6)

Total estimate WP
56 MD (14MD * 4 Experts)

Expert	WP1	WP2	WP3	WP4	WP5	WP6	Total
Policy Modelling	0	4	4	2	4	0	14
Policy & Technical	3	4	0	3	0	4	14
Geospatial Standards	0	0	6	4	4	0	14
Environmental Policy	0	5	5	0	0	4	14
Total	**3**	**13**	**15**	**9**	**8**	**8**	**56**

Section 4: Members of the consortium

4.1. Participants

Partner 1: Informatie Vlaanderen (AIV)

INFORMATIE VLAANDEREN	**Informatie Vlaanderen** (AIV) (Belgium) Partner n° 1

Partner Introduction

Informatie Vlaanderen (Dutch, translated: Informatie Vlaanderen) is part of the Flemish Government, in Belgium. AIV is a public body tasked with support in the areas of digitization of data in e-government, GIS and public information.

Informatie Vlaanderen is responsible for several project-related domains:

- Policy support on digitization, information acquisition, information access;
- Responsible for service creation, service management and access in the GIS and e-government domains;
- Solution realization and optimization in cooperation with government, private organizations and
- companies in the fields of GIS and e-government;
- Realisation of a central information platform of services for citizens, organizations and companies - https://joinup.ec.europa.eu/community/epractice/case/magda-20-platform;
- Supporting government organizations (direct or indirect, via other intermediate organizations) of citizens, organizations and companies;
- Supporting government organizations to improve their internal processes and services by simplification
- and digitalisation to enhance a better level of service to their (external) customers;
- Delivery of a central data exchange platform to maximize the usage of government information focussed on information about persons, organisations and companies;
- Information exchange on government services including real estate data of the Flemish government;
- Delivery and access to geographical information via an efficient GDI (Geo-Data Infrastructure) platform including all the inspire datasets and other (authentic) geo-data sources (many of them are real estate oriented or can be used in the field of real estate context);

Establishing a digital framework to support and stimulate the realisation of a single and unique information infrastructure.

Key Personnel

Lieven Raes (male), xxx, holds master degrees in Administrative Management and land-use planning. Lieven joined in 1999 the Flemish government Transport and Mobility unit. He was responsible for the evaluation methodology of the Flemish local mobility plans, he was project leader of the Flemish cycling plan and participated to the first global Flemish Mobility plan. He was also involved in several fourth, fifth and sixth framework transport, land-use and environment-related EU projects. Since 2005 Lieven joined CORVE, the e-Government service of the Flemish Region which is actually merged to the Informatie Vlaanderen agency. He was responsible for the support and management of several innovative e-government applications. As a GIS expert, he was also involved in analyzing and managing several GIS applications. Lieven was one of the driving forces behind the electronic building grant in cooperation with the department of Land-use planning. Lieven was also responsible for the first business analysis of the Flemish government real estate information exchange process between regional, provincial, local government, real estate sector and the Notaryship. Lieven was the consortium coordinator of the EU project “Open TransportNet” project that focuses on making GI Data more accessible and

useable for business innovators and public sector stakeholders alike. OTN is focussing on the realization of several smart cities initiatives based on open data in Antwerp, Birmingham, Paris and the Czech Republic. Today, Lieven is coordinating the research and development Smart City programme at Informatie Vlaanderen and is coordinating the PoliVisu H2020 consortium. PoliVisu enhances public involvement and support in urban policy making, by equipping decision makers with the skills and tools - from open (geo) data processing to advanced visualisations - to use big data for collaborative policy experimentation. As a result the city makes better sustainable policy decisions and manages operations more effectively. Involved cities are Pilsen, Issy-Les-Moulineaux, Gent, Mechelen and Kortrijk. Lieven is also chair of the Open Geospatial Consortium Metadata and Catalogue services domain working group.

Raf Buyle (male), holds a Masters Degree of Applied Engineering in Electronics and is involved in strategic e-Government projects for local and regional governments since 2002.
As an advisor e-government strategy for the regional government administration of Flanders in Belgium, Raf tries to implement a more rational, interoperable e-government , promoting open data, open standards and open processes. Raf takes, in close collaboration with the European Commission, the lead in the development of a generic data standard for government administrations in Flanders (OSLO – Open Standards for Linked Organisations), including modelling of persons, addresses, organizations, buildings and public services. Raf is also involved in the development of a citizens portal in the region of Flanders, in Belgium. The portal gives citizens insights into their personal information kept by the government and allows them to give feedback.
He is a PhD student at Ghent University, active in research into the potential of interoperability in the public sector using Semantic Web concepts, technologies and applications Research from a technical, semantic, organisational, legal and political point of view. Raf is also active in the in the Open Data community, advocating Open Data as a member of the board of Open Knowledge Belgium. Before joining the regional government administration of Flanders, he was program manager and advisor e-government strategy at The Flemish Organization for ICT in Local Governments. His major expertise is centred around metadata modelling, data governance, semantic web technologies, e-government, geographical information systems (GIS) and web development in general.

Jo Van Valckenborgh (male), xxx, holds master degree in Agricultural Engineering, Master Degree in Landscape and Land-Use Planning and is certified in different Geo-IT skills.
He is Program Manager of the R&D unit 'Earth Observation Data Science (EODaS)' within Informatie Vlaanderen. Within the program he is responsible for the knowledge platform where sensor technology of different platforms (airborne, drone, satellites), eg optical imaging is combined with Big data, Geo-data, 3D and Smart City platforms. Methods of data science and artificial intelligence (AI), such as machine learning are becoming indispensable for projects within the government. Especially Deep learning is used in several projects for multi-modal data, remote sensing data, image time series or large-scale data.

Jo was initiator and project leader of several national and international projects. Topics are related to remote sensing, geo-innovation, 3D GRB, Geoportals (former portals Geo2002, Geo-Vlaanderen, now Geopunt) or the use of sensorweb.
Before joining the regional government administration of Flanders, he was freelancer, research assistant at the KULeuven and co-founder of Ground for Gis (R&D division), now Spatial Applications Diviison Leuven.

Geert Mareels (male), xxx, holds master degrees in Administrative Management and in Political Science. He was chief of staff to 3 different ministers from 1995 till 2004. From 1 October 2004 till April 2016 he led CORVE, the eGovernment service of the Flemish Region in Belgium. They built the "MAGDA" platform for sharing data across all government agencies on the Flemish and city level and with Federal data. CORVE is now merged in the Agency Informatie Vlaanderen, where is he now head of division. In 2017 he was asked to be an expert for the Research Executive Agency of the European Commission.
He is chairman of the Flemish Privacy Commission since june 2018. He was project coordinator of two EU projects: "Citadel on the Move" that aims to facilitate the use of Mobile apps by all municipalities, and "Open TransportNet" that focuses on making GI Data more accessible and useable for business innovators and public sector stakeholders alike. In his spare time, he wrote a novel and is a member of the board of editors of a magazine on political and social topics.

Jessica Vandendries (female), xxx, is since 10 year active in CORVE and Informatie Vlaanderen and was responsible in the "Citadel on the Move project" and the "OpenTransportNet" project for the organisation of external activities, dissemination, organisational, administrative and financial support.

Relevant Previous and Ongoing Projects & Activities

2017-2020	H2020	**PoliVisu Project** PoliVisu enhances public involvement and support in urban policy making, by equipping decision makers with the skills and tools - from open (geo) data processing to advanced visualisations - to use big data for collaborative policy experimentation. As a result, the city makes better sustainable policy decisions and manages operations more effectively. The highlights of PoliVisu are: ● Changing the way of policy-making by using policy ready data made available for policymakers and the public; ● Building tools that support the PoliVisu policymaking approach and allows policy experimentation; ● Enables cities to test a variety of policy hypotheses with stakeholders using local data sets. The PoliVisu solution will be validated in three pilot locations in Belgium (Ghent), France (Issy-les-Moulineaux), and the Czech Republic (Pilsen).
2014- 2017	EU CIP	**Open Transport Net (OTN)** OTN creates collaborative geo-data hubs that aggregate, harmonise, and visualise open transport-related data to make it easier for innovators to create new services and applications. The three high-level goals of OTN are: ● Data Challenge: Harmonise geographic data and open data from a wide variety of sources (city and national geo-data, INSPIRE data, volunteered geographic information, OpenStreetMap…); ● Technology Challenge: Combine geographic information, location-based services and open data to extract new information, data visualisations, mashups, and insights; ● Innovation Challenge: Provide tools (APIs) and skills to innovators for using geographic information and location-based services in rapid service creation. The OTN solution was validated in four pilot locations in the UK (Birmingham), Belgium (Antwerp), France (Issy-les-Moulineaux), and the Czech Republic (Liberec).
2012-2015	EU CIP	**Citadel On The Move** unleashes the power of mobile technology and open access data to tap into the innovative potential of citizens to deliver smarter city services. It aims to make it easier for cities, citizens, and application developers alike from all over Europe to use Open Data to create the type of innovative mobile applications fulfilling today's societies' needs. At present, governmental Open Data is often difficult to access and use for the developer community, let alone average citizens. Citadel on the Move aims to fill this void by creating: ● Formats that make it easier for local government to release data in usable, interoperable formats, and; ● Tools (a dataset converter and an application generator tool) that make it easier for citizens to create mobile applications that may be shared across Europe and offer services, which may be used on any device, anytime, and anywhere.

Role in the Project

AIV is the Coordinator of PoliVisu and is ultimately responsible for the successful implementation of the project. In addition to management activities, AIV works closely together with ISP.

Linked third party involved

none

Partner 2: Interuniversitair Micro-Electronica Centrum vzw

imec	**Interuniversitair Micro-Electronica Centrum vzw** (IMEC) (Belgium) Partner n° 2

Partner Introduction

Interuniversitair Micro-Electronica Centrum vzw (IMEC) is a Belgian not-for-profit research and Technology organization (RTO). imec vzw (headquarters Leuven, Belgium) is the world-leading research and innovation hub in nanoelectronics and digital technologies. As of October 1st 2016, iMinds, the digital research and incubation center has merged with imec into one high-tech research and innovation hub for nanoelectronics and digital technologies, under the name imec.

imec's broadened research and collaboration offering makes it a unique and world-class research center in the field of nanoelectronics, excelling in software and ICT expertise. The broadened innovation center – which will operate under the imec name – will use this knowledge to develop disruptive technologies and solutions in application areas such as manufacturing and logistics , health, smart cities and mobility, and energy. The renewed imec organization now brings together nearly 3,500 researchers, to make the impossible possible in each of those application areas. It also has access to a unique research infrastructure and an extensive network of local and international industrial and university partners for intensive collaboration. As a trusted partner for companies, start-ups and academia we bring together brilliant minds from all over the world in a creative and stimulating environment.

The research group SMIT-VUB is part of imec and is specialized in socio-economical research concerning digital innovations in IT and media. SMIT, established at the Vrije Universiteit Brussel (VUB) - Free University of Brussels in 1990, is specialized in fundamental, applied and contract research in the area of ICT and media, markets and policy. With currently a staff of over 70 researchers, and an annual turnover of well over 4.5 M€, SMIT is a major research center in Europe for policy & socio-economic research relating to ICT and media. SMIT specializes in social scientific research on media and ICT, with an emphasis on innovation, policy and socio-economic questions. ICT and the advent of an information and knowledge society leads to new forms of organizing work, education, leisure, social interaction, political participation, health, well-being etc. To understand the mutual shaping of technological, societal and individual processes SMIT research combines user, policy and business analysis with both quantitative and qualitative research methodologies.

Within imec-SMIT, the expertise center on smart cities consists of a research team of 25 researchers with technological, business, communication and user research background. On a methodological level, the Living Lab approach is a core expertise of imec-SMIT. It is amongst others applied in creating pilots in a smart city context with city administrations, in health, in social innovation with grassroots organizations, and in media with the public sector.

City of Things is a department of imec that is focusing on how technology can be addressed to tackle the complex urban challenges of a city. The rise of the Internet of Things opens the door to new ideas and (smart) innovative ways to tackle urban challenges such as mobility, sustainability and safety. These are concerns that matter not only to local governments but also the citizens themselves, researchers and companies. One of the strengths of the City of Things (CoT) initiative is that we include all these stakeholders. The aim of the program is to develop and implement a living lab where businesses, researchers, citizens and city officials can co-create, test and experiment with smart technologies that aim to make urban life more enjoyable and sustainable. The City of Things is a large-scale and real-life living lab where businesses can test and develop their smart city applications, products and services. We developed a testing ground comprising thousands of citizens, together with a wide range of expertise in the development of smart city applications and business innovation. Our goal is to advance the state-of-the-art of

smart city technology. By granting universities and other research institutions access to the unique City of Things testbeds, we aim to combine the unique expert knowledge of all partners and push innovation forward.

The true essence of a smart city is not that it is crammed full of new technology just for the sake of doing so. It is first and foremost a city where the quality of living is raised to a new level, capitalizing on the practical needs and expectations of its residents. In the City of Things, citizens are put center-stage during the entire innovation process, from idea development to the validation of the final product. City of Things provides the city with a unique infrastructure to develop and test innovative solutions to tackle its urban challenges. And it also offers a window to the what's and how's of creating a truly smart city –from a technological, logistical and legal point of view.

To reach those goals, City Of Things collaborates with many stakeholders and has a wide network of partners. For each layer in a Smart City, different competences are required. A collaboration has been set up with SMIT-VUB, Living Labs, IDLab Antwerp, IDLab Gent, Application Prototyping Team and external partners. The City of Things teams consists of pay roll 15 researchers but combines the knowledge of more than 50 researchers and partners.

Key Personnel

Prof. Dr. Pieter Ballon (male) is the Director of research centre SMIT (with currently more than 60 researchers), as well as Scientific Director Living Labs at imec, the internationally leading research institute for ICT innovation. In this capacity, he is leading various national and international programmes on Living Labs, Smart Cities, and Business Models for new media services and platforms.

Dr. Shenja van der Graaf (female) heads the strategic & innovative (r&d) cluster "Smart Cities: ICTs & Society" at imec-SMIT, VUB (Belgium). She is an honorary fellow at MIT Media Lab ID³ Hub (USA), and a Futures of Entertainment fellow (USA). She is principal investigator at imec-SMIT, coordinator and WP lead of (international) projects such as IA4SI, I3, and m-Resist. Expertise: her current work is concerned with social, economic, and policy issues arising from innovations associated with the ICTs. Specific lines of inquiry include the integration of new technologies into society; management of technological innovation in firms, cities and communities; (new) media users and 'cultures of expertise'; mediation of social and economic life, theoretical perspectives; smart cities; organizational change management; cyber security; public safety; healthy city living; government affairs/EU (EMEIA) relations; policy; management consulting; software/code market.
Van der Graaf is a graduate of Utrecht University (MA, 1999) and the London School of Economics and Political Science (PhD, 2009). She was a Fellow at the Berkman Center for Internet and Society (Harvard) and the Research Center for Information Law (University of St. Gallen), a consulting researcher at Convergence Culture Consortium (MIT), an alumna of the Oxford Internet Institute, and worked as consultant for Hakuhodo Inc. in Tokyo.

Dr. Nils Walravens (male) graduated cum laude as Master in Communication Sciences at the Free University of Brussels in July 2007 with a thesis on the introduction of High Definition Television in Flanders, from a political economy perspective. Mr Walravens started working for SMIT in August of 2007 as a researcher in the Media, Market & Innovation cluster. His main expertise is in the field of business modeling research in both the mobile and media industries and he has been involved in short-running consultancy assignments, national imec-projects and European-level FP6 and FP7 Integrated Projects. He has experience in the mobile services domain, on high definition television and digital television business aspects, digital news and e-reading, and platformisation in the media and mobile industry. Since 2011, he focused his research on smart cities through a PhD on Smart Cities (completed 2016) and through a 4-year Prospective Research for Brussels project, funded by Innoviris and the Brussels Capital Region. Nils currently coordinates the Smart Flanders programme, funded by the Flemish Government and supporting the 13 centre cities of Flanders on strategic and technical aspects related to open data.

Nik Van den Wijngaert (male) is business development manager at imec for the City of Things program, and program manager for the digital twin activities. More specifically, he helps develop the way imec collaborates with industrial partners, both commercially as well as in terms of research, to build the smart city of tomorrow. Before coming to work at imec, he operated worldwide as a consultant specializing in network performance management and simulations for military and commercial applications. He was also the co-founder and CEO of a start-up spin off from iMinds (now imec) in the area of wireless communications, which was acquired in 2012. Nik has a

master's degree in mathematics and computer science, and a PhD in telecommunications from the University of Antwerp.

Stefan Lefever (male) is technical director of City Of Things at imec. He is fascinated by technological domains where cutting-edge hardware and software solutions are combined to realize complex use cases, especially when these serve the goal to make this world a better place.

Stefan obtained a master's in industrial science (electronics) and a master's in engineering science (computer science). He worked for 20 years in the telecommunication industry in the domain of professional ethernet access devices and multi-service access routers, playing a key role in the transition of single-core monolithic firmware platforms to a versatile, multi-core software execution environment that can be deployed on physical edge equipment and within virtual (on-prem and cloud) environments, enabling the implementation of SDN/NFV scenarios. He supported this transition process first as taskforce manager and then as program director.

At Imec, he is responsible for the definition of an open city architecture and translate this into specific recommendations for scaling smart city infrastructure in Flanders, using the pragmatic realization approach and making sure future-proof solutions are kept in mind by keeping an eye on the next-step evolutions.

David Vermeir graduated in Interactive Multimedia Design in 2008. After working first as a Rich Internet Applications consultant and later Mobile development team lead and Gamification consultant for 7 years, he joined iMinds in 2014. Working as a Prototype developer until the merger of iMinds and imec in 2016, he continued working at imec in the Application Prototyping Team as an engineer and since 2018 as an architect.

In a professional function, David has developed and lead development of both frontend and backend systems for mobile, web, IOT applications and AR/VR experiences. Most recently, David was the lead architect and developer of the Digital Twin project for the imec City Of Things program. This was showcased as a leading demo at the SuperNova conference in Antwerp in September 2018. David is currently continuing that role in the expansion of that platform.

Philippe Michiels (male), xxx, holds a PhD in Science. After obtaining his Masters degree he spent five years studying and implementing database optimization techniques for semi structured data in collaboration with IBM Watson Research and AT&T research. After obtaining his PhD in 2007, Philippe took a position as an IT consultant working on integration projects in industry.
In 2011 Philippe joined a mid-sized Maritime Logistics Service company Shipex as lead IT consultant. Together with the owner and CEO and through technological innovation he helped the company more than double the turnover in five years, securing strategic contracts with large companies including Greenyard and McCain Foods. Part of the success was driven by the ability to industrialize complex supply chains through IT tooling and automation. From that experience Philippe co-founded Antser. Antser is a leading business-to-business platform that has proven to be successful in managing complex supply chains. It connects businesses worldwide and provides process sharing solutions that drive collaboration. His present work with IMEC focuses on defining guidelines, best practices and architectural frameworks for the implementation of open smart cities.

Koen Triangle (male) is a project manager at imec. Since his high interest in technological progress, the projects he has managed have always had a technological flavor. Before joining imec, Koen was working for Delaware Consulting. This global company is focused on software implementation, helping their customers in converting their strategic goals into applicable software tools. While working at Delaware Consulting he has managed projects in an international context, with customers based in Israel, America and Belgium, with an internationally based team. Therefore, he has managed teams in America, China and Vietnam in order to convert the goals of our customers into delivered projects. It has always been Koen's role to deliver projects meeting the customers' needs and according to the defined scope, while taking into consideration contextual changes. To support transparent decision-making in the project, he applies an open, constructive and inclusive communication style. This keeps all parties informed and enables them to contribute to the project and the strategic goals. Koen Triangle was also the project manager of the Digital Twin that imec has implemented for Antwerp in 2018 and is continuing this role in the Digital Twin program.

Relevant Publications

- Walravens, N., Breuer, J. & P. Ballon (2014) "Open Data as a Catalyst For The Smart City as a Local Innovation Platform", Communications and Strategies, Special Issue: Smart City, N°96, ISBN-ISSN: 1157-8637. (A2 publication)
- Walravens, N. (2015) "Mobile City Applications for Brussels Citizens: Smart City Trends, Challenges and a Reality Check", Telematics & Informatics, 32, 2, pp. 282-299, ISBN-ISSN: 0736-5853.
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- Walravens, N., & Ballon, P. (2017). Policy Recommendations Supporting Smart City Strategies: Towards a New Methodological Tool. Lecture Notes in Computer Science, (10268), 97-106.
- Walravens, N., Waeben, J., Van Compernolle, M., & Colpaert, P. (2018). The Smart Flanders program: a collaborative and co-creative approach to the development and implementation of a joint open data policy amongst cities. In Proceedings of TPRC46: Research Conference on Communications, Information and Internet Policy.
- Walravens, N., Van Compernolle, M., & Colpaert, P. (2018). Open Data en Lokale Besturen. Politeia.
- Walravens, N., Waeben, J., Van Compernolle, M., & Colpaert, P. (2018). Co-creating a practical vision on the Smart City. In 15th Architectural Humanities Research Association International Conference, Eindhoven, 15-17 November.
- Mechant, P., & Walravens, N. (2018). E-Government and Smart Cities: Theoretical Reflections and Case Studies. Media and Communication, 6(4), 119–122.

Relevant Previous and Ongoing Projects & Activities

City of Things, Flemish Government, Dec 2016 – 2020, The City of Things project builds an IoT testbed infrastructure in the city of Antwerp, offering – by the end of 2016 – access to hundreds of gateways that will eventually connect hundreds of sensors scattered around the city. The combination of a large-scale network experimentation facility with data from sensors deployed in a major European city and a supporting living lab is unique, allowing for integrated and highly realistic smart city experiments.

SynchroniCity – EU-H2020 “Delivering an IoT enabled Digital Single Market for Europe and Beyond” (2017-2019), it represents the first attempt to deliver a Single Digital City Market for Europe by piloting its foundations at scale in 11 reference zones - 8 European cities & 3 more worldwide cities - connecting 34 partners from 11 countries over 4 continents. Building upon a mature European knowledge base derived from initiatives such as OASC, FIWARE, FIRE, EIP-SCC, and including partners with leading roles in standardization bodies, e.g. ITU, ETSI, IEEE, OMA, IETF, SynchroniCity will deliver a harmonized ecosystem for IoT-enabled smart city solutions where IoT device manufacturers, system integrators and solution providers can innovate and openly compete.

FLAMENCO (Flanders Mobile Enacted Citizen Observatories) is a four-year (2016-2019) interdisciplinary Strategic Basic Research (SBO) project funded by Agentschap Innoveren en Ondernemen. The main objective of the project is to create an open cloud-based software platform, specifically designed for allowing different types of (technology-agnostic) stakeholders to create and participate in citizen observatory campaigns. Today citizen observatories have to be developed from scratch for each application area, which makes it a difficult and labour-intensive task. By joining the forces of specialists in software engineering, data analysis, environmental monitoring, mobility and ICT user studies, the project aims to build and valorise an open reusable and reconfigurable citizen observatory platform for Flanders. Through this platform, stakeholders will be able to set up their own participatory data collection campaigns in a simple and scalable way, while targeting both sensorial (e.g. noise, air quality,...) and behavioural (e.g. mobility patterns) parameters.

FloodCitiSense, Urban Europe, ERA-NET Cofund Smart Urban Futures, April 2017 – March 2020. FloodCitiSense aims at developing an urban pluvial flood early warning service for, but also by citizens and city authorities. This service will reduce the vulnerability of urban areas and citizens to pluvial floods, which cause serious damage to the urban environment. Citizens will be actively involved in the monitoring of rainfall and flooding, making use of low-cost sensors and web-based technologies. The early warning service will enable ‘citizens and cities’ to be better prepared and to better respond to urban pluvial floods. FloodCitiSense targets a co-creation of this innovative public service in an urban living lab context with all actors.

