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EUROPEAN RESEARCH EXECUTIVE AGENCY (REA)

REA.A – Marie Skłodowska-Curie Actions & Support to Experts
A.1 – MSCA Doctoral Networks

GRANT AGREEMENT

Project 101072456 — RELAX

PREAMBLE

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

on the one part,

the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and

on the other part,

1. 'the coordinator':

CHALMERS TEKNISKA HOGSKOLA AB (CTH), PIC 999980373, established in -, GOTEBORG 412 96, Sweden,

and the following other beneficiaries, if they sign their 'accession form' (see Annex 3 and Article 40):

2. **INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS (ICCS)**, PIC 999654356, established in Patission Str. 42, ATHINA 10682, Greece,

3. **THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN (TCD)**, PIC 999845446, established in COLLEGE GREEN TRINITY COLLEGE, DUBLIN 2 D02 CX56, Ireland,

4. **AARHUS UNIVERSITET (AU)**, PIC 999997736, established in NORDRE RINGGADE 1, AARHUS C 8000, Denmark,

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator and affiliated entities (if any).

If only one beneficiary signs the grant agreement ('mono-beneficiary grant'), all provisions referring to the 'coordinator' or the 'beneficiaries' will be considered — mutatis mutandis — as referring to the beneficiary.

The parties referred to above have agreed to enter into the Agreement.

By signing the Agreement and the accession forms, the beneficiaries accept the grant and agree to

implement the action under their own responsibility and in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

The Agreement is composed of:

Preamble

Terms and Conditions (including Data Sheet)

Annex 1   Description of the action[1]

Annex 2   Estimated budget for the action

Annex 2a   Additional information on unit costs and contributions (if applicable)

Annex 3   Accession forms (if applicable)[2]

Annex 3a   Declaration on joint and several liability of affiliated entities (if applicable)[3]

Annex 4   Model for the financial statements

Annex 5   Specific rules (if applicable)

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[1] Template published on Portal Reference Documents.
[2] Template published on Portal Reference Documents.
[3] Template published on Portal Reference Documents.

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TERMS AND CONDITIONS

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DATA SHEET

1.   General data

Project summary:

Project summary
The RELAX European Doctoral Network aims to train a cohort of highly mobile and adaptable researchers to become experts in the design of scalable and efficient data-intensive software systems. These experts will master the specific skill of navigating the semantics or correctness conditions of applications, with the goal of enhancing scalability, response times, and availability. Working across the disciplinary specialisms of data science, data management, distributed computing and computing systems, the Fellows will develop knowledge of the broad issues underpinning data analytics systems. The bespoke training programme fosters intellectual enquiry and combines technical and scientific research training with courses in innovation, management and leadership. The training network addresses a critical skills gap in data analytics expertise, which needs urgently addressed to support innovation and employment in a fast-growing European data economy. The 14 partner organisations representing 8 countries will benefit first-hand through intersectoral collaboration and an Open Innovation model.

Keywords:

- Algorithms, distributed, parallel and network algorithms, algorithmic game theory
- Data mining
- Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)

Project number: 101072456

Project name: Relaxed Semantics Across the Data Analytics Stack

Project acronym: RELAX

Call: HORIZON-MSCA-2021-DN-01

Topic: HORIZON-MSCA-2021-DN-01-01

Type of action: HORIZON TMA MSCA Doctoral Networks

Granting authority: European Research Executive Agency

Grant managed through EU Funding & Tenders Portal: Yes (eGrants)

Project starting date: fixed date: 1 March 2023

Project end date: 28 February 2027

Project duration: 48 months

Consortium agreement: Yes

2.   Participants

List of participants:

N°	Role	Short name	Legal name	Ctry	PIC	Total eligible contrib.	Max grant amount
1	COO	CTH	CHALMERS TEKNISKA HOGSKOLA AB	SE	999980373	881 128.80	881 128.80
2	BEN	ICCS	INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS	EL	999654356	480 196.80	480 196.80
3	BEN	TCD	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	IE	999845446	572 976.00	572 976.00

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N°	Role	Short name	Legal name	Ctry	PIC	Total eligible contrib.	Max grant amount
4	BEN	AU	AARHUS UNIVERSITET	DK	999997736	603 576.00	603 576.00
5	AP	VOL	VOLVO AUTONOMOUS SOLUTIONS AB	SE	895727877	0.00	0.00
6	AP	RYAX	RYAX TECHNOLOGIES	FR	909541938	0.00	0.00
7	AP	MDBS	MONETDB SOLUTIONS BV	NL	949731657	0.00	0.00
8	AP	VAIX	Vaix Limited	UK	896592244	0.00	0.00
9	AP	UBO	UBOTICA TECHNOLOGIES LIMITED	IE	904875268	0.00	0.00
10	AP	AE	ANALYTICS ENGINES LIMITED	UK	965580487	0.00	0.00
11	AP	DMJX	DANMARKS MEDIE-OG JOURNALISTHOJSKOLE	DK	949275369	0.00	0.00
12	AP	BSEC	B-secur Limited	UK	895126865	0.00	0.00
13	AP	QUB	THE QUEEN'S UNIVERSITY OF BELFAST	UK	999992013	0.00	0.00
14	AP	FZJ	FORSCHUNGSZENTRUM JULICH GMBH	DE	999980470	0.00	0.00
Total						2 537 877.60	2 537 877.60

Coordinator:

– CHALMERS TEKNISKA HOGSKOLA AB (CTH)

3. Grant

Maximum grant amount, total estimated eligible costs and contributions and funding rate:

Total eligible contributions (unit, flat-rate and lump sum contributions and financing not linked to costs)	Maximum grant amount (Annex 2)	Maximum grant amount (award decision)
2 537 877.60	2 537 877.60	2 537 877.60

Grant form: Unit

Grant mode: Action grant

Budget categories/activity types:

- A. Contributions for recruited researchers
    - A.1 Living allowance
    - A.2 Mobility allowance
    - A.3 Family allowance
    - A.4 Long-term leave allowance
    - A.5 Special needs allowance

- B. Institutional contributions
    - B.1 Research, training and networking contribution
    - B.2 Management and indirect contribution

Cost eligibility options:

- In-kind contributions eligible costs

Budget flexibility: Yes (flexibility with conditions)

4. Reporting, payments and recoveries

4.1 Continuous reporting (art 21)

Deliverables: see Funding & Tenders Portal Continuous Reporting tool

4.2 Periodic reporting and payments

Reporting and payment schedule (art 21, 22):

Reporting					Payments	
Reporting periods			Type	Deadline	Type	Deadline (time to pay)
RP No	Month from	Month to				
					Initial prefinancing	30 days from entry into force/10 days before starting date – whichever is the latest
1	1	24	Periodic report	60 days after end of reporting period	Interim payment	90 days from receiving periodic report
2	25	48	Periodic report	60 days after end of reporting period	Final payment	90 days from receiving periodic report

Prefinancing payments and guarantees:

Prefinancing payment	
Type	Amount
Prefinancing 1 (initial)	2 030 302.08

Reporting and payment modalities (art 21, 22):

Mutual Insurance Mechanism (MIM): Yes

MIM contribution: 5% of the maximum grant amount (126 893.88), retained from the initial prefinancing

Restrictions on distribution of initial prefinancing: The prefinancing may be distributed only if the minimum number of beneficiaries set out in the call condititions (if any) have acceded to the Agreement and only to beneficiaries that have acceded.

Interim payment ceiling (if any): 90% of the maximum grant amount

No-profit rule: n/a

Late payment interest: ECB + 3.5%

Bank account for payments:

SE4395000099604208456758

Conversion into euros: n/a

Reporting language: Language of the Agreement

4.3 Certificates (art 24): n/a

4.4 Recoveries (art 22)

First-line liability for recoveries:

Beneficiary termination: Beneficiary concerned

Final payment: Each beneficiary for their own debt

After final payment: Beneficiary concerned

Joint and several liability for enforced recoveries (in case of non-payment):

Individual financial responsibility: Each beneficiary is liable only for its own debts (and those of its affiliated entities, if any)

5.   Consequences of non-compliance, applicable law & dispute settlement forum

Suspension and termination:

Additional suspension grounds (art 31)

Additional termination grounds (art 32)

Applicable law (art 43):

Standard applicable law regime: EU law + law of Belgium

Dispute settlement forum (art 43):

Standard dispute settlement forum:

EU beneficiaries: EU General Court + EU Court of Justice (on appeal)

Non-EU beneficiaries: Courts of Brussels, Belgium (unless an international agreement provides for the enforceability of EU court judgements)

6.   Other

Specific rules (Annex 5): Yes

Standard time-limits after project end:

Confidentiality (for X years after final payment): 5

Record-keeping (for X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Reviews (up to X years after final payment): 2

Audits (up to X years after final payment): 2

Extension of findings from other grants to this grant (no later than X years after final payment): 2

Impact evaluation (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

CHAPTER 1   GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

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

ARTICLE 2 — DEFINITIONS

For the purpose of this Agreement, the following definitions apply:

Actions —   The project which is being funded in the context of this Agreement.

Grant —   The grant awarded in the context of this Agreement.

EU grants — Grants awarded by EU institutions, bodies, offices or agencies (including EU executive agencies, EU regulatory agencies, EDA, joint undertakings, etc.).

Participants — Entities participating in the action as beneficiaries, affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties.

Beneficiaries (BEN) — The signatories of this Agreement (either directly or through an accession form).

Affiliated entities (AE) — Entities affiliated to a beneficiary within the meaning of Article 187 of EU Financial Regulation 2018/1046[4] which participate in the action with similar rights and obligations as the beneficiaries (obligation to implement action tasks and right to charge costs and claim contributions).

Associated partners (AP) — Entities which participate in the action, but without the right to charge costs or claim contributions.

Purchases — Contracts for goods, works or services needed to carry out the action (e.g. equipment, consumables and supplies) but which are not part of the action tasks (see Annex 1).

Subcontracting — Contracts for goods, works or services that are part of the action tasks (see Annex 1).

In-kind contributions — In-kind contributions within the meaning of Article 2(36) of EU Financial

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[4] For the definition, see Article 187 Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012 ('EU Financial Regulation') (OJ L 193, 30.7.2018, p. 1): "**affiliated entities** [are]:
   (a) entities that form a sole beneficiary [(i.e. where an entity is formed of several entities that satisfy the criteria for being awarded a grant, including where the entity is specifically established for the purpose of implementing an action to be financed by a grant)];
   (b) entities that satisfy the eligibility criteria and that do not fall within one of the situations referred to in Article 136(1) and 141(1) and that have a link with the beneficiary, in particular a legal or capital link, which is neither limited to the action nor established for the sole purpose of its implementation".

Regulation 2018/1046, i.e. non-financial resources made available free of charge by third parties to a beneficiary.

Fraud — Fraud within the meaning of Article 3 of EU Directive 2017/1371[5] and Article 1 of the Convention on the protection of the European Communities' financial interests, drawn up by the Council Act of 26 July 1995[6], as well as any other wrongful or criminal deception intended to result in financial or personal gain.

Irregularities — Any type of breach (regulatory or contractual) which could impact the EU financial interests, including irregularities within the meaning of Article 1(2) of EU Regulation 2988/95[7].

Grave professional misconduct — Any type of unacceptable or improper behaviour in exercising one's profession, especially by employees, including grave professional misconduct within the meaning of Article 136(1)(c) of EU Financial Regulation 2018/1046.

Applicable EU, international and national law — Any legal acts or other (binding or non-binding) rules and guidance in the area concerned.

Portal — EU Funding & Tenders Portal; electronic portal and exchange system managed by the European Commission and used by itself and other EU institutions, bodies, offices or agencies for the management of their funding programmes (grants, procurements, prizes, etc.).

CHAPTER 2   ACTION

ARTICLE 3 — ACTION

The grant is awarded for the action **101072456 — RELAX** ('action'), as described in Annex 1.

ARTICLE 4 — DURATION AND STARTING DATE

The duration and the starting date of the action are set out in the Data Sheet (see Point 1).

CHAPTER 3   GRANT

ARTICLE 5 — GRANT

5.1   Form of grant

The grant is an action grant[8] which takes the form of a unit grant.

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[5] Directive (EU) 2017/1371 of the European Parliament and of the Council of 5 July 2017 on the fight against fraud to the Union's financial interests by means of criminal law (OJ L 198, 28.7.2017, p. 29).

[6] OJ C 316, 27.11.1995, p. 48.

[7] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

[8] For the definition, see Article 180(2)(a) EU Financial Regulation 2018/1046: '**action grant**' means an EU grant to finance "an action intended to help achieve a Union policy objective".

5.2   Maximum grant amount

The maximum grant amount is set out in the Data Sheet (see Point 3) and in the estimated budget (Annex 2).

5.3   Funding rate

Not applicable

5.4   Estimated budget, budget categories and forms of funding

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

It contains the estimated eligible contributions for the action (unit contributions), broken down by participant and budget category.

Annex 2 also shows the types of contributions (forms of funding)[9] to be used for each budget category.

The details on the calculation of the unit contributions will be explained in Annex 2a.

5.5   Budget flexibility

The budget breakdown may be adjusted — without an amendment (see Article 39) — by transfers of units between participants, as long as this does not imply any substantive or important change to the description of the action in Annex 1. Transfers between budget categories are not allowed.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE CONTRIBUTIONS

6.1   General eligibility conditions

The **general eligibility conditions** for the unit contributions are the following:

   (a) the units must:

       - be actually used or produced by the beneficiary in the period set out in Article 4 (with the exception of units relating to the submission of the final periodic report, which may be used or produced afterwards; see Article 21)

       - be necessary for the implementation of the action and

   (b) the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 20).

6.2   Specific eligibility conditions for each budget category

For each budget category, the **specific eligibility conditions** are as follows:

A.   Contributions for recruited researchers

Contributions for recruited researchers (A.1 Living allowance, A.2 Mobility allowance, A.3 Family

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[9] See Article 125 EU Financial Regulation 2018/1046.

allowance, A.4 Long-term leave allowance and A.5 Special needs allowance) are eligible, if they fulfil the general eligibility conditions and are calculated as unit contributions in accordance with the method set out in Annex 2a, and if:

for A.1 Living allowance and A.2 Mobility allowance:

(a) the number of units declared:

  (i) corresponds to the number of months spent by the recruited researchers on the research training activities

  (ii) does not exceed the maximum number of months (per researcher) set out in the call conditions and

  (iii) comply with the requirements for non-academic exposure set out in the call conditions (for industrial doctorates only)

(b) the recruited researchers comply with the following conditions:

  (i) be — at the date of recruitment — a doctoral candidate (i.e. not already in possession of a doctoral degree[10])

  (ii) be enrolled in a doctoral programme leading to the award of a (for joint doctorates: joint, multiple or double) degree in at least one EU Member State or Horizon Europe associated country (for joint doctorates: at least two)

  (iii) be recruited by the beneficiaries under an employment contract (or other direct contract with equivalent benefits, including social security coverage) or — if not otherwise possible under national law — under a fixed amount fellowship agreement with minimum social security coverage, including during periods of secondment

  (iv) be employed full-time, unless the granting authority has approved a part-time employment for personal or family reasons

  (v) be working exclusively for the action

  (vi) not have resided or carried out their main activity (work, studies, etc.) in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before the recruitment date — unless as part of a compulsory national service or a procedure for obtaining refugee status under the Geneva Convention[11]

  For beneficiaries that are international European research organisations or international organisations: not have spent with the beneficiary more than 12 months in the 36 months immediately before the recruitment date

(c) the contributions have been fully incurred for the benefit of the recruited researchers

  This condition is met if:

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[10] As defined in the call conditions.
[11] 1951 Refugee Convention and the 1967 Protocol.

$\Big\{$ {**total remuneration costs** (salaries, social security contributions, taxes and other costs included in the remuneration under the employment contract or other direct contract) or **total fixed-amount fellowship costs** for the researcher during the action

plus

total mobility costs (household, relocation and travel expenses and, if they must be paid under national law, taxes, duties and social security contributions) for the researcher during the action}

divided by

the number of actual units$\Big\}$.

is equal to or higher than the following amount:

{amount per unit contribution set out in Annex 2 as living allowance

plus

amount per unit contribution set out in Annex 2 as mobility allowance}.

for A.3 Family allowance:

(a) the recruited researchers have a family.

'Family' means persons linked to the researcher by marriage (or a relationship with equivalent status to a marriage recognised by the legislation of the country where this relationship was formalised) or dependent children who are actually being maintained by the researcher.

(b) the number of units declared:

  (i) corresponds to the number of months spent by the recruited researchers with a family on the research training activities and

  (ii) does not exceed the maximum number of months (per researcher) set out in the call conditions.

(c) the contributions have been incurred for the benefit of the recruited researchers

This condition is met if they have been fully used for the recruited researchers for whom they are claimed.

for A.4 Long-term leave[12] allowance:

(a) the general and specific eligibility conditions for the living and mobility allowances were fulfilled before the long-term leave and

(b) the number of units declared corresponds to the number of months paid by the beneficiary.

for A.5 Special needs allowance:

(a) they are used for recruited researchers with disabilities whose long-term physical, mental, intellectual or sensory impairments are certified by a competent national authority and of such

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[12] Long-term leave includes maternity, paternity, parental, sick or special leave of more than 30 days.

nature that their participation in the action would not be possible without the special needs items or services

(b) the special needs items or services are not already covered from another source (such as social security or health insurance)

(c) the number of units declared corresponds to the number of special needs units that were needed for implementing the action.

B. Institutional contributions

Institutional contributions (B.1 Research, training and networking contribution and B.2 Management and indirect contribution) are eligible, if they are calculated as unit contributions in accordance with the method set out in Annex 2a, and if the living and mobility allowances are eligible.

Moreover, no more than 40% of the maximum grant amount may be allocated to beneficiaries located in the same country or to any one international European research organisation or international organisation.

6.3 Ineligible contributions

'Ineligible contributions' are:

(a) units that do not comply with the conditions set out above (see Article 6.1 and 6.2)

(b) units implemented during grant agreement suspension (see Article 31) and

(c) units for activities already funded under other EU grants (or grants awarded by an EU Member State, non-EU country or other body implementing the EU budget), except for the following case:

(i) Synergy actions: not applicable

(d) other:

(i) country restrictions for eligible costs: not applicable.

6.4 Consequences of non-compliance

If a beneficiary declares unit contributions that are ineligible, they will be rejected (see Article 27).

This may also lead to other measures described in Chapter 5.

CHAPTER 4 GRANT IMPLEMENTATION

SECTION 1 CONSORTIUM: BENEFICIARIES, AFFILIATED ENTITIES AND OTHER PARTICIPANTS

ARTICLE 7 — BENEFICIARIES

The beneficiaries, as signatories of the Agreement, are fully responsible towards the granting authority for implementing it and for complying with all its obligations.

They must implement the Agreement to their best abilities, in good faith and in accordance with all the obligations and terms and conditions it sets out.

They must have the appropriate resources to implement the action and implement the action under their own responsibility and in accordance with Article 11. If they rely on affiliated entities or other participants (see Articles 8 and 9), they retain sole responsibility towards the granting authority and the other beneficiaries.

They are jointly responsible for the *technical* implementation of the action. If one of the beneficiaries fails to implement their part of the action, the other beneficiaries must ensure that this part is implemented by someone else (without being entitled to an increase of the maximum grant amount and subject to an amendment; see Article 39). The *financial* responsibility of each beneficiary in case of recoveries is governed by Article 22.

The beneficiaries (and their action) must remain eligible under the EU programme funding the grant for the entire duration of the action. Unit contributions will be eligible only as long as the beneficiary and the action are eligible.

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

(a) Each beneficiary must:

  (i)   keep information stored in the Portal Participant Register up to date (see Article 19)

  (ii) inform the granting authority (and the other beneficiaries) immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 19)

  (iii) submit to the coordinator in good time:

     - the prefinancing guarantees (if required; see Article 23)

     - the financial statements and certificates on the financial statements (CFS) (if required; see Articles 21 and 24.2 and Data Sheet, Point 4.3)

     - the contribution to the deliverables and technical reports (see Article 21)

     - any other documents or information required by the granting authority under the Agreement

  (iv) submit via the Portal data and information related to the participation of their affiliated entities.

(b) The coordinator must:

  (i)   monitor that the action is implemented properly (see Article 11)

  (ii) act as the intermediary for all communications between the consortium and the granting authority, unless the Agreement or granting authority specifies otherwise, and in particular:

- submit the prefinancing guarantees to the granting authority (if any)

- request and review any documents or information required and verify their quality and completeness before passing them on to the granting authority

- submit the deliverables and reports to the granting authority

- inform the granting authority about the payments made to the other beneficiaries (report on the distribution of payments; if required, see Articles 22 and 32)

(iii) distribute the payments received from the granting authority to the other beneficiaries without unjustified delay (see Article 22).

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

However, coordinators which are public bodies may delegate the tasks set out in Point (b)(ii) last indent and (iii) above to entities with 'authorisation to administer' which they have created or which are controlled by or affiliated to them. In this case, the coordinator retains sole responsibility for the payments and for compliance with the obligations under the Agreement.

Moreover, coordinators which are 'sole beneficiaries'[13] (or similar, such as European research infrastructure consortia (ERICs)) may delegate the tasks set out in Point (b)(i) to (iii) above to one of their members. The coordinator retains sole responsibility for compliance with the obligations under the Agreement.

The beneficiaries must have **internal arrangements** regarding their operation and co-ordination, to ensure that the action is implemented properly.

If required by the granting authority (see Data Sheet, Point 1), these arrangements must be set out in a written **consortium agreement** between the beneficiaries, covering for instance:

- the internal organisation of the consortium

- the management of access to the Portal

- different distribution keys for the payments and financial responsibilities in case of recoveries (if any)

- additional rules on rights and obligations related to background and results (see Article 16)

- settlement of internal disputes

- liability, indemnification and confidentiality arrangements between the beneficiaries.

The internal arrangements must not contain any provision contrary to this Agreement.

ARTICLE 8 — AFFILIATED ENTITIES

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[13] For the definition, see Article 187(2) EU Financial Regulation 2018/1046: "Where several entities satisfy the criteria for being awarded a grant and together form one entity, that entity may be treated as the **sole beneficiary**, including where it is specifically established for the purpose of implementing the action financed by the grant."