HackAir, H2020-ICT-2015, Research and Innovation action, CAPS Project, HackAIR, Jan 2016 – Dec 2018: The objective of the project is to create an open platform enabling communities of citizens to easily set up air quality monitoring networks and to engage citizens in measuring outside air pollution levels, leveraging the power of online social networks and open hardware technologies such as sensors. imec-SMIT is involved in the co-creation methodology, engagement and behavioural change strategy and impact assessment of the project. More information at www.hackair.eu

U4IOT, or User Engagement for Large Scale Pilots in the Internet of Things (2017-2019), is a CSA that aims at raising end-user and societal acceptance of the IoT large scale pilots in the call, which is critical to their success. U4IoT combines expertise encompassing social and economic sciences, communication, crowdsourcing, living labs, co-creative workshops, meetups, and personal data protection to actively engage end-users and citizens in the large scale pilots. It develops a toolkit for LSPs end-user engagement and adoption. It offers direct support to mobilize end-user engagement with co-creative workshops and meetups, trainings, Living Labs support, and an online pool of experts. It analyses societal, ethical and ecological issues and adoption barriers related to the pilots provides recommendations for tackling them. It supports communication, knowledge sharing and dissemination. The U4IoT platform will thus support IoT take-up in Europe by better aligning it with end-user and societal expectations, mutualizing information and learning experiences, and improving communication with the public,- enabling Europe to take the lead in IoT user (and market) adoption.

The PAR4-B project - Participatory Action Research for an e-inclusive Smart Brussels - aims to develop a widely supported e-inclusive smart city master plan for Brussels through a participative and action-oriented research process that (a) identifies the current challenges specific to a digital Brussels; (b) formulates solutions and actions for the realization of an e-inclusive digital Brussels; and (c) develops a future vision for tomorrow's digital Brussels. The PAR4-B project actively focuses on the offline and online bringing together of 4 stakeholder groups from the smart city domain and the e-inclusion field, in particular (1) policy makers; (2) private actors; (3) civil society organizations and public institutions; and (4) citizens of Brussels, including vulnerable social groups such as people in poverty, long-term unemployed, NEETs (not in training, training, or employment), existing civil society platforms, action groups, neighborhood committees, …

City of Things, Flemish Government, Dec 2016 – 2020, The City of Things project builds an IoT testbed infrastructure in the city of Antwerp, offering – by the end of 2016 – access to hundreds of gateways that will eventually connect hundreds of sensors scattered around the city. The combination of a large-scale network experimentation facility with data from sensors deployed in a major European city and a supporting living lab is unique, allowing for integrated and highly realistic smart city experiments.

Smart Flanders, Flemish Government, Jan 2017-Dec 2019, Smart Flanders is funded by the Flemish government and operated by imec, to support the 13 largest cities in the region with opening up data related to complex urban challenges. More information on xxx

Digital Twin Antwerp, This digital 3D replica of the city of Antwerp combines noise pollution data with real-time sensor information from air quality and traffic, and computer models. It offers an up-to-date and predictive view of the situation in the city whereby the impact of planned measures can be simulated and tested.

Cities face major and complex challenges to reduce CO2 emissions, noise and traffic pollution in the city center and to keep the city attractive, liveable and healthy. Interventions to improve a situation in a particular neighborhood can have an impact on multiple factors and/or multiple locations in a city. For example, making a specific street car-free can have a positive impact on the air quality and noise pollution of adjacent neighborhoods, but could also cause mobility and air quality in other places to deteriorate.

The digital twin developed by imec and its partners (TNO, TomTom, MOW, PTV) is a highly realistic virtual representation of the city of Antwerp. It bridges the digital and physical worlds and supports policymakers and area developers in making complex decisions about urban quality of life. With the 'push of a button' the effects of certain scenarios on traffic, noise and air quality can be predicted in advance. The availability of more and up-to-date data from various sensors in the city makes future forecasts even more accurate and enables planners to make

the best decisions for short-term measures. The digital twin was created on the basis of the simulation platform 'Urban Strategy' of the Dutch research institute TNO, on which imec builds a new interactive interface and provides sensor data to enable the real-time linking and enrichment of the models.

Role in the Project

In the DUET project imec will bring in expertise related to the socio-economic impact of technology on society and an urban policy-making context in particular. Imec has a background in tackling urban challenges from an interdisciplinary perspective and working closely with policy makers, companies, knowledge institutions and citizens.

Imec has developed a Digital Twin for Antwerp in collaboration with different partners (MOW, PTV, TNO and TomTom). We will bring the knowledge gained during that project to the table, including technical/architectural best practices, business knowledge and functional insights.

Partner 3: Katholieke Universiteit Leuven

KU LEUVEN	Katholieke Universiteit Leuven (KUL) (Belgium) Partner n° 3

Partner Introduction

KU Leuven is an autonomous university founded in 1425. KU Leuven is a research-intensive, internationally oriented university that carries out both fundamental and applied research. It is strongly inter- and multidisciplinary in focus and strives for international excellence. To this end, KU Leuven works together actively with its research partners at home and abroad.

The Leuven Mobility Research Centre, L-Mob, brings together and integrates complementary expertise on mobility, infrastructure, logistics and environment.

Within this broad domain, L-Mob focuses on smart mobility: optimization of operational traffic and logistic processes using real-time data; optimization of logistics from a company profile; development, pricing and financing of infrastructure; land-use mobility interaction; innovative mobility services; optimization of public transport; and mobility indicators and monitoring.

L-Mob CIB is mainly active in the research domains of traffic and infrastructure, public transportation optimisation and logistics. The group is specialised in the development and deployment of mathematical models that can be used to analyse transport system related problems. The scope of the models varies from short-term microscopic simulation models used to analyse the impact of dynamic traffic management measures, to long-term macroscopic planning models used to describe the mutual relationship between the quality of infrastructure and activity patterns.

Key Personnel

Prof.dr.ir. Chris M. J. Tampère (xxx) received his Ph.D. from Delft University of Technology (The Netherlands, 2004). As a professor at KU Leuven in xxx he specializes in mathematical modelling and simulation of traffic and transportation systems. This includes traffic flow theory, network dynamics and equilibrium modelling, and bi-level problems with network modelling as a side-constraint. He assisted the Flemish Traffic Management Centre in developing traffic data processing algorithms, evaluating various traffic management measures (eg variable speed limits), and by developing dynamic traffic models.

Dr.ir. Willem Himpe xxx) graduated xxx as a civil engineer at the KU Leuven specializing in traffic engineering. As a student he collaborated with the transport & mobility laboratory at the École polytechnique fédérale de Lausanne (EPFL) for his master thesis. In September 2010 he joined L-Mob CIB as a junior research assistant. His research was funded with a scholarship of the Flemish government for 4 years (IWT/SBO 101684) and on March 9th 2016 he successfully defended his PhD thesis (Integrated algorithms for repeated dynamic traffic assignments). As a Postdoc he is currently working on the development of toolboxes for Dynamic Traffic Assignments to facilitate the usage of advanced traffic models. His work also includes the exploration of novel data collection methods for mobility analysis, like the extraction of information from mobile phones and navigation services.

Relevant Publications

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2. Viti Francesco, Rinaldi Marco, Corman Francesco, Tampère Chris (2014). Assessing partial observability in network sensor location problems. Transportation Research Part B, 70, 65-89.

3. Himpe Willem, Tampère Chris, Moelans Bieke (2014). A Parsimonious method for off-line freeway travel time estimation from sectional speed detectors. Journal of Intelligent Transportation Systems, 18(1), 67-80.
4. Himpe, W., Corthout, R., Tampère, M.J.C., 2016. An efficient iterative link transmission model. Transportation Research Part B: Methodological, Within-day Dynamics in Transportation Networks 92, Part B, 170–190. doi:10.1016/j.trb.2015.12.013.
5. Himpe Willem, Ginestou Romain, Tampère Chris (2019). High Performance Computing applied to Dynamic Traffic Assignment. Proceedings of the 10th International Conference on Ambient Systems, Networks and Technologies (ANT)

Relevant Previous and Ongoing Projects & Activities

1. **SABARIS** (ERA-NET Road, 2010-2011)

The research project SABARIS addresses the challenge of road agencies to select an optimal intervention strategy for a particular part of a road network taking into consideration the varying and conflicting values of road benefits for the stakeholders of this road section. The role of L-Mob CIB in this project has been to provide a traffic analyst view on the identification of stakeholders and their benefits; to set up and coordinate a case study (road intervention on the E17 motorway) and obtain benefit values to feed the optimization tool; to set up and implement traffic simulations for both Dutch and Belgian case studies.

2. **STEP** (ERA-NET Road II, 2011-2012)

The research project STEP aims at gaining a better understanding of the operational short term prediction requirements of traffic managers at Interurban and Urban Traffic Control Centres (TCC's) in Europe. One of the key objectives was to explore the gaps between the state-of-the-art and requirements of operators in terms of functional application, interfacing and the success of existing tools that are currently being used by TCCs.

3. **Urban Logistics and Mobility** (IWT-SBO 2014-2016)

The expertise developed in this project concerns: demand Modelling, GPS tracking data processing, dynamic network traffic modelling, analysis of origin-destination demand patterns, development of dynamic traffic management tools and evaluation of E-bike use patterns.

4. **Integrated traffic management** (KUL research fund, 2011-2016)

The objective of this research project is to develop integrated control strategies that align multiple (network capacity, travel demand management and dynamic traffic management) control measures in a regional/metropolitan network, so that users exhibit desired collective travel patterns under variable traffic conditions

5. **The first open LTM Workshop** (University of Sydney 2016)

In this international workshop access is provided to open source library of codes and insights into a practical implementation of the Link Transmission Model (LTM) a state-of-the-art dynamic traffic model.

Significant infrastructure

The Flemish Supercomputer Centre (VSC) is a virtual centre making supercomputer infrastructure available for both the academic and industrial world. The KUL has premium access and reduced fees for the usage of HPC within European projects.

Role in the Project

The main role for KUL in the project consists of development and application of a methodology to build a dynamic traffic model based on observed (open) data for a large region using High Performance Computing (HPC). Expanding data into a full traffic state estimation by means of a network wide model is indispensable in order to infer evidence based policy KPI's like congestion levels, emissions estimates in a specific region under different scenarios.

Static traffic models traditionally used in policy evaluation are not accurate enough to present a detailed view of congestion and its build up/dissipation in a network such as observed in real data. Therefore L-Mob CIB has

developed open source tools to facilitate the construction of more advanced dynamic traffic models that are calibrated on time varying traffic state observations. Within the project this toolset will be expanded for and applied on a large scale region. This will require the use of the HPC infrastructure provided by the Flemish Supercomputer Centre and developed in partnership with the KUL.

Partner 4: Athens Technology Center

	Athens Technology CEnter (ATC) (Greece) Partner n° 4

Partner Introduction

Founded in 1987, ATC (www.atc.gr) is an Information Technology Company (SME) offering solutions and services targeting specific sectors incl. the Media, Banking and Retail Sectors, Utilities and Public Sector Organisations as well as horizontal solutions focusing on Content Management, Enterprise Software, Web Applications, Human Capital Resource Management and eLearning, and Mobile Applications. The activities of the Company span among several countries in EU, Eastern Europe and CIS countries, as well as the Balkans.

Having acquired ISO 9001 certification since 2000, the company provides a broad spectrum of value-added products and services such as consulting, customer training, installation and maintenance, warranty and post-warranty services, SLA projects, project management, and professional support. ATC is also certified with the ISO/IEC 27001:2005 an information security management system (ISMS) standard published in October 2005 by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Its full name is ISO/IEC 27001:2005 – Information technology – Security techniques – Information security management systems – Requirements.

Central to the Company's strategy is the conduction of vivid Research and Development, focusing both in improving current Products and Solutions, as well as in exploring new technologies for future growth. All ATC own products and services are based on early prototypes and/or "proof of concept" obtained through R&D Projects, whether funded by the Company, the Greek State or the Commission.

The ATC Innovation Lab (http://ilab.atc.gr/) carries more than 25 years of expertise in Research and Development. The focus is on innovation aspects, which are often overshadowed by research concerns, and on turning promising ideas into concrete and robust products, in a cost and time-efficient manner. Having incubated most of the current commercially oriented ATC business units we are committed to continue along this successful path: Discover or conceptualize Innovation first, then turn it into working systems through intense and continuous involvement in cutting-edge research projects. The focus is primarily given on areas that can offer the next big advance to ATC's commercial offerings, but also on discovering new domains and creating the next company targets. ATC has long experience in integrating applications related to the analysis of large scale data sets. Our experience lies both in the combination of different modules as well as in the setting up of large databases and search engines. ATC, is a partner in the NESSI ETP (www.nessi-europe.com) and a full member in the Big Data Value Association (www.bdva.eu).

ATC offers professional solutions for eGovernance portals based on popular Open Source and Open Platform Solutions. We support all popular platforms as DNN (Dot Net Nuke), WordPress, Joomla, Drupal and Liferay. Capitalizing on the technological know-how accumulated in several European eGovernance pilot projects, we are offering solutions for eGovernment and Co-creation based on our own open source platform. The platform comprises a set of modules supporting the interaction between public bodies and citizens enabling the latter to actively participate in public affairs, in decision-making and in the shaping of policies with security, reliability and efficiency.

Key Personnel

Anna Triantafillou (female) is working as the Deputy Head of ATC's Innovation Lab. She is a Master degree holder in Organisational Behavior & HR Management and a BSc Degree holder in Management & Systems Science from City University of London. Currently she is a PhD candidate in the field of Management Information Systems at the Department of Information and Communication Systems, University of the Aegean. She has

worked as a Researcher for the City University, of London. She has more than 14 years of professional experience in the domain of Information Services as a Project Coordinator / Manager of European and National R&D projects. Her research interests' lie in the fields of Systems Analysis, Enterprise level Modelling, eGovernment & eBusiness applications. She has also extensive experience in the analysis and implementation of IT systems. Mrs. Triantafillou has been the Project Coordinators of the CO-VAL, YOURDATASTORIES, CROSSOVER, OURSPACE, eMPOWER, MOMENTUM, LEX-IS, WEB-DEP.

Kostas Giannakakis (male) is a Senior Software Developer in the ATC R&D Department. He has received his diploma in Electric Engineering and Computer Science from the National Technical University of Athens. He has twelve years of experience working as a Software Developer and Architect in both EU funded research projects and commercial applications. While working in ATC he has been the lead software developer in many projects, including GRIDECON, GREDIA, COCKPIT and ANIKETOS projects.

Stratos Tzoannos (male) is a Senior Software Engineer in the R&D Unit. He has a MBA in Business Administration from Athens University of Economics and Business and an Engineering Diploma in Electrical and Computer Engineering from the National Technical University of Athens. He has participated in a number of research projects including RUSHES, MESH IP, ASSESTS, PAPYRUS, CASAM, ARCOMEM and i-SEARCH. He is specialised in search and indexing technologies and solutions of which he also holds a certification for the FAST ESP system. In his previous employment he was specialised in telecommunication VoIP systems. Mr Tzoannos is a member of the Technical Chamber of Greece.

Relevant Publications

1. Petasis. G, Triantafillou. A, Karstens. E: YourDataStories: Transparency and Corruption Fighting Through Data Interlinking and Visual Exploration (2018), Springer International Publishing; p.95-108.
2. Charalabidis Y., Loukis E., Androutsopoulou A., Triantafillou A.(2014): Passive Crowdsourcing in Government Using Social Media; Transforming Government: People, Process and Policy, Emerald, United Kingdom.
3. Charalabidis Y., Triantafillou A., Karkaletsis V. and Loukis E., Public Policy Formulation through Non Moderated Crowdsourcing in Social Media: Lecture Notes in Computer Science Volume 7444, 2012, pp 156-169 (http://link.springer.com/chapter/10.1007/978-3-642-33250-0_14#page-1).
4. Spiliotopoulos, D, Dalianis, A., Kouroupetroglou, G. (2014): Accessibility Driven Design for Policy Argumentation Modelling, Proc. 15th Int. Conf. on Human Computer Interaction, Heraklion, Crete,
5. Spiliotopoulos, D., Bouwmeester, R., Proios, D. (2013): Relation Visualization for Semantically Enriched Web Content, Proc. Communicating Complexity International Design Conference, 25-26 October 2013, Alghero, Italy.

Relevant Previous and Ongoing Projects & Activities

ATC has served as a major technology provider and/or as coordinator to the following H2020 & FP7, as well as Google DNI funded, related projects:

1. H2020, **YDS - Your Data Stories,** 2.802.188 EUR (ATC share: 443.625 EUR), 02/2015 – 01/2018: YourDataStories has developed a highly customisable online platform for data exploitation focused in the financial flows that are critical for transparency, collaboration and participation. Users, ranging from governmental bodies to journalists and to citizens, will be facilitated by powerful and established tools, not only to discover relevant information but also to remix it with diverse and dynamic data sources: YourDataStories acts like an interactive canvas to enable data citizens to (re)write their own data history. Building on top of the "Transparency Portal" initiative of the Greek government, YourDataStories can be viewed as a way to showcase and transfer the existing expertise to European level, in an attempt to transform governments and governance in Europe. At the same time, YourDataStories seeks to exploit and embed in this effort the benefits of the social Web, establishing an innovative bidirectional channel between the Social and Semantic Web. Finally, YourDataStories aims to support sustainable services, supported by a marketing ecosystem of applications offering cross-border services of public finance flows across Europe.

ATC's Role: Project Coordinator, Platform development, Technical Integration

2. Google DNI Innovation Fund, **DataStories**, 559.000 EUR (ATC share: 158.900 EUR), 12/2018 – 11/2020:

DataStories seeks to provide a product targeting journalists wanting to perform data journalism. The envisioned solution will help journalists interconnect, search, analyse, explore and understand available data, in order to extract insights, facts, and material to support and shape their data stories.
ATC's Role: Platform development, Technical Integration

3. H2020, **FotoInMotion** - Repurposing and enriching images for immersive storytelling through smart digital tools, 2.548.288,75 EUR (ATC share: 405.000 EUR), 01/2018 – 12/2020:

FotoInMotion provides an innovative solution to the repurposing of content by offering automated tools for innovative contextual data extraction, object recognition, creative transformation, editing and text animation as well as state of the art 3D conversion options that allow content creators to transform their photos into highly engaging spatial and three dimensional video experiences. FotoInMotion will focus on three major creative industries sectors: photojournalism to develop interactive photo driven stories; fashion, by opening up new forms of marketing, product placement and event coverage; and festivals, by enabling PR and publicity managers to communicate the festival experiences and engage audiences through immersive communication and repurposing festival archives.
ATC's Role: Technical Coordinator, Mobile and Web development, Technical Integration.

4. H2020, **PoliVisu** - Policy Development based on Advanced Geospatial Data Analytics and Visualisation, 3.907.700 EUR (ATC share: 242.250 EUR), 11/2017 – 10/2020:

PoliVisu is a Research and Innovation project designed to evolve the traditional public policy making cycle (outlined by Patton & Sawicki1) using big data. The aim is to enhance an open set of digital tools to leverage data to help public sector decision-making become more democratic by (a) experimenting with different policy options through impact visualisation and (b) using the resulting visualisations to engage and harness the collective intelligence of policy stakeholders for collaborative solution development. Working with three cities to address societal problems linked to smart mobility and urban planning, the intention is to enable public administrations to respond to urban challenges by enriching the policy making process with opportunities for policy experimentation at three different steps of the policy cycle (policy design, policy implementation, and policy evaluation). Experimentation of policy options will enable the cities to tackle complex, systemic policy problems that require innovative thinking to develop transformative solutions.
ATC's Role: ATC leads the integration activities and is responsible for adapting and improving the Social Media Analysis Service, based on its commercially available service (TruthNest).

5. FP7-ICT, **SYMPHONY** - Orchestrating Information Technologies and Global Systems Science for Policy Design and Regulation of a Resilient and Sustainable Global Economy, 3.886.497 EUR (ATC share: 355.875 EUR), 10/2013 – 09/2016:

SYMPHONY, a project co-funded by the EU under the 7th Framework programme, aims to provide a set of innovative ICT tools in strict cooperation with stakeholders and policy-makers, involved in the project to devise appropriate scenarios and modelling requirements. The main objective of the project is to develop a framework for designing and testing policies and regulatory measures regarding:

- Preventing and mitigating economic and financial crises;
- Fostering an economically and ecologically sustainable growth path.

SYMPHONY's strategy to successfully accomplish its mission is to orchestrate a set of tools that will be able to:

- Collect and analyze relevant information by means of social media mining tools and web-based information markets;
- Simulate the complex economic dynamics by means of an agent based model of the global economy, explicitly designed for policy making;
- Involve citizens in the decision making process through a serious game interface, and through a set of information markets on the artificial economy that will allow us to overcome the huge economic impasse of properly modeling expectations.

ATC's Role: ATC is one of the main technology providers in SYMPHONY, mainly involved in the integration tasks.

Role in the Project

ATC is an innovative software company with global business capability, with over 25 years of experience as an EU technology partner, focusing on developing business solutions and continuous high investment in R&D. ATC has significant experience in the development of Collaborative Platforms linking in Service Oriented Architectures, mobile applications and solutions as well as significant experience in building highly scalable applications for indexing huge and fast changing data sets (big data). In addition, the coordination of collaborative R&D Projects is a capacity well developed by ATC, having managed 32 projects so far, with a total budget of over €53M euros. Based on this successful track-record of coordinating and supporting IT projects, ATC can ensure effective and efficient management of the project. ATC has also a proven expertise in the area of the dissemination and exploitation of research project results, so it will significantly contribute to the corresponding WPs and tasks of the project.

Significant infrastructure

ATC has implemented a cloud infrastructure combining with virtualization for all its production services as well as development needs. Our software stack for providing cloud infrastructure includes, but not limited to, OpenStack, Hyper-V 2012 R2 and VMware products. In the above described infrastructure, ATC has integrated an open source portal for Cloud Computing to automate the provisioning of a full suite of services on Windows servers that also supports provisioning of Windows and Linux Virtual Machines. We use a combination of Orchestrators based on the cloud provision suitable to the infrastructure be provided with commercial and open-source software. ATC' private cloud, consists of powerful Intel platform servers, suitable high-performance storage devices, firewall hardware and software and networking equipment combining technologies to provide performance and flexibility. ATC's cloud solutions offers flexible, dynamic and efficient configuration to provide the best solution according to specific computing needs.

Partner 5: 21c Consultancy

21c Work Smarter	21c Consultancy (21C) (United Kingdom) Partner n° 5

Partner Introduction

21c is an SME with an established track record in designing, delivering and promoting successful ICT research and innovation initiatives that generate multi-stakeholder engagement (business, public sector, civil society and academia) across multiple communication channels. The team specializes in using new technologies for co-creation to kick start innovation, citizen engagement and improve public services and policy. For close to a decade, 21c has driven the shift toward citizen-centric government. We are experts in understanding the new technologies that are about to reshape the way government is delivered, and work alongside public administrators in driving successful change. National government departments that consult 21c on our path breaking work in the rapidly evolving world of Smart ICT include: India Department of Administrative Reform (DARPG), Oman Information Technology Authority (ITA), Emirates Identity Authority (EIDA), Bahrain government Authority, Kazakhstan National Information Centre (NIC), Flemish eGovernment Authority (CORVE) and UK Communities and Local Government (CLG).

Our work centres on three key areas:

- Open Innovation: A trend toward greater co-creation and collaboration between government and citizens in the creation of new public services
- Open Data: The fuel for 'Open Innovation' and 'Smarter Government'
- eParticipation: The use of new social media tools to foster a more transparent and collaborative relationship between citizens and government.

We regularly work on a collaborative model with subject matter experts from throughout the ICT innovation world on European projects (H2020, FP7, CIP, ERASMUS+, LLP) to create, deploy and promote user-friendly ICT solutions. Blending ICT and communications expertise, our team draft research frameworks, White Papers and Policy Briefings for policy-makers at the local, regional, and national level, organize/facilitate workshops, conferences and exhibits, engage and enthuse stakeholders and promote ICT projects, initiatives and publications. Few other firms combine's 21c's unique blend of deep Open Data domain expertise, academic writing credentials, analytic skills and specialist PR/Marketing expertise.

Website: www.21cconsultancy.com

Key Personnel

Susie Ruston McAleer (female), is an accomplished Digital Government practitioner and thought leader with over 15 years' experience helping public administrations across the globe harness the transformational power of technology. A founding partner of 21c consultancy, Ms. McAleer regularly works with international organisations such as the United Nations as an expert eGovernment consultant and evaluator. Her portfolio of global clients includes the governments of Great Britain, Belgium, UAE, Bahrain, Kazakhstan and India as well as multiple pan-European cities and regions. She created Puzzled by Policy, an initiative focused on immigration policy, ASK, a project that reconnects youth with policy makers using social media, and she recently wrote PoliVisu – a multimillion Euro geospatial project which aims to make transport-related data more open and accessible for policy making. Prior to PoliVisu Susie directed communications for Citadel-on-the-Move – a pioneering Smart City Open Data project that has helped over 140 cities across 6 continents to open and use data to improve public services.

Pavel Kogut (male), is an experienced researcher, analyst and training facilitator. He has worked across our extensive portfolio of data projects including agINFRA, which partnered with the UN Food and Agricultural Organisation to create an international infrastructure for sharing agricultural research, Citadel on the Move, which

created tools to make it easier for local authorities (regardless of their size or budget) to open and use data, and OpenTransportNet and ECIM, which use geospatial data to deliver cross-border Smart Mobility. Pasha worked as a researcher on a European Commission study on online intermediary liability. Currently Pasha is involved in the day to day tasks of the PoliVisu H2020 project and is the main contact point for Plan4All network. Prior to joining 21c Pavel was an assistant analyst at the Hague Centre for Strategic Studies, a think-tank, where he worked on projects commissioned by high-level clients, among them the Ministry of Defence, the Ministry of Foreign Affairs and the Dutch Safety Board.

Laura Gavrilut (female), Laura earned her MSc in Information Networking from Carnegie Mellon University, USA and her Bachelor in Computer Science from the University of Oradea, Romania. Laura is a seasoned Project Manager that has been involved in numerous bid preparations and in the coordination of multiple projects types: H2020, FP7, CIP-ICT-PSP, Erasmus+ and LLP. She is adept at creating compelling communication material as well as organizing high impact large and small scale educative, scientific and/or dissemination activities, including numerous international expert groups meetings. Currently Laura is managing Communication and Dissemination Work Package for the H2020 project SELECT for Cities and is involved in the day to day activities of the PoliVisu H2020 project.

Relevant Publications

1. Ruston McAleer Susie, Kogut Pavel, Raes Lieven. The Case for Collaborative Policy Experimentation Using Advanced Geospatial Data Analytics and Visualisation, 'Workshop on the 4th International Conference on Internet Science', 20 November 2017, Thessaloniki, Greece
2. Glidden, Julia, Ruston McAleer, Susie. '6 Top Tips for Building a Smart City with Data,' Open Data Institute Blog, 14 July 2015.
3. Glidden, Julia, Ruston McAleer, Susie et.al. 'Puzzled by Policy: Helping You be part of the EU' 5th International conference on eParticipation, 17-19 September 2013 Koblenz, Germany.
4. Glidden, Julia, Ruston McAleer, Susie et.al. 'Citadel on the Move: Open Data...Unlocking Cross Border Innovation,' OneConference in Prague, April 2013.
5. Ballon, Pieter, Glidden, Julia, Kranas, Pavlos, Menychtas, Andreas, Ruston, Susie, Van Der Graaf, Shenja. (2011) 'Is there a Need for a Cloud Platform for European Smart Cities?', eChallenges e-2011 Conference.

Relevant Previous and Ongoing Projects & Activities

PoliVisu (H2020) (2017-2020)
PoliVisu aims is to enhance an open set of digital tools to leverage data to help public sector decision-making become more democratic by (a) experimenting with different policy options through impact visualisation and (b) using the resulting visualisations to engage and harness the collective intelligence of policy stakeholders for collaborative solution development. Working with three cities to address societal problems linked to smart mobility and urban planning, the intention is to enable public administrations to respond to urban challenges by enriching the policy making process with opportunities for policy experimentation at three different steps of the policy cycle (policy design, policy implementation, and policy evaluation). Experimentation of policy options will enable the cities to tackle complex, systemic policy problems that require innovative thinking to develop transformative solutions.

21c involvement: Proposal writing, leading WP7 Communication and dissemination, support research tasks related to building the PoliVisu framework and developing the PoliVisu Playbox.

SELECT for Cities (H2020) (2015-2019)
SELECT for Cities is searching for new technologies to create a state-of-the-art, large-scale, citywide, 'Internet-of-Everything lab' to assist cities in developing, testing and validating innovative smart services and solutions. The new IoE platform is sought by using a Pre-Commercial Procurement (PCP) process, which provides R&D funding to a number of suppliers to help develop innovative ideas.
21c involvement: Proposal writing, leading WP7 Dissemination and Networking, support to Pre-Commercial Procurement evaluations

agINFRA (FP7) (2011-2015)

agINFRA will design and develop a scientific data infrastructure for agricultural sciences that will facilitate the development of policies and services that promote the sharing of data among agricultural scientists in a manner that develops trust within and amongst their communities. Through the establishment of an open and interoperable data e-Infrastructure, agINFRA will remove existing obstacles concerning sharing, processing and accessing scientific information and data in agriculture, as well as it will improve the preparedness of agricultural scientific communities to face, manage and exploit the ever-increasing abundance of multi-disciplinary data that is available to support agricultural research.

21c involvement: Leaded WP N3 Dissemination, Training and Sustainability. Responsible for Dissemination Planning and Reporting; Clustering and Coordinating Meetings & Workshops; Short-term, Mid-term and Long-term Sustainability. 21c also contributed to WP N1 Project Management.

Role in the Project

21c will be responsible for leading WP7 Dissemination, ecosystem management and exploitation: to plan, establish and manage the tasks related to dissemination, engagement, exploitation and stakeholder management.

Partner 6: Aegis IT Research LTD

	AEGIS IT RESEARCH LTD (AEG) (United Kingdom) Partner n° 6

Partner Introduction

AEGIS IT RESEARCH LTD is a research and development company based in United Kingdom. It aims to develop and manage innovative IT solutions for numerous business sectors. It is based on a highly effective professional team consisting of talented researchers and top-class IT experts from all over the world. This team empowers the company with a strong, diverse skillset which helps AEGIS offer innovative products and high-tech business solutions to the market. AEGIS' main areas of expertise include Forensic Digital Investigations, adaptive Big Data visualization systems, Geographical Information Systems, secure embedded platforms, access control and network security systems, privacy preserving systems, enterprise web applications and all the lifecycle of IT systems (design, development, deployment, optimisation and maintenance). AEGIS also has a long-term involvement in security and data management solutions, offering:

- Digital Forensics investigation and security-related situational awareness for the decision makers, (e.g. consultation, collection and analysis of digital evidence; analysis of Critical Infrastructures); (EU-2020-CIPSEC, EU-2020- I-BiDaaS);
- Physical forensics services, that support a post-mortem digital forensics investigation for IT and non-IT cybersecurity experts, including but not limited to basic forensics activities like forensics analysis of physical assets/objects and complementary ones like consultation, and training; (EU-2020-CIPSEC, EU-2020- I-BiDaaS);
- Cyber forensics services, empowered with correlation algorithms and innovative capabilities (e.g. Preconfigured views and Timeline analysis), for almost real-time mitigation actions (e.g. threat-hunting: automatic digital forensics investigation and recommendation/identification of potential threats); (EU-2020-CIPSEC, EU-2020- I-BiDaaS);
- A Security Information and Event Management (SIEM), toolkit that is based on open source frameworks; (EU-2020-CIPSEC, EU-2020- I-BiDaaS);
- Visualisation and monitoring tools and services for both historical and real-time Big Data analytics; (EU-2020- I-BiDaaS);
- Consulting services, (e.g. penetration testing, design and implementation of secure network solutions, etc.)

Key Personnel

Prof. **Vassilis Prevelakis** (male), is Director of Research at AEGIS IT RESEARCH LTD and a visiting professor at the Technical University, Braunschweig, in Germany. He has worked in various areas of security in Systems and Networks. Prevelakis current research involves issues related to automation network security, secure software design, auto-configuration issues in secure VPNs, etc. He has published numerous papers in these areas and is actively involved in standards bodies such as the IETF. He has received research funding from the European Union, the German DFG and US funding agencies such as DARPA and NSF. He was awarded the CAREER award from NSF and recently received the "Test of Time" award at CCS'13 for his work on Instruction Set Randomization.

Dr. **Ilias Spais** (male), is a senior project manager in AEGIS. He received the diploma in Electrical and Computer Engineering from the University of Patras in 2000, and the PhD degree in Analysis, Design and Development of Processes, Systems and Computer Engineering from the National Technical University of Athens (NTUA) in 2006. He has been involved in several research projects in the context of the ICT framework as project manager, research associate and senior developer. His research interests include, adaptive Big Data visualization systems, edge computing applications, natural language processing algorithms, speech recognition and synthesis, distributed SOA-based systems and multimedia e-learning platforms. He is currently involved in the field of business applications, user requirements capture, specifications analysis, dissemination and exploitation activities and

project management in European and National R&D projects. Dr. Spais is a member of the Technical Chamber of Greece.

Leonidas Kallipolitis (male), holds a BSc in Informatics and Telecommunications and a MSc in Advanced Information Systems from the National and Kapodistrian University Of Athens, Greece. He has been working as a software engineer since 2008. He has great experience in EU funded projects working as technical coordinator and contributing to the analysis, design and implementation of the developed systems. He is particularly involved in web applications development and system integration using up to date technologies and modern software development methodologies. Leonidas has strong communication skills acquired through interaction and collaboration with people from diverse backgrounds and a proven record of successful projects via smooth teamwork and effective problem solving.

Relevant Publications

1. Tzermias, Z., Prevelakis, V., and Ioannidis, S., "Privacy Risks from Public Data Sources," SEC 2014, IFIP AICT 428, pp. 156-168, IFIP International Federation for Information Processing (2014).
2. Panagiotis Andriotis, Theo Tryfonas, George Oikonomou, Shancang Li, Zacharias Tzermias, Konstantinos Xynos, Huw Read, and Vassilis Prevelakis, "On the Development of Automated Forensic Analysis Methods for Mobile Devices," 7th International Conference on Trust & Trustworthy Computing June 30 - July 2, 2014 - Hersonissos, Crete, Greece.
3. Vassilis Prevelakis, Diomidis Spinellis, "The Athens Affair (an analysis of the Vodafone wiretaps)," IEEE Spectrum, 44(7), pp. 26-33, July 2007.
4. "The Virtual Firewall," Vassilis Prevelakis, USENIX;login: Magazine, December 2005, Vol. 30, Num. 6.

Relevant Previous and Ongoing Projects & Activities

1. **I-BiDaaS**: Industrial-Driven Big Data as a Self-Service Solution. Under Grant Agreement Preparation. This project is supported by the European Commission under the Horizon 2020 Program. I-BiDaaS will develop, validate, demonstrate, and support, a complete and solid big data solution that can be easily configured and adopted by practitioners. Duration 2018-2020.

2. **CIPSEC**: Enhancing Critical Infrastructure Protection with innovative SECurity framework. This project is supported by the European Commission under the Horizon 2020 Program. Duration 2016-2019.

Role in the Project

AEGIS will offer its cyber-security solutions and services to ensure security, privacy, trustworthiness and integrity (Demo site[45]). Specifically, (i) Cyber Forensics Monitoring and Visualization toolkit to help operators (IT and non-IT experts) to gain situational awareness and react fast in cases of security breaches as well as discover potential threats; (ii) Timeline analysis service, that offers the ability to "travel back in time" and compare the current situation with similar events that occurred in the past. This allows fresh data to be compared against patterns encountered before (correlation algorithms); (iii) Preconfigured views service, that offers the ability to adapt the display of information based on previously encountered situations; and (iv) Threat hunting service, that offers the ability of proactively and iteratively search through networks to detect and isolate advanced threats that evade existing security solutions.

[45] Demo site: http:xxx

Partner 7: Open & Agile Smart Cities

	Open & Agile Smart Cities (OASC) (Belgium) Partner n° 7

Partner Introduction

Open & Agile Smart Cities (OASC) is a non-profit, international smart city network. The mission of OASC is to unite cities around the world to build a global market for smart city data and services from the demand side and based on the needs of cities and communities
OASC is already today at the forefront of tomorrow's standards for city data, services, and technology - and works based on city needs with support from industry. Unlike
any other city network, OASC is driven by implementation and focused on open platforms and citizen engagement. OASC is growing rapidly and connects over 100 cities & communities globally.

Together, the network strives to establish the Minimal Interoperability Mechanisms (MIMs) needed to create a smart city market. MIMs are simple and transparent mechanisms, ready to use in any city, regardless of size or capacity. By implementing MIMs cities increase the speed and openness of innovation and development, whilst decreasing cost and inefficiency. In essence, MIMs allow cities to engage in global digital transformation.

In practice, the Open & Agile Smart Cities (OASC) MIMs are a 1) a context management information API, 2) common data models, 3) marketplace API.

OASC represents a vibrant network over 120 smart cities. The organisation is experienced in organising workshops and a yearly conference, the Connected Smart Cities Conference, which attracts over 300 attendees each year. Through its database, OASC is well-positioned in collecting and disseminating information.

Key Personnel

Davor Meersman (male), PhD, is CEO of Open & Agile Smart Cities (OASC). OASC and its member cities are shaping the global smart cities data and services market in collaboration with partners such as the European Commission, the United Nation's International Telecommunications Union, the European Telecommunications Standards Institute, TM Forum, etc. Davor Meersman is also Co-Chair of the BDVA Task Force on Smart Cities, Ambassador of the International Society of Service Innovation Professionals, and a senior consultant on smart city technology, strategies, and funding. As senior researcher at the world's leading nano and digital technologies research institute IMEC, Davor was one of the founders of City of Things, the largest smart city IoT living lab in Europe. Davor holds a PhD in Information Systems from Curtin University, Australia.

Lea Hemetsberger (female), MSc, Communications & Project Manager is working at OASC as Communications & Project Manager. She is responsible for network coordination, event and workshop organisation, and communication and dissemination activities for OASC and related projects. With a background in journalism as well as new media and ICT, she has been working as a communicator for carmaker Audi, Brussels-based NGO Transport & Environment, and the Brussels office of the German Friedrich-Ebert-foundation.

Relevant Publications

Based on standards and consensus, OASC – as neutral ground focusing on the needs of cities and communities – provides the concept of OASC Minimal Interoperability Mechanisms. SynchroniCity has developed reference implementations based on standards (such as ITU-T SG20*/FG-DPM* (*drafts), ISO TC268) and based on references from FIWARE, EIP-SCC, NIST IES-CF, and others. The MIMs have been adopted by the OASC Council of Cities as universal tools for achieving interoperability of systems, data, and services between cities around the world.

The MIMs are:
MIM 1 - OASC Context Information Management MIM
MIM 2 - OASC Data Models MIM
MIM 3 - OASC Ecosystem Transaction Management MIM

Relevant Previous and Ongoing Projects & Activities

1. **SynchroniCity** (H2020-IOT-2016) is one of the European IoT Large Scale Pilots. The project represents the first attempt to deliver a digital single market for IoT-enabled urban services by piloting its foundations at scale in 11 reference zones - 8 European cities & 3 more worldwide cities - connecting 39 participants. Building upon a mature European knowledge base derived from initiatives such as OASC, FIWARE, FIRE, EIP-SCC, and including partners with leading roles in standardisation bodies, e.g. ITU, ETSI, IEEE, OMA, IETF, SynchroniCity will deliver a harmonised ecosystem for IoT-enabled smart city solutions where IoT device manufacturers, system integrators and solution providers can innovate and openly compete: (http://synchronicity-iot.eu/)

2. **CyberSec4Europe** (H2020-SU-ICT-2018-2020) is a research-based consortium with 44 participants covering 21 EU Member States and Associated Countries. Starting on 1 February, it has received more than 40 support letters and promises of cooperation from public administrations, international organisations, and key associations worldwide including Europe (such as ECSO), Asia, and North America. As pilot for a Cybersecurity Competence Network, it will test and demonstrate potential governance structures for the network of competence centres using the best practices examples from the expertise and experience of the participants

Role in the Project

OASC will lead WP 6 (Pilot scenarios, deployment, and impact validation) and given the relevant network and communication activities will support WP7 (Dissemination, ecosystem management and exploitation).

Partner 8: Grimaldi Studio Legale

GRIMALDI STUDIO LEGALE	Grimaldi Studio Legale (GSL) (Belgium-Italy) Partner n° 8

Partner Introduction

With offices in Milan, Rome, Bari, Brussels, London, Lugano and New York, 37 partners and more than 150 lawyers, Grimaldi Studio Legale (hereinafter, "GSL") is recognized for its quality and business-oriented approach. GSL advises Italian and international clients on all areas of business law.

The firm's privacy and IT law department encompasses a team of several professionals working in Brussels, and Milan, who have wide academic knowledge and professional experience, gained as scholars in reputable universities (e.g. College of Europe, US Ivy Leagues, UK leading universities) and as lawyers in leading international law firms. They advise Italian and international clients on matters concerning telecommunications and media. GSL also has significant EU regulatory law expertise, specifically with respect to the following sectors: public procurement, environment, energy, transportation, infrastructures, public services, financial services, and telecommunications. In addition, GSL advises companies on matters of EU law encompassing freedom of movement of services and capital, intellectual property as well as on European funds.

Further to participating in very demanding and selective tender procedures launched by the European Commission and the European Parliament, GSL been awarded several contracts to provide legal assistance with carrying out studies/assessments/evaluations on behalf of the EU institutions, some of whom on matters of foremost relevance to the European Union, including competition law matters, but also the digital single market, etc.

Key Personnel

Silva Annovazzi (female), Partner, Grimaldi Studio Legale; Team leader on behalf of Grimaldi, Silva Annovazzi is specialized in corporate law, with particular reference to corporate and regulatory/compliance matters, including corporate governance, corporate responsibility, money-laundering counter-measures and data protection, where she assists companies, banks and financial institutions. Prior to joining Grimaldi, she practiced at Dewey&LeBoeuf, the law firm of Professor Galgano, Deloitte and Clinco&Fisher in Los Angeles. She is a leading expert in identifying criminal risks for companies. She leads the Corporate Governance and Compliance Department at Grimaldi, including a team of attorneys operating in the field of governance development and compliance programs aimed at assessing and managing relevant legal risks. She is also an expert in the field of e-money services and information technology, having assisted several firm's clients on these matters.

Kletia Noti (female), Associate, Grimaldi Studio Legale, Project Coordinator. Kletia practices EU law and competition law, intellectual property and IT law at Grimaldi Studio Legale since 2015 and she is currently based in Brussels. She advises firm's international clients on a broad range of matters regarding EU competition, compliance with state aid rules and EU law. Kletia is specialised in EU competition law, with a particular focus on high-technology matters and intellectual property law. Prior to joining Grimaldi Studio Legale, Kletia practiced EU competition law at the Brussels offices of Clifford Chance LLP, Cleary, Gottlieb, Steen and Hamilton LLP, Studio Legale Monti in Milan and the European Commission's Directorate General for Competition. For several years, Kletia was an academic assistant in the Economic and the Legal Department at "College of Europe", Bruges (European Law and Economic Analysis), where she taught tutorials in EU competition law. She is currently a Member of the American Bar Association, Intellectual Property Law Category, where she serves as Vice-Chair in its IP Transactions & Licencing Committee. Since 2017, Kletia serves as a policy monitor on EU intellectual property developments in such committee.

Relevant Publications

1. Article on “Spa a capitale pubblico e applicabilità del D.Lgs. n. 231/2001” (Joint stock companies with public majority shareholdings and applicability of Legislative Decree no. 231/2001) in Avvocati24, 2011
2. The Crime of Money Laundering from a Contextual Perspective: CertainComparative Aspects Between the Implementation of Preventive Measures for the Legal Profession in Italy and England", Lambert Academic Publishing, 2010
3. "La responsabilità dell’Internet Provider: spunti e riflessioni sui profili di rischio penale amministrativo ai sensi del d.lgs. 231/01" - Rivista della responsabilità amministrativa delle società e degli enti (2010)
4. Stanford-Vienna Transatlantic Technology Law Forum Transatlantic Antitrust and IPR Developments, Issue 5/2018, Other developments European Union Injunctions and Article 15(I) of the E-Commerce Directive: The Pending Glawischnig-Piesczek v. Facebook Ireland Limited Preliminary Ruling
5. Qualcomm’s Acquisition of NXP Receives Antitrust Clearance by the European Commission, Subject to Commitments, Stanford TTFL Newsletter, 2/2018
6. European Commission Presents Comprehensive Soft Law Measures to Ensure that Intellectual Property Rights are Well Protected, Including Issuing Guidance on the Enforcement Directive, Stanford TTFL Newsletter, 4/2017

Relevant Previous and Ongoing Projects & Activities

1. European Commission: Framework Service Contract concerning the provision of services of legal, economic and technical assistance in the fields of energy and mobility and transport policies. (SRD MOVE/ENER/SRD. 1/2012-409): legal assistance in the field of mobility and transport
2. Private client: Antitrust authorisations for an aerospace, defence and security company [CONFIDENTIAL]
3. European Commission: E-commerce: The liability regime and notice-and-action procedures- Article 14 of the E-Commerce Directive;
4. European Commission: SRD MOVE/D3/2015-564 Study on passenger transport by taxi, hire car with driver and ridesharing in the EU
5. Private client: Legal assistance to Iperal S.A: assistance, inter alia, with GDPR-related compliance
6. Private client Telecommunications: Legal assistance to Enel Open Fiber in the acquisition of Metroweb

Role in the Project

GSL will contribute to WP1 (Ethics, privacy and legal requirements for a European Cloud infrastructure). In particular, GSL will take the lead of Task 1.1., Identification of legal and ethical considerations (M1 - M36). This will require both a combination of desk research on the current use of cloud in public administration and stakeholder consultation.

In delivering such work product, GSL will closely collaborate with its partners and use research skills and the firm’s experience in legal matters (GDPR-related, security and interoperability) in assisting the partner team with the legal compliance aspects and challenges underpinning the infrastructure proposed.

Partner 9: City of Athens

	DIMOS ATHINAION EPICHEIRISI MICHANOGRAFISIS (DAEM) (Greece) Partner n° 9

Partner Introduction

DAEM S.A. (City of Athens IT Company) is the oldest and most significant Local Government IT Company, as it has been operating since 1983, aimed at providing Cloud based multiplatform e-Governance to local government organizations, public administration and other authorities and organizations. The development and promotion of new innovative services which are fundamental to the smart and sustainable city idea, lies at the heart of DAEM's interest and is a strategic objective at the city level.

The specialized Co-funded and EU projects Sector along with the Directorate of Informatics, are fully qualified for the design, development and implementation of integrated information systems and committed to the success of any scale and scope Information and Communications Technology (ICT) project by building on relevant project and activities experience and expertise in key areas and by exploiting communication channels to further promote project developments.