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Not applicable

ARTICLE 9 — OTHER PARTICIPANTS INVOLVED IN THE ACTION

9.1   Associated partners

The following entities which cooperate with a beneficiary will participate in the action as 'associated partners':

- **VOLVO AUTONOMOUS SOLUTIONS AB (VOL)**, PIC 895727877

- **RYAX TECHNOLOGIES (RYAX)**, PIC 909541938

- **MONETDB SOLUTIONS BV (MDBS)**, PIC 949731657

- **Vaix Limited (VAIX)**, PIC 896592244

- **UBOTICA TECHNOLOGIES LIMITED (UBO)**, PIC 904875268

- **ANALYTICS ENGINES LIMITED (AE)**, PIC 965580487

- **DANMARKS MEDIE-OG JOURNALISTHOJSKOLE (DMJX)**, PIC 949275369

- **B-secur Limited (BSEC)**, PIC 895126865

- **THE QUEEN'S UNIVERSITY OF BELFAST (QUB)**, PIC 999992013

- **FORSCHUNGSZENTRUM JULICH GMBH (FZJ)**, PIC 999980470

Associated partners must implement the action tasks attributed to them in Annex 1 in accordance with Article 11. They may not charge contributions to the action (no unit contributions) and the costs for their tasks are not eligible.

The tasks must be set out in Annex 1.

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interests), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the associated partners.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the associated partners.

9.2   Third parties giving in-kind contributions to the action

Other third parties may give in-kind contributions to the action (i.e. personnel, equipment, other goods, works and services, etc. which are free-of-charge) if necessary for the implementation.

Third parties giving in-kind contributions do not implement any action tasks. They may not charge contributions to the action (no unit contributions) and their costs are considered entirely covered by the unit contributions paid to the beneficiaries.

The third parties and their in-kind contributions should be set out in Annex 1.

9.3   Subcontractors

Subcontractors may participate in the action, if necessary for the implementation.

Subcontractors must implement their action tasks in accordance with Article 11. The beneficiaries' costs for subcontracting are considered entirely covered by the unit contributions (irrespective of the actual subcontracting costs incurred, if any).

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the subcontractors.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the subcontractors.

9.4   Recipients of financial support to third parties

If the action includes providing financial support to third parties (e.g. grants, prizes or similar forms of support), the beneficiaries must ensure that their contractual obligations under Articles 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping)also apply to the third parties receiving the support (recipients).

The beneficiaries must also ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the recipients.

ARTICLE 10 — PARTICIPANTS WITH SPECIAL STATUS

10.1   Non-EU participants

Participants which are established in a non-EU country (if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)

- for the submission of certificates under Article 24: to use qualified external auditors which are independent and comply with comparable standards as those set out in EU Directive 2006/43/EC[14]

- for the controls under Article 25: to allow for checks, reviews, audits and investigations (including on-the-spot checks, visits and inspections) by the bodies mentioned in that Article (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.).

Special rules on dispute settlement apply (see Data Sheet, Point 5).

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[14] 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 or similar national regulations (OJ L 157, 9.6.2006, p. 87).

10.2   Participants which are international organisations

Participants which are international organisations (IOs; if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)

- for the submission of certificates under Article 24: to use either independent public officers or external auditors which comply with comparable standards as those set out in EU Directive 2006/43/EC

- for the controls under Article 25: to allow for the checks, reviews, audits and investigations by the bodies mentioned in that Article, taking into account the specific agreements concluded by them and the EU (if any).

For such participants, nothing in the Agreement will be interpreted as a waiver of their privileges or immunities, as accorded by their constituent documents or international law.

Special rules on applicable law and dispute settlement apply (see Article 43 and Data Sheet, Point 5).

10.3   Pillar-assessed participants

Pillar-assessed participants (if any) may rely on their own systems, rules and procedures, in so far as they have been positively assessed and do not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries.

'Pillar-assessment' means a review by the European Commission on the systems, rules and procedures which participants use for managing EU grants (in particular internal control system, accounting system, external audits, financing of third parties, rules on recovery and exclusion, information on recipients and protection of personal data; see Article 154 EU Financial Regulation 2018/1046).

Participants with a positive pillar assessment may rely on their own systems, rules and procedures, in particular for:

- record-keeping (Article 20): may be done in accordance with internal standards, rules and procedures

- currency conversion for financial statements (Article 21): may be done in accordance with usual accounting practices

- guarantees (Article 23): for public law bodies, prefinancing guarantees are not needed

- certificates (Article 24):

    - certificates on the financial statements (CFS): may be provided by their regular internal or external auditors and in accordance with their internal financial regulations and procedures

    - certificates on usual accounting practices (CoMUC): are not needed if those practices are covered by an ex-ante assessment

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and use the following specific rules, for:

- recoveries (Article 22): in case of financial support to third parties, there will be no recovery if the participant has done everything possible to retrieve the undue amounts from the third party receiving the support (including legal proceedings) and non-recovery is not due to an error or negligence on its part

- checks, reviews, audits and investigations by the EU (Article 25): will be conducted taking into account the rules and procedures specifically agreed between them and the framework agreement (if any)

- impact evaluation (Article 26): will be conducted in accordance with the participant's internal rules and procedures and the framework agreement (if any)

- grant agreement suspension (Article 31): certain costs incurred during grant suspension are eligible (notably, minimum costs necessary for a possible resumption of the action and costs relating to contracts which were entered into before the pre-information letter was received and which could not reasonably be suspended, reallocated or terminated on legal grounds)

- grant agreement termination (Article 32): the final grant amount and final payment will be calculated taking into account also costs relating to contracts due for execution only after termination takes effect, if the contract was entered into before the pre-information letter was received and could not reasonably be terminated on legal grounds

- liability for damages (Article 33.2): the granting authority must be compensated for 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 only if the damage is due to an infringement of the participant's internal rules and procedures or due to a violation of third parties' rights by the participant or one of its employees or individual for whom the employees are responsible.

Participants whose pillar assessment covers procurement and granting procedures may also do purchases, subcontracting and financial support to third parties (Article 6.2) in accordance with their internal rules and procedures for purchases, subcontracting and financial support.

Participants whose pillar assessment covers data protection rules may rely on their internal standards, rules and procedures for data protection (Article 15).

The participants may however not rely on provisions which would breach the principle of equal treatment of applicants or beneficiaries or call into question the decision awarding the grant, such as in particular:

- eligibility (Article 6)

- consortium roles and set-up (Articles 7-9)

- security and ethics (Articles 13, 14)

- IPR (including background and results, access rights and rights of use), communication, dissemination and visibility (Articles 16 and 17)

- information obligation (Article 19)

- payment, reporting and amendments (Articles 21, 22 and 39)

- rejections, reductions, suspensions and terminations (Articles 27, 28, 29-32)

If the pillar assessment was subject to remedial measures, reliance on the internal systems, rules and procedures is subject to compliance with those remedial measures.

Participants whose assessment has not yet been updated to cover (the new rules on) data protection may rely on their internal systems, rules and procedures, provided that they ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subject

- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes

- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed

- accurate and, where necessary, kept up to date

- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- processed in a manner that ensures appropriate security of the personal data.

Participants must inform the coordinator without delay of any changes to the systems, rules and procedures that were part of the pillar assessment. The coordinator must immediately inform the granting authority.

Pillar-assessed participants that have also concluded a framework agreement with the EU, may moreover — under the same conditions as those above (i.e. not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries) — rely on the provisions set out in that framework agreement.

SECTION 2   RULES FOR CARRYING OUT THE ACTION

ARTICLE 11 — PROPER IMPLEMENTATION OF THE ACTION

11.1   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, the call conditions and all legal obligations under applicable EU, international and national law.

11.2   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 12 — CONFLICT OF INTERESTS

12.1 Conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the Agreement could be compromised for reasons involving family, emotional life, political or national affinity, economic interest or any other direct or indirect interest ('conflict of interests').

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

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

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the beneficiary may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 13 — CONFIDENTIALITY AND SECURITY

13.1 Sensitive information

The parties must keep confidential any data, documents or other material (in any form) that is identified as sensitive in writing ('sensitive information') — during the implementation of the action and for at least until the time-limit set out in the Data Sheet (see Point 6).

If a beneficiary requests, the granting authority may agree to keep such information confidential for a longer period.

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

The beneficiaries may disclose sensitive information to their personnel or other participants involved in the action only if they:

   (a) need to know it in order to implement the Agreement and

   (b) are bound by an obligation of confidentiality.

The granting authority may disclose sensitive information to its staff and to other EU institutions and bodies.

It may moreover disclose sensitive information to third parties, if:

   (a) this is necessary to implement the Agreement or safeguard the EU financial interests and

   (b) the recipients of the information are bound by an obligation of confidentiality.

The confidentiality obligations no longer apply if:

    (a) the disclosing party agrees to release the other party

    (b) the information becomes publicly available, without breaching any confidentiality obligation

    (c) the disclosure of the sensitive information is required by EU, international or national law.

Specific confidentiality rules (if any) are set out in Annex 5.

13.2   Classified information

The parties must handle classified information in accordance with the applicable EU, international or national law on classified information (in particular, Decision 2015/444[15] and its implementing rules).

Deliverables which contain classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving classified information may be subcontracted only after explicit approval (in writing) from the granting authority.

Classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

Specific security rules (if any) are set out in Annex 5.

13.3   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 14 — ETHICS AND VALUES

14.1   Ethics

The action must be carried out in line with the highest ethical standards and the applicable EU, international and national law on ethical principles.

Specific ethics rules (if any) are set out in Annex 5.

14.2   Values

The beneficiaries must commit to and ensure the respect of basic EU values (such as respect for human dignity, freedom, democracy, equality, the rule of law and human rights, including the rights of minorities).

Specific rules on values (if any) are set out in Annex 5.

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[15] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

14.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 15 — DATA PROTECTION

15.1 Data processing by the granting authority

Any personal data under the Agreement will be processed under the responsibility of the data controller of the granting authority in accordance with and for the purposes set out in the Portal Privacy Statement.

For grants where the granting authority is the European Commission, an EU regulatory or executive agency, joint undertaking or other EU body, the processing will be subject to Regulation 2018/1725[16].

15.2 Data processing by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679[17]).

They must ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subjects

- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes

- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed

- accurate and, where necessary, kept up to date

- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- processed in a manner that ensures appropriate security of the data.

The beneficiaries may grant their personnel access to personal data only if it is strictly necessary for implementing, managing and monitoring the Agreement. The beneficiaries must ensure that the personnel is under a confidentiality obligation.

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[16] Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC (OJ L 295, 21.11.2018, p. 39).

[17] 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 ('GDPR') (OJ L 119, 4.5.2016, p. 1).

The beneficiaries must inform the persons whose data are transferred to the granting authority and provide them with the Portal Privacy Statement.

15.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 16 — INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS —ACCESS RIGHTS AND RIGHTS OF USE

16.1 Background and access rights to background

The beneficiaries must give each other and the other participants access to the background identified as needed for implementing the action, subject to any specific rules in Annex 5.

'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 is:

   (a) held by the beneficiaries before they acceded to the Agreement and

   (b) needed to implement the action or exploit the results.

If background is subject to rights of a third party, the beneficiary concerned must ensure that it is able to comply with its obligations under the Agreement.

16.2 Ownership of results

The granting authority does not obtain ownership of the results produced under the action.

'Results' means any tangible or intangible effect of the action, such as data, know-how or information, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.

16.3 Rights of use of the granting authority on materials, documents and information received for policy, information, communication, dissemination and publicity purposes

The granting authority has the right to use non-sensitive information relating to the action and materials and documents received from the beneficiaries (notably summaries for publication, deliverables, as well as any other material, such as pictures or audio-visual material, in paper or electronic form) for policy, information, communication, dissemination and publicity purposes — during the action or afterwards.

The right to use the beneficiaries' materials, documents and information is granted in the form of a royalty-free, non-exclusive and irrevocable licence, which includes the following rights:

   (a) **use for its own purposes** (in particular, making them available to persons working for the granting authority or any other EU service (including institutions, bodies, offices, agencies, etc.) or EU Member State institution or body; copying or reproducing them in whole or in part, in unlimited numbers; and communication through press information services)

(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** (including shortening, summarising, inserting other elements (e.g. 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) **storage** in paper, electronic or other form

(f) **archiving**, in line with applicable document-management rules

(g) the right to authorise **third parties** to act on its behalf or sub-license to third parties the modes of use set out in Points (b), (c), (d) and (f), if needed for the information, communication and publicity activity of the granting authority

(h) **processing**, analysing, aggregating the materials, documents and information received and **producing derivative works**.

The rights of use are granted for the whole duration of the industrial or intellectual property rights concerned.

If materials or documents are subject to moral rights or third party rights (including intellectual property rights or rights of natural persons on their image and voice), the beneficiaries must ensure that they comply with their obligations under this Agreement (in particular, by obtaining the necessary licences and authorisations from the rights holders concerned).

Where applicable, the granting authority will insert the following information:

"© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the [name of granting authority] under conditions."

16.4 Specific rules on IPR, results and background

Specific rules regarding intellectual property rights, results and background (if any) are set out in Annex 5.

16.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

ARTICLE 17 — COMMUNICATION, DISSEMINATION AND VISIBILITY

17.1 Communication — Dissemination — Promoting the action

Unless otherwise agreed with the granting authority, the beneficiaries must promote the action and its

results by providing targeted information to multiple audiences (including the media and the public), in accordance with Annex 1 and in a strategic, coherent and effective manner.

Before engaging in a communication or dissemination activity expected to have a major media impact, the beneficiaries must inform the granting authority.

17.2   Visibility — European flag and funding statement

Unless otherwise agreed with the granting authority, communication activities of the beneficiaries related to the action (including media relations, conferences, seminars, information material, such as brochures, leaflets, posters, presentations, etc., in electronic form, via traditional or social media, etc.), dissemination activities and any infrastructure, equipment, vehicles, supplies or major result funded by the grant must acknowledge EU support and display the European flag (emblem) and funding statement (translated into local languages, where appropriate):

Funded by the
European Union

Co-funded by the
European Union

Funded by the
European Union

Co-funded by the
European Union
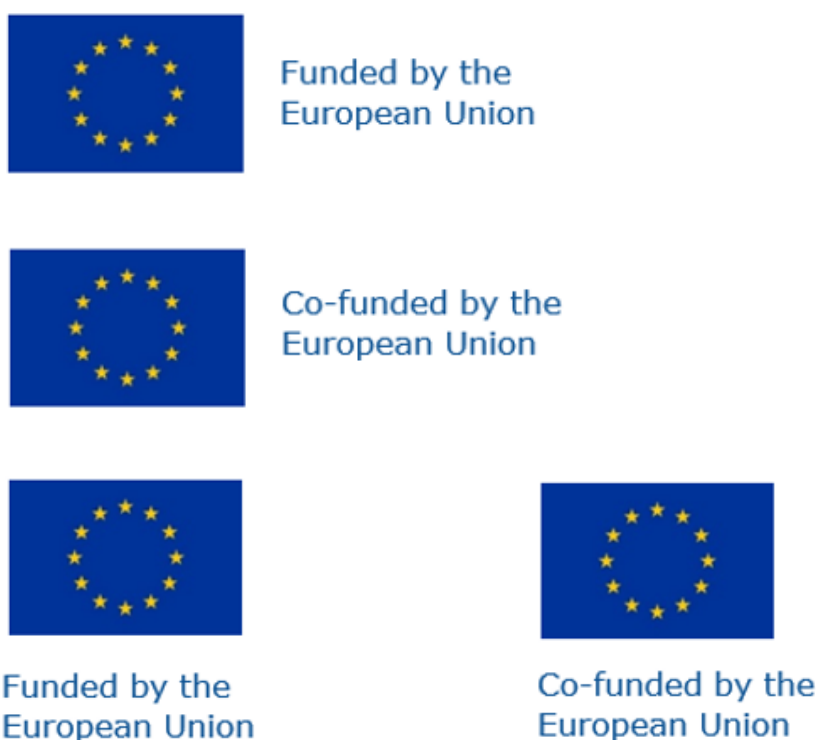
The emblem must remain distinct and separate and cannot be modified by adding other visual marks, brands or text.

Apart from the emblem, no other visual identity or logo may be used to highlight the EU support.

When displayed in association with other logos (e.g. of beneficiaries or sponsors), the emblem must be displayed at least as prominently and visibly as the other logos.

For the purposes of their obligations under this Article, the beneficiaries may use the emblem without first obtaining approval from the granting authority. This does not, however, give them the right to exclusive use. Moreover, they may not appropriate the emblem or any similar trademark or logo, either by registration or by any other means.

17.3   Quality of information — Disclaimer

Any communication or dissemination activity related to the action must use factually accurate information.

Moreover, it must indicate the following disclaimer (translated into local languages where appropriate):

> "Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or [name of the granting authority]. Neither the European Union nor the granting authority can be held responsible for them."

17.4 Specific communication, dissemination and visibility rules

Specific communication, dissemination and visibility rules (if any) are set out in Annex 5.

17.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 18 — SPECIFIC RULES FOR CARRYING OUT THE ACTION

18.1 Specific rules for carrying out the action

Specific rules for implementing the action (if any) are set out in Annex 5.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

SECTION 3   GRANT ADMINISTRATION

ARTICLE 19 — GENERAL INFORMATION OBLIGATIONS

19.1 Information requests

The beneficiaries must provide — during the action or afterwards and in accordance with Article 7 — any information requested in order to verify eligibility of the unit contributions declared, proper implementation of the action and compliance with the other obligations under the Agreement.

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

19.2 Participant Register data updates

The beneficiaries must keep — at all times, during the action or afterwards — their information stored

in the Portal Participant Register up to date, in particular, their name, address, legal representatives, legal form and organisation type.

19.3   Information about events and circumstances which impact the action

The beneficiaries must immediately inform the granting authority (and the other beneficiaries) of any of the following:

(a) **events** which are likely to affect or delay the implementation of the action or affect the EU's financial interests, in particular:

  (i)   changes in their legal, financial, technical, organisational or ownership situation (including changes linked to one of the exclusion grounds listed in the declaration of honour signed before grant signature)

  (ii)   linked action information: not applicable

(b) **circumstances** affecting:

  (i)   the decision to award the grant or

  (ii) compliance with requirements under the Agreement.

19.4   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 20 — RECORD-KEEPING

20.1   Keeping records and supporting documents

The beneficiaries must — at least until the time-limit set out in the Data Sheet (see Point 6) — keep records and other supporting documents to prove the proper implementation of the action in line with the accepted standards in the respective field (if any).

In addition, the beneficiaries must — for the same period — keep adequate records and supporting documents to prove the number of units declared; beneficiaries do not need to keep specific records on the actual costs incurred.

The records and supporting documents must be made available upon request (see Article 19) or in the context of checks, reviews, audits or investigations (see Article 25).

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 25), the beneficiaries must keep these 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 granting authority may accept non-original documents if they offer a comparable level of assurance.

20.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, unit contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 21 — REPORTING

21.1 Continuous reporting

The beneficiaries must continuously report on the progress of the action (e.g. **deliverables, milestones, outputs/outcomes, critical risks, indicators,** etc; if any), in the Portal Continuous Reporting tool and in accordance with the timing and conditions it sets out (as agreed with the granting authority).

Standardised deliverables (e.g. progress reports not linked to payments, reports on cumulative expenditure, special reports, etc; if any) must be submitted using the templates published on the Portal.

21.2 Periodic reporting: Technical reports and financial statements

In addition, the beneficiaries must provide reports to request payments, in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2):

- for additional prefinancings (if any): an **additional prefinancing report**

- for interim payments (if any) and the final payment: a **periodic report**.

The prefinancing and periodic reports include a technical and financial part.

The technical part includes an overview of the action implementation. It must be prepared using the template available in the Portal Periodic Reporting tool.

The financial part of the additional prefinancing report includes a statement on the use of the previous prefinancing payment.

The financial part of the periodic report includes:

- the financial statements (individual and consolidated; for all beneficiaries/affiliated entities)

- the explanation on the use of resources (or detailed cost reporting table, if required)

- the certificates on the financial statements (CFS): not applicable.

The **financial statements** must detail the contributions for the units implemented in the reporting period.

Unit contributions which are not declared in a financial statement will not be taken into account by the granting authority.

By signing the financial statements (directly in the Portal Periodic Reporting tool), the beneficiaries confirm that:

- the information provided is complete, reliable and true

- the unit contributions declared are eligible (see Article 6)

- the contributions can be substantiated by adequate records and supporting documents (see Article 20) that will be produced upon request (see Article 19) or in the context of checks, reviews, audits and investigations (see Article 25)

Beneficiaries will have to submit also the financial statements of their affiliated entities (if any). In case of recoveries (see Article 22), beneficiaries will be held responsible also for the financial statements of their affiliated entities.

21.3 Currency for financial statements and conversion into euros

The financial statements must be drafted in euro.

21.4 Reporting language

The reporting must be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

21.5 Consequences of non-compliance

If a report submitted does not comply with this Article, the granting authority may suspend the payment deadline (see Article 29) and apply other measures described in Chapter 5.

If the coordinator breaches its reporting obligations, the granting authority may terminate the grant or the coordinator's participation (see Article 32) or apply other measures described in Chapter 5.

ARTICLE 22 — PAYMENTS AND RECOVERIES — CALCULATION OF AMOUNTS DUE

22.1 Payments and payment arrangements

Payments will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

They will be made in euro to the bank account indicated by the coordinator (see Data Sheet, Point 4.2) and must be distributed without unjustified delay (restrictions may apply to distribution of the initial prefinancing payment; see Data Sheet, Point 4.2).

Payments to this bank account will discharge the granting authority from its payment obligation.

The cost of payment transfers will be borne as follows:

- the granting authority 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.

Payments by the granting authority will be considered to have been carried out on the date when they are debited to its account.

22.2 Recoveries

Recoveries will be made, if — at beneficiary termination, final payment or afterwards — it turns out that the granting authority has paid too much and needs to recover the amounts undue.

Each beneficiary's financial responsibility in case of recovery is in principle limited to their own debt and undue amounts of their affiliated entities.

In case of enforced recoveries (see Article 22.4), affiliated entities will be held liable for repaying debts of their beneficiaries, if required by the granting authority (see Data Sheet, Point 4.4).