DAEM constitutes one of the most solid links in the chain of implementation and support of two-way communication nodes with citizens, residents and visitors of the city. At the same time, it significantly contributes to the digital convergence of the operational standards of the City of Athens with those of other European Municipalities.

DAEM partners with leading IT companies, research institutions, SMEs and other local authorities providers within Greece and Europe when implementing co-funded EU projects, national projects, NSRF projects, with the commitment of quality services provision certified according to Quality management systems ISO 9001:2015 and Managerial Competence ELOT 1429.

Key Personnel

Stavros Asthenidis (male), Chief Executive Officer of DAEM S.A, holds a degree in Electrical and Computer Engineering from the National Technical University of Athens. His academic (and not only) interests include Public Policy, electronics and open government, which led him to attend the Graduate Program "Public Policy and Administration" at Athens University of Economics and Business. He served for several years as head of state aid schemes at Intermediate Management Agencies (Elanet, EFEPAE) during the 2nd and 3rd CSF. He was the Telecommunication Networks Project Manager (during the preparation) and the Telecommunications Manager at the Technology Control Center during the Athens 2004 Olympic Games, as a member of the Organizing Committee. Stavros has also worked for the "Information Society SA" as a Project Officer in the era of Intelligent Transport Systems, Digital Culture, Digital Health and Energy Saving Systems, for Cramoni Trading Ltd (Cyprus), as a Program Manager responsible for telecommunications projects in the international economic environment, for Egnatia Odos SA, ICAP Business Consultants and the Ministry of Development and Competitiveness as a Director of Technology and Project Management. He has served as an advisor to the Special Secretary for Digital Planning at the Ministry of Development, Competitiveness and Shipping for eGovernment projects. He has also served as a technical advisor to the Special Secretary for Public Private Partnerships (PPPs) in the Ministry of Development, Infrastructure, Transport and Networks.
He is the Chief Executive Officer of DAEM S.A.

Dimitra Tsakanika (female), Head of Projects Planning and Management Department, is a National and Kapodistrian University of Athens graduate and holds a BSc Degree in Literature and a post graduate degree (MSc) in Organizational and Economical Psychology. She has been working for DAEM S.A. since 2007, and since 2010 has been working in EU Sector as Project Manager and later as Head of EU Projects Networking & Management Dpt. Since 2017 she is Head of Project Management and Planning Dpt. and has been involved in the

complete set of activities, tasks and projects of the EU Sector. Her tasks include also the management of NSRF and other national projects.

Ilia Christantoni (female), Head of EU Projects Sector is a National and Kapodistrian University of Athens graduate and holds a BSc Degree in Computer Science and Telecommunications (2004) and two post graduate degrees (MSc) in: Radioelectrology and Electronics (2012), as well as in Neurosciences, Socio-biology and Education (2014). She has been working in the IT sector (System Administration, Education) and since 2014 is a freelance Scientific Collaborator in the National Hellenic Research Foundation. Her professional skills were further enriched in the field of project management as a financial and project officer in EACEA (Education, Audiovisual and Culture Executive Agency), European Commission. Since 2017 is the Head of EU Projects Sector in DAEM S.A. and has been involved in the projects City4Age, CharGED, VisiOn, CO3 and EXTREMA.

Relevant Publications

1. A Holistic Approach for Privacy Protection in E-Government (2017), Angelopoulos, V. Diamantopoulou, H. Mouratidis, M. Pavlidis, M. Salnitri, P. Giorgini, J.F. Ruiz, ARES 2017 12th International Conference on Availability, Reliability and Security
2. Secure and Trustworthy Service Composition, The Aniketos Approach (2015), Brucker, A., Dalpiaz, F., Giorgini, P., Meland, P.H., Rios, E. (Eds.), Springer
3. Ensuring Trustworthiness and Security in Service Compositions (2014), Vasilios Tountopoulos, Ira Giannakoudaki, Konstantinos Giannakakis, Lefteris Korres, Leonidas Kallipolitis, Springer
4. Urban Smartness: Perspectives Arising in the Periphéria Project (2013), Grazia Concilio, Luciano De Bonis, Jesse Marsh, Ferdinando Trapani, Springer

Relevant Previous and Ongoing Projects & Activities

1. VisiOn [653642] (www.visioneuproject.eu) H2020-DS-2014-1-IA “Visual Privacy Management in User Centric Open Environments”. Leverage existing software, tools and methodologies towards the implementation of privacy platform software components. Visual Privacy Management Platform empowers any citizen to achieve desired levels of privacy by creating and monitoring a personal Privacy Level Agreement. The platform provides clear visualisation of privacy preferences, relevant threats and trust issues along with an insight into the economic value of user data. The platform will equip PAs with the right tools to improve the transparency and accountability of their operations.
2. Citadel…on the move [297188] (www.citadelonthemove.eu) CIP-ICT-PSP-2011-5 “Helping cities design and apply strategies on opening up and exploiting their data and providing easy to use tools that can help anybody to create a mobile application by using open data”
3. Puzzled by Policy [256261] (www.puzledbypolicy.eu) CIP-ICT-PSP-2009-3bis “Helping you be part of the EU: Provision of a platform and easy-to-use communication and interaction tools so that citizens have a voice and a say in immigration policy making at all levels while interacting with decision-makers”
4. Aniketos [257930] (www.aniketos.eu) FP7-ICT-2009-5 “Secure and Trustworthy Composite Services: Development of new technology, methods, tools and security services that support the design-time creation and run-time dynamic behaviour of composite services”.

Role in the Project

DAEM will contribute the following expertise to the project:

- Excellent experience in participating and managing Co-funded and EU projects.
- Strong experience in supporting public administration and in designing of relevant software and applications.
- Strong network of decision-makers, local government organizations, governmental organizations, and businesses among others for dissemination purposes.
- Large community of citizens, NGOs, academics, researchers and end-users for the pilot implementation.
- Access to extensive sources of data due to public administration support and networking with other organizations and authorities.

- Research work in active ageing, eGovernance, eParticipation, data protection, energy efficiency, and cultural heritage due to participation in EU projects
- Technical experience in software development & engineering, IT infrastructure development and maintenance.

Partner 10: VirtualCitySystems

	VirtualCitySystems (VCS) (Germany) Partner n° 10

Partner Introduction

For over 10 years, virtualcitySYSTEMS (VCS) with its small but innovative and creative team has provided GIS services for customers in the private and public sector. CityGML consulting, software development, project implementation and systems integration are our core competencies. The company has further distinguished itself by becoming one of the leading experts in 3D spatial data infrastructures (SDI) based on the OGC Standard CityGML, with customers and business partners in Europe and all over the world. virtualcitySYSTEMS delivers high quality, end-to-end 2D and 3D GIS solutions based on the OGC Standard CityGML by leveraging our experience, technology, best practices and strategic partnerships, offering products and services for the lifecycle management of digital cities and the implementation of smart city applications globally.

VCS solutions and services have been successfully implemented for cities inside and outside Europe, amongst them Berlin, Hamburg, Vienna, Salzburg, Zurich, Lyon, Munich, Singapore, Rotterdam, and Helsinki.

Key Personnel

Dr. **Claus Nagel** (male), Chief Technology Officer (CTO), virtualcitySYSTEMS GmbH. Graduated as Master of Science at the University of Applied Sciences Karlsruhe in 2007, and worked on early methods for the conversion from BIM/IFC to OGC CityGML in his Master's thesis. From 2007 to 2013, he was research assistant in the research group of Prof. Dr. Thomas H. Kolbe at the Institute for Geodesy and Geoinformation Science at Technische Universität Berlin. In his PhD thesis "Spatio-Semantic Modelling of Indoor Environments for Indoor Navigation", Dr. Nagel presented a framework for the representation of indoor spaces addressing indoor navigation challenges such as context-aware path planning, localization, tracking and guidance. Concepts of this research work were adopted for the OGC IndoorGML standard. Since 2008, he is vice chair of the CityGML Standards Working Group at OGC and co-editor of the CityGML and IndoorGML standards. Dr. Nagel is a core developer and head of the steering group of the open source CityGML database solution 3D City Database. Since 2013 he is Head of Software Development at VCS and since 2016 Chief Technology Officer (CTO).

Dr. **Arne Schilling** (male), Head of Research, virtualcitySYSTEMS GmbH. Has more than 15 years experience in the areas of Geographic Information Science, Spatial Analysis, 3D Computer Graphics, and Computer Aided Design in academia and business. In 2002 he graduated in Geography and received his doctoral degree in geo informatics at the University of Heidelberg in 2014. His thesis "3D Spatial Data Infrastructures for web-based Visualization" covers many aspects of how geo science can benefit from concepts developed in computer graphics and how large scale urban and landscape models can be managed in web-based environments.
At virtualcitySYSTEMS he is in charge of many publicly funded research projects dealing with the integration of 3D city models with applied research topics that can open new market opportunities such as flood simulation and other numerical simulations, decision support systems for police forces and fire fighters, urban planning, and others. Furthermore, he has been working on streaming technologies and performance optimizations that allow virtualcitySYSTEMS to publish CityGML content online using state of the art WebGL rendering frameworks.

Relevant Publications

1. 3DCityDB - a 3D geodatabase solution for the management, analysis, and visualization of semantic 3D city models based on CityGML; Yao, Zhihang; Nagel, Claus; Kunde, Felix; Hudra, György; Willkomm, Philipp; Donaubauer, Andreas; Adolphi, Thomas; Kolbe, Thomas H. Open Geospatial Data, Software and Standards, Vol. 3, No. 5, Springer International Publishing, 2018

2. CityGML Application Domain Extension (ADE): overview of developments; Filip Biljecki, Kavisha Kumar and Claus Nagel; Open Geospatial Data, Software and Standards20183:13; https://doi.org/10.1186/s40965-018-0055-6
3. Löwner M.-O., Gröger G., Benner J., Biljecki F., Nagel C. (2016). PROPOSAL for A NEW LOD and MULTI-REPRESENTATION CONCEPT for CITYGML. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences 4 (2W1) : 3-12. ScholarBank@NUS Repository. https://doi.org/10.5194/isprs-annals-IV-2-W1-3-2016
4. Arne Schilling, Jannes Bolling, and Claus Nagel. 2016. Using glTF for streaming CityGML 3D city models. In Proceedings of the 21st International Conference on Web3D Technology (Web3D '16). ACM, New York, NY, USA, 109-116. DOI: https://doi.org/10.1145/2945292.2945312
5. Gröger,G., Kolbe, T.H., Nagel, C., Häfele, K.H. OGC. OGC City Geography Markup Language (CityGML) Encoding Standard 2.0.0, Standard OGC 12-019. Open Geospatial Consortium. 2012.

Relevant Previous and Ongoing Projects & Activities

1. SDDI – Smart Sustainable District Data Infrastructure Demonstrator Queen Elisabeth Park London (Climate-KIC, EIT, 2018-2019)
2. OPMOPS – Organized Pedestrian Movement in Public Spaces: Preparation and Crisis Management of Urban Parades and Demonstration Marches with High Conflict Potential (BMBF, Germany, 2017-2020)
3. SAVe - Functional safety and traffic safety for automated and connected mobility based on a digital regional model (BMVI, Germany, 2018-2020)
4. BUOLUS – Building physical design of urban surfaces for a sustainable quality of life and environment in cities (BMBF, Germany, 2018-2021)

Role in the Project

VCS will lead WP4 (Digital Twin Front-end), which is in line with the company's strategic product development plan. VCS will also contribute to WP2,3,5,6 with its products, solutions and experiences as they are directly linked or part of the technical implementation and connected to the Digital Twin Front-end. VCS will provide strategic support to WP1,7,8.

Partner 11: TNO

TNO innovation for life	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek (TNO) (The Netherlands) Partner n° 11

Partner Introduction

TNO (The Netherlands Organization for applied scientific research TNO) was founded by law in 1932 to enable business and government to apply knowledge. As an organisation regulated by public law, TNO is independent: not part of any government, university or company. TNO is one of the major contract research organisations in Europe. With a staff of approximately 3200 and an annual turnover of 426 million Euros, TNO is carrying out research in order to achieve impact on the following units:

TNO functions as an intermediary between basic research organizations and industry. By translating scientific knowledge into practical applications, TNO contributes to innovation capacity of businesses and government. TNO is involved in many international projects (about 25% of the market turnover), including EU-funded collaborations.

In the Unit Traffic and Transport applied research is carried out related to solutions for liveable and competitive cities. This is done together with collaboration partners, governments and industry.

In the research group of Sustainable Urban Mobility & Safety the main activities focus on modelling and simulation of the urban environment from a traffic point of view. This is complemented by the development of an urban planning tool which is built especially for fast decision making in the domain of urban planning. Within the research group we also have a vast experience in the impact and evaluation of policy measures including a wide experience within European projects such as eCoMove, ecodriver and U-Drive.

Key Personnel

Jeroen Borst (male) is program manager of the development and application of platform for interactive urban planning. (www.tno.nl/urbanstrategy) He is an expert on implementation of environmental (noise) models in Geographical Information Systems (GIS). He implemented methods for assessment of noise into operational software systems. He performed scientific research on the relation between the local environment and health and on the use noise impact indicators.

He participated in several EU projects such as QCity, aiming at developing knowledge and instruments to support local authorities in the framework of the European Directive on Environmental Noise (END).

As program manager he is responsible for the development of the TNO roadmap on digitalization in the field of traffic and transport..

Walter Lohman (male), works at TNO as a senior scientist in the field of ICT system architect & software engineering/innovation. With more than 30 years of experience he has led several projects related to new innovations in HPC (High Performance Computing) utilizing parallel hardware (GPU) and/or cloud computing (ITEA2, MACH 2013-2016, € 2M). He participates in several TNO ERP/ETP programs (Early Research Programs; ERP MSoBD, ERP Exposense, ETP Models) in the field of Big Data and the integration of multi scale, multi domain computational models and tools.

He is the architect and main software developer of the Urban Strategy instrument. Urban Strategy was developed from scratch from mid 2005. His role in the team will be to manage and evaluate software changes and ensure a proper implementation in the Urban Strategy architecture/instrument.

Aroen Soekroella (male) has obtained his Master's Degree in Civil Engineering in 2011 at Delft University of Technology, focusing on traffic flow theory and simulation. After one year work in a regional traffic management center as operational traffic engineer, he works for TNO since 2012 as scientist in the area of analysis on traffic data, traffic modelling and simulation and (dynamic) traffic management. One of the TNO tools he often uses for these studies is Urban Strategy, in which spatial impacts on traffic, air quality and noise levels can be calculated. He is also involved in projects on integrating traffic with geospatial information systems and evaluating concepts for and impacts of C-ITS, for example in the EU projects COBRA, ecoDriver and ANACONDA.

Stefan Talen (male) (1991) finished his masters in transportation, infrastructure and logistics at Delft university of technology with honours in 2016. Stefan started at TNO as a junior consultant in 2016 and contributed to projects regarding monitoring and evaluation of ITS measured, building tools and architectures for the analysis of large data sets.

Ir. Ernst Jan van Ark (male) received the M.Sc. degrees in civil engineering from the University of Twente, Enschede, The Netherlands, in 2013. Since completing his study he has been working as a traffic engineer at TNO and has been involved in various projects in the field of (big) data analysis in the field of mobility, transport and logistics. Moreover as the GDPR coordinator he is able to establish the link with the subject of privacy.

His work contributed to the architecture and development of the algorithms and models to determine the current and future traffic situations within the Practical Field Trial Amsterdam. He furthermore contributed to the development of so-called 'city dashboards' which display relevant information about mobility, logistics, and air quality in real time, in one web environment.

Relevant Previous and Ongoing Projects & Activities

The vision of the **C-Mobile** project is to provide fully safe and efficient road transport without casualties and serious injuries on European roads, in particular in complex urban areas and for Vulnerable Road Users. It is also a vision of congestion-free, sustainable and economically-viable mobility, minimizing the environmental impact from road surface transport. C-Mobile also aims to stimulate and push existing and new pilot sites towards large-scale, real-life C-ITS deployments that are interoperable across Europe.
C-the-Difference will contribute to make significant progress towards full scale deployment of Connected and Cooperative Intelligent Transport Services (C-ITS) in the urban environment. The C-the-Difference scaling-up of C-ITS deployment focusses on Helmond, the Netherlands and Bordeaux, France, and additional twinning cities. The C-the-Difference project will provide evidence-based impacts of scaled-up deployment of C-ITS in Helmond and Bordeaux.
The main goal of the **Practical Trial Amsterdam** is to investigate how effective in-car information services are in reducing delays and improving travel time reliability. Another goal is to learn as much as possible from the field trials, especially regarding the collaboration between government and industry partners in the trial and the behaviour of the users of the services. Application of the Superroute app by 60.000 participants, 1.000.000 trips.

The **Digital Twin Antwerp** is a digital 3D replica of the which combines noise pollution data with real-time sensor information from air quality and traffic, and computer models. TNO supported the development with by providing the simulation platform 'Urban Strategy' on which imec build a new interactive interface and provides sensor data on to enable the real-time linking and enrichment of the models.

Role in the Project

DUET will be able to use TNO's experience in the field of SmartCities and Digital Twin solutions. TNO's involvement is based on its state-of-the-art distributed, cloud and HPC technology to speed up model calculations and cross domain interconnection. . Knowledge and experience will be brought in from e.g. the collaboration between TNO, Imec, MOW, TomTom and PTV, which developed a Digital Twin for Antwerp in 2018.

Reinforcing TNO's role in DUET is TNO's interactive and integral 'Urban Strategy' tool. A model for spatial planning which shall help decisionmakers of the (smart) city. Areas covered are: Traffic analysis, Air pollutions, Noise pollutions, Safety, Energy, Solar Potential and Heat.

Partner 12: Plan4All

Plan4all	Plan4all z.s. (P4All) (Czech Republic) Partner n° 12

Partner Introduction

Plan4all is a non-profit association sustaining and further enhancing results of multiple research and innovation projects. Plan4all is fast developing association set up in 2015 by three partners. At this moment, Plan4all is an umbrella of 56 organisations from 22 countries worldwide. Plan4all includes members from public administration, universities, research organisations, NGOs, SMEs and industries.

Plan4all is a member of the Global Open Data for Agriculture and Nutrition (GODAN) initiative and closely cooperates with the Research Data Alliance, World Wide Web Consortium, Open Geospatial Consortium and the Joint Research Centre of the European Commission in Ispra.

Plan4all conducts research and experimental development and transfers the gained knowledge into practice. In addition to that, Plan4all aggregates large open datasets related to planning activities in different specialisms including spatial planning, transport, urban planning, environment, tourism and precision farming. These datasets include:

- Open Land Use Map (OLU - https://sdi4apps.eu/open_land_use/) - Open Land-Use Map is a composite map that is intended to create detailed land-use maps of various regions based (cadastre, LPIS) on certain pan-European datasets such as CORINE Land Cover, Urban Atlas enriched by available regional data.

- Smart Points of Interest (SPOI - https://sdi4apps.eu/spoi/) - The Smart Points of Interest data set is the seamless and open resource of POIs that is available for other users to download, search or reuse in applications and services. Its principal target is to provide information as Linked data together with other data set containing road network. The added value of the Smart approach in comparison to other similar solutions consists in implementation of linked data, using of standardized and respected datatype properties and development of the completely harmonized data set with uniform data model and common classification.

- Open Transport Map (OTM http://opentransportmap.info/) - The Open Transport Map displays a road network which is suitable for routing and includes average daily traffic volumes for the entire EU.

Plan4all makes sure that open data are easily accessible for reuse, data are maintained, their quality is improved and they are aligned with international standards and initiatives.

Plan4All together with its member organisations InnoConnect and the University of West Bohemia (see section 4.2 for details) maintains and further contributes to **WebGLayer**, an open source Javascript library used for development of analytical maps. The WebGLayer library allows to develop interactive analytical maps with large datasets (up to 1.5 mil data records) by implementing multiple linked views to present data. Each of the views enables different interactions (such as filtering or relationship analysis) that trigger an instant update of the other views. Users thus benefit from immediate and dynamic data visualizations, gain a better understanding of data by applying filters, and develop the opportunity to discover relationships and patterns in the data.

Plan4all is the main organiser of the INSPIRE Hackathons. The INSPIRE Hackathons are collaborative events for developers, researchers, designers and others interested in open data, volunteered geographic information and citizen observatories. The main driving force for the INSPIRE Hackathon is provided by experts from existing EU projects, and its primary objective is to share knowledge and experience between the participants and demonstrate to wider audiences the power of data and information supported by modern technologies and common standards, originating from INSPIRE, Copernicus, GEOSS and other initiatives.

The INSPIRE Hackathon concept has been developed using the INSPIRE initiative as an umbrella or framework for the continuous inclusion of new contributions from European and international professional networks and projects such as the H2020.

Key Personnel

Dr **Tomáš Mildorf** (male), Ph.D. (2012) in Geomatics, University of West Bohemia in Pilsen. Tomas is the project manager at Plan4all and at the Department of Geomatics at the University of West Bohemia in Pilsen (a Plan4all member). He is an experienced manager of large EU projects with more than 15 partners (e.g. Plan4all or SDI4Apps) as well as an evaluator of EU projects at the Commission. He was involved in numerous EU projects including PoliVisu, EUXDAT, EO4Agri, Plan4business, OpenTransportNet, DataBio, AFarCloud, Plan4all, BRISEIDE, Humboldt, NaturNet Plus and SDI-EDU.
Tomáš acted as an expert for defining the Danube Reference Data and Services Infrastructure (2014/2016) and did a traineeship at the Joint Research Centre of the European Commission in Ispra (Italy) – Institute for Environment and Sustainability, Spatial Data Infrastructure Unit (2007-2008).
Tomáš is the chairman of the Plan4all association. He is a reviewer of the International Journal of Geographical Information Science and an editorial board member of the International Journal of Heritage in the Digital Era.

Dr **Karel Charvat** (male), graduated in theoretical cybernetics. He is a member of the International Society for Precision Agriculture, Research Data Alliance, vice president of Club of Ossiach, Czech Association for Geoinformation and CSITA. He was in period 2005 - 2007 the president of the European Federation for

Information Technology in Agriculture Food and Environment (EFITA). He is currently the vice chair for Europe in the OGC Agriculture DWG. He was an organiser of many hackathons, where as most important were INSPIRE Hackathons and MEDHackathon. He work on implementation on the national INSPIRE Geoportal. Now he is also active in the Plan4all association chairing a group for research projects.
He has a long time experience in ICT for tourism, environment, transport, agriculture and precision farming. Now he is one of the promoters of open and big data in agriculture in Europe. He has an expertise in project management of research projects, he is an evaluator of EC projects.
Karel participated in a numerous projects as project manager and senior researcher: Wirelessinfo, Premathmod, EMIRES, REGEO, Rural Wins, Armonia, a Bard, EPRI Start, Ami@netfood, AMI4For, Voice, Naturnet Redime, Mobildat, SpravaDat, Navlog, c@r, Humboldt, WINSOC, Study for DG AGRI Broadband in Rural Development, Plan4all, Habitats, Plan4business, SmartOpenData, FOODIE, SDI4Apps, AgriXchange, FOODIE, SDI4Apps, OTN. Currently he is a part of the project management team of the Data Driven Bioeconomy – DataBio projet.

Dr **Karel Jedlicka** (male), an experienced researcher that participated in many EU projects (e.g. AFarCloud, EUXDAT, PoliVisu, DataBio, OpenTransportNet, GEPAM) as data modeller and technical manager. Traineeship at ESRI Redlands, CA (2003). PostDoc internship at TU Delft (2014). Karel's research is focused to following topics: Geographic Information Systems (GIS), multidimensional data modelling according open standards (e.g. INSPIRE, CityGML, etc.) ~ particularly data structures for Smart Cities. Specialized in the areas of 3D GIS, Building Information Management (BIM) and traffic modelling.

Alvaro Silva (male) is a senior software engineer responsible for developing web applications for data visualization built with WebGLayer. Alvaro's main fields of expertise include software architecture, web development, Agile methodologies, software quality assurance and management of startup ecosystems.
Alvaro previously worked for a multitude of startup companies, starting his career in Brazil and later working for companies around the world, including startups in Chile, London and now Czechia.
Alvaro was part of the South America team which took part in the Software Testing World Cup finals in 2016, held in Potsdam, Germany, as his previous company in Brazil won the South America continental preliminaries that year.
Alvaro holds a B.Eng. diploma in Computer Engineering and a B.Sc. in Computer Science, both from one of the most prestigious public universities in Brazil. He also was an exchange student at the University of West Bohemia in Plzeň, where he developed an Augmented Reality (AR) software application for smartglasses for the New Technologies Research Centre (NTIS).

Frantisek Kolovsky (male), graduated at Geomatics at the University of West Bohemia, currently a PhD candidate. His PhD thesis is focused on algorithms in transport domain. He participated in several EU projects including Plan4bussines, OpenTransportNet and PoliVisu. Frantisek is one of the developers of the Traffic Modeller and the library for big data visualisation - WebGLayer.

Dzmitry Kozhukh (male), studied cartography and geoinformatics at the Faculty of Natural Sciences of the Charles University in Prague. He works in his field (cartography and GIS) since 2012. Since then he gained a lot of experience in everyday work tasks, such as collecting, processing, harmonizing, analyzing, visualizing spatial data, creating metadata, developing web GIS applications, preparing maps for print, automating processes, writing projects' reports etc. He has taken part in several European projects, for example, NisaGo, Plan4business, SDI4Apps, Foodie, OpenTransportNet. Actively takes part in various hackathons and challenges.

Relevant Publications

1. Jedlička, K. (2018) A comprehensive overview of a core of 3D GIS. In 7th International Conference on Cartography and GIS Proceedings, Vol. 1 and Vol. 2. Sofia: Bulgarian Cartographic Association. ISSN: 1314-0604
2. Čerba O, Jedlička K, Čada V, Charvát, K (2017). Centrality as a method for the evaluation of semantic resources for disaster risk reduction. In ISPRS International Journal Of Geo-Information 6(8): 237, DOI: 10.3390/ijgi6080237
3. Veeckman, C., Jedlička, K., De Paepe, D., Kozhukh, D., Kafka, Š., Colpaert, P., Čerba, O. (2017) Geodata interoperability and harmonization in transport: a case study of Open Transport Net. Open Geospatial Data, Software and Standards, ISSN: 2363-7501.

4. Ježek, J., Jedlička, K., Mildorf, T., Kellar, J., Beran, D. (2017). Design and Evaluation of WebGL-Based Heat Map Visualization for Big Point Data. In The Rise of Big Spatial Data. Heidelberg: Springer. ISBN: 978-3-319-45122-0 , ISSN: 1863-2246
5. Jedlička, K., Ježek, J., Kepka, M., Hájek, P., Mildorf, T., Kolovský, F., Beran, D. (2015) Dynamic Visualization of Volume of Traffic. In Papers ICC 2015. Brazílie: ICA, 2015. ISBN: 978-85-88783-11-9

Relevant Previous and Ongoing Projects & Activities

2017 - 2020	H2020	**PoliVisu** - Policy Development based on Advanced Geospatial Data Analytics and Visualisation PoliVisu is a Research and Innovation project designed to evolve the traditional public policy making cycle using big data. The aim is to enhance an open set of digital tools to leverage data to help public sector decision-making become more democratic by (a) experimenting with different policy options through impact visualisation and (b) using the resulting visualisations to engage and harness the collective intelligence of policy stakeholders for collaborative solution development. Working with three cities to address societal problems linked to smart mobility and urban planning, the intention is to enable public administrations to respond to urban challenges by enriching the policy making process with opportunities for policy experimentation at three different steps of the policy cycle (policy design, policy implementation, and policy evaluation). Experimentation of policy options will enable the cities to tackle complex, systemic policy problems that require innovative thinking to develop transformative solutions.
2015 - 2017	CIP ICT PSP	**OpenTransportNet** (OTN) - Spatially Referenced Data Hubs for Innovation in the Transport Sector OTN was addressing key challenges hindering the use of geographic information (GI) in Europe. Standards and tools have been identified as two main issues around which these challenges revolve. Standards because they can be difficult to apply in practice, even by experienced users; tools because their features are often inaccessible to non – technical ordinary citizens – the greatest source of innovative potential in every country. OTN created collaborative virtual hubs where everyone from individuals to SMEs to city managers can access harmonised data and visualise it using simple tools.
2015 - 2017	CIP IcT PSP	**SDI4Apps** - Uptake of Open Geographic Information Through Innovative Services Based on Linked Data The SDI4Apps project received funding from the Competitiveness and Innovation Framework Programme and the Czech Ministry of Interior. The project is focused on the use of open geographic information through innovative services based on Linked Data. The objective is to establish a platform and conditions to support development of innovative services and applications employing geographical data.
2017 - 2020	H2020	**EUXDAT** - European e-Infrastructure for Extreme Data Analytics in Sustainable Development EUXDAT develops an e-Infrastructure, which addresses agriculture, land monitoring and energy efficiency for a sustainable development, as a way to support planning policies. In order to do so, we need to address the problems related to the current and future huge amount of heterogeneous data to be managed and processed.

2012 - 2014	FP7	**Plan4business** - A Service Platform for Aggregation, Processing and Analysis of Urban and Regional Planning Data The heterogeneous nature of regional and urban planning data prevents integration and analysis of these data on the European and cross-border level. The ever-increasing requirements of the users - i.e. research institutions, regional and urban planners and real estate agencies - necessitate harmonisation of these data, making them available through website services and allowing for data analyses. The Plan4business project developed a platform that can be used as a catalogue of regional and urban planning data, and namely as an integrator enabling visualization and spatial analyses on the European and international level.

Role in the Project

Plan4All will be responsible for the tasks related to 2D visualisations built with WebGLayer (T4.2), T4.3 UX/UI design, dashboarding and interaction support and T4.4 Data analysis & Visualisations and their integration in the platform (WP5).

P4All (through its linked 3rd party UWB, see below in section 4.2) will also be responsible for the traffic and noise modelling by implementing the Traffic Modeller and for integrating into the Digital Twin concept within the Pilsen pilot.

Partner 13: Správa informačních technologií města Plzně (City of Pilsen)

[redacted]	SPRAVA INFORMACNICH TECHNOLOGII MESTA PLZNE (City of Pilsen) (PLZ) (Czech Republic) Partner n° 13

Partner Introduction

Správa Informačních Technologií města Plzně, as a part of the city of Plzeň, is the public company which is responsible for ICT of the city Plzeň with annual turnover 7,5 mil Euro and 107 employees.
Basic quantification of our core business: 6000 PCs, 150 km of optical metropolitan network, around 1400 request from customers/monthly, 2 data centres (level TIER 3), key app. SAP, MS, AGENDIO, GIS, eSPIS, SOL, etc., we provide services for city hall, city parts, city police and around 100 city companies (elementary schools, kindergartens, city waterworks, heating plants, transport company, other city companies).
Our other activities/projects:

- Education (we focused in education process – interactive education technology, education of teachers in ICT, cybernetics, et., education of children in leisure education, we operated Centre of Robotics, etc. = support of technical education in Pilsen
- TechTower Světovar (science and technology park for unmanned aerial vehicles = drones)
- IoT - we operated IoT on the LoRa platform in Pilsen, we use it for city companies and for research (cooperation with local university)
- We participate in SMART CITY PILSEN as the ICT integrator.

Key Personnel

Luděk Šantora (male) is CEO of Správa Informačních Technologií města Plzně. Last projects – Smart City, Dronet, Smart Edu, Pilsen Card, Centre of Robotics, etc.

Stanislav Štangl (male) is the leader of our GIS department. He is responsible for city GIS platform development. Stanislav participated on the key projects as a Opendata, Online network report, GIS waste management, Plznito (online citizen reporting of any problems and issues in the city), etc.

Václav Kučera (male) is a senior engineer in GIS department. He participated on our main GIS projects as a Opendata, Online network report, GIS waste management, Plznito, integration of municipality GIS (waterworks, heating plants, transportation).

Ondřej Bouček (male) is the director of the Drones section, responsible for the management of the drones unit, big data processing and management, research and innovation.

Relevant Publications

none

Relevant Previous and Ongoing Projects & Activities

2017-2020	H2020 (RIA)	**PoliVisu** https://www.polivisu.eu/ PoliVisu enhances public involvement and support in urban policy making, by equipping decision makers with the skills and tools - from open (geo) data processing to advanced visualisations - to use big data for collaborative policy experimentation. As a result the city makes better sustainable policy decisions and manages operations more effectively.

2017-2018	local	**Inspections of bridges' structures using drones** Project focused on the inspections of bridges using drones, with connected real-time sensors, creation of the digital twins of the bridges, usage of AI to evaluate changes on the bridge structure while using laser scanning (cloud of points, 3D model)
From 2016	local	**Smart City Plzeň** https://smartcity.plzen.eu/
From 2015	local	**Plznito** (http://www.plzni.to) Application (web, mobile) for city residents. Reporting of issues and problems in the city (city infrastructure, furniture, lighting, waste, etc.)
From 2016	local	**Online network reporting** (https://gis.plzen.eu/vfe/) Web application for "builders" where they can get confirmation of city networks existence (metropolitan data network, public lighting, water, heating, transportation, etc.)
From 2015	local	**Open data portal** (http://opendata.plzen.eu) Publishing of the city data sets (collection, metadata, control, publishing)
2014-2016	EU structural funds	**Data warehouse** City data warehouse – design, implementation

Role in the Project

Správa Informačních Technologií města Plzně is a pilot city in the project. The focus of the pilot activities is to further develop the 3D digital twin of the city by integrating the traffic, noise and air pollution modelling tools, and other data sources managed by the city (building information management, digital technical map etc.), in order to improve the efficiency of the day-to-day city management as well as the longer-term policy decisions.

Partner 14: IS-practice

IS-practice Program Management in Information Society	IS-practice BVBA (ISP) (Belgium) Partner n° 14

Partner Introduction

IS-practice is a Program Management Office that delivers project management and high-level advice in the broader field of the Information Society for major projects within the international and national public sector. It brings together specialized parties for ambitious research and consultancy projects.

IS-practice is led by Hugo Kerschot, based on more than 20 years of experience in communication, IT, consultancy and project management in both the private and the public sector and multidisciplinary settings within the framework of the European Information Society. It calls its own an international network of experts in the development of innovative projects in the areas of, amongst others, eGovernment, eParticipation, eHealth, and eInclusion that make up Europe's Knowledge Society.

IS-practice works together with both large consulting organizations such as Capgemini and Deloitte Consulting as well as with smaller, highly specialized, companies in the fields of research, technology, and consultancy. The IS-practice network in this way covers a large scope of skills as well as a broad swath of European countries.

IS-practice has a successful track record in the management of the FP7/CIP/H2020 projects, working closely with the coordinators towards the objectives of the projects, by implementing its trusted project management methodology, setting up and enforcing quality management procedures, and managing the risks of the projects.

IS-practice also benefits from its large international network of partner organisation and experts when disseminating the results of the research and innovation projects to the wider audience of stakeholders.
IS-practice provides business development consultancy services, focusing on the innovation projects and design of appropriate business models, pricing schemes, and financial plans.

Key Personnel

Hugo Kerschot (male) is the founder and Managing Director of IS-practice has years of experience in both the private and the public sector that have proved to be valuable for companies and organizations in realizing projects in a multidisciplinary setting within the framework of the European Information Society. More than 20 years of experience in communication, IT, consultancy and project management together with an international network of expertise are at the disposal of potential clients to assist for developing innovative projects in the area of eGovernment, Smart Cities, Smart Mobility, Open Data, eParticipation, & eInclusion.

Hugo managed the following H2020/CIP/FP7 projects during the last years: Smart City/Public Cloud projects EPIC, ECIM, and PoliVisu, Open Data projects CITADEL, OpenTransportNet, SSEDIC (Thematic Network electronic ID), project developing smart systems learning from users' behaviour and objects' context (bIoTope), and Coordination action MAGHRENOV (Sustainable Energy).

Hugo has been a founder/partner in several start-ups created over the last decade: Indigov (a spin-off from the University Leuven, eGovernment consultancy), iVOX (online market research and market research technology), IS-practice (information society consultancy and program management) and most recently ECIM NV (a spin-off of the CIP project ECIM focused on smart mobility and mobility-as-a-service) and InnoConnect (a software startup that provides location intelligence services and big geo-data analysis). He contributed to the emergence of an Internet industry since its beginnings in Europe in the mid-1990s in diverse companies and positions.

Jiri Bouchal (male) holds a position of senior consultant at IS-practice, Jiri is a project manager of ICT research & innovation projects and an experienced policy consultant. Jiri's main fields of expertise include smart city policies,

eGovernment services, smart mobility, geographic information systems, open (geo)-data, geo-location technologies, eID etc. His main responsibilities at IS-practice include consultancy services to public and private entities, development of innovative project ideas, project management and coordination of the innovation CIP, FP7 and Horizon2020 projects.

Jiri is a co-founder and CEO at InnoConnect.net, a digital technology start-up company that delivers location intelligence services to clients in the fields of smart cities, smart mobility, Internet of Things, open data and geo-data analytics & visualization.

Jiri previously worked at the Ministry of Industry and Trade of the Czech Republic dealing with the EU internal market and competitiveness agenda. He was responsible for the implementation of the Services Directive (2006/123/EC) in the Czech Republic and is a co-author of the Czech Republic's Competitiveness Strategy for 2020, which formulated crosscutting national policy reforms in the field of R&D, innovation and trade promotion.

Relevant Publications

- Kerschot, H., & Bouchal, J. (2013, April). Electronic Identity Adoption: Online Survey. In Cyber Security and Privacy Forum(pp. 153-164). Springer, Berlin, Heidelberg.
- Van Gompel, R., & Kerschot, H. Development of a Standardized Framework for Measuring E-Government User Satisfaction and Impact in the EU. (pp. 159-177) in Alan R. Shark and S. Toporkoff (eds) Beyond eGovernment Measuring Performance: a global perspective, Washington DC 2010 (US).
- Indigov, B. V. B. A., Whitepapers, I., Van Gompel, R., Steyaert, J., & Kerschot, H. e-Democracy in Flanders. (pp. 227-248) in Shark, A.R., Toporkoff, S. (eds.) Beyond e-Government & e-Democracy: A Global perspective. Public Technology Institute & ITEMS International (Washington, Paris)
- Kerschot, H., Steyaert, J. & Van Gompel, R. (2006) Fed-eView Citizen: Longitudinal study of the internet and eGovernment in Belgium. What citizens think. Leuven, Indigov Research Report, study commissioned by FEDICT, Belgian Federal Administration of ICT.

Relevant Projects & Activities

2017-2020	H2020 (RIA)	**PoliVisu** https://www.polivisu.eu/ PoliVisu enhances public involvement and support in urban policy making, by equipping decision makers with the skills and tools - from open (geo) data processing to advanced visualisations - to use big data for collaborative policy experimentation. As a result the city makes better sustainable policy decisions and manages operations more effectively. IS-practice involvement: Proposal writing, project management & coordination, management of Pilsen pilot, business development.
2019-2022	H2020 (RIA)	**Locard** http://locard.eu/ Digital evidence is currently an integral part of criminal investigations, and not confined to pure cybercrime cases. Due to its nature, the use of digital evidence in a court of law has always been challenging. It is critical that it should be accompanied by a proper chain of custody, guaranteeing its source and integrity. LOCARD aims to provide a holistic platform for chain of custody assurance along the forensic workflow, a trusted distributed platform allowing the storage of digital evidence metadata in a blockchain. Each node of LOCARD will be able to independently set its own permission policies and to selectively share access to digital evidence with other nodes when deemed necessary and upon proper authorization through fine-grained policies. IS-practice involvement (through V-ICT-OR): Proposal writing, project management.
2016-2019	H2020 (RIA)	**bIoTope** http://www.biotope-project.eu/ The overall objective of bIoTope is to create Systems of Systems (SoS) where information from cross- domain platforms, devices and other information

		sources can be accessed when, and as needed using Standardised Open APIs. bIoTope Systems are smart in the sense that they learn from experience to make, or propose the most appropriate actions depending on the current user's or object's context/situation. Standardised Open APIs make it possible to compose new SoS from new or existing components and platforms, even without programming. This contributes to speed up the creation of new Internet of Things (IoT) applications and services in open innovation SoS ecosystems. IS-practice involvement: Proposal writing, project management & coordination, business development.
2014-2017	CIT ICT PSP (FP7)	**ECIM** - European Cloud Marketplace for Intelligent Mobility ECIM developed a state-of-the-art solution that combines the strong cloud capabilities of an existing CIP cloud-based platform, EPIC, with new functionalities that facilitate the easy migration of existing city services and innovative creation of new ones. It is designed to help support smart, liveable, and connected cities by fostering and bringing together transportation services that make it easier for people and goods to move between destinations as quickly, cheaply, and green as possible. As a part of ECIM pilot validation in Brussels, the Belgian eID card will be used to issue resident parking permits online via ECIM cloud services, building on STORK and STORK 2.0 outcomes. IS-practice involvement: Proposal idea, writing, project management & coordination of the Brussels pilot
2012-2015	CIT ICT PSP (FP7)	**Citadel on the Move** Citadel unleashes the power of mobile technology and open access data to tap into the innovative potential of citizens to deliver smarter city services. It aims to make it easier for cities, citizens, and application developers alike from all over Europe to use Open Data to create the type of innovative mobile applications fulfilling today's societies' needs. At present, governmental Open Data is often difficult to access and use for the developer community, let alone average citizens. Citadel on the Move aims to fill this void by creating: ● Formats that make it easier for local government to release data in usable, interoperable formats, and; ● Tools (a dataset converter and an application generator tool) that make it easier for citizens to create mobile applications that may be shared across Europe and offer services, which may be used on any device, anytime, and anywhere. IS-practice involvement: Proposal idea, proposal writing, project management & coordination.

Role in the Project

IS-practice will work closely with the Coordinator to assist with the project coordination and to take over day-to-day project management activities (WP8) such as supporting the coordinator when liaising with the EU Commission and managing the resources, meetings and conference calls organization, quality assurance, risk management, progress monitoring and reporting, and supporting partners with all issues related to the financial and administration management of the project. ISP will also closely support the Pilsen pilot.

Partner 15: GFOSS – Open Technologies Alliance

	GFOSS – Open Technologies Alliance (GFOSS) (Greece) Partner n° 15

Partner Introduction

GFOSS - Open Technologies Alliance is a non-profit organization founded in 2008, 36 Universities and Research Centers are shareholders of GFOSS.

Our main goal is to promote Openness through the use and the development of Open Standards and Open Technologies in Education, Public Administration and Business in Greece.

We are platform for Open Standards, Free Software, Open Content, Open Data & Open Hardware in Greece. The major Greek Universities and Research Centers participate in GFOSS, while leading members of the Greek community of developers play a key role in the implementation of our policies.

GFOSS is affiliated with Creative Commons, is a founding member of COMMUNIA and FAB LAB ATHENS, member of the Open Government Partnership (OGP) Network, Node of the Open Data Institute (http://opendatainstitute.org/), member of the Open Budget Initiative (http://internationalbudget.org/what-we-do/major-ibp-initiatives/open-budget-initiative/), member of the Open Policy Network (https://openpolicynetwork.org/), Associate Organisation of FSFE (Free Software Foundation Europe), Associate Member of Eclipse Foundation (https://eclipse.org/), Associate Organization of OW2 Consortium (https://www.ow2.org/) and local hub of MyData (https://mydata.org/hubs/).

GFOSS also cooperates with the Enterprise Europe Network – Hellas in the ICT sector, with the aim to assist companies that provide Open Technology services. GFOSS experts share extensive multidisciplinary experience in the development and operation of major education, transparency and public engagement projects in Greece. These include the projects on electronic deliberation for participatory decision making, open innovation and open education.

Key Personnel

Theodoros Karounos (male)**,** he has completed the School of Contemporary studies of the City University of New York in 1979, received his B.Sc. in Computer Science in 1983 and the M.Sc. Degree in Information & Communication Systems from Polytechnic University, New York in 1985. From 1984 to 1987 he was employed by IBM, New York, USA, as a Systems Analyst involved in the adaptation and testing of pre-commercial network management tools and the operation of the IBM international corporate data network. From 1987 to 1990 he was a coordinator for systems support and R&D at the Informatics Development Agency of the Greek Ministry of Presidency and Special Advisor for Informatics to the Greek Minister of the Interior. From 1990 onwards he has been actively involved with the National Technical University of Athens, in various posts including managing the R&D activities of the Network and Optimal Design Laboratory – NETMODE, acting as Technical Manager of the telecommunications network of NTUA, and the implementation of GRNET and where he acted as technical coordinator. He also represented NTUA at the GUNET policy committee as well as being a member of its technical committee. He has also acted as advisor to the Ministries of Development and Education on information and communication technologies, as well as to the Prime Minister, and e-government coordinator for Greece. Currently he is vice president of the Executive Board of GFOSS.

Despina Mitropoulou: (female) Despina Mitropoulou received her BSc (Hons) in Digital Media from the University of Portsmouth in 2005 and her MSc in Child-Computer Interaction from the University of Central Lancashire in 2006. In 2010 she joined GFOSS as the project coordinator and had the overview of all the projects and activities GFOSS was involved in. From 2015, she has been appointed the director of the Organisation.

Relevant Publications

1. Prodromos Tsiavos, Petros S. Stefaneas, and Theodoros Karounos, "The Transposition of European Union Open Data/Public Sector Information Policies in Greece: A Critical Analysis". Policy & Internet, Vol. 5, No. 4, pp 402-418, Wiley 2013.
2. Siani Pearson, Prodromos Tsiavos: Taking the Creative Commons beyond copyright: developing Smart Notices as user centric consent management systems for the cloud. IJCC 3(1): 94-124 (2014)
3. Siani Pearson, Prodromos Tsiavos: From Creative Commons to Smart Notices - Designing user Centric Consent Management Systems for the Cloud. CLOSER 2012: 647-660.

Relevant Projects & Activities

1. **SlideWiki** – HORIZON2020 (2016 - 2018)**: -** https://slidewiki.eu/

The project is using the open source SlideWiki platform (available at SlideWiki.org) for large-scale pilots for collaborative OpenCourseWare authoring, multiplatform delivery and Learning Analytics. Our role in the project is to set up, execute and evaluate part of the professional and vocational trials.

2. **YDS –** HORIZON2020 (2015-2018): https://yourdatastories.eu/

YDS - Your Data Stories:"YourDataStories" (YDS) is a highly customisable online platform for data exploitation focused in the financial flows that are critical for transparency, collaboration and participation, all pressing social challenges ranked highly in the European agenda tools, not only to discover relevant information but also to remix it with diverse and dynamic data sources: YDS acts like an interactive canvas to enable data citizens to (re)write their own data history. Users are facilitated by powerful and established tools, not only to discover relevant information but also to remix it with diverse and dynamic data sources: YDS acts like an interactive canvas to enable data citizens to (re)write their own data history.