22.3 Amounts due

22.3.1 Prefinancing payments

The aim of the prefinancing is to provide the beneficiaries with a float.

It remains the property of the EU until the final payment.

For **initial prefinancings** (if any), the amount due, schedule and modalities are set out in the Data Sheet (see Point 4.2).

For **additional prefinancings** (if any), the amount due, schedule and modalities are also set out in the Data Sheet (see Point 4.2). However, if the statement on the use of the previous prefinancing payment shows that less than 70% was used, the amount set out in the Data Sheet will be reduced by the difference between the 70% threshold and the amount used.

The contribution to the Mutual Insurance Mechanism will be retained from the prefinancing payments (at the rate and in accordance with the modalities set out in the Data Sheet, see Point 4.2) and transferred to the Mechanism.

Prefinancing payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.2 Amount due at beneficiary termination — Recovery

At beneficiary termination there will be no payment, but the grant must be provisionally closed for the beneficiary which leaves the consortium (and the affiliated entities which had to end their participation together with the beneficiary, if any).

Payments (if any) will be made with the next interim or final payment.

The **amount due** will be calculated in the following step:

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the beneficiary for all reporting periods, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution' for the beneficiary.

The **balance** is then calculated by deducting the payments received (if any; see report on the distribution of payments in Article 32), from the total accepted EU contribution:

> **{**total accepted EU contribution for the beneficiary
>
> minus
>
> {prefinancing and interim payments received (if any)}**}**.

If the balance is **positive**, the amount will be included in the next interim or final payment to the consortium.

If the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount due, the amount to be recovered and the reasons why and

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered and ask this amount to be paid to the coordinator (**confirmation letter**).

If payment is not made to the coordinator by the date specified in the confirmation letter, the granting authority may call on the Mutual Insurance Mechanism to intervene, if continuation of the action is guaranteed and the conditions set out in the rules governing the Mechanism are met.

In this case, it will send a **beneficiary recovery letter**, together with a **debit note** with the terms and date for payment.

The debit note for the beneficiary will include the amount calculated for the affiliated entities which also had to end their participation (if any).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

The amounts will later on also be taken into account for the next interim or final payment.

22.3.3 Interim payments

Interim payments reimburse the eligible contributions claimed for the units implemented during the reporting periods (if any).

Interim payments (if any) will be made in accordance with the schedule and modalities set out the Data Sheet (see Point 4.2).

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

The **interim payment** will be calculated by the granting authority in the following steps:

> Step 1 — Calculation of the total accepted EU contribution

> Step 2 — Limit to the interim payment ceiling

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for the reporting period, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions from beneficiary termination (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the interim payment ceiling

The resulting amount is then capped to ensure that the total amount of prefinancing and interim payments (if any) does not exceed the interim payment ceiling set out in the Data Sheet (see Point 4.2).

Interim payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.4 Final payment — Final grant amount — Revenues and Profit — Recovery

The final payment (payment of the balance) reimburses the eligible contributions claimed for the remaining units implemented (if any).

The final payment will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

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

The **final grant amount for the action** will be calculated in the following steps:

> Step 1 — Calculation of the total accepted EU contribution

> Step 2 — Limit to the maximum grant amount

> Step 3 — Reduction due to the no-profit rule

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Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for all reporting periods, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the maximum grant amount

If the resulting amount is higher than the maximum grant amount set out in Article 5.2, it will be limited to the latter.

Step 3 — Reduction due to the no-profit rule

Not applicable

The **balance** (final payment) is then calculated by deducting the total amount of prefinancing and interim payments already made (if any), from the final grant amount:

$\{$final grant amount

minus

{prefinancing and interim payments made (if any)}$\}$.

If the balance is **positive**, it will be **paid** to the coordinator.

The amount retained for the Mutual Insurance Mechanism (see above) will be released and **paid** to the coordinator (in accordance with the rules governing the Mechanism).

The final payment (or part of it) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

If — despite the release of the Mutual Insurance Mechanism contribution — the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to recover, the final grant amount, the amount to be recovered and the reasons why

- requesting a report on the distribution of payments to the beneficiaries within 30 days of receiving notification and

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received) and the coordinator has submitted the report on the distribution of payments, it will calculate the **share of the debt per beneficiary**, by:

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

$\Bigg\{\bigg\{$ {total accepted EU contribution for the beneficiary

divided by

total accepted EU contribution for the action}

multiplied by

final grant amount for the action$\bigg\}$,

minus

{prefinancing and interim payments received by the beneficiary (if any)}$\Bigg\}$

and

(b) dividing the debt:

$\bigg\{$ {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 to be recovered$\bigg\}$.

and confirm the amount to be recovered from each beneficiary concerned (**confirmation letter**), together with **debit notes** with the terms and date for payment.

The debit notes for beneficiaries will include the amounts calculated for their affiliated entities (if any).

If the coordinator has not submitted the report on the distribution of payments, the granting authority will **recover** the full amount from the coordinator (**confirmation letter** and **debit note** with the terms and date for payment).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.3.5 Audit implementation after final payment — Revised final grant amount — Recovery

If — after the final payment (in particular, after checks, reviews, audits or investigations; see Article 25) — the granting authority rejects unit contributions (see Article 27) or reduces the grant (see Article 28), it will calculate the **revised final grant amount** for the beneficiary concerned.

The **beneficiary revised final grant amount** will be calculated in the following step:

Step 1 — Calculation of the revised total accepted EU contribution

<u>Step 1 — Calculation of the revised total accepted EU contribution</u>

The granting authority will first calculate the 'revised accepted EU contribution' for the beneficiary, by calculating the 'revised accepted contributions'.

After that, it will take into account grant reductions (if any). The resulting 'revised total accepted EU contribution' is the beneficiary revised final grant amount.

If the revised final grant amount is lower than the beneficiary's final grant amount (i.e. its share in the final grant amount for the action), it will be **recovered** in accordance with the following procedure:

The **beneficiary final grant amount** (i.e. share in the final grant amount for the action) is calculated as follows:

$$\left\{ \left\{ \frac{\text{total accepted EU contribution for the beneficiary}}{\text{total accepted EU contribution for the action}} \right\} \times \text{final grant amount for the action} \right\}.$$

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount to be recovered and the reasons why and

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered (**confirmation letter**), together with a **debit note** with the terms and the date for payment.

Recoveries against affiliated entities (if any) will be handled through their beneficiaries.

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.4 Enforced recovery

If payment is not made by the date specified in the debit note, the amount due will be recovered:

(a) by offsetting the amount — without the coordinator or beneficiary's consent — against any amounts owed to the coordinator or beneficiary by the granting authority.

In exceptional circumstances, to safeguard the EU financial interests, the amount may be offset before the payment date specified in the debit note.

For grants where the granting authority is the European Commission or an EU executive agency, debts may also be offset against amounts owed by other Commission services or executive agencies.

(b) financial guarantee(s): not applicable

(c) joint and several liability of beneficiaries: not applicable

(d) by holding affiliated entities jointly and severally liable (if any, see Data Sheet, Point 4.4)

(e) by taking legal action (see Article 43) or, provided that the granting authority is the European Commission or an EU executive agency, by adopting an enforceable decision under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 100(2) of EU Financial Regulation 2018/1046.

If the Mutual Insurance Mechanism was called on by the granting authority to intervene, recovery will be continued in the name of the Mutual Insurance Mechanism. If two debit notes were sent, the second one (in the name of the Mutual Insurance Mechanism) will be considered to replace the first one (in the name of the granting authority). Where the MIM intervened, offsetting, enforceable decisions or any other of the above-mentioned forms of enforced recovery may be used mutatis mutandis.

The amount to be recovered will be increased by **late-payment interest** at the rate set out in Article 22.5, from the day following the payment date in the debit note, up to and including the date the full payment is received.

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 2015/2366[18] applies.

For grants where the granting authority is an EU executive agency, enforced recovery by offsetting or enforceable decision will be done by the services of the European Commission (see also Article 43).

22.5 Consequences of non-compliance

22.5.1 If the granting authority 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 the rate specified in the Data Sheet (Point 4.2). 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 on 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).

If payments or the payment deadline are suspended (see Articles 29 and 30), payment will not be considered as late.

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.

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[18] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (OJ L 337, 23.12.2015, p. 35).

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

22.5.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 29) and the grant or the coordinator may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 23 — GUARANTEES

Not applicable

ARTICLE 24 — CERTIFICATES

Not applicable

ARTICLE 25 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

25.1 Granting authority checks, reviews and audits

25.1.1 Internal checks

The granting authority may — during the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing unit contributions, deliverables and reports.

25.1.2 Project reviews

The granting authority may carry out reviews on the proper implementation of the action and compliance with the obligations under the Agreement (general project reviews or specific issues reviews).

Such project reviews may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiary concerned and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent, outside experts. If it uses outside experts, the coordinator or beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The coordinator or beneficiary concerned must cooperate diligently and 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 granting authority may request beneficiaries to provide such information to it directly. Sensitive information and documents will be treated in accordance with Article 13.

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

For **on-the-spot visits**, the beneficiary concerned must allow access to sites and premises (including to the outside experts) and must ensure that information requested is readily available.

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

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

The granting authority will formally notify the project review report to the coordinator or beneficiary concerned, which has 30 days from receiving notification to make observations.

Project reviews (including project review reports) will be in the language of the Agreement.

25.1.3 Audits

The granting authority may carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Such audits may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the beneficiary concerned and will be considered to start on the date of the notification.

The granting authority may use its own audit service, delegate audits to a centralised service or use external audit firms. If it uses an external firm, the beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. Sensitive information and documents will be treated in accordance with Article 13.

For **on-the-spot** visits, the beneficiary concerned must allow access to sites and premises (including for the external audit firm) 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 auditors will formally notify the draft audit report to the beneficiary concerned, which has 30 days from receiving notification to make observations (contradictory audit procedure).

The **final audit report** will take into account observations by the beneficiary concerned and will be formally notified to them.

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

25.2 European Commission checks, reviews and audits in grants of other granting authorities

Where the granting authority is not the European Commission, the latter has the same rights of checks, reviews and audits as the granting authority.

25.3 Access to records for assessing simplified forms of funding

The beneficiaries must give the European Commission access to their statutory records for the periodic assessment of simplified forms of funding which are used in EU programmes.

25.4 OLAF, EPPO and ECA audits and investigations

The following bodies may also carry out checks, reviews, audits and investigations — during the action or afterwards:

- the European Anti-Fraud Office (OLAF) under Regulations No 883/2013[19] and No 2185/96[20]

- the European Public Prosecutor's Office (EPPO) under Regulation 2017/1939

- the European Court of Auditors (ECA) under Article 287 of the Treaty on the Functioning of the EU (TFEU) and Article 257 of EU Financial Regulation 2018/1046.

If requested by these bodies, the beneficiary concerned must provide full, accurate and complete information in the format requested (including complete accounts, individual salary statements or other personal data, including in electronic format) and allow access to sites and premises for on-the-spot visits or inspections — as provided for under these Regulations.

To this end, the beneficiary concerned must keep all relevant information relating to the action, at least until the time-limit set out in the Data Sheet (Point 6) and, in any case, until any ongoing checks, reviews, audits, investigations, litigation or other pursuits of claims have been concluded.

25.5 Consequences of checks, reviews, audits and investigations — Extension of results of reviews, audits or investigations

25.5.1 Consequences of checks, reviews, audits and investigations in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to rejections (see Article 27), grant reduction (see Article 28) or other measures described in Chapter 5.

Rejections or grant reductions after the final payment will lead to a revised final grant amount (see Article 22).

Findings in checks, reviews, audits or investigations during the action implementation may lead to a request for amendment (see Article 39), to change the description of the action set out in Annex 1.

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations in any EU grant may also lead to consequences in other EU grants awarded under similar conditions ('extension to other grants').

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

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[19] 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).

[20] 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).

25.5.2 Extension from other grants

Results of checks, reviews, audits or investigations in other grants may be extended to this grant, if:

(a) the beneficiary concerned is found, in other EU 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 — within the time-limit for audits set out in the Data Sheet (see Point 6).

The granting authority will formally notify the beneficiary concerned of the intention to extend the findings and the list of grants affected.

If the extension concerns **rejections of unit contributions**: the 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 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.

If the extension concerns **grant reductions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings and

(b) the **correction rate for extrapolation**, established on the basis of the systemic or recurrent errors and the principle of proportionality.

The beneficiary concerned has **60 days** from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method/rate**.

On the basis of this, the granting authority will analyse the impact and decide on the implementation (i.e. start rejection or grant reduction procedures, either on the basis of the revised financial statements or the announced/alternative method/rate or a mix of those; see Articles 27 and 28).

25.6   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, unit contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 26 — IMPACT EVALUATIONS

26.1 Impact evaluation

The granting authority may carry out impact evaluations of the action, measured against the objectives and indicators of the EU programme funding the grant.

Such evaluations may be started during implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiaries and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent outside experts.

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

26.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the granting authority may apply the measures described in Chapter 5.

CHAPTER 5   CONSEQUENCES OF NON-COMPLIANCE

SECTION 1   REJECTIONS AND GRANT REDUCTION

ARTICLE 27 — REJECTION OF CONTRIBUTIONS

27.1   Conditions

The granting authority will — at beneficiary termination, interim payment, final payment or afterwards — reject any unit contributions which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 25).

The rejection may also be based on the extension of findings from other grants to this grant (see Article 25).

Ineligible unit contributions will be rejected.

27.2   Procedure

If the rejection does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the rejection, the amounts and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the rejection (payment review procedure).

If the rejection leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

27.3   Effects

If the granting authority rejects unit contributions, it will deduct them from the contributions declared and then calculate the amount due (and, if needed, make a recovery; see Article 22).

ARTICLE 28 — GRANT REDUCTION

28.1   Conditions

The granting authority may — at beneficiary termination, final payment or afterwards — reduce the grant for a beneficiary, if:

(a) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU 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 (see Article 25).

The amount of the reduction will be calculated for each beneficiary concerned and proportionate to the seriousness and the duration of the errors, irregularities or fraud or breach of obligations, by applying an individual reduction rate to their accepted EU contribution.

28.2   Procedure

If the grant reduction does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the reduction, the amount to be reduced and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the reduction (payment review procedure).

If the grant reduction leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

28.3   Effects

If the granting authority reduces the grant, it will deduct the reduction and then calculate the amount due (and, if needed, make a recovery; see Article 22).

SECTION 2   SUSPENSION AND TERMINATION

ARTICLE 29 — PAYMENT DEADLINE SUSPENSION

29.1   Conditions

The granting authority may — at any moment — suspend the payment deadline if a payment cannot be processed because:

(a) the required report (see Article 21) has not been submitted or is not complete or additional information is needed

(b) there are doubts about the amount to be paid (e.g. ongoing audit extension procedure, queries about eligibility, need for a grant reduction, etc.) and additional checks, reviews, audits or investigations are necessary, or

(c) there are other issues affecting the EU financial interests.

29.2 Procedure

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

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

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining time to pay (see Data Sheet, Point 4.2) will resume.

If the suspension exceeds two months, the coordinator may request the granting authority to confirm if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the report and the revised report is not submitted (or was submitted but is also rejected), the granting authority may also terminate the grant or the participation of the coordinator (see Article 32).

ARTICLE 30 — PAYMENT SUSPENSION

30.1 Conditions

The granting authority may — at any moment — suspend payments, in whole or in part for one or more beneficiaries, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

   (i) substantial errors, irregularities or fraud or

   (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU 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.

If payments are suspended for one or more beneficiaries, the granting authority will make partial payment(s) for the part(s) not suspended. If suspension concerns the final payment, the payment (or recovery) of the remaining amount after suspension is lifted will be considered to be the payment that closes the action.

30.2   Procedure

Before suspending payments, the granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to suspend payments and the reasons why and

- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

At the end of the suspension procedure, the granting authority will also inform the coordinator.

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

If the conditions for resuming payments are met, the suspension will be **lifted**. The granting authority will formally notify the beneficiary concerned (and the coordinator) and set the suspension end date.

During the suspension, no prefinancing will be paid to the beneficiaries concerned. For interim payments, the periodic reports for all reporting periods except the last one (see Article 21) must not contain any financial statements from the beneficiary concerned (or its affiliated entities). 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.

ARTICLE 31 — GRANT AGREEMENT SUSPENSION

31.1   Consortium-requested GA suspension

31.1.1 Conditions and procedure

The beneficiaries may request the suspension of the grant or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 35) — make implementation impossible or excessively difficult.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the date the suspension takes effect; this date may be before the date of the submission of the amendment request and

- the expected date of resumption.

The suspension will **take effect** on the day specified in the amendment.

Once circumstances allow for implementation to resume, the coordinator must immediately request another **amendment** of the Agreement to set the suspension end date, the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The

suspension will be **lifted** with effect from the suspension end date set out in the amendment. This date may be before the date of the submission of the amendment request.

During the suspension, no prefinancing will be paid. Moreover, no units may be implemented. Ongoing units must be interrupted and no new units may be started. Unit contributions for activities implemented during grant suspension are not eligible (see Article 6.3).

31.2 EU-initiated GA suspension

31.2.1 Conditions

The granting authority may suspend the grant or any part of it, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

   (i) substantial errors, irregularities or fraud or

   (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU 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

(c) other:

   (i) linked action issues: not applicable

   (ii) the action has lost its scientific or technological relevance

31.2.2 Procedure

Before suspending the grant, the granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to suspend the grant and the reasons why and

- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

The suspension will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification).

Once the conditions for resuming implementation of the action are met, the granting authority will formally notify the coordinator a **lifting of suspension letter**, in which it will set the suspension

end date and invite the coordinator to request an amendment of the Agreement to set the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the lifting of suspension letter. This date may be before the date on which the letter is sent.

During the suspension, no prefinancing will be paid. Moreover, no units may be implemented Ongoing units must be interrupted and no new units may be started. Unit contributions for activities implemented during suspension are not eligible (see Article 6.3).

The beneficiaries may not claim damages due to suspension by the granting authority (see Article 33).

Grant suspension does not affect the granting authority's right to terminate the grant or a beneficiary (see Article 32) or reduce the grant (see Article 28).

ARTICLE 32 — GRANT AGREEMENT OR BENEFICIARY TERMINATION

32.1 Consortium-requested GA termination

32.1.1 Conditions and procedure

The beneficiaries may request the termination of the grant.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the date the consortium ends work on the action ('end of work date') and

- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

The termination will **take effect** on the termination date specified in the amendment.

If no reasons are given or if the granting authority considers the reasons do not justify termination, it may consider the grant terminated improperly.

32.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the unit contributions for activities implemented before the end of work date (see Article 22).

If the granting authority does not receive the report within the deadline, only unit contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Improper termination may lead to a grant reduction (see Article 28).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and

security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.2 Consortium-requested beneficiary termination

32.2.1 Conditions and procedure

The coordinator may request the termination of the participation of one or more beneficiaries, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing)

- the date the beneficiary ends work on the action ('end of work date')

- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

If the termination concerns the coordinator and is done without its agreement, the amendment request must be submitted by another beneficiary (acting on behalf of the consortium).

The termination will **take effect** on the termination date specified in the amendment.

If no information is given or if the granting authority considers that the reasons do not justify termination, it may consider the beneficiary to have been terminated improperly.

32.2.2 Effects

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 **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, the financial statement and the explanation on the use of resources

(iii) a second **request for amendment** (see Article 39) with other amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted and taking into account the unit contributions for activities implemented before the end of work date (see Article 22).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only unit

contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, 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.

If the second request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the second request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

Improper termination may lead to a reduction of the grant (see Article 31) or grant termination (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.3   EU-initiated GA or beneficiary termination

32.3.1 Conditions

The granting authority may terminate the grant or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 40)

(b) a change to the action or the legal, financial, technical, organisational or ownership situation of a beneficiary is likely to substantially affect the implementation of the action or calls into question the decision to award the grant (including changes linked to one of the exclusion grounds listed in the declaration of honour)

(c) following termination of one or more beneficiaries, the necessary changes to the Agreement (and their impact on the action) would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(d) implementation of the action has become impossible or the changes necessary for its continuation would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(e) a beneficiary (or person with unlimited liability for its debts) is subject to bankruptcy proceedings or similar (including insolvency, winding-up, administration by a liquidator or court, arrangement with creditors, suspension of business activities, etc.)

(f) a beneficiary (or person with unlimited liability for its debts) is in breach of social security or tax obligations

(g)   a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has been found guilty of grave professional misconduct

(h)   a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed fraud, corruption, or is involved in a criminal organisation, money laundering, terrorism-related crimes (including terrorism financing), child labour or human trafficking

(i)   a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) was created under a different jurisdiction with the intent to circumvent fiscal, social or other legal obligations in the country of origin (or created another entity with this purpose)

(j)   a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

   (i)   substantial errors, irregularities or fraud or

   (ii)   serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.)

(k)   a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU 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 25)

(l)   despite a specific request by the granting authority, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its affiliated entities or associated partners that is in one of the situations under points (d), (f), (e), (g), (h), (i) or (j) and to reallocate its tasks, or

(m)   other:

   (i)   linked action issues: not applicable

   (ii)   the action has lost its scientific or technological relevance

32.3.2 Procedure

Before terminating the grant or participation of one or more beneficiaries, the granting authority will send **a pre-information letter** to the coordinator or beneficiary concerned:

-   formally notifying the intention to terminate and the reasons why and

-   requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite

the observations it has received, it will confirm the termination and the date it will take effect (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

For beneficiary terminations, the granting authority will — at the end of the procedure — also inform the coordinator.

The termination will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification; 'termination date').

32.3.3 Effects

(a) for **GA termination**:

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the last open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted (see Article 22). Only units implemented until termination will be accepted.

If the grant is terminated for breach of the obligation to submit reports, the coordinator may not submit any report after termination.

If the granting authority does not receive the report within the deadline, only unit contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Termination does not affect the granting authority's right to reduce the grant (see Article 28) or to impose administrative sanctions (see Article 34).

The beneficiaries may not claim damages due to termination by the granting authority (see Article 33).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

(b) for **beneficiary termination**:

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 **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, the financial statement, and the explanation on the use of resources

(iii) a **request for amendment** (see Article 39) with any amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted (see Article 22). Only units implemented until termination will be accepted.

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only unit contributions included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, 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.