3. **ODEON –** Interreg MED Programme (2018 - 2020)**:** https://odeon.interreg-med.eu/

ODEON project addresses the exploitation of Open Data and aims at strengthening the relationship between digital agenda, e-government strategy, the open data platforms implemented at several levels and the availability of Open Data to support innovation process within Interreg Mediterranean Area**.**

4. **+RESILIENT –** Interreg MED Programme (2018 - 2022)**:** https://plus-resilient.interreg-med.eu/

RESILIENT puts together a 4-helix partnership of 8 MED countries to tackle the need for innovation conducive to increased socially-responsive competitiveness of SMEs & stimulate new jobs, especially for companies operating in the social economy. It aims to kickstart a process of policy change at regional level in the involved areas resulting in the integration of successful elements into the new Cohesion policy (EU2020+). The overall objective is to positively influence, adapt/change the different structural elements of policy governing "clusters with high social vocation and responsiveness" (SVRC) by leveraging on innovation dynamics led by technology, open data & successful models with social relevance & impact, creating socially-responsive value chains at a transnational level.

Role in the Project

GFOSS will participate in WP2 (Co-creation design process), WP6 (Pilot Activities for Athens), WP7 (Dissemination) and WP8 (Project Management). In WP6 GFOSS will support the pilot activities in Athens with the provision of transport & mobility data.

4.2. Third parties involved in the project (including use of third party resources)

Participant 1 (AIV, Informatie Vlaanderen) and Participant 12 (Plan4All) will involve third parties in the project. There are no third parties involved by the other participants.

Participant 1 (Informatie Vlaanderen, AIV)

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	**Y**
AIV will appoint an external panel of eminent policy experts who will help guide the steering of the project and provide a critical role in terms of methodology and outputs. The experts will be selected within the first 6 months of the project according to the public procurement procedure of AIV and with respect to the principles of best value for money and absence of any conflict of interest. Please refer to the section 3.4.5. Subcontracting for more details on experts' tasks and man-days distribution per WP.	
Does the participant envisage that part of its work is performed by linked third parties	**N**
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	**N**
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	**N**

Participant 12 (Plan4All)

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	**N**
Does the participant envisage that part of its work is performed by linked third parties	**Y**
Linked Third Party: University of West Bohemia (UWB) The UWB is the founder of the Plan4all association. The university, established through the merger of the Institute of Technology and the Faculty of Education in 1991, has 8 faculties with more than 60 departments and three institutes of higher education. Nearly 19,000 students can choose from a wide range of Bachelor, Master and PhD study programmes. The Department of Geomatics (geos: Earth, matics: informatics), Faculty of Applied Sciences, is one of the leading research groups in geomatics in the Czech Republic. The Geomatics section provides education in the following specialisations: geodesy, geographic information systems (GIS), cadastre, cartography and spatial planning. The UWB provides applied and interdisciplinary research in different thematic areas. The disciplines	

include geography, astronomy, geophysics, informatics, cybernetics and mathematics. The key thematic areas include spatial and urban planning and smart cities, transport planning including smart mobility, agriculture and precision/autonomous farming, tourism and cultural heritage including historical maps, environmental protection, disaster management and climate change.

The UWB is one of the main authors of the tool that will be used in the DUET project – the Traffic Modeller. The modeller was developed in previous projects, mainly during the OpenTransportNet and PoliVisu projects.

Link to the participant
UWB is the founding member of the Plan4all association.

Tasks in the Project
UWB will be responsible for the traffic and noise modelling by implementing the Traffic Modeller and for integrating into the Digital Twin concept within the Pilsen pilot.

Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	**Y**

Two members of P4All (InnoConnect s.r.o and EDIP s.r.o.) will make available their resources to P4All under Article 11 '*Use of in-kind contributions provided by third parties against the payment'* to secure the expertise for the implementation of P4All's tasks:

InnoConnect
InnoConnect was founded in 2016 as a digital innovation start-up company located in Plzeň, Czechia. InnoConnect works with companies and public organisations from all over Europe to deliver technology innovation in the fields of smart cities, smart mobility, Internet of Things, open data and geo-data analytics & visualisation. InnoConnect services include big data management, dynamic analytics & visualisation (WebGLayer heatmaps), sensor data & real-time data management, processing & online access, location-based services, and smart mobility consultancy.
InnoConnect develops maps with analytical tools that help people to understand their data and to use it to support their decisions. The maps offer a very high interactivity and quick reaction to user actions. The open source WebGLayer library maintained by InnoConnect allows to develop interactive analytical maps with large datasets (up to 1.5 mil data records) by implementing multiple linked views to present data. Each of the views enables different interactions (such as filtering or relationship analysis) that trigger an instant update of the other views. Users thus benefit from immediate and dynamic data visualizations, gain better understanding of data by applying filters, and develop the opportunity to discover relationships and patterns in the data.

EDIP
EDIP is a Czech company founded in 2003. EDIP specializes in transport engineering. The company has a particular emphasis on traffic safety, safety audits, traffic counting (significantly contributed to national traffic census 2010) and assessing the capacity of the intersections.
EDIP deals with traffic and transport models (modelling of traffic volumes, evaluation of alternative solutions, traffic professional estimate), GIS services (visualization of different types of transport data that includes but is not limited to traffic volumes, accidents and routing, thematic and digital maps, GID database, geographic traffic analysis) , road safety audit (road inspections, traffic accident analysis and

visualization of these type of data, solution suggestions), traffic surveys (research and evaluation all modes of transport, national traffic census), intersection assessment (capacity assessment and solution suggestions), public and cycle transport (analyses, visualization, assessment of the effectiveness and optimalization).
EDIP published twice a year the peer-reviewed journal Traffic Engineering along with organizing a range of conferences and smaller events.
EDIP is a member of the Czech Association of Road Companies and Association of Research Organizations and involves in a number of research projects with the Czech Research Program CR Technology Agency, or the Ministry of Interior. During the last three years EDIP collaborated in EU project OpenTransportNet dealing with data modeling and visualization.

These two organisations will not be implementing action tasks however will make available its resources (invoiced on cost-basis) to the P4All's tasks as follows:

P4A Member	PIC	Share of the P4A's direct personnel costs budget	Involvement in tasks	Brief description
InnoConnect s.r.o.	916115919	50 000 EUR = approx. 10 person months	T4.2 T4.3 T4.4	Development of 2D visualisations with the WebGLayer library (see the Part B, section 4.1, chapter 12 of the proposal)
EDIP s.r.o.	950418708	15 000 EUR = approx. 3.75 person months	T4.2 T4.4	Providing traffic engineering expertise for the traffic modelling and traffic model data analysis

It's envisaged for both InnoConnect and EDIP that the seconded personnel will work on the premises of the organisation providing the resource.
Providing a personnel (seconding) is not an economic activity of InnoConnnect nor of EDIP.

- InnoConnect's core activity is big data analysis & visualization and development of analytical maps.
- EDIP's core activity is traffic engineering, creating traffic models, traffic census, traffic data collection, processing and analysis.

Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	**N**

Section 5: Ethics and Security

5.1 Ethics

DUET project focuses on leveraging the advanced capabilities of cloud and high-performance computing to evolve the traditional public policy making cycle using large open data sources. Due to the subject of the project, the risks of ethical violations are low. Participants of the project will conduct all work respecting the principles of the Charter of Fundamental Rights of the European Union[46], which covers issues of dignity, freedom, equality, solidarity, citizens' rights and justice. The project will comply with Article 8 of the European Human Rights Convention[47].

A Digital Twin as an open platform for cities, citizens, private companies has limited risks regarding security (who has access to what), privacy (protection of personal data) and ethics (is what is available responding to ethical principles). DUET will take care of:

- Ensuring that the results are translated in objective and truthful conclusions.
- Transparency and accountability in the acquisition, processing, storage and use of data;
- Ensuring that the algorithms driving HPC analytics are open and fair;
- Protecting the privacy of data using data anonymization and coding techniques;
- Demonstrating a clear public benefit;
- Proportionality;
- Recognition of the limitations of the data used and a precautionary approach.
- Transparency check procedure.

All partners will conform, aside from the abovementioned primary EU law, to relevant secondary EU legislation, namely, the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC ("General Data Protection Regulation", hereinafter "GDPR"), to the extent the data processed by the team is "personal data"[48]. They will also conform to relevant national legislation. In particular, researchers will consider the sensitive implications of their proposals in terms of respecting privacy, inclusiveness and autonomy. The project and the proposed work will ensure that all material and data will be used with the utmost confidentiality and dignity, and thus no risk, nor harm to third parties is caused. Researchers will take into account the opinions of the European Group on ethics.
Below we provide an overview of some aspects underpinning the interplay between data protection laws in the EU and the technical infrastructure.

5.1.1 Infrastructure: Processing of personal data and legal safeguards

To the extent possible, efforts to anonymise personal data should be made. However, when that is not possible and when at stake may be processing of personal data by the consortium[49], the GDPR principles will be complied with. Under Article 5(1) of the GDPR, they are: lawfulness, fairness and transparency, purpose limitation, data

[46] Charter of Fundamental Rights of the European Union, OJ C 326, 26.10.2012, p. 391–407.
[47] "1. Everyone has the right to respect for his private and family life, his home and his correspondence. 2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others."
[48] When the processed data is non-personal, see EU Regulation 2018/1807 on a framework for the free flow of non-personal data in the European Union (the "Non-personal Data Regulation"), which will become directly applicable in the EU Member States as of May 2019.
[49] Under Article 4(8) of the GDPR, 'processor' means a natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller.

minimisation, accuracy, storage limitation and integrity and confidentiality. Under Article 5(2) of the GDPR, the controller[50] shall be responsible for, and be able to demonstrate compliance with, paragraph 1 ('accountability') of Article 5 of the GDPR, as well as Article 6 of the GDPR.

Personal data should only be collected based on informed consent by providing – as much as possible – choices and control of the process to the users, and/or obligations to delete such data later[51] .

Privacy by design

Privacy by design has become a legal requirement with the GDPR, in accordance with Article 25 of the GDPR. Such concept calls for the inclusion of data protection from the onset of the designing of systems, rather than an addition. Under Article 28(1): "Where processing is to be carried out on behalf of a controller, the controller shall use only processors providing sufficient guarantees to implement appropriate technical and organisational measures in such a manner that processing will meet the requirements of this Regulation and ensure the protection of the rights of the data subject."

This means that the privacy will be embedded into the design specification of technologies and physical infrastructure[52]. This will entail for the privacy protection to be kept in mind throughout the entire life cycle of the technology, from the very early stage of its design until its ultimate deployment, use and disposal[53].

This also means that as much data as possible should strive to remain with the user, rather than otherwise, to abide by the GDPR-related principle of data minimisation.

In particular, as has been observed, "it is worth mentioning a trade-off may exist between maintaining privacy and providing smartness. The trade-off decision should be under the control of the respective persons"[54]. They should be able to make the decision which data are provided and for which purpose and for how long these data should be accessible and available to the system afterwards. In addition, when processing is controlled locally, code constraints can be built[55].

Privacy Impact Assessments

According to the GDPR, "in order to enhance compliance with this Regulation where processing operations are likely to result in a high risk to the rights and freedoms of natural persons, the controller should be responsible for the carrying-out of a data protection impact assessment to evaluate, in particular, the origin, nature, particularity and severity of that risk. The outcome of the assessment should be taken into account when determining the appropriate measures to be taken in order to demonstrate that the processing of personal data complies with this Regulation. Where a data-protection impact assessment indicates that processing operations involve a high risk which the controller cannot mitigate by appropriate measures in terms of available technology and costs of implementation, a consultation of the supervisory authority should take place prior to the processing."

5.1.2 Pilots

In the pilots, volunteers whose personal data may need to be processed will be involved. The personal data are basically identification, profession and the opinions and answers given by the participants. In this respect, the following safeguards to ensure privacy will need to be adopted:

[50] Under Article 4(7) of the GDPR, 'controller' means the natural or legal person, public authority, agency or other body which, alone or jointly with others, determines the purposes and means of the processing of personal data; where the purposes and means of such processing are determined by Union or Member State law, the controller or the specific criteria for its nomination may be provided for by Union or Member State law.

[51] For an overview of the challenges in an ambient intelligence dimension, see Streitz, Norberta; * | Charitos, Dimitris | Kaptein, Mauritsc; | Böhlen, Marc, Grand challenges for ambient intelligence and implications for design contexts and smart societies, Journal of Ambient Intelligence and Smart Environments, vol. 11, no. 1, pp. 87-107, 2019.

[52] L.Edwards, Privacy, Security and Data Protection in Smart Cities: a Critical EU Law Perspective, CREATe Working Paper, December 2015.

[53] Recital 61 of the European Parliament pre-trilogue draft of the GDPR. Edwards, *supra,* page 28.

[54] Streitz et al, *supra.*

[55] L.Edwards, *supra.*

Informed consent, enshrined under Article 7 of the GDPR, will be *ex ante* sought whenever ICT research involves volunteers in interviews and the project will ensure that subjects have the information they need specifying the alternatives, risks, and benefits for those involved in ways that they understand. The participants in pilots (subjects) will be adult healthy volunteers. None of the methodologies and technologies intended to be used are known to inflict any psychological damage on participants. Great care will be taken that the experiment itself will not contain any elements that may harm or threaten the participant, either physically or psychologically. Protection of humans is the primary imperative and, in addition to legal and ethical standards, individual investigators' commitment to the protection of research participants should not be underestimated. Without their volunteer participation in research, it is not possible to gather the knowledge needed to advance science and technology. Participants will be debriefed after the experiments. The investigations included in the project are not medical examinations and do not warrant conclusions on any potential diseases. In order to ensure an informed consent procedure that is in line with international standards of research ethics, as well as the GDPR, recruitment of participants will be performed as a two-stage process.

Privacy

With regard to managing personal data, DUET will process the data as confidential and will take every precaution to guarantee the privacy to participants, i.e. ensuring that personal data will be appropriately anonymised and be made inaccessible to third parties. It is foreseen that all the third party data that will be processed and analysed in the project will have been anonymised before they are made available to the DUET researchers.

When analysing the data of pilot participants, researchers will use digital data files with no identification data (a participant number will be used for data-linkage purposes). These files will be stored on special domains within the participating organisations' network architectures (within EU). Only the researchers involved in the project will have access to this password protected storage area. The GDPR will be complied with (researchers would be data processors pursuant to Article 28 of the GDPR)[56]. Data retention will be minimal: at the end of the project (or earlier, if possible), all questionnaires and identification data file will be destroyed. Precautions to ensure anonymisation of personal data be exercised: That is, the remaining digital data files will be such that the participants (data subjects) can no longer be identified or become again identifiable. All researchers participating in the project will undersign a nondisclosure agreement concerning the personal data of the participants. Prior to the actual experiments, each project partner will draw up a description of the scientific research data file and will keep this description available to anyone. These procedures comply with the aforementioned EU and national legislation.

Inclusiveness

The contents developed and used in the project will be compliant to the W3C Content accessibility guidelines. The guidelines discuss accessibility issues and provide accessible design solutions. They address typical scenarios that may pose problems for users with certain disabilities.

Actions

In order to follow-up the ethical aspects of the project, the consortium will nominate a person in charge of this:

- the "ethics manager" Geert Mareels (AIV - Vlaams Gewest) will ensure the project is run ethically,
- the solution legal and ethics manager is Grimaldi (GSL) will ensure the Digital Twin processes for how they process, use and integrate data for policy outcomes.

Ethical issues will be explicitly reported on in the respective periodic reports (end of period 1, 2 and 3).

The following measures will be taken during the project to fulfill the **EC's ethics requirements:**

Ethics requirement: Humans

Due to the nature of our project there will be no tests on human embryos and fetuses or animals. It does not involve physical interventions on the study participants. DUET will pay attention to the possible involvement of vulnerable categories of individuals. The participants in pilots (subjects) will be adult healthy volunteers. None of the methodologies and technologies intended to be used are known to inflict any psychological damage on participants. There will probably be a use of personal data as defined by GDPR. In that case the rules of GDPR

[56] See *supra*, note 5.

will be followed strictly and followed up by the DPO of each partner, including the higher protection of sensitive data, pursuant to Article 9 of the GDPR.
As described in the Methodology section, selecting research participants through desk research will be performed by the project team. Its aim will be to identify and invite the most relevant actors in both civil service and non-government camps that have the best understanding of and greatest influence on big data driven policymaking. After selecting candidates for the interviews, the interviewees would then be approached by email and telephone.
Researchers conducting Expert Lens Interviews will follow a step-by-step protocol to guide them through the process. The protocol will adhere to the common norms and rules of qualitative research such as informed consent, participant rights and confidentiality. All the users included in the different trials will receive an informed consent in which they will be duly informed about how their personal data will be processed. Templates of the informed consent forms and information sheet will be drawn up at the very beginning of the project. They will contain the information and procedures listed above.
See also above in the 5.1.2. Pilots for more details.

Ethics Requirement: Personal data
The Data Management Plan will provide detailed information on the procedures that will be implemented for data collection, processing, storage, protection, retention and destruction and confirmation that they comply with national and EU legislation. More specifically, details on the type of data collected, the retention period, and whether it will be destroyed at the end of the project will be provided.
A special effort will be made to collect as little restricted and personal data as possible. The personal data involved will be the identification, profession and the opinions and answers given by the participants.
All data will be handled only by qualified researchers under strict confidentiality agreements, who will ensure that data access, data protection and privacy standards are in compliance with national and EU regulations. All the users included in the different trials will sign an informed consent in which they will be duly informed about how their personal data will be processed. Should any sensitive data be obtained during the project, the project will see to it that it be made anonymous and rigorously protected for the duration of the action (in accordance with Article 9 of the GDPR) and destroyed at the conclusion.
Data used in the project (Big Data, Open data) will be subject of a paper analyzing the potential conflict with respect to privacy. The big data can be categorized in levels of (personal) detail. Ways to anonymize data will be proposed and for each level of anonymization the achievable analytics use cases will be listed.
When processing personal data, as mentioned above, the consortium will comply with the GDPR principles. This means that at the outset, when the data cannot be anonymised fully, in the development of the project, Article 5(1) of the GDPR, enshrining the principles of personal data protection[57], will be taken into account.
Prior to the beginning of an activity raising an ethical issue, the beneficiary will confirm that any ethics committee opinion required under national law has been obtained, and is kept on file.
See also above in the 5.1.2. Pilots for more details.

5.2 Security

Security issues in DUET:

- activities or results raising security issues: NO
- 'EU-classified information' as background or results: NO

Annex 1 - Letters of Intent

1. Wirelesssinfo

[57] Under Article 5(1), they are: lawfulness, fairness and transparency, purpose limitation, data minimisation, accuracy, storage limitation and integrity and confidentiality. Under Article 5(2), the controller shall be responsible for, and be able to demonstrate compliance with, paragraph 1 (‘accountability’).

2. Czech Centre for Science and Society
3. City of Pilsen, Vlastimil Gola, the City Council Member for Smart Cities and Enterprise Support

ESTIMATED BUDGET FOR THE ACTION

Associated with document Ref. Ares(2019)6736983 - 30/10/2019

	Estimated eligible[1] 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[2]	Total costs	Reimbursement rate %	Maximum EU contribution[3]	Maximum grant amount[4]	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]*	D.5 Costs of internally invoiced goods and services						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 funding/ international partners
Form of costs[6]	Actual	Unit[7]	Unit[8]		Actual	Actual	Actual	Unit[9]	Flat-rate[10] 25%							
	a	Total b	No hours	Total c	d	*[e]*	f	Total g	h = 0,25 x (a +b+c+f+g +*[i1]*[13]+*[i2]*[13]-n)	j = a+b+c+d +*[e]*+f+g+h +*[i1]*+*[i2]*	k	l	m	n	Yes/No	
1. AIV	510 000.00	0.00	0.00	0.00	75 000.00	0.00	130 000.00	0.00	160 000.00	875 000.00	100.00	875 000.00	875 000.00	0.00	No	n/a
2. IMEC	461 016.00	0.00	0.00	0.00	0.00	0.00	24 250.00	0.00	121 316.50	606 582.50	100.00	606 582.50	606 582.50	0.00	No	n/a
3. KUL	142 500.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	39 375.00	196 875.00	100.00	196 875.00	196 875.00	0.00	No	n/a
4. ATC	275 000.00	0.00	0.00	0.00	0.00	0.00	22 500.00	0.00	74 375.00	371 875.00	70.00	260 312.50	260 312.50	0.00	No	n/a
5. 21c	280 500.00	0.00	0.00	0.00	0.00	0.00	35 000.00	0.00	78 875.00	394 375.00	70.00	276 062.50	276 062.50	0.00	No	n/a
6. AEG	130 050.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	36 262.50	181 312.50	70.00	126 918.75	126 918.75	0.00	No	n/a
7. OASC	280 000.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	73 750.00	368 750.00	100.00	368 750.00	368 750.00	0.00	No	n/a
8. GSL	104 000.00	0.00	0.00	0.00	0.00	0.00	10 000.00	0.00	28 500.00	142 500.00	70.00	99 750.00	99 750.00	0.00	No	n/a
9. DAEM	92 750.00	0.00	0.00	0.00	0.00	0.00	12 500.00	0.00	26 312.50	131 562.50	70.00	92 093.75	92 093.75	0.00	No	n/a
10. VCS	240 500.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	63 875.00	319 375.00	70.00	223 562.50	223 562.50	0.00	No	n/a
11. TNO	149 500.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	41 125.00	205 625.00	100.00	205 625.00	205 625.00	0.00	No	n/a
12. P4All	95 000.00	0.00	0.00	0.00	0.00	0.00	8 500.00	0.00	25 875.00	129 375.00	100.00	129 375.00	129 375.00	0.00	No	n/a
- UWB	66 500.00	0.00	0.00	0.00	0.00	0.00	8 500.00	0.00	18 750.00	93 750.00	100.00	93 750.00	93 750.00	0.00	No	n/a
Total beneficiary	161 500.00	0.00			0.00	0.00	17 000.00	0.00	44 625.00	223 125.00		223 125.00	223 125.00	n/a	n/a	0.00
13. PLZ	112 000.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	31 750.00	158 750.00	100.00	158 750.00	158 750.00	0.00	No	n/a
14. ISP	216 000.00	0.00	0.00	0.00	0.00	0.00	15 000.00	0.00	57 750.00	288 750.00	70.00	202 125.00	202 125.00	0.00	No	n/a
15. GFOSS	54 000.00	0.00	0.00	0.00	0.00	0.00	10 000.00	0.00	16 000.00	80 000.00	100.00	80 000.00	80 000.00	0.00	No	n/a
Total consortium	3 209 316.00	0.00		0.00	75 000.00	0.00	366 250.00	0.00	893 891.50	4 544 457.50		3 995 532.50	3 995 532.50			0.00

[1] See Article 6 for the eligibility conditions.
[2] Indirect costs already covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary/linked third party 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, unless it can demonstrate that the operating grant does not cover any costs of the action (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 Agency decided to grant for the action) (see Article 5.1).
[4] The 'maximum grant amount' is the maximum grant amount decided by the 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 the beneficiary's usual accounting practice.
[8] See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
[9] Unit and costs per unit : calculated according to the beneficiary's usual accounting practices.
[10] 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).
[11] See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
[12] See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc).
[13] Only specific unit costs that do not include indirect costs.
[14] See Article 9 for beneficiaries not receiving funding.
[15] Only for linked third parties that receive funding.

ANNEX 2a

ADDITIONAL INFORMATION ON THE ESTIMATED BUDGET

- **Instructions and footnotes in blue will not appear in the text generated by the IT system (since they are internal instructions only).**
- **For options *[*in square brackets*]*: the applicable option will be chosen by the IT system. Options not chosen will automatically not appear.**
- **For fields in [grey in square brackets] (even if they are part of an option as specified in the previous item): IT system will enter the appropriate data.**

⚠ **Transitory period: Until SyGMa fully supports Annex 2a, you must prepare it manually (using this template by choosing and deleting the options/entering the appropriate data).**
For the 'unit cost tables': either fill them out manually or use currently existing tables from Annex 1 or the proposal.
The document can then be uploaded in SyGMa and attached to the grant agreement.

Unit cost for SME owners/natural beneficiaries without salary

1. Costs for a *[*SME owner*][*beneficiary that is a natural person*]* not receiving a salary

Units: hours worked on the action

Amount per unit ('hourly rate'): calculated according to the following formula:

{the monthly living allowance for researchers in MSCA-IF actions / 143 hours}
multiplied by
{country-specific correction coefficient of the country where the beneficiary is established}

The monthly living allowance and the country-specific correction coefficients are set out in the Work Programme (section 3 MSCA) in force at the time of the call:

- for calls *before* Work Programme 2018-2020:
  - for the monthly living allowance: **EUR 4 650**
  - for the country-specific correction coefficients: see Work Programme 2014-2015 and Work Programme 2016-2017 (available on the Participant Portal Reference Documents page)
- for calls *under* Work Programme 2018-2020:
  - for the monthly living allowance: **EUR 4 880**
  - for the country-specific correction coefficients: see Work Programme 2018-2020 (available on the Participant Portal Reference Documents page)

[additional OPTION for beneficiaries/linked third parties that have opted to use the unit cost (in the proposal/with an amendment): For the following beneficiaries/linked third parties, the amounts per unit (hourly rate) are fixed as follows:

- beneficiary/linked third party [short name]: EUR [insert amount]
- beneficiary/linked third party [short name]: EUR [insert amount]

[same for other beneficiaries/linked third parties, if necessary] *]*

Estimated number of units: see Annex 2

Energy efficiency measures unit cost

2. Costs for energy efficiency measures in buildings

Unit: m^2 of eligible 'conditioned' (i.e. built or refurbished) floor area

Amount per unit*: see (for each beneficiary/linked third party and BEST table) the 'unit cost table' attached

* Amount calculated as follows:
{EUR 0.1 x estimated total kWh saved per m^2 per year x 10}

Estimated number of units: see (for each beneficiary/linked third party and BEST table) the 'unit cost table' attached

Unit cost table (energy efficiency measures unit cost)[1]

Short name beneficiary/linked third party	BEST No	Amount per unit	Estimated No of units	Total unit cost (cost per unit x estimated no of units)

[1] Data from the 'building energy specification table (BEST)' that is part of the proposal and Annex 1.

Research infrastructure unit cost

3. Access costs for providing trans-national access to research infrastructure

Units[2]: see (for each access provider and installation) the 'unit cost table' attached

Amount per unit*: see (for each access provider and installation) the 'unit cost table' attached

* Amount calculated as follows:

$$\frac{\text{average annual total access cost to the installation (over past two years}^{3}\text{)}}{\text{average annual total quantity of access to the installation (over past two years}^{4}\text{)}}$$

Estimated number of units: see (for each access provider and installation) the 'unit cost table' attached

Unit cost table (access to research infrastructure unit cost)[5]

Short name access provider	Short name infrastructure	Installation		Unit of access	Amount per unit	Estimated No of units	Total unit cost (cost per unit x estimated no of units)
		No	Short name				

Clinical studies unit cost

4. Costs for clinical studies

Units: patients/subjects that participate in the clinical study

Amount per unit*: see (for each sequence (if any), clinical study and beneficiary/linked third party) the 'unit cost table' attached

* Amount calculated, for the cost components of each task, as follows:

For **personnel costs**:

For personnel costs of doctors: 'average hourly cost for doctors', i.e.:

{certified or auditable total personnel costs for doctors for year N-1

{1720 * number of full-time-equivalent for doctors for year N-1}
multiplied by
estimated number of hours to be worked by doctors for the task (per participant)**}**

For personnel costs of other medical personnel: 'average hourly cost for other medical personnel', i.e.:

{certified or auditable total personnel costs for other medical personnel for year N-1

{1720 * number of full-time-equivalent for other medical personnel for year N-1}

2 Unit of access (e.g. beam hours, weeks of access, sample analysis) fixed by the access provider in proposal.
3 In exceptional and duly justified cases, the Commission/Agency may agree to a different reference period.
4 In exceptional and duly justified cases, the Commission/Agency may agree to a different reference period.
5 Data from the 'table on estimated costs/quantity of access to be provided' that is part of the proposal and Annex 1.

multiplied by
estimated number of hours to be worked by other medical personnel for the task (per participant)**}**

For personnel costs of technical personnel: **'**average hourly cost for technical personnel', i.e.:

{certified or auditable total personnel costs for technical personnel for year N-1

{1720 * number of full-time-equivalent for technical personnel for year N-1}
multiplied by
estimated number of hours to be worked by technical personnel for the task (per participant)**}**

'total personnel costs' means actual salaries + actual social security contributions + actual taxes and other costs included in the remuneration, provided they arise from national law or the employment contract/equivalent appointing act

For **consumables**:

For each cost item: 'average price of the consumable', i.e.:

{{certified or auditable total costs of purchase of the consumable in year N-1

total number of items purchased in year N-1}
multiplied by
estimated number of items to be used for the task (per participant)**}**

'total costs of purchase of the consumable' means total value of the supply contracts (including related duties, taxes and charges such as non-deductible VAT) concluded by the beneficiary for the consumable delivered in year N-1, provided the contracts were awarded according to the principle of best value- for-money and without any conflict of interests

For **medical equipment**:

For each cost item: 'average cost of depreciation and directly related services per unit of use', i.e.:

{{ certified or auditable total depreciation costs in year N-1 + certified or auditable total costs of purchase of services in year N-1 for the category of equipment concerned}

total capacity in year N-1
multiplied by
estimated number of units of use of the equipment for the task (per participant)**}**

'total depreciation costs' means total depreciation allowances as recorded in the beneficiary's accounts of year N-1 for the category of equipment concerned, provided the equipment was purchased according to the principle of best value for money and without any conflict of interests + total costs of renting or leasing contracts (including related duties, taxes and charges such as non-deductible VAT) in year N-1 for the category of equipment concerned, provided they do not exceed the depreciation costs of similar equipment and do not include finance fees

For **services**:

For each cost item: 'average cost of the service per study participant', i.e.:

{certified or auditable total costs of purchase of the service in year N-1

total number of patients or subjects included in the clinical studies for which the service was delivered in year N-1**}**

'total costs of purchase of the service' means total value of the contracts concluded by the beneficiary (including related duties, taxes and charges such as non-deductible VAT) for the specific service delivered in year N-1 for the conduct of clinical studies, provided the contracts were awarded according to the principle of best value for money and without any conflict of interests

For **indirect costs**:

{{{cost component 'personnel costs' + cost component 'consumables' + cost component 'medical equipment'}

minus

{costs of in-kind contributions provided by third parties which are not used on the beneficiary's premises + costs of providing financial support to third parties (if any)}**}**

multiplied by

25%**}**

The estimation of the resources to be used must be done on the basis of the study protocol and must be the same for all beneficiaries/linked third parties/third parties involved.

The year N-1 to be used is the last closed financial year at the time of submission of the grant application.

Estimated number of units: see (for each clinical study and beneficiary/linked third party) the 'unit cost table' attached

Unit cost table: clinical studies unit cost[6]

Task, Direct cost categories	**Resource per patient**	**Costs year N-1 Beneficiary 1 [short name]**	**Costs year N-1 Linked third party 1a [short name]**	**Costs year N-1 Beneficiary 2 [short name]**	**Costs year N-1 Linked third party 2a [short name]**	**Costs year N-1 Third party giving in-kind contributions 1 [short name]**
Sequence No. 1						
Task No. 1 Blood sample						
(a) **Personnel costs:** - Doctors	n/a					
- Other Medical Personnel	Phlebotomy (nurse), 10 minutes	8,33 EUR	11,59 EUR	10,30 EUR	11,00 EUR	9,49 EUR
- Technical Personnel	Sample Processing (lab technician), 15 minutes	9,51 EUR	15,68 EUR	14,60 EUR	15,23 EUR	10,78 EUR
(b) **Costs of consumables**:	Syringe	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Cannula	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Blood container	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(c) **Costs of medical equipment**:	Use of -80° deep freezer, 60 days	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Use of centrifuge, 15 minutes	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(d) **Costs of services**	Cleaning of XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(e) **Indirect costs** (25% flat-rate)		XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
Task No. 2						
…						
Amount per unit (unit cost sequence 1):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**
Sequence No. 2						
Task No. 1						

[6] Same table as in proposal and Annex 1.

XXX						
(a) **Personnel costs:** - Doctors	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
- Other Medical Personnel	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
- Technical Personnel	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(b) **Costs of consumables**:	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(c) **Costs of medical equipment**:	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(d) **Costs of services**	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(e) **Indirect costs** (25% flat-rate)		XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
Task No. 2						
…						
Amount per unit (unit cost sequence 2):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**
…						
Amount per unit (unit cost entire study):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**

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ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM (IMEC), established in KAPELDREEF 75, LEUVEN 3001, Belgium, VAT number: BE0425260668, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Luc VAN DEN HOVE with ECAS id nhoveluc signed in the Participant Portal on 25/11/2019 at 09:16:57 (transaction id SigId-143288-272yJlwTOfzewELnFH31UQpkM0gYL42HzV1mA1b578EZ0RR7MzmWjQ4EghlQNSey8x3bzfH1l4brZ5QrJL9cl6G-rS0vSrmBGYCg83u8uLaUrK-aZ8gHIo12a95gKjiDuc19PZM4okavxOL33k0pXv4g5S). Timestamp by third party at Mon Nov 25 09:17:03 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

KATHOLIEKE UNIVERSITEIT LEUVEN (KUL), established in OUDE MARKT 13, LEUVEN 3000, Belgium, VAT number: BE0419052173, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Elke LAMMERTYN with ECAS id nlammeel signed in the Participant Portal on 28/11/2019 at 10:09:20 (transaction id SigId-199167-GwrNyCbDY5ncpvcPX76RpzuoiNntyZNdMv8OUnEvV09dfGPFU8d6mAGbhJdk5tYjJVtNR78OCFXrnnA5BKBxDq-rS0vSrmBGYCg83u8uLaUrK-SGl4n0YOLFg6fSzbgtf51yN83RvJFqPuzex83SQVPMJG). Timestamp by third party at Thu Nov 28 10:09:26 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ATHENS TECHNOLOGY CENTER ANONYMI BIOMICHANIKI EMPORIKI KAI TECHNIKI ETAIREIA EFARMOGON YPSILIS TECHNOLOGIAS (ATC), established in RIZAREIOU 10, ATHINA 152 33, Greece, VAT number: EL094360380, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Yiannis KLIAFAS with ECAS id nkliafya signed in the Participant Portal on 18/11/2019 at 17:03:28 (transaction id SigId-71370-nzcgrpma1yM1czxuK7ZMnQCXNq5RO504oou8WXMyTJNkby4q6viVFvVldqiWdb6zdrhZ3hzhGufPs3Ip0f3iURK-rS0vSrmBGYCg83u8uLaUrK-ivWIKzzNOvVaX3NmF9dawqAYs0In1k0nqpGKblHgCtwm). Timestamp by third party at Mon Nov 18 17:03:36 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

21C CONSULTANCY LIMITED (21c), established in THE WORK PLACE, LADBROKE GROVE 105, LONDON W11 1PG, United Kingdom, VAT number: GB868818265, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Susan RUSTON with ECAS id nrustosu signed in the Participant Portal on 13/11/2019 at 13:04:02 (transaction id SigId-17130-Fvcu8zyMHGc3wYGFYEKie2J1pCTimEl2AzY29ctQ6pRoGeBmgOCIfFKkkL0N1UzYh7dlc3plZLEbngdme5gDAjG-rS0vSrmBGYCg83u8uLaUrK-cBXkhI6UY5p1Nzn1kZdt0H98ZFaVDm3gDzZkGPdoge40) . Timestamp by third party at Wed Nov 13 13:04:07 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AEGIS IT RESEARCH LTD (AEG), established in 20-22 WENLOCK ROAD, LONDON N1 7GU, United Kingdom, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Vassilis PREVELAKIS with ECAS id nprevass signed in the Participant Portal on 13/11/2019 at 13:35:20 (transaction id SigId-17713-nJcZzUzWB7UcqXOtDYMcx9JjNQbXrjvoOvHwsgjSMnq0FodTzzYmqe36SC5rD7H0G536bDa5KseFnzxzOuzRVvsW-rS0vSrmBGYCg83u8uLaUrK-SVA89Zbgr50tKhD0dzztUjWNYWdHDOHTRUzXnmzobR8T). Timestamp by third party at Wed Nov 13 13:35:26 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

OPEN & AGILE SMART CITIES (OASC), established in PLEINLAAN 9, BRUSSEL 1050, Belgium, VAT number: BE0686623804, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Davor Meersman with ECAS id n001zx5b signed in the Participant Portal on 28/11/2019 at 06:48:14 (transaction id SigId-196597-eAK5s2WhFeCx1bcVTevb6Y8zx8RSyBtfiODd8LLAx2QsSvnyP5M87hQ29aw5CvGWtSzPukb8wNGF4CBaUTRlaH-rS0vSrmBGYCg83u8uLaUrK-FXP1KvVOQuD5v1JzvguztX8OH6MQAzvT8RKYSmu72QFO). Timestamp by third party at Thu Nov 28 06:48:20 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

GRIMALDI STUDIO LEGALE SPRL (GSL), established in BOULEVARD DE WATERLOO 30, Brussels 1000, Belgium, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

SIMONA FRAZZANI with ECAS id nfrazzsi signed in the Participant Portal on 27/11/2019 at 12:45:24 (transaction id SigId-185404-8TNF4fgNTEnzkwetWFj1hDgWEbtIrBzgg6jMkCPedpAIIzKBizGJmRQNj2Omah1NiuVbIIBsvpHgtI2vsYutACy-rS0vSrmBGYCg83u8uLaUrK-q1J3sbG8Rn5Alfzd8ifI4vfgZtzS09bmWj7SR1iR0uNW). Timestamp by third party at Wed Nov 27 12:45:32 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

DIMOS ATHINAION EPICHEIRISI MICHANOGRAFISIS (DAEM), established in LIOSSION 22, ATHENS 104 38, Greece, VAT number: EL090033107, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Dimitris Stamatis with ECAS id n002zifb signed in the Participant Portal on 14/11/2019 at 13:11:28 (transaction id SigId-33387-ogRRROZ6YUIsfc1tzZFzPKKe0xsvUO74X9Ve0J2ZFYKjuuvu8CzWEJwxmMzJEYNKOIymcVZOEzmAtwBqcKZRrL7-rS0vSrmBGYCg83u8uLaUrK-quVecddHK0gyXzpIQyzH2eSAoXHaOsL8hRHmBl6kAsfG). Timestamp by third party at Thu Nov 14 13:11:35 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

virtualcitySYSTEMS GmbH (VCS), established in Tauentzienstraße 7 b/c, Berlin 10789, Germany, VAT number: DE244937391, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Lutz ROSS with ECAS id nrossltz signed in the Participant Portal on 14/11/2019 at 18:51:43 (transaction id SigId-40838-YcvrjrEdcs7Lfpd9oP5CaTmqKPmfm1LXCQPnEizeHM5RzIYwxn8ID7Ga3BipJaiHDzzg0VjhVtUzxrOB2hHx64p-rS0vSrmBGYCg83u8uLaUrK-ATyhImvZYdNLzL5B8FU5hLezg6WEobnE6AVof0CssmNW). Timestamp by third party at Thu Nov 14 18:51:50 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO (TNO), established in ANNA VAN BUERENPLEIN 1, DEN HAAG 2595 DA, Netherlands, VAT number: NL002875718B01, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Ellen Lastdrager with ECAS id n002ho47 signed in the Participant Portal on 05/12/2019 at 12:45:04 (transaction id SigId-43944-ZlVofaPIJOan8ZzkwcdAOHmAr5qcXXQiDaxBKt3jEhOY1dj6j97pX52n1RQG6P8PNJFcyaK6QyosnHJphlzpUj-jpJZscgsw0KqszaRezgPjqG-m1eYRWJEwg58dMMH6maFwVYHgzQWE8Y4AEW2sMVKi50). Timestamp by third party at Thu Dec 05 12:45:12 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

PLAN4ALL ZS (P4All), established in K RYBNICKU 557, HORNI BRIZA 330 12, Czechia, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Tomas MILDORF with ECAS id nmildoto signed in the Participant Portal on 13/11/2019 at 13:52:52 (transaction id SigId-18058-wx6PJvbaD88WttuWfUW98VZN2RgMzPhRHO9hMzP5p9EtlKcVegbv8v3EPhPt04gWnMzecljv40WFWPe2VzgO5nS-rS0vSrmBGYCg83u8uLaUrK-IYPn8X8oPV4kKVeBERXg3V03q4KhZTV8Rr7LuH6lzgT). Timestamp by third party at Wed Nov 13 13:52:58 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

SPRAVA INFORMACNICH TECHNOLOGII MESTA PLZNE, PRISPEVKOVA ORGANIZACE (PLZ), established in DOMINIKANSKA 4, PLZEN 301 00, Czechia, VAT number: CZ66362717, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Ludek SANTORA with ECAS id nsanlude signed in the Participant Portal on 13/11/2019 at 13:29:09 (transaction id SigId-17619-fBowirqt1SYCHnoZMGEWXBxgHpxASBSjApQLq1PIDXX6qLEr03YCKwvKZjzzZt1ozzHNf8nEmA6azSC5R8FWgNI-rS0vSrmBGYCg83u8uLaUrK-SO1mNOL46VuMoEmcOWbyYXPshL6GJbNaQGSY4UMWbAS). Timestamp by third party at Wed Nov 13 13:29:15 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

IS-practice (ISP), established in Renkinstraat 71, Schaarbeek 1030, Belgium, VAT number: BE0478042526, ('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 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Hugo KERSCHOT with ECAS id nkerschu signed in the Participant Portal on 13/11/2019 at 13:02:36 (transaction id SigId-17106-dfKfJuNqlQ8zwNCiPRUjs2EyOYbSnkybKYQ3sCE8wPXzOvKzRUgf1TKY3zhYfjnY4GQ8pGWv7cVg6xSY3WEP3YK-rS0vSrmBGYCg83u8uLaUrK-chaLWWhygBTwTAnkmuczqTkB43RKiTIU6wFnVwpkHpL). Timestamp by third party at Wed Nov 13 13:02:42 CET 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ETAIREIA ELEYTHEROY LOGISMIKOY LOGISMIKOY ANOIKTOY KODIKA (GFOSS), established in MESOGEION AVENUE 56, ATHINA 115 27, Greece, VAT number: EL998092605, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('15')

in Grant Agreement No 870697 ('the Agreement')

between VLAAMSE GEWEST **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Digital Urban European Twins for smarter decision making (DUET)'.

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 it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Theodoros KAROUNOS with ECAS id nkarothe signed in the Participant Portal on 18/11/2019 at 17:39:31 (transaction id SigId-72154-nv0wwQszyvQpOBBX5eJrqRSrN6zpm1EheEeYY73GBwBW2bWwJgzbZuctDKzqGi2ZozhilwPKmBhMOvkfUxDzvjG0-rS0vSrmBGYCg83u8uLaUrK-y9fVXWDRkJ9SG9rk01DRCADxWsG4lCWozzT5PkB0NuJG). Timestamp by third party at Mon Nov 18 17:39:39 CET 2019

ⓘ print format A4 landscape

Associated with document Ref. Ares(2019)6736983 - 30/10/2019

FINANCIAL STATEMENT FOR *[BENEFICIARY [name]/ LINKED THIRD PARTY [name]]* FOR REPORTING PERIOD [reporting period]

	Eligible[1] 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[2]	*[F. Costs of …]*		Total costs	Receipts	Reimbursement rate %	Maximum EU contribution[3]	Requested EU contribution	Information for indirect costs :
	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			*[C.1 Financial support]* *[C.2 Prizes]*	D.1 Travel D.2 Equipment D.3 Other goods and services	*[D.4 Costs of large research infrastructure]*	D.5 Costs of internally invoiced goods and services		*[F.1 Costs of …]*	*[F.2 Costs of …]*		Receipts of the action, to be reported in the last reporting period, according to Article 5.3.3				Costs of in-kind contributions not used on premises
Form of costs[4]	Actual	Unit	Unit		Actual	Actual	Actual	Actual	Unit	Flat-rate[5] 25%	Unit		*[Unit][Lump sum]*					
	a	Total b	No hours	Total c	d	*[e]*	f	*[g]*	Total h	i=0,25 x (a+b+ c+f+*[g]* + h+ *[j 1]*[6] +*[j2]*[6] -p)	No units	Total *[j1]*	Total *[j2]*	k = a+b+c+d+*[e]* +*f* + *[g]* +h+ i + *[j1]* +*[j2]*	l	m	n	o	p
[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.

[1] See Article 6 for the eligibility conditions

[2] 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 indirect costs unless you can demonstrate that the operating grant does not cover any costs of the action.

[3] 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 be less,

[4] See Article 5 for the forms of costs

[5] 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)

[6] Only specific unit costs that do not include indirect costs

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)[1] 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').]*

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;

[1] By which costs under the Agreement are declared (see template 'Model Financial Statements' in Annex 4 to the Grant Agreement).

- 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]:*

- 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

The Auditor must comply with these Terms of Reference and with[2]:

- 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*[, 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 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 *[, 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*]*.

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]*

[2] 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.

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],

have carried out the procedures agreed with you regarding the costs declared in the Financial Statement(s)[3] 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 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.

[3] By which the Beneficiary declares costs under the Agreement (see template 'Model Financial Statement' in Annex 4 to the Agreement).

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.

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.

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 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[4] 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

[4] 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	**ACTUAL PERSONNEL COSTS AND UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICE**		
	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. (*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)* The Auditor sampled _____ people out of the total of _____ people.		