If the request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

SECTION 3   OTHER CONSEQUENCES: DAMAGES AND ADMINISTRATIVE SANCTIONS

ARTICLE 33 — DAMAGES

33.1   Liability of the granting authority

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

The granting authority cannot be held liable for any damage caused by any of the beneficiaries or other participants involved in the action, as a consequence of the implementation of the Agreement.

33.2   Liability of the beneficiaries

The beneficiaries must compensate the granting authority 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, provided that it was caused by gross negligence or wilful act.

The liability does not extend to indirect or consequential losses or similar damage (such as loss of

profit, loss of revenue or loss of contracts), provided such damage was not caused by wilful act or by a breach of confidentiality.

ARTICLE 34 — ADMINISTRATIVE SANCTIONS AND OTHER MEASURES

Nothing in this Agreement may be construed as preventing the adoption of administrative sanctions (i.e. exclusion from EU award procedures and/or financial penalties) or other public law measures, in addition or as an alternative to the contractual measures provided under this Agreement (see, for instance, Articles 135 to 145 EU Financial Regulation 2018/1046 and Articles 4 and 7 of Regulation 2988/95[21]).

SECTION 4   FORCE MAJEURE

ARTICLE 35 — FORCE MAJEURE

A party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

'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 other participants involved in the action), and

- proves to be inevitable in spite of exercising all due diligence.

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.

CHAPTER 6   FINAL PROVISIONS

ARTICLE 36 — COMMUNICATION BETWEEN THE PARTIES

36.1   Forms and means of communication — Electronic management

EU grants are managed fully electronically through the EU Funding & Tenders Portal ('Portal').

All communications must be made electronically through the Portal, in accordance with the Portal Terms and Conditions and using the forms and templates provided there (except if explicitly instructed otherwise by the granting authority).

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[21] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

Communications must be made in writing and clearly identify the grant agreement (project number and acronym).

Communications must be made by persons authorised according to the Portal Terms and 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 their appointment letter (see Portal Terms and Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Portal.

36.2   Date of communication

The sending date for communications made through the Portal will be the date and time of sending, as indicated by the time logs.

The receiving date for communications made through the Portal will be the date and time the communication is accessed, as indicated by the time logs. Formal notifications that have not been accessed within 10 days after sending, will be considered to have been accessed (see Portal Terms and Conditions).

If a communication is exceptionally made on paper (by e-mail or postal service), general principles apply (i.e. date of sending/receipt). Formal notifications by registered post with proof of delivery will be considered to have been received either on 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.

36.3   Addresses for communication

The Portal can be accessed via the Europa website.

The address for paper communications to the granting authority (if exceptionally allowed) is the official mailing address indicated on its website.

For beneficiaries, it is the legal address specified in the Portal Participant Register.

ARTICLE 37 — INTERPRETATION OF THE AGREEMENT

The provisions in the Data Sheet take precedence over the rest of the Terms and Conditions of the Agreement.

Annex 5 takes precedence over the Terms and Conditions; the Terms and Conditions take precedence over the Annexes other than Annex 5.

Annex 2 takes precedence over Annex 1.

ARTICLE 38 — CALCULATION OF PERIODS AND DEADLINES

In accordance with Regulation No 1182/71[22], 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.

'Days' means calendar days, not working days.

ARTICLE 39 — AMENDMENTS

39.1 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.

39.2 Procedure

The party requesting an amendment must submit a request for amendment signed directly in the Portal Amendment tool.

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 granting authority may request additional information.

If the party receiving the request agrees, it must sign the amendment in the tool within 45 days of receiving notification (or any additional information the granting authority 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 of entry into force or other date specified in the amendment.

ARTICLE 40 — ACCESSION AND ADDITION OF NEW BENEFICIARIES

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[22] 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).

40.1   Accession of the beneficiaries mentioned in the Preamble

The beneficiaries which are not coordinator must accede to the grant by signing the accession form (see Annex 3) directly in the Portal Grant Preparation tool, within 30 days after the entry into force of the Agreement (see Article 44).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 44).

If a beneficiary does not accede to the grant within the above deadline, the coordinator must — within 30 days — request an amendment (see Article 39) to terminate the beneficiary and make any changes necessary to ensure proper implementation of the action. This does not affect the granting authority's right to terminate the grant (see Article 32).

40.2   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 39. It must include an accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool.

New beneficiaries will assume the rights and obligations under the Agreement with effect from the date of their accession specified in the accession form (see Annex 3).

Additions are also possible in mono-beneficiary grants.

ARTICLE 41 — TRANSFER OF THE AGREEMENT

In justified cases, the beneficiary of a mono-beneficiary grant may request the transfer of the grant to a new beneficiary, provided that this would not call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiary must submit a request for **amendment** (see Article 39), with

-   the reasons why

-   the accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool and

-   additional supporting documents (if required by the granting authority).

The new beneficiary will assume the rights and obligations under the Agreement with effect from the date of accession specified in the accession form (see Annex 3).

ARTICLE 42 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE GRANTING AUTHORITY

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

If the granting authority has not accepted the assignment or if 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 granting authority.

ARTICLE 43 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

43.1   Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

Special rules may apply for beneficiaries which are international organisations (if any; see Data Sheet, Point 5).

43.2   Dispute settlement

If a dispute concerns the interpretation, application or validity of the Agreement, the parties must bring action before the EU General Court — or, on appeal, the EU Court of Justice — under Article 272 of the Treaty on the Functioning of the EU (TFEU).

For non-EU beneficiaries (if any), such disputes must be brought before the courts of Brussels, Belgium — unless an international agreement provides for the enforceability of EU court judgements.

For beneficiaries with arbitration as special dispute settlement forum (if any; see Data Sheet, Point 5), the dispute will — in the absence of an amicable settlement — be settled in accordance with the Rules for Arbitration published on the Portal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 22 and 34), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice — under Article 263 TFEU.

For grants where the granting authority is an EU executive agency (see Preamble), actions against offsetting and enforceable decisions must be brought against the European Commission (not against the granting authority; see also Article 22).

ARTICLE 44 — ENTRY INTO FORCE

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

HE Unit MGA — Multi & Mono: v1.0

SIGNATURES

For the coordinator   For the granting authority
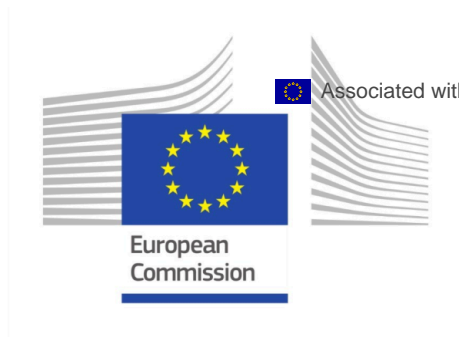
Horizon Europe (HORIZON)

Description of the action (DoA)

Part A

Part B

DESCRIPTION OF THE ACTION (PART A)

COVER PAGE

Part A of the Description of the Action (DoA) must be completed directly on the Portal Grant Preparation screens.

PROJECT	
Grant Preparation (General Information screen) — Enter the info.	
Project number:	101072456
Project name:	Relaxed Semantics Across the Data Analytics Stack
Project acronym:	RELAX
Call:	HORIZON-MSCA-2021-DN-01
Topic:	HORIZON-MSCA-2021-DN-01-01
Type of action:	HORIZON-TMA-MSCA-DN
Service:	REA/A/01
Project starting date:	fixed date: 1 March 2023
Project duration:	48 months

TABLE OF CONTENTS

PROJECT SUMMARY

Project summary
Grant Preparation (General Information screen) — Provide an overall description of your project (including context and overall objectives, planned activities and main achievements, and expected results and impacts (on target groups, change procedures, capacities, innovation etc)). This summary should give readers a clear idea of what your project is about. *Use the project summary from your proposal.*
The RELAX European Doctoral Network aims to train a cohort of highly mobile and adaptable researchers to become experts in the design of scalable and efficient data-intensive software systems. These experts will master the specific skill of navigating the semantics or correctness conditions of applications, with the goal of enhancing scalability, response times, and availability. Working across the disciplinary specialisms of data science, data management, distributed computing and computing systems, the Fellows will develop knowledge of the broad issues underpinning data analytics systems. The bespoke training programme fosters intellectual enquiry and combines technical and scientific research training with courses in innovation, management and leadership. The training network addresses a critical skills gap in data analytics expertise, which needs urgently addressed to support innovation and employment in a fast-growing European data economy. The 14 partner organisations representing 8 countries will benefit first-hand through intersectoral collaboration and an Open Innovation model.

LIST OF PARTICIPANTS

PARTICIPANTS
Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
1	COO	CTH	CHALMERS TEKNISKA HOGSKOLA AB	SE	999980373
2	BEN	ICCS	INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS	EL	999654356
3	BEN	TCD	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	IE	999845446
4	BEN	AU	AARHUS UNIVERSITET	DK	999997736
5	AP	VOL	VOLVO AUTONOMOUS SOLUTIONS AB	SE	895727877
6	AP	RYAX	RYAX TECHNOLOGIES	FR	909541938
7	AP	MDBS	MONETDB SOLUTIONS BV	NL	949731657
8	AP	VAIX	Vaix Limited	UK	896592244
9	AP	UBO	UBOTICA TECHNOLOGIES LIMITED	IE	904875268
10	AP	AE	ANALYTICS ENGINES LIMITED	UK	965580487
11	AP	DMJX	DANMARKS MEDIE-OG JOURNALISTHOJSKOLE	DK	949275369
12	AP	BSEC	B-secur Limited	UK	895126865
13	AP	QUB	THE QUEEN'S UNIVERSITY OF BELFAST	UK	999992013
14	AP	FZJ	FORSCHUNGSZENTRUM JULICH GMBH	DE	999980470

LIST OF WORK PACKAGES

Work packages						
Grant Preparation (Work Packages screen) — Enter the info.						
Work Package No	**Work Package name**	**Lead Beneficiary**	**Effort (Person-Months)**	**Start Month**	**End Month**	**Deliverable No(s)**
WP1	Qualitative Aspects of Data Analytics	3 - TCD	144.00	7	48	D1.1, D1.2, D1.3
WP2	Indexing and Summarisation	2 - ICCS	144.00	7	48	D2.2, D2.3, D2.1
WP3	Computation and Coordination	1 - CTH	144.00	7	48	D3.2, D3.1, D3.3
WP4	Training and Personal Development	2 - ICCS	8.00	7	48	D4.2, D4.1, D4.3
WP5	Dissemination, Communication, Expoitation	1 - CTH	8.00	1	48	D5.1, D5.3, D5.5, D5.2, D5.4
WP6	Management	1 - CTH	14.00	1	48	D6.3, D6.1, D6.2, D6.4, D6.5
WP7	Ethics requirements	1 - CTH	0.00	1	48	D7.1, D7.3, D7.2

Work package WP1 – Qualitative Aspects of Data Analytics

Work Package Number	WP1	Lead Beneficiary	3. TCD
Work Package Name	Qualitative Aspects of Data Analytics		
Start Month	7	End Month	48

Objectives
To develop the principles of robust data analytic algorithms in the face of uncertain, inaccurate and/or biased data. The targets are (i) to understand the interplay between imperfections of the data and imperfections of the computation in order to tune one within the boundaries allowed by the other; (ii) to design methodologies and algorithms to ensure robust decision-making, in particular by ensuring qualitative properties such as uncertainty, reproducibility, and explainability.

Description
T1.1 (Lead: ICCS. Partners: AU, VAIX) Address the challenging aspects of data uncertainty and data churn in view of a content-centric data analytics approach. Design and implement methods and tools that model, maintain in real time and robustly fuse multiple data inputs that change in different aspects and/or contain varying degrees of uncertainty.   T1.2 (Lead: TCD. Partners: QUB, UBO) Numeric accuracy, reproducibility and robustness in deep learning, where different hardware and software combinations yield slightly different numerical results; techniques to make trained models less "spiky" and improve reproducibility across targets.   T1.3 (Lead: AU. Partners: QUB, DMJX) Provide explanations, transparency and verification approaches for data-intensive systems involving artificial intelligence techniques; support interpretability beyond single components; develop concepts, algorithmic solutions, prototype implementations and empirical evaluations.

Work package WP2 – Indexing and Summarisation

Work Package Number	WP2	Lead Beneficiary	2. ICCS
Work Package Name	Indexing and Summarisation		
Start Month	7	End Month	48

Objectives
To develop new algorithms for indexing and summarisation building upon the data attributes explored in WP1. The targets are (i) to develop algorithms and indexing structures that explore application-tailored trade-offs between accuracy, speed and performance; (ii) to investigate algorithms for compression, summarisation and approximation based on controlling the precision and quality of data.

Description
T2.1 (Lead: QUB. Partners: CTH, IBM) Study fusion of heterogeneous data streams for applications in urban mobility; develop algorithms and indexing mechanisms to enable fast and efficient algorithms to support real-time urban mobility applications. This will be led by QUB with support from CTH on streaming data algorithms.   T2.2 (Lead: CTH. Partners: ICCS, VOL) Study adaptive semantic relaxation of concurrent data-structures in both (coarse-grained) batch and fine-grained streaming scenarios of large data processing and analytics and concurrent data summarization, to regulate accuracy/speed/performance trade-offs.   T2.3 (Lead: ICCS. Partners: TCD, MDBS) Study the problem of modelling and predicting analytics performance based on different data input attributes. Develop novel performance models for arbitrary series of analytics operators (workflows) that may require multiple input parameters and utilize data which reside in different physical locations.

Work package WP3 – Computation and Coordination

Work Package Number	WP3	Lead Beneficiary	1. CTH

Work Package Name	Computation and Coordination	
Start Month	7	**End Month** 48

Objectives
To develop new algorithms and new coordination and synchronisation models to support asynchronous and incremental AI and ML and large data processing for better performance, better freshness and without loss of accuracy, when compared to contemporary barrier-based synchronous approaches that suffer from scalability.

Description
T3.1 (Lead: QUB. Partners: ICCS, Ryax) Investigate intelligent and interactive data exploration techniques to cope with very large and complex dynamic data such as graphs, trajectories or texts using modern hardware architectures. T3.2 (Lead: QUB. Partners: CTH, AE) Develop relaxed coordination models for batch-oriented graph processing by leveraging monotonicity and related semantics of graph analytics problems. T3.3 (Lead: CTH. Partners: QUB, VOL) Investigate process coordination models/algorithms to trade staleness of state for gaining performance without losing accuracy in deep learning and iterative large data processing algorithms. T3.4 (Lead: TCD. Partners: QUB, UBO) Arithmetic and number systems for deep neural network training, with the goal of developing numeric types that better match value distributions and incremental changes in training; adjusting the accuracy to the level of the memory hierarchy; lower precision and incremental data transfer.

Work package WP4 – Training and Personal Development

Work Package Number	WP4	Lead Beneficiary	2. ICCS
Work Package Name	Training and Personal Development		
Start Month	7	**End Month**	48

Objectives
To develop and organize a bespoke network-wide joint training programme

Description
T4.1: Monitoring institutional training programmes; identifying shared provision opportunities and further training needs (Lead) T4.2: Development of joint transferable skills training programme (Lead) T4.3: Development of joint technical skills training programme (Lead) T4.4: Organisation of joint Training Days (Lead) T4.5: Collecting and archiving training material (Lead)

Work package WP5 – Dissemination, Communication, Expoitation

Work Package Number	WP5	Lead Beneficiary	1. CTH
Work Package Name	Dissemination, Communication, Expoitation		
Start Month	1	**End Month**	48

Objectives
To develop and implement the communication strategy, including social media and web presence, traditional media announcements, identifying and taking part in outreach activities, exploitation of results, managing open source software and open data.

Description
T5.1 Ensuring communication, outreach and dissemination are embedded in Personal Development Plans (Lead) T5.2 Communication through social media and web presence (Lead with DC(s)) T5.3 Outreach activities: identifying opportunities, planning, training, delivering (Lead with supervisors and DCs) T5.4 IPR management: assisting partners in IPR identification and assisting negotiation of secondment agreements (Lead) T5.5 Dissemination: planning and organization of joint dissemination activities, including tutorials at mainstream scientific venues (Lead with all beneficiaries and partners)

Work package WP6 – Management

Work Package Number	WP6	Lead Beneficiary	1. CTH
Work Package Name	Management		
Start Month	1	End Month	48

Objectives
CUT Is the project Coordinator responsible for the project management responsibilities that cannot be delegated to other Beneficiaries or external organisations. Project decision making will be conducted by the Supervisory Board. Project coordination and reporting; ensuring compliance with Grant Agreement and Consortium Agreement; quality control of the implementation, research and training programme; convening of Supervisory Board, Network Management Committee and Network Assembly meetings; communication with PO; promoting gender equality within project.

Description
T6.1 Project start up, including agreeing contractual responsibilities of all partners and financial arrangements; Consortium Agreement, Data Management Plan, and ethics approval (Lead) T6.2 Establish and monitor management structures and associated terms of reference for sub-committees and board (Lead) T6.3 Coordinating recruitment process, checking eligibility of applicants, checking recruitment process against standards (Lead) T6.4 Convening, presiding and minute taking for meetings of the Supervisory Board, Network Management Committee (Lead) T6.5 Quality control of the research, training and secondment programmes (Lead) T6.6 Review of Risk Register and contingency planning (Lead)

Work package WP7 – Ethics requirements

Work Package Number	WP7	Lead Beneficiary	1. CTH
Work Package Name	Ethics requirements		
Start Month	1	End Month	48

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

Description
This work package sets out the 'ethics requirements' that the project must comply with.

STAFF EFFORT

Staff effort per participant								
Grant Preparation (Work packages - Effort screen) — Enter the info.								
Participant	**WP1**	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**	**WP7**	**Total Person-Months**
1 - CTH	36.00	36.00	36.00	2.00	2.00	14.00		126.00
2 - ICCS	36.00	36.00	36.00	2.00	2.00			112.00
3 - TCD	36.00	36.00	36.00	2.00	2.00			112.00
4 - AU	36.00	36.00	36.00	2.00	2.00			112.00
Total Person-Months	144.00	144.00	144.00	8.00	8.00	14.00	0.00	462.00

LIST OF DELIVERABLES

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

Public — fully open (⚠ automatically posted online)

Sensitive — limited under the conditions of the Grant Agreement

EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	WP1 Initial Report on Qualitative Aspects of Data Analytics	WP1	3 - TCD	R — Document, report	SEN - Sensitive	13
D1.2	WP1 Preliminary Result on Relaxed Semantics and Qualitative Aspects of Data Analytics	WP1	3 - TCD	R — Document, report	SEN - Sensitive	24
D1.3	WP1 Final Report on Achieving Qualitative Aspects of Data Analytics through Relaxed Semantics	WP1	3 - TCD	R — Document, report	SEN - Sensitive	48
D2.1	WP2 Initial Report on Indexing and Summarisation	WP2	2 - ICCS	R — Document, report	SEN - Sensitive	13
D2.2	WP2 Preliminary Results on Indexing and Summarisation	WP2	2 - ICCS	R — Document, report	SEN - Sensitive	24
D2.3	WP2 Final Report on Indexing and Summarisation Algorithms with Relaxed Semantics	WP2	2 - ICCS	R — Document, report	SEN - Sensitive	48
D3.1	WP3 Initial Report on Relaxed Semantics in Computation and Coordination	WP3	1 - CTH	R — Document, report	SEN - Sensitive	13
D3.2	WP3 Preliminary Results on Computation and Coordination	WP3	1 - CTH	R — Document, report	SEN - Sensitive	24

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

   Public — fully open (⚠ automatically posted online)

   Sensitive — limited under the conditions of the Grant Agreement

   EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D3.3	WP3 Final Report on Relaxed Semantics in Computation and Coordination	WP3	1 - CTH	R — Document, report	SEN - Sensitive	48
D4.1	Personal Development Plans	WP4	2 - ICCS	R — Document, report	SEN - Sensitive	13
D4.2	All DCs: Conference attendance report	WP4	2 - ICCS	R — Document, report	SEN - Sensitive	24
D4.3	All DCs: Secondment report	WP4	2 - ICCS	R — Document, report	SEN - Sensitive	40
D5.1	Web page	WP5	1 - CTH	DEC —Websites, patent filings, videos, etc	PU - Public	2
D5.2	Plan for the dissemination and exploitation of results, including communication activities	WP5	1 - CTH	R — Document, report	SEN - Sensitive	13
D5.3	Intermediate list of dissemination and exploitation of results, including communication activities (1)	WP5	3 - TCD	R — Document, report	PU - Public	24
D5.4	Intermediate list of dissemination and exploitation of results, including communication activities (2)	WP5	3 - TCD	R — Document, report	PU - Public	36
D5.5	Plan for the dissemination and exploitation of results, including communication activities (updated)	WP5	3 - TCD	R — Document, report	SEN - Sensitive	48
D6.1	Supervisory board of the network	WP6	1 - CTH	OTHER	SEN - Sensitive	2

Deliverables

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Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D6.2	Data Management Plan	WP6	1 - CTH	DMP — Data Management Plan	SEN - Sensitive	13
D6.3	Risk Management Plan and Initial Risk Register	WP6	1 - CTH	R — Document, report	SEN - Sensitive	10
D6.4	Recruitment report	WP6	1 - CTH	R — Document, report	SEN - Sensitive	12
D6.5	Progress report	WP6	1 - CTH	R — Document, report	SEN - Sensitive	13
D7.1	OEI - Requirement No. 1	WP7	1 - CTH	ETHICS	SEN - Sensitive	6
D7.2	OEI - Requirement No. 2	WP7	1 - CTH	ETHICS	SEN - Sensitive	24
D7.3	OEI - Requirement No. 3	WP7	1 - CTH	ETHICS	SEN - Sensitive	48

Deliverable – WP1 Initial Report on Qualitative Aspects of Data Analytics

Deliverable Number	D1.1	Lead Beneficiary	3. TCD
Deliverable Name	WP1 Initial Report on Qualitative Aspects of Data Analytics		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP1

Description
Literature survey and overview of the current state of the art relating to the research challenges addressed in WP1 in particular: challenges of big data management relating to data uncertainty, volatility, velocity, and churn of data; data quality, transparency, and verification of artificial intelligence applications; numeric analysis and deep learning software library reliability and portability. Elaboration of research objectives and methodology. Initial PhD project work plans.

Deliverable – WP1 Preliminary Result on Relaxed Semantics and Qualitative Aspects of Data Analytics

Deliverable Number	D1.2	Lead Beneficiary	3. TCD
Deliverable Name	WP1 Preliminary Result on Relaxed Semantics and Qualitative Aspects of Data Analytics		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP1

Description
Progress report of achievements across the ESR projects in WP1. At this stage the ESRs associated to WP1 will have made important decisions on the data analysis techniques that they will use to model and interpret uncertain, inaccurate or biased data. The ESRs will present initial result that demonstrate the effectiveness of numerical and statistical techniques to model and explain the effects of data and computation imperfections. The report will also present an outline of plans for further study and the potential of this further work for data-intensive analysis applications.

Deliverable – WP1 Final Report on Achieving Qualitative Aspects of Data Analytics through Relaxed Semantics

Deliverable Number	D1.3	Lead Beneficiary	3. TCD
Deliverable Name	WP1 Final Report on Achieving Qualitative Aspects of Data Analytics through Relaxed Semantics		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	48	Work Package No	WP1

Description
The report will document the design, theoretical validation and experimental evaluation of techniques and their practical implementation for realising qualitative aspects of data analytics: data uncertainty, churn, numerical accuracy and stability and explainability. These techniques will enable data analysts to have better control over the quality of data analytics, which can be measured through performance and efficiency metrics specific to the data quality aspect. The report will provide an in-depth understanding of the properties of the proposed methods. Experimental demonstrators will be developed and described in the report.

Deliverable – WP2 Initial Report on Indexing and Summarisation

Deliverable Number	D2.1	Lead Beneficiary	2. ICCS
Deliverable Name	WP2 Initial Report on Indexing and Summarisation		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP2

Description
Literature survey and overview of the current state of the art relating to the research challenges addressed in WP2 in particular: strategies for indexing and summarisation for streaming data; techniques for relaxation of semantics (e.g., accuracy, consistency) in indexing and summarisation; and techniques for multi-modal data sets and fusion of analytics operators in workflows. Elaboration of research objectives and methodology. Initial PhD project work plans.

Deliverable – WP2 Preliminary Results on Indexing and Summarisation

Deliverable Number	D2.2	Lead Beneficiary	2. ICCS
Deliverable Name	WP2 Preliminary Results on Indexing and Summarisation		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP2

Description
Progress report on the identification of new and emerging scenarios in urban mobility, and the development of efficient and effective algorithms towards addressing 1-2 handpicked scenarios. This report would convey details on key decisions made on the kind of algorithmic building blocks that would be leveraged towards addressing the scenarios in urban mobility, the key evaluation metrics to be optimised for, decisions on how to respect and assimilate soft and hard domain constraints within the algorithms, and the choice of programming language, data and computation platforms that would be leveraged. An initial experimental evaluation would be expected to be completed by this stage, along with a quantitative and qualitative comparison against state of the art algorithms.

Deliverable – WP2 Final Report on Indexing and Summarisation Algorithms with Relaxed Semantics

Deliverable Number	D2.3	Lead Beneficiary	2. ICCS
Deliverable Name	WP2 Final Report on Indexing and Summarisation Algorithms with Relaxed Semantics		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	48	Work Package No	WP2

Description
The report will document the design, theoretical validation and experimental evaluation of novel indexing and summarisation techniques based on relaxation of semantics. Such algorithms will be designed and evaluated for data streaming applications around urban mobility, concurrent streaming analytics, and analytics workflow management. The accuracy and speed of these algorithms will be tunable by varying the degree of relaxation of semantics, resulting in improved performance compared to the state of the art. The report will provide an in-depth understanding of the properties of the proposed methods. Experimental demonstrators will be developed and described in the report.

Deliverable – WP3 Initial Report on Relaxed Semantics in Computation and Coordination

Deliverable Number	D3.1	Lead Beneficiary	1. CTH
Deliverable Name	WP3 Initial Report on Relaxed Semantics in Computation and Coordination		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP3

Description
Literature survey and overview of the current state of the art relating to the research challenges addressed in WP3 in particular: applications of high-performance computing and data mining for big, dynamic and complex data and machine learning, with a focus on anytime approximation algorithms; semantics, consistency and asynchrony for applications in graph analytics and deep learning. Elaboration of research objectives and methodology. Initial PhD project work plans.

Deliverable – WP3 Preliminary Results on Computation and Coordination

Deliverable Number	D3.2	Lead Beneficiary	1. CTH
Deliverable Name	WP3 Preliminary Results on Computation and Coordination		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP3

Description
progress report of achievements across the ESR projects in WP3. At this stage, the ESRs will have made important decisions on key designs, evaluation frameworks, scope of work to focus on, and the most promising approaches that will be consider at the second part of the project. Some initial experimental results are expected also to be reported by the ESRs together with some preliminary novel algorithms and models demonstrating the effectiveness of techniques that trade communication or memory access via relaxation for scaling computations.

Deliverable – WP3 Final Report on Relaxed Semantics in Computation and Coordination

Deliverable Number	D3.3	Lead Beneficiary	1. CTH
Deliverable Name	WP3 Final Report on Relaxed Semantics in Computation and Coordination		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	48	Work Package No	WP3

Description
The report will document the design, theoretical validation and experimental evaluation of scalable data analytics systems. It will describe novel algorithms in clustering, asynchronous graph analytics, deep learning and iterative data processing where adherence to semantics is a tuneable parameter, enabling cost-effective and scalable analytics systems. The report will provide an in-depth understanding of the properties of the proposed methods. Experimental demonstrators will be developed and described in the report.

Deliverable – Personal Development Plans

Deliverable Number	D4.1	Lead Beneficiary	2. ICCS
Deliverable Name	Personal Development Plans		

Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP4

Description
Also known as "Career Development Plans". Document describing how the individual Personal Development Plans have been established (listing also the researchers for whom such plans have been put in place). To be submitted before the mid-term meeting.

Deliverable – All DCs: Conference attendance report

Deliverable Number	D4.2	Lead Beneficiary	2. ICCS
Deliverable Name	All DCs: Conference attendance report		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP4

Description
All DCs: Conference attendance report

Deliverable – All DCs: Secondment report

Deliverable Number	D4.3	Lead Beneficiary	2. ICCS
Deliverable Name	All DCs: Secondment report		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	40	Work Package No	WP4

Description
All DCs: Secondment report

Deliverable – Web page

Deliverable Number	D5.1	Lead Beneficiary	1. CTH
Deliverable Name	Web page		
Type	DEC —Websites, patent filings, videos, etc	Dissemination Level	PU - Public
Due Date (month)	2	Work Package No	WP5

Description
Web and Social Media Presence

Deliverable – Plan for the dissemination and exploitation of results, including communication activities

Deliverable Number	D5.2	Lead Beneficiary	1. CTH
Deliverable Name	Plan for the dissemination and exploitation of results, including communication activities		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP5

Description
Communication, Dissemination and Exploitation (C/D/E) Plan Plan for the dissemination and exploitation of results, including communication activities, submitted at mid- term (M13) and an update towards the end of the project (M48). This plan should be periodically updated, and an updated version is required by M48. More information on how to prepare this deliverable can be found online at https://rea.ec.europa.eu/horizon-europe- dissemination-and-exploitation_en and in the Horizon Europe Programme Guide

Deliverable – Intermediate list of dissemination and exploitation of results, including communication activities (1)

Deliverable Number	D5.3	Lead Beneficiary	3. TCD
Deliverable Name	Intermediate list of dissemination and exploitation of results, including communication activities (1)		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	24	Work Package No	WP5

Description
Intermediate list of C/D/E activities (1)

Deliverable – Intermediate list of dissemination and exploitation of results, including communication activities (2)

Deliverable Number	D5.4	Lead Beneficiary	3. TCD
Deliverable Name	Intermediate list of dissemination and exploitation of results, including communication activities (2)		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	36	Work Package No	WP5

Description
Intermediate list of C/D/E activities (2)

Deliverable – Plan for the dissemination and exploitation of results, including communication activities (updated)

Deliverable Number	D5.5	Lead Beneficiary	3. TCD

Deliverable Name	Plan for the dissemination and exploitation of results, including communication activities (updated)		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	48	Work Package No	WP5

Description
Plan for the dissemination and exploitation of results, including communication activities, submitted at mid- term (M13) and an update towards the end of the project (M48). This plan should be periodically updated, and an updated version is required by M48. More information on how to prepare this deliverable can be found online at https://rea.ec.europa.eu/ horizon-europe- dissemination-and-exploitation_en and in the Horizon Europe Programme Guide

Deliverable – Supervisory board of the network

Deliverable Number	D6.1	Lead Beneficiary	1. CTH
Deliverable Name	Supervisory board of the network		
Type	OTHER	Dissemination Level	SEN - Sensitive
Due Date (month)	2	Work Package No	WP6

Description
Document establishing the supervisory board and defining the way of working

Deliverable – Data Management Plan

Deliverable Number	D6.2	Lead Beneficiary	1. CTH
Deliverable Name	Data Management Plan		
Type	DMP — Data Management Plan	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP6

Description
Data Management Plan submitted to the REA

Deliverable – Risk Management Plan and Initial Risk Register

Deliverable Number	D6.3	Lead Beneficiary	1. CTH
Deliverable Name	Risk Management Plan and Initial Risk Register		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	10	Work Package No	WP6

Description
Risk Management Plan and Initial Risk Register

Deliverable – Recruitment report

Deliverable Number	D6.4	Lead Beneficiary	1. CTH
Deliverable Name	Recruitment report		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	12	Work Package No	WP6

Description
Report about the recruitment process, including statistics about applications received, eligibility check .

Deliverable – Progress report

Deliverable Number	D6.5	Lead Beneficiary	1. CTH
Deliverable Name	Progress report		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	13	Work Package No	WP6

Description
progress report due M13

Deliverable – OEI - Requirement No. 1

Deliverable Number	D7.1	Lead Beneficiary	1. CTH
Deliverable Name	OEI - Requirement No. 1		
Type	ETHICS	Dissemination Level	SEN - Sensitive
Due Date (month)	6	Work Package No	WP7

Description
The project requires an Ethics Advisor to be appointed by M6 to make sure that ethics rules and guidelines will be adhered to. While the self-assessment did not recognize any ethics issues, it seems apparent that the project will involve processing of personal data (image processing, speech recognition, audio and video processing).
The ethics advisor must be consulted at least on the following points: a) The processing of personal data: protection of privacy (human speech, images/videos of persons), the principle of data minimization.   b) The project involves the design of algorithms for grouping or structuring data for efficient retrieval. Although the proposal describes "Transparent Data Management and Verification" no sufficient details are provided on how to avoid algorithmic biases or discrimination (ethics by design).

Deliverable – OEI - Requirement No. 2

Deliverable Number	D7.2	Lead Beneficiary	1. CTH
Deliverable Name	OEI - Requirement No. 2		
Type	ETHICS	Dissemination Level	SEN - Sensitive

Due Date (month)	24	Work Package No	WP7

Description
First report of the ethics advisor. Topics to be covered: a) The processing of personal data: protection of privacy (human speech, images/videos of persons), the principle of data minimization. b) The project involves the design of algorithms for grouping or structuring data for efficient retrieval. Although the proposal describes "Transparent Data Management and Verification" no sufficient details are provided on how to avoid algorithmic biases or discrimination (ethics by design).

Deliverable – OEI - Requirement No. 3

Deliverable Number	D7.3	Lead Beneficiary	1. CTH
Deliverable Name	OEI - Requirement No. 3		
Type	ETHICS	Dissemination Level	SEN - Sensitive
Due Date (month)	48	Work Package No	WP7

Description
Second report of the ethics advisor. Topics to be covered: a) The processing of personal data: protection of privacy (human speech, images/videos of persons), the principle of data minimization. b) The project involves the design of algorithms for grouping or structuring data for efficient retrieval. Although the proposal describes "Transparent Data Management and Verification" no sufficient details are provided on how to avoid algorithmic biases or discrimination (ethics by design).

LIST OF MILESTONES

Milestones

Grant Preparation (Milestones screen) — Enter the info.

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
1	Project kick-off	WP6	1-CTH	Governance structures constituted; terms of reference agreed	1
2	Recruitment complete	WP5, WP7, WP3, WP6, WP1, WP2, WP4	1-CTH	All DCs are employed at their host organisations	12
3	Mid-Term meeting	WP5, WP7, WP3, WP6, WP1, WP2, WP4	1-CTH	Mid-Term meeting held in conjunction with Training Days 2	15
4	Demonstrable impact of relaxed semantics on data quality and approximation	WP1	3-TCD	Initial results show that relaxation can be applied to summarise, approximate and/or compress streaming data better	20
5	Delivery of first scientific results, outreach and dissemination	WP5, WP3, WP1, WP2	3-TCD	Initial publications submitted, first dissemination and outreach activities completed	24
6	Delivery of training programme	WP4	2-ICCS	Training days organised, secondments accomplished	40
7	Successful completion of research projects	WP3, WP1, WP2	1-CTH	Public closing event held, PhD thesis drafts complete	48
8	Training of DCs successfully completed	WP4	2-ICCS	PDPs executed, secondments completed	48
9	Consortium Agreement	WP6	1-CTH	Signatures collected from all HEs	2
10	All recruited Fellows enrolled in PhD programme	WP6	1-CTH	Proof of enrolment for each Fellow	12
11	Vacancies advertised	WP6	1-CTH	Copy of advertisements available	2
12	Closing event	WP5	1-CTH	Participant list, agenda, presentations available	48

LIST OF CRITICAL RISKS

Critical risks & risk management strategy			
Grant Preparation (Critical Risks screen) — Enter the info.			

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
1	Delay in recruitment	WP6	(i) The consortium plans to hire the majority of DCs by M7 This leaves adequate time to re-advertise any positions that may remain vacant, or to redistribute vacant positions between partners. (ii) An active promotion of open positions. (iii) The streamlined recruitment procedure with a reserve list of candidates, in case main candidates drop out . (iv) The use of teleconference for the interviews of candidates from remote areas, or where local health regulations restrict travel.
2	DC cancelling appointment / resignation	WP6	The coordinator will maintain a short list of candidates that have not been recruited, to replace DCs. The coordinator will offer the vacant position to the candidates on the reserve list
3	Supervisor leaves organisation	WP6	Identify replacement supervisor at organisation. If no replacement supervisor can be found at this organisation, a transfer of the student to another beneficiary will be considered.
4	Poor quality secondment	WP4	(i) The PMC will collect ESR and partner feedback and check if the agreements in the PDP and Partner Agreement have been upheld; (ii) the ESR's PDP will be revisited to meet the goals through different means; (iii) potential implications on other secondments at the same organisation will be assessed and mitigating actions undertaken.
5	ESR does not qualify for PhD within 36 months	WP4	Supervisors search for follow-up funding before end of contract. Some beneficiaries run a 4-year PhD programme and have already actions in place.
6	Delay in procuring large relevant data sets	WP3, WP1, WP2	(i) ESRs will use the same and share data sets where relevant to minimise effort collecting, cleaning and preprocessing data sets; (ii) The PMC will set up agreements with industrial partners to access relevant data sets; (iii) ESRs will procure large historical datasets from public sources.
7	Rapid changes in technology landscape	WP3, WP1, WP2	Consortium members and ESRs, both individually and collectively, will closely follow technology developments and will adapt their research goals accordingly, if need arises. External industry and research leaders will be invited for presentations to Network events

Critical risks & risk management strategy

Grant Preparation (Critical Risks screen) — Enter the info.

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
			and Advisory Board members will be asked to provide feedback on the timeliness of RELAX research activities.
8	ESR propositions too ambitious to yield the expected results	WP3, WP1, WP2	The project will make careful steps towards the realization of ESR objectives. If need be, the SC will re-adjust the technical objectives, and the CDEC the dissemination, communication and exploitation objectives, so that they can be achievable within the project time frame and still yield the anticipated results. Redistribution of tasks among ESRs may be considered to reach the overall objectives.
9	No adequate resources (be they computational or organisational) available to ESRs	WP5, WP7, WP3, WP6, WP1, WP2, WP4	(i) Beneficiaries have assured that they will allocate the appropriate personnel to carry out and implement all agreed activities, and will make binding agreements on the availability of these resources; (ii) Beneficiaries already maintain sufficient computational (in-premise or otherwise) infrastructure that successfully supports multiple scholars and students; (ii) Consortium members and ESRs closely monitor and report on temporary lack of resources, handled either within the organisation or with help of partner resources. The same applies for personnel resources.
10	Loss of focus, inadequate quality of outcome	WP5, WP3, WP6, WP1, WP2, WP4	Intensified guidance by rest of consortium and scientific coordinator, research visit to functioning beneficiary, intensified collaboration.
11	Failure to reach milestone	WP5, WP7, WP3, WP6, WP1, WP2, WP4	A sign of major problems with quality or progress of the project, which should be avoided by the management structure of the project.
12	Visa issues related to recruitment	WP6	Liaise with Border Agency; if needed seek NCP advice and/or contact REA for support letters
13	Visa issues related to secondments	WP6, WP4	Liaise with Border Agency, reschedule secondments; if needed seek NCP advice and/or contact REA for support letters

Horizon Europe (HORIZON)
Marie Skłodowska-Curie Actions
Doctoral Networks (MSCA-DN)

ANNEX 1

Description of the action (DoA)
Part B

101072456 – RELAX

HORIZON – MSCA – 2021 – DN

Relaxed Semantics Across the Data Analytics Stack

History of changes	Section	Page	Description of change
1	List of participating organisations	5	QUB removed as beneficiary, added as associated partner due to delays in UK association to Horizon Europe. CTH takes over coordination of the project from QUB AP IBM India replaced with B-secur and Forschungszentrum Jülich added as AP.
2	Table 1.1a 1.3 a	9, 16 and throughout the text	ESR replaced by DC, numbering adapted according to appearance in the Portal End month for WP1,2,3 changed to M48
3	Data sources	12	Clarification about data sources added
4	1.2.5 Research data management		Some text deleted to adjust to routines at the new coordinator
6	Table 1.3.c	18	Training on AI, Machine Learning: IBM replaced by BSEC "Ethics" added to training on Academic Integrity/Plagiarism
7	Table 1.4.a	20	V. Gulisano added as supervisor for DC 3 at CTH
8	2.3.1	22,23	Clarifications on role of supervisors in dissemination/ communication activities added
9	2.3.2	24	Some changes made due to change of coordinator. Details will be specified in the Consortium Agreement instead.
10	3.1.1.		WP description, list of Deliverables and Milestones deleted
11	3.1.4, Individual Research projects	30-32	Order of DCs changed with UK DCs numbered 9,10,11 at the end. DC3 added for CTH, DC9 added for AU Deliverable numbering adapted according to Portal.
12	3.2	33-34	Changes made in management structure to adapt to new coordinator. Details on voting removed, will be included in CA instead
13	3.2.3	35	Minor adjustments made to recruiting strategy to make it more easy to monitor.
14	3.2.4	35	Clarifications on progress monitoring added
15	Table 3.2.a	36	Implementation risks deleted
16	3.2.7	37	Changes made on gender aspects
17	Table 3.4.a	38	Expertise of partner BSEC added (IBM removed)

18	4. Ethics issues	39	Description of the handling of ethics issues added.
19	Table 3.4.a	29	Table 3.4 a has been updated (FZJ
20	DC 3 and 9, contribution description	5, 7, 8	Added description

TABLE OF CONTENTS

LIST OF PARTICIPATING ORGANISATIONS

Consortium Member	Legal Entity Short Name	Academic (tick)	Non-academic (tick)	Awards Doctoral Degrees (tick)	Country	Dept./ Division / Laboratory	Scientist- in-Charge	Role of Partner Organisation
Beneficiaries								
Chalmers University of Technology	CTH	X		X	Sweden	Networks and Systems Division, Computer Science and Engineering Department	Prof Philippas Tsigas	
The Institute of Communication and Computer Systems (ICCS)	ICCS	X		X	Greece	Computing Systems Lab, School of Electrical and Computer Engineering (ECE), National Technical University of Athens (NTUA)	Prof Dimitris Tsoumakos	
The Provost, Fellows, Foundation Scholars and the other members of Board, of the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin	TCD	X		X	Ireland	School of Computer Science and Statistics	Prof David Gregg	
Aarhus University	AU	X		X	Denmark	Department of Computer Science	Prof. Ira Assent	
Associated Partners								
Volvo AB	VOL		X		Sweden		Dr Giorgos Georgiadis	Secondment, mentoring, training
Ryax Technologies	RYAX		X		France		Dr Yiannis Georgiou	Secondment, mentoring, training
MonetDB Solutions B.V.	MDBS		X		The Netherlands		Dr Ying Zhang	Secondment, mentoring, training
VAIX	VAIX		X		United Kingdom and Greece		Dr Konstantinos Bitsakos	Secondment, mentoring, training

Ubotica Technologies Limited	UBO		X		Ireland		Dr Fintan Buckley	Secondment, mentoring, training
Analytics Engines	AE		X		United Kingdom		Prof Roger Woods	Secondment, mentoring, training
Danish School of Media and Journalism	DMJX	X			Denmark		Prof Helle Kryger Aggerholm	Secondment, mentoring, training
Queen's University Belfast	QUB	X		X	United Kingdom	School of Electronics, Electrical Engineering and Computer Science	Prof Hans Vandierendonck	Contribution to all project activities,
B-secur	BSEC		X		UK		Dr Adrian Conlon	Secondment, mentoring, training
Forschungs-zentrum Jülich	FZJ	X			Germany		Prof dr Astrid Lambrecht	Secondment, mentoring, training

Declarations

Name (institution / individual)	Nature of inter-relationship
Analytics Engines / Prof Roger Woods	Prof Woods is Chief Scientist of AnalyticsEngines and academic staff member at QUB. He is involved in RELAX only through AnalyticsEngines.

1. Excellence

The RELAX European Doctoral Network aims to train a cohort of highly mobile and adaptable researchers to become experts in the design of scalable and efficient data-intensive software systems. These experts will master the specific skill of navigating the semantics or correctness conditions of applications, with the goal of enhancing scalability, response times, and availability. Working across the disciplinary specialisms of data science, data management, distributed computing and computing systems, the Fellows will develop knowledge of the broad issues underpinning data analytics systems. The bespoke training programme fosters intellectual enquiry and combines technical and scientific research training with courses in innovation, management and leadership. The training network addresses a critical skills gap in data analytics expertise, which needs urgently addressed to support innovation and employment in a fast-growing European data economy. The 10 partner organisations representing 7 countries will benefit first-hand through intersectoral collaboration and an Open Innovation model.