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A.1	**PERSONNEL COSTS** 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) To confirm standard factual findings 1-5 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary: o 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; o the payslips of the employees included in the sample; o reconciliation of the personnel costs declared in the Financial Statement(s) with the accounting system (project accounting and general ledger) and payroll system; o information concerning the employment status and employment conditions of personnel included in the sample, in particular their employment contracts or equivalent; o the Beneficiary's usual policy regarding payroll matters (e.g. salary policy, overtime policy, variable pay); o applicable national law on taxes, labour and social security and o any other document that supports the personnel costs declared. 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.	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 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.	
	Further procedures if 'additional remuneration' is paid To confirm standard factual findings 6-9 listed in the next column, the Auditor: o reviewed relevant documents provided by the Beneficiary (legal form, legal/statutory	6) The Beneficiary paying "additional remuneration" was a non-profit legal entity.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	obligations, the Beneficiary's usual policy on additional remuneration, criteria used for its calculation, the Beneficiary's usual remuneration practice for projects funded under national funding schemes…); o 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, usual remuneration paid for projects funded by national schemes) 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'). *'ADDITIONAL REMUNERATION' MEANS ANY PART OF THE REMUNERATION WHICH EXCEEDS WHAT THE PERSON WOULD BE PAID FOR TIME WORKED IN PROJECTS FUNDED BY NATIONAL SCHEMES.* *IF ANY PART OF THE REMUNERATION PAID TO THE EMPLOYEE QUALIFIES AS "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:* *(A) IF THE PERSON WORKS FULL TIME AND EXCLUSIVELY ON THE ACTION DURING THE FULL YEAR: UP TO EUR 8 000/YEAR;* *(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 IN ACCORDANCE TO ARTICLE 6.2.A.1.*	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.	
		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).	
	Additional procedures in case "unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices" is applied: 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	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	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	factual findings 10-13 listed in the next column: o obtained a description of the Beneficiary's usual cost accounting practice to calculate unit costs;. o reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS; o 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; o 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; o 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.	used in all H2020 actions.	
		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.	
	<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> To confirm standard factual findings 14-17 listed in the next column the Auditor reviewed following information/documents provided by the Beneficiary: o the contracts, especially the cost, contract duration, work description, place of work, ownership of the results and reporting obligations to the Beneficiary; o the employment conditions of staff in the same category to compare costs and; o any other document that supports the costs declared and its registration (e.g. invoices, accounting records, etc.).	14) The natural persons worked under conditions similar to those of an employee, in particular regarding the way the work is organised, the tasks that are performed and the premises where they are performed.	
		15) The results of work carried out belong to the Beneficiary, or, if not, the Beneficiary has obtained all necessary rights to fulfil its obligations as if those	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
		results were generated by itself.	
		16) Their costs were not significantly different from those for staff who performed similar tasks under an employment contract with the Beneficiary.	
		17) The costs were supported by audit evidence and registered in the accounts.	
	<u>For personnel seconded by a third party and included in the sample (not subcontractors)</u> To confirm standard factual findings 18-21 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary: o their secondment contract(s) notably regarding costs, duration, work description, place of work and ownership of the results; o 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; o 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;	18) Seconded personnel reported to the Beneficiary and worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	
		19) The results of work carried out belong to the Beneficiary, or, if not, the Beneficiary has obtained all necessary rights to fulfil its obligations as if those results were generated by itself..	
		If personnel is seconded against payment: 20) The costs declared were supported with documentation and recorded in the	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	○ any other document that supports the costs declared (e.g. invoices, etc.).	Beneficiary's accounts. The third party did not include any profit.	
		If personnel is seconded free of charge: 21) 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.	
A.2	**PRODUCTIVE HOURS** To confirm standard factual findings 22-27 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: ○ the annual productive hours applied were calculated in accordance with one of the methods described below, ○ the full-time equivalent (FTEs) ratios for employees not working full-time were correctly calculated. 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. 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	22) The Beneficiary applied method [*choose one option and delete the others*] [**A**: 1720 hours] [**B**: the 'total number of hours worked'] [**C**: 'standard annual productive hours' used correspond to usual accounting practices]	
		23) Productive hours were calculated annually.	
		24) For employees not working full-time the full-time equivalent (FTE) ratio was correctly applied.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	hours can be supported by records, such as national legislation, labour agreements, and contracts. *BENEFICIARY'S PRODUCTIVE HOURS' FOR PERSONS WORKING FULL TIME SHALL BE ONE OF THE FOLLOWING METHODS:* ***A**. 1720 ANNUAL PRODUCTIVE HOURS (PRO-RATA FOR PERSONS NOT WORKING FULL-TIME)* ***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).* ***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 'STANDARD ANNUAL PRODUCTIVE HOURS' IN THE NEXT COLUMN). THIS NUMBER MUST BE AT LEAST 90% OF THE STANDARD ANNUAL WORKABLE HOURS.* *'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 Beneficiary applied method B.* 25) The calculation of the number of 'annual workable hours', overtime and absences was verifiable based on the documents provided by the Beneficiary. 25.1) The Beneficiary calculates the hourly rates per full financial year following procedure A.3 (method B is not allowed for beneficiaries calculating hourly rates per month).	
		If the Beneficiary applied method C. 26) The calculation of the number of 'standard annual workable hours' was verifiable based on the documents provided by the Beneficiary.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
		27) 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'.	
A.3	**HOURLY PERSONNEL RATES** I) For unit costs calculated in accordance to the Beneficiary's usual cost accounting practice (unit costs): 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. If the Beneficiary does not have a "Certificate on Methodology" (CoMUC) approved by the Commission, or if the methodology approved was not applied, then the Auditor: o reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates; o 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. II) For individual hourly rates: The Auditor: o reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates;	28) The Beneficiary applied [*choose one option and delete the other*]: [Option I: "Unit costs (hourly rates) were calculated in accordance with the Beneficiary's usual cost accounting practices"] [Option II: Individual hourly rates were applied] *For option I concerning unit costs and if the Beneficiary applies the methodology approved by the Commission (CoMUC):* 29) 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	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	○ recalculated the hourly rates of staff included in the sample (recalculation of all hourly rates if the Beneficiary uses annual rates, recalculation of three months selected randomly for every year and person if the Beneficiary uses monthly rates) following the results of the procedures carried out in A.1 and A.2; ○ (only in case of monthly rates) confirmed that the time spent on parental leave is not deducted, and that, if parts of the basic remuneration are generated over a period longer than a month, the Beneficiary has included only the share which is generated in the month. *"UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES":* *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.* *HOURLY RATE FOR INDIVIDUAL ACTUAL PERSONAL COSTS:* *IT IS CALCULATED FOLLOWING ONE OF THE TWO OPTIONS BELOW:* *A) [OPTION BY DEFAULT] BY DIVIDING THE ACTUAL ANNUAL AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH PROCEDURE A.1 BY THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2 (FULL FINANCIAL YEAR HOURLY RATE);* *B) BY DIVIDING THE ACTUAL MONTHLY AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH PROCEDURE A.1 BY 1/12 OF THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2.(MONTHLY HOURLY RATE).*	activities irrespective of the source of funding.	
		For option I concerning unit costs and if the Beneficiary applies a methodology not approved by the Commission: 30) The unit costs re-calculated by the Auditor were the same as the rates applied by the Beneficiary.	
		For option II concerning individual hourly rates: 31) The individual rates re-calculated by the Auditor were the same as the rates applied by the Beneficiary. 31.1) The Beneficiary used only one option (per full financial year or per month) throughout each financial year examined. 31.2) The hourly rates do not include additional remuneration.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A.4	**TIME RECORDING SYSTEM** 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: o description of the time recording system provided by the Beneficiary (registration, authorisation, processing in the HR-system); o its actual implementation; o time records were signed at least monthly by the employees (on paper or electronically) and authorised by the project manager or another manager; o the hours declared were worked within the project period; o 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) ; o the hours charged to the action matched those in the time recording system. *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).*	32) All persons recorded their time dedicated to the action on a **daily/ weekly/ monthly** basis using a **paper/computer-based** system. (*delete the answers that are not applicable)*	
		33) Their time-records were authorised at least monthly by the project manager or other superior.	
		34) Hours declared were worked within the project period and were consistent with the presences/absences recorded in HR-records.	
		35) There were no discrepancies between the number of hours charged to the action and the number of hours recorded.	
	<u>If the persons are working exclusively for the action and without time records</u> 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.	36) The exclusive dedication is supported by a declaration signed by the Beneficiary and by any other evidence gathered.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
B	**COSTS OF SUBCONTRACTING**		
B.1	**The Auditor obtained the detail/breakdown of subcontracting costs and sampled _____ cost items selected randomly** (*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*). To confirm standard factual findings 37-41 listed in the next column, the Auditor reviewed the following for the items included in the sample: o the use of subcontractors was foreseen in Annex 1; o subcontracting costs were declared in the subcontracting category of the Financial Statement; o supporting documents on the selection and award procedure were followed; o 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). In particular, i. if the Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), 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. ii. 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..	37) The use of claimed subcontracting costs was foreseen in Annex 1 and costs were declared in the Financial Statements under the subcontracting category.	
		38) 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. *(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)*	
		39) The subcontracts were not awarded to other Beneficiaries	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	For the items included in the sample the Auditor also verified that: o the subcontracts were not awarded to other Beneficiaries in the consortium; o there were signed agreements between the Beneficiary and the subcontractor; o there was evidence that the services were provided by subcontractor;	of the consortium.	
		40) All subcontracts were supported by signed agreements between the Beneficiary and the subcontractor.	
		41) There was evidence that the services were provided by the subcontractors.	
C	**COSTS OF PROVIDING FINANCIAL SUPPORT TO THIRD PARTIES**		
C.1	**The Auditor obtained the detail/breakdown of the costs of providing financial support to third parties and sampled _____ cost items selected randomly** (*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*). The Auditor verified that the following minimum conditions were met: a) the maximum amount of financial support for each third party did not exceed EUR 60 000, unless explicitly mentioned in Annex 1; 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 respected.	42) All minimum conditions were met	

D	OTHER ACTUAL DIRECT COSTS		
D.1	**COSTS OF TRAVEL AND RELATED SUBSISTENCE ALLOWANCES** **The Auditor sampled _____ cost items selected randomly** (*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*). The Auditor inspected the sample and verified that: o 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; o 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; o no ineligible costs or excessive or reckless expenditure was declared (see Article 6.5 MGA).	43) Costs were incurred, approved and reimbursed in line with the Beneficiary's usual policy for travels.	
		44) There was a link between the trip and the action.	
		45) The supporting documents were consistent with each other regarding subject of the trip, dates, duration and reconciled with time records and accounting.	
		46) No ineligible costs or excessive or reckless expenditure was declared.	
D.2	**DEPRECIATION COSTS FOR EQUIPMENT, INFRASTRUCTURE OR OTHER ASSETS** **The Auditor sampled _____ cost items selected randomly** (*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*). For "equipment, infrastructure or other assets" [from now on called "asset(s)"] selected in the sample the Auditor verified that: o the assets were acquired in conformity with the Beneficiary's internal guidelines and procedures;	47) Procurement rules, principles and guides were followed.	
		48) There was a link between the grant agreement and the asset charged to the action.	
		49) The asset charged to the action was traceable to the accounting records and the underlying documents.	

	○ 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) ○ they were entered in the accounting system; ○ the extent to which the assets were used for the action (as a percentage) was supported by reliable documentation (e.g. usage overview table); 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). 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).	50) 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. 51) The amount charged corresponded to the actual usage for the action. 52) No ineligible costs or excessive or reckless expenditure were declared.	
D.3	**COSTS OF OTHER GOODS AND SERVICES** **The Auditor sampled _____ cost items selected randomly** (*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*). For the purchase of goods, works or services included in the sample the Auditor verified that: ○ the contracts did not cover tasks described in Annex 1; ○ 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); ○ the goods were not placed in the inventory of durable equipment; ○ the costs charged to the action were accounted in line with the Beneficiary's usual accounting practices; ○ no ineligible costs or excessive or reckless expenditure were declared (see Article 6 GA). In addition, the Auditor verified that these goods and services were acquired in conformity with	53) Contracts for works or services did not cover tasks described in Annex 1. 54) Costs were allocated to the correct action and the goods were not placed in the inventory of durable equipment. 55) The costs were charged in line with the Beneficiary's accounting policy and were adequately supported. 56) No ineligible costs or excessive or reckless expenditure were declared. For internal invoices/charges only the cost element was charged, without any mark-ups.	

	the Beneficiary's internal guidelines and procedures, in particular: o if Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), 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. o 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. For the items included in the sample the Auditor also verified that: o 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); *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 AGREEMENT, CERTIFICATES ON THE FINANCIAL STATEMENTS IF THEY ARE REQUIRED BY THE AGREEMENT AND CERTIFICATES ON THE METHODOLOGY, TRANSLATIONS, REPRODUCTION.*	57) 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. *(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)*	
D.4	**AGGREGATED CAPITALISED AND OPERATING COSTS OF RESEARCH INFRASTRUCTURE** 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.	58) 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.	

	In the cases that a positive ex-ante assessment has been issued *(see the standard factual findings 58-59 on the next column)***,** The Auditor ensured that the beneficiary has applied consistently the methodology that is explained and approved in the positive ex ante assessment; ***In the cases that a positive ex-ante assessment has NOT been issued*** *(see the standard factual findings 60 on the next column),* The Auditor verified that no costs of Large Research Infrastructure have been charged as direct costs in any costs category; ***In the cases that a draft ex-ante assessment report has been issued with recommendation for further changes*** *(see the standard factual findings 60 on the next column),* • 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.	59) Any difference between the methodology applied and the one positively assessed was extensively described and adjusted accordingly. 60) The direct costs declared were free from any indirect costs items related to the Large Research Infrastructure.	
D.5	**Costs of internally invoiced goods and services** **The Auditor sampled cost items selected randomly** (*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*). To confirm standard factual findings 61-65 listed in the next column, the Auditor: ○ obtained a description of the Beneficiary's usual cost accounting practice to calculate costs of internally invoiced goods and services (unit costs); ○ reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS; ○ ensured that the methodology to calculate unit costs is being used in a consistent manner, based on objective criteria, regardless of the source of funding; ○ verified that any ineligible items or any costs claimed under other budget categories, in particular indirect costs, have not been taken into account when calculating the costs of	61) The costs of internally invoiced goods and services included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. 62) The cost accounting practices used to calculate the costs of internally invoiced goods and services were applied by the Beneficiary in a consistent manner based on objective criteria regardless of the source of funding. 63) The unit cost is calculated using the actual costs for the good or service recorded in the Beneficiary's accounts, excluding any ineligible cost or costs included in other	

	internally invoiced goods and services (see Article 6 GA); ○ verified whether actual costs of internally invoiced goods and services were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, and correspond to objective and verifiable information. ○ verified that any costs of items which are not directly linked to the production of the invoiced goods or service (e.g. supporting services like cleaning, general accountancy, administrative support, etc. not directly used for production of the good or service) have not been taken into account when calculating the costs of internally invoiced goods and services. ○ verified that any costs of items used for calculating the costs internally invoiced goods and services are supported by audit evidence and registered in the accounts.	budget categories. 64) The unit cost excludes any costs of items which are not directly linked to the production of the invoiced goods or service. 65) The costs items used for calculating the actual costs of internally invoiced goods and services were relevant, reasonable and correspond to objective and verifiable information.	
E	**USE OF EXCHANGE RATES**		
E.1	a) For Beneficiaries with accounts established in a currency other than euros **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)*: *COSTS RECORDED IN THE ACCOUNTS IN A CURRENCY OTHER THAN EURO 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 (https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html), DETERMINED 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, CONVERSION SHALL BE MADE AT THE AVERAGE OF THE MONTHLY ACCOUNTING RATES ESTABLISHED BY THE COMMISSION AND PUBLISHED ON ITS WEBSITE (http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm),*	66) 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.	

	DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.		
	b) For Beneficiaries with accounts established in euros **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)*: *COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO BY APPLYING THE BENEFICIARY'S USUAL ACCOUNTING PRACTICES.*	67) 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>

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').]*.

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]:*

- 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.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with[1]:

- 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 declared 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].

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 of the *[Beneficiary] [Linked Third Party]*

[1] 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.

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],

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[1] 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 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

Please provide the following documents to the auditor and annex them to the report when submitting this CoMUC to the Commission:

[1] Financial Statement in this context refers solely to Annex 4 of the Agreement by which the Beneficiary declares costs under the Agreement.

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[2] 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).

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

[2] 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.

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'.

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**
A. Use of the Methodology 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*]*.	**Procedure:** ✓ The Auditor checked these dates against the documentation the Beneficiary has provided. **Factual finding:** 1. The dates provided by the Beneficiary were consistent with the documentation.
B. Description of the Methodology III. The methodology to calculate unit costs is being used in a consistent manner and is reflected in the relevant procedures. *[Please describe the methodology your entity uses to calculate personnel costs, productive hours and hourly rates, present your description to the Auditor and annex it to this certificate]* *[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 Factual Findings:* - *…]*	**Procedure:** ✓ The Auditor reviewed the description, the relevant manuals and/or internal guidance documents describing the methodology. **Factual finding:** 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.

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**
C. **Personnel costs** General 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. *[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].* 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 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. XI. Personnel costs were not declared under another EU or Euratom grant	**Procedure:** *The Auditor draws a sample of employees to carry out the procedures indicated in this section C and the following sections D to F.* *[The Auditor has drawn a random sample of 10 employees assigned to Horizon 2020 action(s). If fewer than 10 employees are assigned to the Horizon 2020 action(s), the Auditor has selected all employees assigned to the Horizon 2020 action(s) complemented by other employees irrespective of their assignments until he has reached 10 employees.].* For this sample: ✓ 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; ✓ in particular, the Auditor reviewed the employment contracts of the employees in the sample to verify that: i. they were employed directly by the Beneficiary in accordance with applicable national legislation; ii. they were working under the sole technical supervision and responsibility of the latter; iii. they were remunerated in accordance with the Beneficiary's usual practices; 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; ✓ 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 into account when calculating the personnel costs; ✓ 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.

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**
(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 or Euratom budget in the same period, unless the Beneficiary can demonstrate that the operating grant does not cover any costs of the action). <u>If additional remuneration as referred to in the grant agreement(s) is paid</u> XII. The Beneficiary is a non-profit legal entity; XIII. The additional remuneration is part of the beneficiary's usual remuneration practices and paid consistently whenever the relevant work or expertise is required; XIV. The criteria used to calculate the additional remuneration are objective and generally applied regardless of the source of funding; 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). *[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 Factual Findings:* *- …]*	✓ 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; ✓ 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 8 000 per full-time equivalent and that it was reduced proportionately for employees not assigned exclusively to the action(s). ✓ the Auditor recalculated the personnel costs for the employees in the sample. **Factual finding:** 4. All the components of the remuneration that have been claimed as personnel costs are supported by underlying documentation. 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. 6. Their employment contracts were in line with the Beneficiary's usual policy; 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.); 8. The totals used to calculate the personnel unit costs are consistent with those registered in the payroll and accounting records; 9. To the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, those elements were 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). 10. Personnel costs contained no ineligible elements; 11. Specific conditions for eligibility were fulfilled when additional

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**
	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 8 000 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).
D. Productive hours XVI. The number of productive hours per full-time employee applied is *[delete as appropriate]*: A. 1720 productive hours per year for a person working full-time (corresponding pro-rata for persons not working full time). B. the total number of hours worked in the year by a person for the Beneficiary 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. <u>If method B is applied</u> 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). XVIII. 'Annual workable hours' are hours 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. XIX. The contract (applicable collective labour agreement or national working time legislation) do specify the working time enabling to calculate the annual workable hours.	**Procedure (same sample basis as for Section C: Personnel costs):** ✓ The Auditor verified that the number of productive hours applied is in accordance with method A, B or C. ✓ The Auditor checked that the number of productive hours per full-time employee is correct. ✓ 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. ✓ 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. **Factual finding:** <u>General</u> 12. The Beneficiary applied a number of productive hours consistent with method A, B or C detailed in the left-hand column. 13. The number of productive hours per year per full-time employee was accurate. <u>If method B is applied</u> 14. The number of 'annual workable hours', overtime and absences was

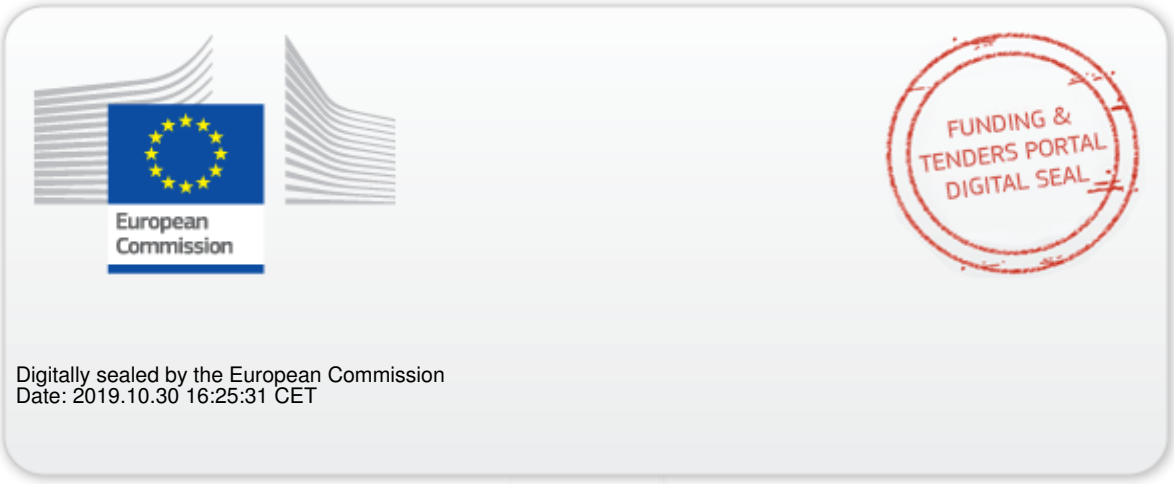
Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	**Procedures to be carried out and Findings to be confirmed by the Auditor**
<u>If method C is applied</u> XX. The standard number of productive hours per year is that of a full-time equivalent. XXI. The 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. XXII. Standard workable (working) hours are hours during which personnel are at the Beneficiary's disposal preforming 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. *[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:* - *…]*	verifiable based on the documents provided by the Beneficiary and the calculation of the total number of hours worked was accurate. 15. The contract specified the working time enabling to calculate the annual workable hours. <u>If method C is applied</u> 16. The calculation of the number of productive hours per year corresponded to the usual costs accounting practice of the Beneficiary. 17. The calculation of the standard number of workable (working) hours per year was corroborated by the documents presented by the Beneficiary. 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.
E. Hourly rates The hourly rates are correct because: XXIII. Hourly rates are correctly calculated since they result from dividing annual personnel 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. *[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:* - *…]*	**Procedure** ✓ The Auditor has obtained a list of all personnel rates calculated by the Beneficiary in accordance with the methodology used. ✓ The Auditor has obtained a list of all the relevant employees, based on which the personnel rate(s) are calculated. For 10 employees selected at random (same sample basis as Section C: Personnel costs): ✓ The Auditor recalculated the hourly rates. ✓ 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. **Factual finding:**

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**
	19. No differences arose from the recalculation of the hourly rate for the employees included in the sample.
F. Time recording 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 **daily/weekly/monthly** basis *[delete as appropriate]* using a **paper/computer-based system** *[delete as appropriate]*; 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; 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; XXVII. Measures are in place to prevent staff from: i. recording the same hours twice, ii. recording working hours during absence periods (e.g. holidays, sick leave), iii. recording more than the number of productive hours per year used to calculate the hourly rates, and iv. recording hours worked outside the action period. XXVIII. No working time was recorded outside the action period; XXIX. No more hours were claimed than the productive hours used to calculate the hourly personnel rates. *[Please provide a brief description of the time recording system in place together with the measures applied to ensure its reliability to the Auditor and annex it to the*	**Procedure** ✓ The Auditor reviewed the brief description, all relevant manuals and/or internal guidance describing the methodology used to record time. The Auditor reviewed the time records of the random sample of 10 employees referred to under Section C: Personnel costs, and verified in particular: ✓ that time records were available for all persons with not exclusive assignment to the action; ✓ 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; ✓ that time records were signed and approved in due time and that all minimum requirements were fulfilled; ✓ that the persons worked for the action in the periods claimed; ✓ that no more hours were claimed than the productive hours used to calculate the hourly personnel rates; ✓ 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; ✓ 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

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**
present certificate[1]]. *[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:* - *…]*	no time worked outside the action period was charged to the action. **Factual finding:** 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. 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; 22. For the random sample the time records were signed by the employee and the action manager/line manager, at least monthly. 23. Working time claimed for the action occurred in the periods claimed; 24. No more hours were claimed than the number productive hours used to calculate the hourly personnel rates; 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. 26. Working time claimed is consistent with that on record at the human-resources department.

[1] 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 it information flow up to its use for the preparation of the Financial Statements.

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**
[official name of the *[Beneficiary] [Linked Third Party]**]*** ***[name and title of authorised representative]*** ***[dd Month yyyy]*** ***<Signature of the*** *[Beneficiary] [Linked Third Party]>*	***[official name of the Auditor]*** ***[name and title of authorised representative]*** ***[dd Month yyyy]*** ***<Signature*** *of the Auditor>*



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