1.1 Quality and pertinence of the project's research and innovation objectives

1.1.1 Introduction

Many companies, across all industry sectors, are increasingly becoming data companies as they collect, curate, and analyse massive amounts of data to increase productivity and cost-effectiveness, or to develop new data-driven products and services. Similarly, governments and administrations world-wide are increasingly reliant upon data science, for instance, in response to the Covid-19 pandemic, as rates of infection and vaccination were tabulated and publicly shared. Modelling of complex processes underpins the estimation of process parameters such as the replication factor. Similarly, data science has a critical role to play in addressing the climate crisis.[1]

Within each problem domain, there is an unmistakable trend that the volume of data increases over time, data is produced at an increasingly higher rate and data types become more complex as experience in modelling grows. Consequently, the amount of data stored in data centres world-wide is **growing exponentially** and is predicted to reach 175 zeta bytes in 2025.[2] Meanwhile, the energy consumed by data centres is increasing and predicted to consume 3% of global electricity consumption by 2030,[3] and data supply through Internet-of-Things consumer devices and communication networks will consume 8% by 2030.[4] For instance, in Ireland, growing the data centre footprint is a strategy to attract high-tech companies that drive economic growth, however, it poses significant environmental challenges as data centres and other large users will consume 29% of Ireland's electricity by 2028.[5]

Clearly, the **efficiency** of data analytics is increasingly important. On the one hand, efficiency of analytics is required **to scale analytics to increasingly larger and more complex data sets** while maintaining low response times. On the other hand, better efficiency is required **to maintain, or ideally reduce, the computational requirements of analytics**, which is challenging in the face of exponentially growing data volumes.

Data analytics, however, operate in a complex software ecosystem combining a multitude of components to handle computation, storage, resource management, etc. Efficiency cannot be isolated in a single component, nor can it be delivered as a service. On the contrary, **efficiency must permeate the system design**. By consequence, data analytics systems need to be built as bespoke software systems that are optimised on the basis of a thorough understanding of the full software stack. This requires developing an understanding of the domains where these systems would be used and embedding such understandings within the design of the software systems developed. In this context, it is notable that current designs are reaching the limits of their scalability. Scaling data analytics to larger and more complex data sets will require a fundamentally new approach.

The RELAX Doctoral Network brings together 5 cross-disciplinary research groups and 7 industry partners

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[1] Rolnick et al. "Tackling Climate Change with Machine Learning." arXiv:1906.05433, Nov 2019.

[2] Reinsel, D., J. Gantz, and J. Rydning. "The digitization of the world: From edge to core (IDC White Paper# US44413318)." (2018).

[3] Andrae, A., and T. Edler. "On global electricity usage of communication technology: trends to 2030." *Challenges* 6, no. 1 (2015): 117-157.

[4] Jones, N.. "How to stop data centres from gobbling up the world's electricity." *Nature* 561, no. 7722 (2018): 163-167.

[5] https://www.theguardian.com/environment/2020/jan/06/why-irish-data-centre-boom-complicating-climate-efforts

to train a new generation of **industry-conscious thinkers and leaders** who will influence the design and operation of future data analytics systems. The strength and unique identifying characteristic of the RELAX Fellows will be their **balanced understanding of cross-disciplinary challenges and methodologies** in the context of data analytics, which will ultimately enable them to design more efficient, more scalable, more usable, resilient, and more valuable data analytics systems. This will address industry needs for scaling up analytics to ever larger data set sizes which underpins economic growth and paves the way for environmentally sustainable analytics.

1.1.2 Objectives

Our hypothesis is that **relaxing the semantics** of data analytics is a **promising and ground-breaking approach** that can enhance the capabilities of data analytics systems, both functionally and performance-wise. Semantics describe with mathematical rigor the correct operation of a software component or service. Relaxed semantics contain deliberate and controlled deviations of the operation, which can increase efficiency by performing less computation, by analysing less data, or by reducing idle time in coordination and synchronisation. This way, we can achieve higher efficiency for existing problem instances, and solve problems that are out of reach of current analytics systems. Critically, RELAX investigates methods to relax semantics of data analytics that maintain accuracy and utility of the analytics. The RELAX project aims to **develop and apply these principles coherently and consistently across the system stack**, not limited to data science and statistics, but to make relaxation of semantics an **inherent aspect of the analytics software design**. We will create a **software toolkit** consisting of algorithms and data structures that are designed by these principles. We will demonstrate the efficacy of the RELAX toolkit on carefully selected exemplar applications in deep learning, streaming analytics, and data retrieval.

The specific objectives are structured around three thrusts:

O1. **Qualitative aspects of analytics:** Data is inherently incomplete and noisy, which poses challenges for designing robust methods to process, reproduce and explain computations based on such data. The RELAX project aims to design algorithms that are robust to noisy data and explore opportunities for approximating established algorithms for scalability, while respecting reproducibility and explainability, which can be viewed as two sides of the same coin.

O2. **Indexing and summarisation:** The cornerstone of data analytics is the ability to group or structure data for efficient retrieval. The abundance of data and the statistical properties that unify large swathes of data enable selective use, modelling and prediction of data. This project aims to develop novel approaches to data-aware indexing and summarisation that leverages relaxed semantics to reduce data movement and computation.

O3. **Computation and coordination:** Computation is designed to be exact, while coordination and synchronisation of distributed computing resources are designed to delay computation until up-to-date data is available. The RELAX project will investigate relaxation of semantics in computation and coordination to enable scalability of analytics to larger data sets as well as larger system sizes.
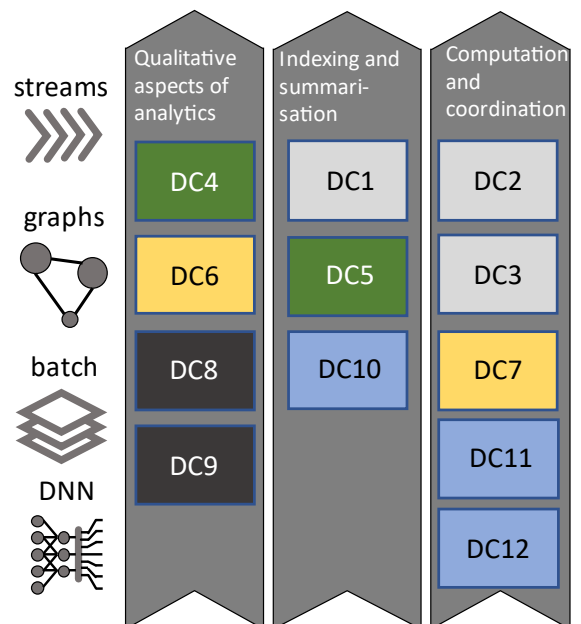
Figure 1.1a: Overview of the RELAX research programme, organized around three thrusts. ESR projects are numbered and colour-coded by beneficiary.

1.1.3 Overview of the Research Programme

The purpose of RELAX is to make a step-change advance in the efficiency and scalability of data analytics systems by operating under relaxed semantics. Achieving this goal requires a thorough understanding of the interplay and interdependencies between data, algorithmic semantics, application domain considerations and performance characteristics of computing systems. Each of the Fellows will study all of these aspects through a combination of theoretical and experimental research methodologies in order to develop that broad

understanding. The level of ambition, in conjunction with the need to disseminate this understanding among practicing data scientists and engineers, implies that a doctoral training network is the ideal instrument to achieve the RELAX goals. Moreover, the demand for data professionals in Europe is larger than the supply, indicated by a skills gap that grew by 18% between 2014 and 2018.[6] RELAX will directly meet this demand for high-skilled professionals that can contribute to developing the data economy.

The RELAX project is organised around three main thrusts - qualitative aspects of analytics, indexing and summarisation, and computation and coordination - as shown in Figure 1.1a. The research projects will cover a variety of data types, in line with the core interests of the industrial partners: stream & batch processing, graph processing, and deep neural networks (DNN). The project will investigate the relaxation of semantics of exemplar applications in each of these domains. An open source analytics toolkit will be developed that implements state-of-the-art algorithms and data structures that are built upon relaxed semantics. This toolkit will demonstrate by its breadth the wide applicability of the principles developed in this project. The work packages required to achieve the research and training goals are described in Table 1.1a.

Table 1.1a: Work Package (WP) List and Involvement of Doctoral Candidates (DC)

WP No.	WP Title	Lead Beneficiary No.	Start Month	End Month	Activity Type	Lead Beneficiary Short Name	DC involvement
1	Qualitative Aspects of Data Analytics	4	7	48	Research	TCD	DC 4,6,8,9
2	Indexing and Summarisation	3	7	48	Research	ICCS	DC 1,5,10
3	Computation and Coordination	2	7	48	Research	CTH	DC 2,3,7,11,12
4	Training and Personal Development	3	7	48	Training	ICCS	DC 1-12
5	Communication, Dissemination and Exploitation	1	1	48	Knowledge Transfer	QUB	DC 1-12
6	Project Management and Quality Control	1	1	48	Management	CTH	DC representatives
7	Ethics Requirements	1	1	48	Ethics	CTH	all

1.1.4 Pertinence and innovative aspects of the research programme

The RELAX DN pursues a **novel research agenda** that aims to make semantics of data analytics a tunable design parameter in order to enhance efficiency and increase scalability of data analytics.

WP1: Qualitative Aspects of Data Analytics

The first work package investigates how to perform meaningful analytics that result in robust insights. Relaxing semantics provides a unique and nuanced means of enabling better data understanding and processing and provides a theoretical framework to reason about this. Specifically, we will investigate following challenges:

Data uncertainty and churn: We will model and maintain, in real time, data uncertainty and churn with the goal of fusing time-varying data inputs, or inputs containing varying degrees of uncertainty. Uncertainty and provenance will be dealt with in a unified manner with a basis on seminal work in probabilistic databases[7], provenance management[8] and uncertainty assessment and propagation[9]. The goal is to continue developing the theory of uncertain and provenance data management.

Reproducibility: We will address challenges that arise in seemingly minor differences between different software and hardware platforms, primarily because of different orders of evaluation of floating-point

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[6] Data as the Engine of Europe's Digital Future: Second Report on Policy Conclusions. 12 June 2019. http://datalandscape.eu/study-reports/data-engine-europes-digital-future-second-report-policy-conclusions

[7] Maniu, S., R. Cheng, and P. Senellart. "An indexing framework for queries on probabilistic graphs." *ACM Transactions on Database Systems (TODS)* 42, no. 2 (2017): 13.

[8] Amarilli, A., P. Bourhis, and P. Senellart. "Provenance circuits for trees and treelike instances." In *International Colloquium on Automata, Languages, and Programming (ICALP)*, pp. 56-68. Springer, Berlin, Heidelberg, 2015.

[9] Abiteboul, S., D. Deutch, and V. Vianu. "Deduction with contradictions in datalog." In *International Conference on Database Theory (ICDT)*. 2014.

computations. In principle the differences should be too small to notice, but very minor changes in computation changes both the percentage accuracy of ML models, and classifications of given inputs. Where ML is used for safety-critical systems, such as autonomous vehicles or medical devices, differences in outputs between the trained and deployed model creates huge problems for testing and certification. An essential part of this work is techniques to increase the discrimination of the ML models, so that the difference between similar outputs becomes larger than the numeric error.

Transparent Data Management and Verification: Deploying and maintaining data analytics and data management systems, in particular systems with an immediate impact on citizens and users, requires a deeper understanding of transparency and verification. As opposed to XAI (Explainable Artificial Intelligence) approaches which provide insights into core data analytics functionality only, we move to holistic end-to-end descriptions and interactions with data-intensive applications. Here, transparency within a system that is built as a pipeline of AI blocks would need to reconcile differences and disconnects between the component-level explanations in a way that meaningful transparency is attained for the system. We will provide new concepts, methods and algorithms for transparent data science systems that allow users to verify and transparently explore the impact of data quality as well as of data science design and modelling decisions on system results. We will define explanation models and devise algorithms at the system level that integrate with XAI approaches for data analytics such as counterfactual examples and feature attribution methods but cover the entire development process of data-intensive applications. We will devise methods that semi-automatically adapt to dynamic changes in batch and streaming data, and that provide the means for interactive updates, suitable interfaces and active learning mechanisms for modern data analysis and XAI.

WP2: Indexing and Summarisation

The growing data volume handled by modern analytics systems coupled with the need to deliver real-time analytics results calls for a departure from the classical approach of delivering theoretical approximation guarantees to analytics. Instead, RELAX aims to leverage data source characteristics, at-hand data summaries and scalable indexing, to explore complex trade-offs that seek a middle ground between speed and accurate semantics. Unlike theoretical approximation approaches which offer guarantees but are often too loose for practical applications, we will target tighter and empirically validated approximations to support effective usage within real-world applications.

In this context, we will design **incremental algorithms for data summarisation and compression** that update results based on newly seen data, in combination with the extension of classical indexing structures such as R-trees and kd-trees to support approximation and summarisation, within the context of urban data types such as trajectories[10].

Additionally, we will explore **new frontiers in parallelism and concurrency in continuous (stream) processing**, which has received relatively less attention[11]. Lack of research in this area forces practitioners to resolve to locks[12], which is counter-productive. We target algorithmic constructs and data structures to maintain synopses in parallel, supporting **concurrent updates and queries in varying window frames**; knowledge and new advances on **combinable summaries, allowing state partitioning**. Building on recent results, we will develop consistency models that are appropriate for the above in the presence of concurrency and ways to achieve them in the aforementioned constructs, while tuning trade-offs among consistency, time-efficiency and cost (in parallelism, memory)[13].

Data is abundant and analysts frequently have a choice of data sets to use. We will explore the options available to focus on **high-impact data**, i.e., intelligence that has the best potential of driving strategic decisions. It is becoming increasingly apparent that, for data-driven decision making, **it is not (only) about**

[10] Sayan R, **P. Deepak**, A. D. Telang, P. Deshpande, and S. Raghavan. "Indexing and matching trajectories under inconsistent sampling rates." In *IEEE 31st International Conference on Data Engineering*, pp. 999-1010. IEEE, 2015.

[11] A. Rinberg, A. Spiegelman, E. Bortnikov, E. Hillel, I. Keidar, L. Rhodes, and H. Serviansky. "Fast Concurrent Data Sketches". In*: 25th ACM Symposium on Principles and Practice of Parallel Programming*. PPoPP 2020.

[12] SketchesArgumentException: Key not found and no empty slot in table. https://groups.google.com/g/sketches-user/c/S1PEAneLmhk/m/dI8RbN6iBAAJ 2019.

[13] C. Stylianopoulos, I. Walulya, M. Almgren, O. Landsiedel, and **M. Papatriantafilou**. "Delegation sketch: a parallel design with support for fast and accurate concurrent operations". In: 15th ACM European Conference on Computer Systems (EuroSys). 2020.

the size, but about the "right" data[14,15,16]. It is not straightforward how choosing or adding a data source improves results, or even in what way: is the process faster? more accurate? Existing solutions do not address the **relation between data content and its impact on the underlying analytics tasks.**

Unlike current and previous research and development approaches, we plan to take a **domain-independent, holistic, and continuous approach to data modeling**. This is a novel effort that sheds light onto the problem of immense numbers of different data sets, rather than the volume of a single one. As such, it recognizes the need to create data models that measurably map dataset interrelations. Consequently, it plans to analyze these data interrelations based on principled statistical and semantic axes taking into consideration **structural, semantic,** and **operational** data attributes: type, distribution, size, order, data uncertainty and data churn.

WP3: Computation and Coordination

The combination of massive data collection, distributed computing and algorithmic breakthroughs have unleashed great possibilities for machine automation of human labour (e.g., vehicle driving, voice-driven assistance, image/video classification, fintech and investment guidance). Yet, even though big adopters such as Google, Facebook and Amazon evangelize the benefits, most of this new technology is still in primitive state at large to the mainstream application-domain users (e.g., business analysts, financial experts, doctors etc.) and smaller corporations. We identify two system challenges that need to be addressed before most of this technology can become mainstream and usable within common application domains.

First, there is a need for **scalable analytics platforms** capable of alleviating from the user the specialized tuning and optimisation needed for model building without violating the expected accuracy.

Second, there is a need for automated end-to-end integration of **incremental model training, data stream processing, real-time prediction serving and reasoning**. We will investigate ways to trade staleness of state for performance and look at variants of deep learning algorithms and general iterative big data processing algorithms, starting from asynchronous stochastic gradient descent variants to examine the impact of parallel computation models on runtime and model accuracy (experimentally and analytically)[17]. Data staleness on one hand has the potential to increase performance and latency by virtue of reducing waiting times and increasing concurrency; but on the other hand, might slow the convergence of the algorithm. There is a clear trade-off that needs to be investigated in order to find the sweet spot and kind of staleness that will improve latency for the same accuracy. Moreover, some algorithms are more sensitive to staleness than others.[18]

We will also investigate how to **leverage incremental stream processing to scale data analytics and ML**. The key idea is explore incremental data steam processing and exploit result-similarity of consecutive data windows, approximating the full data state, to actively compute the expected results.[19]Scalable graph processing requires load-balanced computations, which is achieved through application-specific load balancing criteria.[20,21] We will extend this line of work and explore **relaxed coordination for graph**

[14] Big Data vs. Relevant Data: Intelligence That Matters. https://www.huffingtonpost.com/jim-yu/big-data-vs-relevant-data_b_5022792.htm I, 2017.

[15] R. Baeza-Yates. "Big data or right data?." In *Proceedings of International Workshop on Foundations of Data Management, CEUR Proceedings*, vol. 1087, 2013.

[16] Giannakopoulos, I., **D. Tsoumakos**, and **N. Koziris**. "A Content-Based Approach for Modeling Analytics Operators." In *Proceedings of the 27th ACM International Conference on Information and Knowledge Management (CIKM)*, pp. 227-236. ACM, 2018.

[17] Bäckström, K., **M. Papatriantafilou**, and **P. Tsigas**. "MindTheStep-AsyncPSGD: Adaptive Asynchronous Parallel Stochastic Gradient Descent." In *IEEE International Conference on Big Data (BigData)*, 2019. (TA)

[18] Li, M., D. G. Andersen, J. W. Park, A. J. Smola, A. Ahmed, V. Josifovski, James Long, Eugene J. Shekita, and Bor-Yiing Su. "Scaling distributed machine learning with the parameter server." In *11th USENIX Symposium on Operating Systems Design and Implementation (OSDI)*, pp. 583-598. 2014.

[19] H. Najdataei, **V. Gulisano, P. Tsigas, and M. Papatriantafilou**. "Pi-Lisco: parallel and stream-based point-cloud clustering". In Proceedings of the 37th ACM/SIGAPP Symposium on Applied Computing (SAC '22), 460–469. ACM, 2022-

[20] Sun, J., **H. Vandierendonck**, and D. S. Nikolopoulos. "GraphGrind: addressing load imbalance of graph partitioning." In *Proceedings of the International Conference on Supercomputing (SC)*, p. 16. ACM, 2017.

[21] Sun, J., **H. Vandierendonck**, and D. S. Nikolopoulos. "Accelerating graph analytics by utilising the memory locality of graph partitioning." In *46th International Conference on Parallel Processing (ICPP)*, pp. 181-190. IEEE, 2017.

processing based on the monotonicity of application operations,[22] which drives a trade-off between timeliness, accuracy, and repeated work.[23]

We will devise algorithms for the **simultaneous exploration of approximate and exact data, incremental processing, and parallel processing**.[24] The general idea is letting the algorithms actively learn the intrinsic structures of the data and iteratively choose small data blocks to perform exploration tasks until the final expected results are reached.[25,26]

Orthogonal to the above concerns are the challenging problems relating to data precision, arithmetic, and accuracy of results. Much physical world sensor data is approximate, and algorithms are designed to tolerate data inaccuracies. This creates an opportunity to **reduce numeric precision of data types while maintaining the accuracy of the result**. This accelerates processing and reduces memory requirements and data movement. It has been repeatedly shown that accurate results can be obtained for machine learning (ML) in general, and deep neural networks, with limited precision arithmetic[27,28], especially for the task of inference on mobile devices. However, in domains such as ML, very minor changes to the input or computation can equally cause very large changes in the output, as shown by adversarial inputs[29]. Thus, numeric accuracy is both an opportunity and a challenge. We also build on our existing research on packing and unpacking compact numeric types with vector SIMD instructions[30], software support for low-precision floating point in bitslice representation[31], and operating on several integer sub-values within a long integer[32] to enable low-precision types on commodity hardware.

We will investigate **unconventional number systems for memory-bound algorithms**, primarily neural networks. This will involve examining the distribution of values that arise and finding number encoding systems that can represent the distribution compactly. In many applications the relative error from representing a value is more important than the absolute error, a characteristic on which logarithmic number systems score well. A key part of this work is supporting efficient arithmetic on these compact representations.

Data Sources

Where possible, the research activities in RELAX will be conducted using open access, EU-supported data sets. Using previously curated data sets facilitates scientific comparison of the novel technologies developed by RELAX to the state of the art. Moreover, it ensures compliance with relevant laws and guidelines. Additionally, feeding back insights gained on the data to the community creates further routes for lasting contributions and impact. The precise data sets used by each of the DCs will be identified during the early stages of the DCs' projects as the choice of data sets depend strongly on how the research questions are elaborated by the DCs. All data-related research activities and data science approaches will

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[22] Hellerstein, J. M., and P. Alvaro. "Keeping CALM: When Distributed Consistency is Easy." *arXiv preprint arXiv:1901.01930* (2019).

[23] Alistarh, D., T. Brown, J. Kopinsky, and G. Nadiradze. "Relaxed schedulers can efficiently parallelize iterative algorithms." In *Proceedings of the ACM Symposium on Principles of Distributed Computing (PODC)*, pp. 377-386. ACM, 2018.

[24] **Mai, S. T**., M. Storgaard Dieu, **I. Assent**, Jon Jacobsen, Jesper Kristensen, and Mathias Birk. "Scalable and interactive graph clustering algorithm on multicore CPUs." In *IEEE 33rd International Conference on Data Engineering (ICDE)*, pp. 349-360. IEEE, 2017.

[25] **Mai, S. T**., **I. Assent**, and M. Storgaard. "AnyDBC: an efficient anytime density-based clustering algorithm for very large complex datasets." In *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD)*, pp. 1025-1034. ACM, 2016.

[26] **Mai, S. T.**, S. Amer-Yahia, **I. Assent**, Mathias Skovgaard Birk, Martin Storgaard Dieu, Jon Jacobsen, and Jesper M. Kristensen. "Scalable interactive dynamic graph clustering on multicore CPUs." *IEEE Transactions on Knowledge and Data Engineering (TKDE)* 31, no. 7 (2018): 1239-1252.

[27] Gupta, S., A. Agrawal, K. Gopalakrishnan, and P. Narayanan. "Deep learning with limited numerical precision." In *International Conference on Machine Learning (ICML)*, pp. 1737-1746. 2015.

[28] Micikevicius, P. *et al.*. "Mixed Precision Training.", In *International Conference on Learning Representations (ICLR)*, 2018.

[29] Gragnaniello, D., F. Marra, G. Poggi, and L. Verdoliva. "Analysis of adversarial attacks against cnn-based image forgery detectors." In *26th European Signal Processing Conference (EUSIPCO)*, pp. 967-971. IEEE, 2018.

[30] Anderson, A., S. Muralidharan, and **D. Gregg**. "Efficient Multibyte Floating Point Data Formats Using Vectorization." *IEEE Transactions on Computers* 66, no. 12 (2017): 2081-2096.

[31] Xu, S., and **D. Gregg**. "Bitslice Vectors: A Software Approach to Customizable Data Precision on Processors with SIMD Extensions." In *46th International Conference on Parallel Processing (ICPP)*, pp. 442-451. IEEE, 2017.

[32] Anderson, A., M. Doyle, and **D. Gregg**. "Scalar Arithmetic Multiple Data: Customizable Precision for Deep Neural Networks." In *IEEE 26th Symposium on Computer Arithmetic (ARITH)*, pp. 61-68. IEEE, 2019.

be developed in collaboration with the independent Ethics Advisor (see Section 4). New or derived data sets will be made publicly available (see Section 1.2.5).

Active and Past Research

Several current and recent ETN networks aim to improve the state of the art in data analytics. Most of these networks, however, focus on the **application of analytics to different areas**, e.g., sports analytics (RAIS, 813162), social disruptions (CLEOPATRA, 812997), chemistry (BigChem, 676434), and finance (BigDataFinance, 675044). Some networks are centered around data analytics system design, e.g., databases (BigStorage, 642693). BigMath (812912) focuses on the mathematics behind big data. There is a **clear gap in networks that investigate and develop the critical data analytics infrastructure**, or that address the skills gap in data professionals as broadly as RELAX.

Several collaborative research projects are relevant to RELAX. The H2020 FET-Proactive project OPRECOMP[33] (732631) develops systems and tools that enable developers to experiment with and apply reduced numeric precision in a variety of applications. ALOHA[34] (780788) aims to develop software development tools to automate the porting of DNN inference tasks to low-power and heterogeneous embedded and edge devices. RELAX is concerned with the broader issues that arise in the context of data analytics applications.

The CHIST-ERA 2018 project DiPET[35] uses adaptive numeric precision to schedule distributed applications in cloud and edge environments. Precision is an adaptable parameter that can be traded in response to failures or oversubscriptions of resources. DiPET focuses on scheduling algorithms and resource allocation.

The H2020-ICT-2016 project BONSEYES[36] developed a novel AI marketplace and development platform for deploying AI in embedded and edge devices. The goal is to provide a seamless environment that allows AI models to be trained, shared, and easily ported to resource-constrained devices. BONSEYES uses a variety of techniques to reduce the resource requirements of neural networks, including quantizing to lower precision, and pruning data that has little effect on the output.

1.2 Soundness of the proposed methodology

1.2.1 Overall Methodology

RELAX will lay the **foundations for a novel approach** to designing software systems for data analytics, rooted in the observation that the inherent inaccuracy, uncertainty, and volume of data enables **active adaptation of the semantics** of data analytics **without affecting the robustness** of the insights that are derived from that data. This ambitious goal requires a **disciplined approach** underpinned by **theoretical concepts** and **practical algorithms** and will enable a step-change in the efficiency and scalability of data analytics.

The cross-disciplinary nature of RELAX implies that Fellows will apply different methodologies that are in use in different research communities and approach the concept of relaxed semantics from different complementary angles. Section 1.1.4 explains the key assumptions and models that will be used in each of the computer science sub-disciplines. The Fellows will collaborate on different components and functions of data analytics software systems. Figure 1.1b depicts the project structure from two viewpoints: the application view, and the system view. The application view focuses on data types and workflows. It demonstrates how all Fellows consider a coherent set of data types, creating scope for collaboration across work packages. The system view shows a high-level view of how data flows through Internet-of-Things (IoT) devices, edge and data centre resources. This view demonstrates the complementary goals for relaxation of semantics in different system resources, which have different system optimisation goals. These viewpoints inform the required components for the RELAX toolkit and underpin the collaboration among the Fellows and the complementarity of their expertise.

The RELAX toolkit will be demonstrated on **selected applications identified by the industrial partners**. Example applications include **monitoring and analysis of multi-vehicular streaming data** (e.g., speed/acceleration summaries, inter-vehicle closest distance reports); these are useful in resource

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[33] http://oprecomp.eu/

[34] https://www.aloha-h2020.eu/

[35] http://www.chistera.eu/projects/dipet

[36] https://www.bonseyes.eu/

management as well as in performance and safety-related deep learning applications (e.g., ingestion-time or look-ahead safety checks). The accuracy-preserving, trade-off regulating approaches suggested are especially suited for pipeline data processing (on-/off-vehicle) needs.

Application view

System view
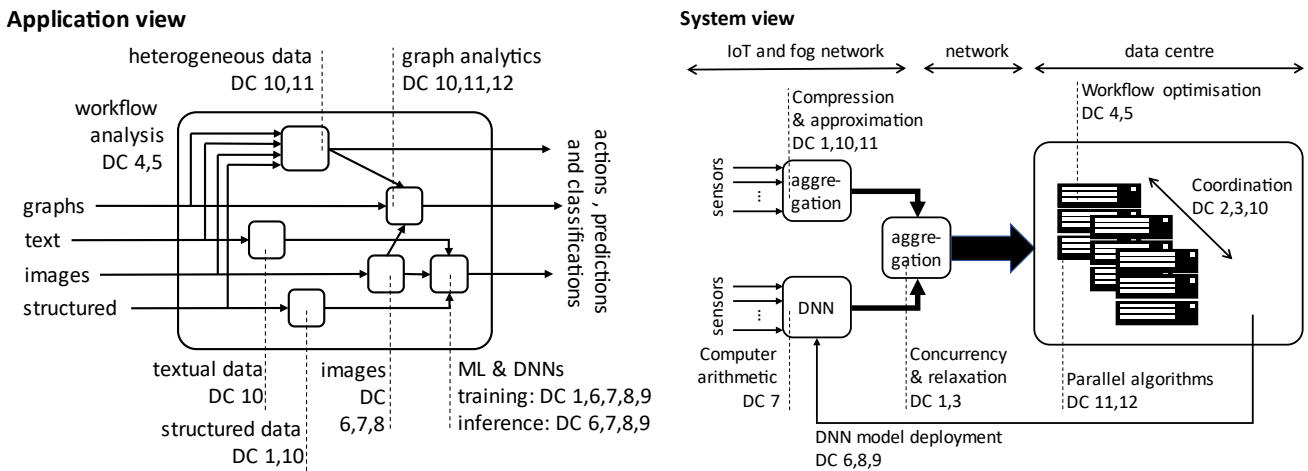
Figure 1.1b: Graphical depiction of the project structure and the collaborative and complementary aspects in the research programme.

1.2.2 Integration of methods and disciplines to pursue the objectives

The RELAX consortium has identified **major challenges** to the deployment of efficient data analytics systems (see Table 1.1b), which collectively motivate the investigation of how to leverage relaxed semantics across the data analytics stack. Addressing these c**ross-disciplinary challenges requires broad knowledge** and a diverse skill set ranging over data science, data management, distributed computing and computer arithmetic. The industry partners, operating in different market segments as they specialise in technology, products, services or consultancy, will contribute a valuable intersectoral dimension. The project will focus on applying relaxed semantics to application types that dominate industrial workloads as advised by our partners. RELAX will thrive on synergistic cross-disciplinary collaboration, which will maximise the potential for innovation.

Table 1.1b Innovative Aspects of RELAX and Progression over State of the Art

Problem	Knowledge Gap	RELAX Solution	Expertise
Data quality and approximation	How to restore and increase data quality?	Robust statistical approaches to data classification and prediction Transparent end-to-end explanations for data and knowledge management	QUB, TCD, AU
	Statistical soundness of summarisation and approximation of data streams, especially streams of graph-structured data	New heuristic-based stratified sampling for real-time data streams	QUB, ICCS, TCD
	Lack of understanding of efficient summarisation and approximation of complex data streams	New approximation algorithms based on classical index structures Small-space synopses that provide deterministic quality guarantee	QUB, ICCS
	Efficiency and relative cost of accuracy/semantics of concurrent updates and queries in continuous data processing	Algorithmic frameworks for semantic relaxation capable of monotonically tuning concurrent data structure semantics/guarantees for better performance within relaxation bounds.	QUB, CTH, ICCS
Data-aware analytics	How to identify what data is most effective, e.g., to train models?	Devising novel predictors of data impact on analytics performance	QUB, ICCS
	Impact of data uncertainty on performance of data analytics tasks	Design models to fuse and select data sets with varying degrees of uncertainty Explainability and transparency methods for systems that involve data analytics tasks	QUB, ICCS, AU
	Streaming data undergoes dynamically changing patterns Unstructured data poses high processing demands	New incremental and anytime algorithms that actively learn the patterns underlying unstructured data	QUB, ICCS

	Selecting and adapting ML models to fit resource-constrained devices	New model exploration algorithms	CTH, TCD
Coordination and synchronisation	Bulk-synchronous parallel processing constrains parallelism	DNN training algorithms that tolerate data staleness Transparent tracking of data usage and impact in entire system	QUB, CTH, AU
	Stale data in graph processing induces redundant work	Leverage application semantics to minimise redundant work	QUB, CTH
	How to move beyond static graph snapshots in incremental graph processing?	Embedding incremental aggregations in models of persistent graphs, leveraging the fundamentally dynamic nature of graph-structured data	QUB, CTH
	Efficient ways for merging persistent nature of graphs with incremental aggregations	New scalable summarisation and aggregation primitives	QUB, CTH, ICCS
Numeric accuracy	Reproducibility and portability of DNN models across software frameworks with different numeric	Study reproducibility and portability; adapt models to improve these aspects	QUB, TCD
	How to predict required numeric precision prior to computation? How to adapt numeric precision and number formats reliably?	Analysis of rounding error introduced by DNN training and inference algorithms	TCD
	Relative importance of absolute vs relative errors in the representation	New application-specific number systems that minimise relative error	QUB, TCD

1.2.3 Gender dimension and other diversity aspects
Application of the guidance on methods of sex/gender analysis[37] has indicated that there is no need for any specific activities to address such issues. The RELAX Fellows will be trained on the Gender in Design Toolkit, which will ensure that there are no unintended negative gender impacts of the work, or the systems developed.

1.2.4 Open Science practices
RELAX will adopt Open Science practices throughout the research cycle. We have incorporated priorities and feedback from the industry partners already during the proposal preparation. We will involve stakeholders further during the development of the research projects, which will be formalised through appointing industrial partners as mentors (Section 1.4.2). Research results will be shared early within the consortium, and online in pre-prints.

DCs will be trained on Open Science and responsibility towards society, secure cooperation during research, optimal solutions for data sharing, considering Intellectual Property and General Data Protection Regulation, data description and the setup of a Research Data Management Plan. The training will include tips on how to enhance visibility and impact of research data. All DCs and Supervisors will receive training on the Open Research Europe publishing platform.

1.2.5 Research data management and management of other research outputs
The Consortium embraces the principles of open data, including the importance of and the need to manage data collected, processed, or generated by the project in a FAIR (Findable, Accessible, Interoperable and Reusable) manner. The consortium will develop a Data Management Plan (DMP) by month 6 of the project. Scientific results will be published through Open Access mechanisms (see Section 2.3.1); each research publication/article will be published in an on-line institutional repository.

1.3   Quality and credibility of the training programme

1.3.1 Overview and Content Structure of the Doctoral Training Programme
The RELAX project will offer 360 months of training across 12 early-stage researchers (DC) (Table 1.3a). The training is scheduled from month 6 to 41 to enable cooperation among the cohort, and to leave sufficient time for recruitment and completion of PhD dissertations.

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[37] See http://ec.europa.eu/research/swafs/gendered-innovations/index_en.cfm

Table 1.3a   Recruitment Deliverables per Beneficiary

Researcher No. (DC1-12)	Recruiting Participant (Research Group)	PhD awarding entities	Planned Start Month (0-45)	Duration (months; 3-36)
10,11,12	QUB	QUB	7	36+36+36 UK-funded
1,2,3	CTH	CTH	7	36+36+36
6,7	TCD	TCD	7	36+36
4,5	ICCS	ICCS (NTUA)	7	36+36
8,9	AU	AU	7	36+36
Total				**360 +108**

Training Objectives: The RELAX DN aims to address industry's need for **talented and versatile data professionals** who **understand the cross-disciplinary challenges** relating to large-scale data analytics. Data analytics are inherently applied to **inter-disciplinary challenges**, which are modeled abstractly in mathematical or computer scientific terms based on real-world entities, behaviors and requirements. The DCs will gain exposure to these challenges during their secondment. RELAX aims to train **creative, innovative** DCs, who are **open-minded, understand the benefits of and threats to gender diversity, and apply the highest ethical standards** in their work. The RELAX DCs will obtain **intersectoral and cross-disciplinary experience** and will be trained to **connect and influence** academic research and industry research and practice. The training objectives are as follows:

Training Objective	Mechanism	Delivered by
Scientific excellence	Training-by-research in PhD project International tandem of supervisors	Supervision by internationally renowned experts and experienced PhD supervisors
Innovation and entrepreneurship	Entrepreneurial Practice programme and CMI accreditation Entrepreneurship and Venture Capital training	QUB Graduate School CTH Chalmers Ventures
Transferable skills	Training days; incorporating training programmes at beneficiaries; conference attendance	Graduate Schools of academic partners; external specialist training providers; supervisory teams
Technical skills	PhD projects, secondments	Hands-on training by experienced experts
Inter- and cross-disciplinary knowledge	Presentations to consortium; collaboration; secondments; conference attendance	Beneficiaries and partners
Social responsibility and ethics	Training on ethics, Open Science/Open Data, gender in research, diversity and unconscious bias, ethical research	Graduate Schools of academic partners; external specialist training providers

The **training activities** comprise **training by research**, **biannual joint training days** supported by all beneficiaries and partners, **secondments** in industry and the **substantial and broad training provision available within each academic beneficiary**.

Training-by-research: Each DC will be enrolled on a PhD programme and will develop technical and scientific research skills under the supervision of academic and industry-based supervisors. Each DC will undertake a **secondment in industry** which will ensure their research is in line with the needs of industry and will facilitate intersectoral collaboration and knowledge transfer. The secondment plan is detailed in Table 3.1d. Each secondment partner has been carefully selected for their complementary skills and for their track record and international leadership in their area of specialisation.

Additionally, DCs will undertake short visits and exchanges with consortium members to benefit additional training, to enable knowledge transfer, and to facilitate cooperation between DCs. Visits and exchanges will be decided on as deemed appropriate during the execution of the project.

Network-Wide Training Events: RELAX will organize biannual network-wide training events, called **Training Days**, to deliver group-building network activities. Additionally, Training Days will encompass progress review of the individual research projects (described in Section 3.2.4), scientific/technical training through seminars and workshops, and training in transferable skills, soft skills and innovation and entrepreneurship. Each of the Training Days events will take 5 days. The provisional schedule of training

events is described in Table 1.3b; and a provisional list of courses is provided in Table 1.3c.

Advanced Scientific and Technical Training courses will be designed with cross- disciplinarity in mind, identifying the relevant connections to the broader challenges in data analytics that intersect with other disciplinary areas. Our bespoke training programme will be delivered by an intersectoral team, leveraging industry expertise and ensuring that the Fellows are maximally prepared to deliver industry-relevant research. The training programme will build on previously existing material for postgraduate training delivered in the context of summer schools,[38,39] national training networks,[40] and industry guest lectures in taught programmes. The development of such training material is essential to disseminating state-of-the-art research outcomes, and to effect knowledge transfer with industry. The RELAX project will invest significant effort to further develop such material, to make it available online through the QUB Canvas platform supported by the Centre for Educational Development, and to sustain its delivery beyond this project.

Table 1.3b Main Network-Wide Training Events, Conferences and Contribution of Beneficiaries

	Main Training Events & Conferences	**ECTS** (*if any*)	**Lead Institution/ Location**	**Action Month** (*estimated*)
1	Training Days 1 (8 days). Focus: induction and transferable skills (IMPACT)	1	QUB	9
2	Training Days 2 (5 days). Focus: transferable skills (IMPACT)	1	QUB	15
3	Tutorial at conference (e.g., SIGMOD) (½ day)	0.3	ICCS	21
4	Training Days 3 (5 days). Focus: Distributed computing & concurrency	1	CTH	22
5	Training Days 4 (5 days). Focus: low-power machine learning	1	TCD	27
6	Tutorial at conference (e.g., SPAA, PODC, MLSys) (1/2 day)	0.3	CTH	30
7	Training Days 5 (5 days). Focus: big data technologies	1	ICCS	33
8	Public Workshop (2 days)	0.5	TCD	36
9	Training Days 6 (5 days). Focus: graph processing; wrap-up	1	QUB	39

Innovation and Entrepreneurship The QUB Graduate School will foster the Fellow's innovation and entrepreneurship skills through the delivery of **Entrepreneurial Practice (EP)** training.[41] The Fellows will use their research skills and creativity in multi-disciplinary teams to create solutions to real-world social and industrial challenges. The programme, building on the Design Thinking methodology,[42] is based in experiential learning and develops **theoretical understanding and competencies in entrepreneurial practice**. The EP unit encompasses 8 training days together with one piece of assessed work. Pre-programme support, based on the Foursight self-assessment tool, helps the learners to **discover their personal thinking and communication style** and introduces them to **team management and effective collaboration**. Completion of this unit will contribute to 50% of the Level 7 Certificate in Strategic Management and Leadership Practice, an internationally recognised qualification, accredited by the Chartered Management Institute.[43]

Transferable Skills Training: A diverse training programme will be available to the Fellows through the training programmes provided by each academic member of the consortium. These training programmes have a common focus on presentation and scientific writing skills, networking skills, ethical research and introduction to teaching and assessment. RELAX will require that all Fellows take this common core of topics.

Gender in Research: To ensure that each project is open to stimulating creative opportunities through **Gendered Innovations**, there will be a workshop on Gender in Research during the joint training days. The workshop will make specific reference to the challenges and pitfalls related to machine learning and

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[38] **H. Vandierendonck**. "High-performance Graph Analytics in Shared Memory," Marionet Summer School. 2018. https://manycore.org.uk/ss_slides/hans.pdf

[39] **P. Tsigas**. "Lock-free Concurrent Data Structures", UPMARC Multicore Computing Summer School, 2018. http://www.it.uu.se/research/upmarc/events/SS2018/ss2018/Start.html

[40] https://wasp-sweden.org/graduate-school/

[41] https://www.qub.ac.uk/graduate-school/development/enterprise-innovation/

[42] Tim Brown. Change by Design. Harper Collins 2009.

[43] https://www.managers.co.uk/

machine learning systems that learn and reproduce bias. The project will make use of and direct researchers to the training, webinars and learning resources developed by the EU initiatives Gender in Research[44] and Gender Action.[45]

Table 1.3c Provisional schedule of training courses and technical talks. Courses delivered by industrial partners are indicated by a dull pink background.

Provisional Title	Partners	Scheduled Duration	Training Event (see Table 1.3b)
Scientific / Technical Training			
Python and R for Machine Learning	QUB	1 day	1
Clocks, consensus, FLP result a.o.	QUB	½ day	2
Scalable data stores for streaming analytics	MDBS	2 hours	2
Big data platforms, analytics, and visualisation	AE	1 day	2
Lock-Free Concurrent Data Structures	CTH	2 days	4
Data structures and algorithms for locality and SIMD parallelism	TCD	1 day	4
Data analysis and statistics in hybrid cloud and edge infrastructures	VOL	2 hours	4
Reduced precision in DNN: data types, arithmetic and code generation	TCD	1 day	5
Embedded and low-power AI	UBO	½ day	5
Data processing for robotics	UBO	½ day	5
Data analytics and tools	ICCS	1 day	7
Scalability and elasticity of streaming in IoT/edge/cloud environments	MDBS	1 day	7
Scalable data pipelines and machine learning models	VAIX	½ day	7
Scheduling analytics workflows in cloud and edge environments	RYAX	½ day	7
High-performance graph processing	QUB	1 day	9
AI, Machine Learning, Deep Learning	BSEC	½ day	9
AI-enhanced tools in journalism	DMJX	½ day	9
Transferable Skills, Personal Development and Innovation/Entrepreneurship			
Research methodology and literature review	QUB	1 day	1
Co-supervision of undergraduate and postgraduate taught research projects	ALL	continuous	n/a
Gender in Research	QUB	½ day	1
Ethics, Academic Integrity and Plagiarism	TCD	2 hours	1
STEM Ambassador Training	QUB	1 hour	2
Social media strategy and creating engaging content	QUB	½ day	2
Innovation and entrepreneurship (IMPACT programme)	QUB	8 days	1, 2
Entrepreneurship and venture capital	CTH	1 day	4
Induction for PhD students - general introduction	Host	½ day	n/a
Planning your career	Host	½ day	n/a
Teaching apprenticeship - introduction to teaching, learning and assessment	Host	1 day	n/a
Scientific writing - writing workshop	Host	1 day	n/a
Unconscious bias	QUB	online	n/a

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[44] https://www.yellowwindow.com/genderinresearch

[45] http://genderaction.eu/

1.3.2 Role of Non-Academic Sector in the Training Programme
All non-academic participants will contribute to the training programme by **involvement in defining the individual research projects**; by **delivering technical training courses** or by hosting the Fellows during intersectoral **secondments**. They will participate in the Training Days by **delivering lectures** (see Section 1.3.1) through which they will **exemplify technology transfer** and **demonstrate entrepreneurship in action**. This will be particularly illustrative in case of those partners that are recent spin-offs or startups with roots in academic research (AE, MDBS, RYAX).

Moreover, as members of the Supervisory Board, non-academic members will actively participate in the **progress review of individual research projects**. As industrial mentors, they will help **define the individual research project objectives and methodology**, as well as the **Personal Development Plans** of their mentees. Their involvement in overseeing the research projects will ensure that the **research is aligned to industry priorities**.

1.4   Quality of the supervision
Each DC will be supported by an **international supervisory team** consisting of two academic supervisors affiliated to distinct institutions and one industry mentor. The supervisory teams will advise on the research and will assist the DCs with their personal development through the definition of a **Personal Development Plan** at the beginning of the Fellowship to be updated every 6 months.

All beneficiaries are aligned to the European Charter for Researchers; UK-based beneficiaries have endorsed the Research Concordat.[46]

1.4.1   Qualifications and Supervision Experience of the Supervisors
RELAX brings together 9 internationally renowned academic supervisors working across 4 disciplinary areas (see Table 1.4a). All supervisors have an extensive track record in academic research and publish in the top venues in their field. All supervisors also have extensive experience collaborating with industry, and most have received industry funding. Most supervisors have extensive experience managing large collaborative research grants funded by the EU and national funding agencies. This experience will ensure good management of the network and delivery of its goals. All supervisors have undertaken international mobility themselves, which will prove beneficial to the general support of the DCs. One of the supervisors, Dr Padmanabhan, has extensive commercialization experience earned through a 10-year industry stint at IBM Research. He has worked across all areas of the product life-cycle, viz., requirements gathering, software architecture, industry-standard product development and testing. Also, Prof. Gregg has commercially licensed the outcomes of a research project that developed game scripting technology and developed it into a successful product.

Table 1.4a: Supervisory experience: H: H-index (Google Scholar); i10: i10-index; EU: EU-funded projects participated in; MCA: Marie Curie Actions participated in; Ind: experience industry collaboration and knowledge transfer; CO: experience public communications or engagement; PhD exp: current/graduated/examined PhD students; Res: number of pre- and post-doctoral researchers mentored. Availability: time committed to RELAX DN.

Partner	Supervisor	H	i10	EU	MCA	Ind	CO	PhD exp	Res	Availability	Publications
QUB	H. Vandierendonck	23	48	7	5	Y	Y	6/5/14	12	25%	http://tiny.cc/5897hz
QUB	T. S. Mai	11	13	0	0	Y	N	4/0/0	2	10%	https://tiny.cc/dq7luz
QUB	D. Padmanabhan	19	37	0	0	Y	N	5/3/5	3	10%	http://tiny.cc/76dluz
CTH	P. Tsigas	36	96	8	0	Y	Y	4/16/>30	25	25%	http://tiny.cc/yhkgiz
CTH	M. Papatriantafilou	25	61	8	0	Y	Y	5/13/>20	25	10%	http://tiny.cc/vjyhiz
CTH	V. Gulisano	19	29	0	0	Y	Y	2/5/0	9	10%	https://tinyurl.com/338926uh
ICCS	N. Koziris	31	91	20	3	Y	Y	7/15/>40	15	10%	http://tiny.cc/tw5iiz
ICCS	D. Tsoumakos	20	36	7	0	Y	N	2/6/15	7	10%	http://tiny.cc/py5iiz

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[46] https://www.vitae.ac.uk/policy/concordat-to-support-the-career-development-of-researchers

| TCD | D. Gregg | 19 | 37 | 1 | 2 | Y | Y | 3/15/14 | 8 | 20% | http://tiny.cc/hy5miz |
| AU | I. Assent | 34 | 63 | 0 | 0 | Y | Y | 5/6/~~0 | >30 | 15% | http://tiny.cc/3pzkuz |

1.4.2   Quality of the Joint Supervision Arrangements

Roles and responsibilities: Each DC will be supervised by at least two supervisors affiliated to different institutions, and an industry mentor. The supervisory teams are listed in Table 3.1d. They will agree the roles and responsibilities of each supervisor with the DC at the start of their appointment.

The primary supervisor, based at the host organisation, will help the DC to develop a research plan, provide guidance about literature, training (including specification of the Personal Development Plan), ethics, research techniques and academic conventions. The primary supervisor is also responsible for developing the DC's critical thinking skills, for providing constructive feedback, and ensuring scientific deliverables are submitted in time. Primary supervisors with less experience will be mentored by an experienced supervisor.

The **external supervisor** will contribute to developing the technical and research dimension of the DC's research project and will ensure the coherence and cohesion of the research within and across work packages.

The **industry mentor**, chosen among the staff at the secondment host, will assist in the development of the DC's Personal Development Plan, contributing a view on the essential skills for a career in industry research and/or development. The mentor will also advise on commercial exploitation of the research. The industrial mentor will supervise the DC during secondment, providing continuity throughout the project.

Supervisory meetings: The primary supervisor and DC will meet in-person on a weekly basis. External supervisors will meet with DCs and primary supervisors through teleconference once per month. E-mail will be used in between meetings to continue interaction as required. The DCs will produce minutes of the supervisory meetings, which they will share with the attendees of the meeting for approval. Meeting records will be stored on a central repository. They will form part of quality control of supervision and will be considered in the resolution of progress issues and complaints. The supervisory team will discuss the PDP at least twice per year in person during the Training Days, and using electronic means (e-mail, teleconference) throughout the year.

Each DC will be **embedded in a research team** at their host institution and will receive hands-on training from PhD students and post-doctoral researchers on specific specialist expertise to ensure that DCs develop their skills rapidly. Specialist team members will temporarily join the supervisory team as needed. This provides a valuable experience for the early career team members and contributes to the training of supervisors.

Supervisors are primarily responsible for the quality of research and training. **The Supervisory Board monitors the quality of research, training and secondments** undertaken by the DCs, as well as the quality of their supervision. DCs present their research twice per year to the consortium during the joint training days, where progress is rigorously monitored. A brief written report that summarizes progress since the previous monitoring event, including an updated work plan, risk assessment and Personal Development Plan, is submitted to the Supervisory Board prior to the meeting.

The Supervisory Board will appoint two Ombudspersons among the academic supervisors who can be contacted by the DCs in case of concerns or **complaints** relating to any aspect of their participation in the DN. The Ombudspersons will liaise with the affected parties to obtain a resolution to the issues raised, with the aim of ensuring that the goals of the DC's research and training programme are achieved. If requested by the DC, the Ombudsperson will retain their anonymity.

2.   Impact

2.1   Structuring doctoral training and strengthening European innovation capacity

The RELAX project embeds the Seven Principles for Innovative Doctoral Training.[47] Its unique training programme will be recognised by the doctoral training programmes of all members of the consortium. This recognition will extend to PhD candidates who are not supported by the DN when they take part in the open training events organised by the network. Each DC will produce a portfolio showcasing their research and training outputs at the end of the project, thereby enhancing their employability, and helping to excite

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[47] https://euraxess.ec.europa.eu/sites/default/files/policy_library/ principles_for_innovative_doctoral_training.pdf

the next generation of doctoral scholars. Core parts of the training will be integrated in **existing and new courses** in postgraduate programmes, ensuring a **lasting impact** on the training provision in Europe. Training material will be shared between participants, **removing fragmentation of the training provision**. Leading-edge training programmes such as the Entrepreneurship and Innovation programme delivered by the QUB Graduate School originate in **cross-university collaboration.**[48] It is our ethos to continue this innovation in education by **expanding and sustaining these programmes**. Moreover, RELAX will identify and engage with relevant Doctoral Networks to maximize the impact of the networks by sharing knowledge and good practice, and delivering joint training activities. Plans will be developed for future programmes and proposals that extend the effort and accomplishments of RELAX, in terms of training provision, networking and collaboration.

The RELAX project pursues a **future-ready** approach to the structuring of research training based on **leverage funding** beyond the EU contribution to the project and a **close academic-industry collaboration**. As a leading UK institution for technology transfer,[49] QUB will search to build new knowledge transfer relationships and share best practice with the partners.

The RELAX project will grow the European research base and innovation capacity by **introducing new industrial partners to EU-funded collaborative research and training** (VAIX, UBO). The integration of European SMEs in European research and training networks will make a step-change to knowledge transfer (both to and from these high-tech companies) and will drastically increase their ability to recruit top European talent. The equitable diffusion of knowledge and skills throughout European SMEs is an important precondition to the growth and effectiveness of the European data economy according to the Digital Future report.

The European innovation capacity will be strengthened by ensuring the RELAX Fellows are prepared to recognise opportunities for **technology transfer and commercialisation**, which will be enabled through 6-monthly reports on commercially relevant results developed in collaboration with an industry mentor. The extensive entrepreneurial training programme in conjunction with industry mentoring will ensure that Fellows will be well-prepared to undertake innovation activities. By establishing long-term research collaborations, the RELAX DN will confront the different points of view, vocabularies and methodologies that are employed by the disciplines that underpin data analytics. This will initially demand effort for the research groups to understand each other but will have a long-term advantage when researchers **adopt and assimilate the methodologies** promoted by a different research area. This will instill a **culture of openness, interest and respect** for other research areas, and will pave the way for effective collaboration. Achieving this culture will have a lasting impact on the European innovation capacity.

2.1.1 Meaningful contribution of the non-academic sector

The non-academic sector is **convincingly represented** in the Supervisory Board and will actively contribute to the **setting of objectives** and **selection of methodologies** during the development of individual research projects, and to shaping the Fellows' Personal Development Plan. The research and training programme was designed through dialogue during which each DC project was discussed for novelty, scientific rigor, and suitability as a PhD topic. Non-academic partners will **remain involved throughout the project** by participating in PhD supervision meetings, progress review panels and joint training activities, and will provide feedback and inspiration on the research and its relevance to industry. They will be a major contributor to the 6-monthly exploitation reports that Fellows produce. Table 1.4a in Section 1.4.2 summarises the contribution of each participant.

The industry partners have an **active involvement in basic research**, testified by their **previous involvement in successful collaborative research projects and training networks**. Several partners are academic startups (AE, MDBS, Ryax), and have retained a strong link with basic academic research. All industry partners will **contribute to the training programme**, which will introduce the Fellows to the state of the art in European industry. Some partners have an **extensive set of training material** already, while others will **develop bespoke training material for the first time**. It is an express goal to build **new and lasting international and intersectoral collaborations** (see Table 3.1d) that will underpin future research and knowledge transfer grant applications.

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[48] https://www.tcd.ie/news_events/articles/innovation-and-entrepreneurship-students-graduate-from- innovation-academy/

[49] https://www.timeshighereducation.com/world-university-rankings/queens-university-belfast

2.2 Credibility of the measures to enhance the career perspectives and employability of researchers and contribution to their skills development

Data is the engine of Europe's digital future.[50] The EU28 data market has grown from €47B in 2014 to €72B in 2018. The key to sustaining this economic growth is the widespread diffusion of digital transformation, enabling European SMEs to quickly adopt data monetisation solutions. This requires skilled workers. However, the demand for data professionals is larger than the supply, indicated by a **skills gap that grew by 18%** between 2014 and 2018. About 7.2% of total skills demand are data professionals, which is expected to grow to 9.2% by 2025. The RELAX DN will make a **direct contribution to this skills supply** by training a cohort of mobile data professionals skilled also in knowledge transfer. The RELAX DN pursues a **broad cross-disciplinary skills base**, ensuring that its Fellows are knowledgeable on diverse issues in the design and deployment of data analytics. We envision that our Fellows will be **particularly in demand with SMEs** with small data team sizes, where the broad skills base will pay off most. Moreover, the consortium will seek to **train a much larger cohort of data professionals** by inviting additional researchers from the network participants to the joint training activities, and by expanding and sustaining the developed training programme beyond the lifetime of the project.

The RELAX Fellows will face **no challenges finding employment**. This will be amplified by the individually tuned personal training programmes that will develop leadership skills, experience in teamwork, and instill an innovation and entrepreneurship mindset. **International mobility** will contribute to a **widespread and balanced diffusion of skills across Europe**, a key concern expressed in the Digital Future report.

Fellows who pursue an **academic career** will do so with a **ready-made network** of academic and industrial collaborators across a variety of disciplines.

2.3   Quality of the proposed measures to exploit and disseminate the results

2.3.1 Plan for the dissemination and exploitation activities, including communication activities

Each Fellow's Personal Development Plan will include a **communication, outreach, dissemination and exploitation plan**, identifying potential publications and results that may be amenable for exploitation. The Fellows will moreover report on their activities and experiences during the biannual Training Days.

Disseminating Novel Results: Each Fellow will be mentored by their supervisors to produce at least **two high-profile scientific publications in major conferences** in their field of expertise and **one distinguished journal publication** (see Table 2.3a for a tentative list). **All publications will be made publicly available** through Open Access Gold standard, or by Green publishing routes by posting pre- or post-prints on personal homepages and university repositories. ACM publications will be disseminated through the ACM Authorizer service, which effectively provides Open Access at no cost. News releases through a dedicated project website, social media and Research*EU will draw attention to the research. **Scientific reproducibility** will be supported by publishing research artefacts such as software and data sets under an Open Source, Creative Commons, or similar license. Processes will be put in place to ensure these artefacts remain accessible after the end of the project.

To help a new generation of European researchers work in this rapidly changing environment, we will provide training on the effective use of these "Science 2.0" approaches where this is appropriate. This includes how to balance conflicting issues in this context, such as: maximizing impact and publication speed of research results; ensuring proper scientific credit for DCs; ensuring researchers build up the "traditional" track record of recognized publications, which will still be important for their career progression to become independent researchers; and IP protection of research results.

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[50]   Data as the Engine of Europe's Digital Future: Second Report on Policy Conclusions. 12 June 2019. http://datalandscape.eu/study-reports/data-engine-europes-digital-future-second-report-policy-conclusions

Table 2.3a Scientific Dissemination Targets

WP1	WP2
ACM Conf. on Knowledge Discovery from Data (SIGKDD)	ACM International Conference on Management of Data
IEEE Transactions on Knowledge and Data Engineering	Proceedings of the VLDB Endowment
ACM Transactions on Intelligent Systems and Technology	ACM International Conference on Information and Knowledge Management
WP3	
International Symposium on Distributed Computing	IEEE International Conference on Computer Arithmetic
ACM International Conference on Principles and Practice of Parallel Programming	ACM International Conference for High-Performance Computing, Networking, Storage and Analysis
SIAM Symposium on Algorithmic Principles of Computing Systems (APoCS)	ACM Transactions on Architecture and Compiler Optimisation

General dissemination of RELAX to the general public, industry, government, and academia: We aim to **increase public awareness** of the opportunities and capabilities of data analytics, to **inspire youngsters to pursue a career as a data professional**, and to inform about relevant career pathways and degrees. The DCs will be **trained in communication and outreach activities**. They will attend public engagement events such as the European Researchers' Night (EU-wide), the All-Island Innovation Programme[51] (Ireland and UK), and the Northern Ireland Science Festival (UK)[52] where they will be assisted also by the supervisors. DCs will register as Maria Sklodowska Curie Ambassadors. The Fellows will be trained on the General Data Protection Regulations, as well as the distribution of photos and videos featuring minors, which is relevant to their outreach activities to the general public.

Dissemination to industry will leverage established **industry knowledge sharing events**, such as Big Data Belfast, which is organized annually by our partner AE, events organized by the Digital DNA media company and the Secure Connected Intelligence Summit organized by the ECIT Institute at QUB. Both DCs and supervisors will take part in these events to disseminate the RELAX research outcomes.

A **dedicated website** will be set up with two-level access. A general access space will communicate project activities and results to the public, policy makers and the commercial sector. A blog and chat space will be set up, which will be monitored by the Project Manager. All DCs will be motivated to contribute to the **project blog**, which will help them to develop their writing skills. For **internal dissemination,** a restricted access space will serve as a communication and reporting tool for the consortium, including a document store for official project documents.

The project will use **social media** as a key part of its communication strategy and will seek the direct involvement of one or more DCs to drive this effort. The project will communicate through LinkedIn and Twitter. In addition, it will leverage the DCs perspective on social media, who, contrary to their supervisors, have grown up with smartphones and the internet and have a fundamentally different view on the function that social media provides today, or may evolve to in the future.

Press releases will be prepared to disseminate relevant results to the general public and to raise awareness with policymakers, and to the academic and industry sectors through press releases to the technical press (e.g., ArsTechnica, InsideHPC, Framtidens Forskning).

Table 2.3b. Communication and dissemination activities

Activity	Type	Audience	Year	Expected Impact
Press releases (technical)	Press	Academia, industry	1,2,3,4	Initiate interaction
Press releases (non-specialised)	Press	Public, policymakers	1,2,3,4	Raise awareness
School visits	Local event	Public, youth	1,2,3,4	Enhance career interests
University Open days	Local event	Public, youth	2,3,4	Stimulate career choice
Outreach/ambassador events	EU-wide event	Public	1,2,3,4	Informing public
Popular science articles	Press	Public	2,3,4	Informing public

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[51] https://intertradeireland.com/innovation/all-island-innovation-programme/

[52] https://www.nisciencefestival.com/

Scientific publications	Web	Academia, industry	2,3,4	Dissemination
Organisation of tutorials	Scientific	Academia, industry	3,4	Dissemination, networking
Organisation of workshop	Scientific	Academia, industry	4	Dissemination, networking
Multimedia publications (YouTube)	Web	All	2,3,4	Informing public
Website and blogs	Web	All	1,2,3,4	In-depth information dissemination
Social media announcements	Web	Public, academia, industry	1,2,3,4	Generate interest

2.3.2 Strategy for the management of intellectual property, foreseen protection measures

The participating organisations subscribe to the principles of Open Innovation, recognising the necessity to build on expertise external to their organisation, as well as sharing their expertise with others. The key principles for the handling of IPR and exploitation of the project results will be specified in the Consortium Agreement based on a standard H2020 DESCA model customised for the project. If necessary, results thought to be commercially exploitable will be protected. The project Coordinator will ensure that the appropriate Horizon Europe reference documents and contact details of the EU IPR helpdesk are circulated to all beneficiaries. IPR and confidentiality agreements will be described in the Consortium Agreement and will depart from the principle that the beneficiaries own the IPR generated by the DCs they host. Individual agreements will be set up with partners to agree on sharing of foreground and background IPR. These agreements will be designed to maximise the impact of training during secondments, allowing DCs maximum exposure to proprietary information where appropriate, and/or to enable technology transfer.

We will use Technology Readiness Levels (TRL) to visualize and understand opportunities towards commercialisation in a structured way. We will mainly consider TRL 1 to 5-6 since RELAX is a basic/PhD-student-training research project. We base that on the common practice that TRL 1-4 applies to basic and academic research, TRL 5-6 to pre-development and TRL 7-9 to product development. Thus, we stretch the project to pre-development where we can meet industrial stakeholders. To succeed in this, DCs will produce exploitation reports on a 6-monthly basis in collaboration with their supervisors and mentor, which will be reviewed by the Network Assembly. The exploitation report will differentiate research suitable for commercialisation, as well as research that is more suitable for sharing in the public domain. The basic idea is to visualize this as an innovation funnel, starting with new ideas in form of e.g., new algorithms and methods, continuing with matching the modelling of real-life applications/problems, analytical and experimental evaluation in the lab with synthetic data, testing/validating with real-world data from open repositories and use-cases of the industry partners in the project, possibly also in the relevant environment, such as industry test-beds. Each exploitation report will include a brief statement of the current state of the technology, assess the TRL level at the current assessment and set a target TRL level for the next assessment. DC Supervisors and mentors will be involved in the exploitation process, providing guidance, and assisting with creating collaboration networks.

Based on such a plan, the project can maximize the benefit of support by the host organizations innovation offices, which can aid researchers and students in innovation processes and the transfer of research results into impact for society[53] and associated instruments (e.g., the Enterprise & Innovation training at QUB,[54] Chalmers entrepreneurship school,[55] AU's entrepreneurship and eventship hub The Kitchen[56]).

Several high-value outputs are anticipated (see Table 2.3b, next page). A primary exploitation pathway is publishing open source software using permissible licenses such as Apache License 2.0, which encourages for-profit utilisation of the research outcomes. Specialist training material is an increasingly valuable asset for universities, which prompts the academic participants to embed the developed material in sustainable courses for PhD programmes, MSc programmes and undergraduate education.

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[53] See beneficiaries innovation offices, e.g., https://www.qubis.co.uk, https://www.chalmers.se/en/collaboration/innovation-and-entrepreneurship/chalmers-innovation-office/Pages/default.aspx, https://international.au.dk/collaboration/technology-transfer/about-tto

[54] https://www.qub.ac.uk/graduate-school/development/enterprise-innovation/

[55] http://www.chalmers.se/en/departments/tme/school-of-entrepreneurship/Pages/SchoolofEntreprenurship.aspx

[56] https://thekitchen.io

Table 2.3b Expected Exploitable Outcomes

Expected exploitable outcomes	Pathway
The RELAX data analytics toolkit	Publish open-source software
Novel methods for DNN training and deployment	Publish method (Open Access)
Relaxed coordination protocol for bulk synchronous systems	Patent for licensing
Specialist training material	Sustainable course development

2.4 The magnitude and importance of the project's contribution to the expected scientific, societal, and economic impacts

As a project whose target is to navigate the nuances of the trade-off between systems considerations (performance, response time etc.) and conventional utilitarian metrics (accuracy, correctness etc.) in ways that are tailored to the application domains, RELAX will generate several unique impacts within scientific, economic, and societal dimensions.

The **scientific impact** generated by RELAX will be spread across a wide scientific community located within computer science. As illustrated by Table 1.1b, the scientific challenges span across data science, data systems, distributed computing, and computer architecture. Given that RELAX addresses issues in the intersection of the aforementioned areas, RELAX will **enhance cross-pollination across computing sub-disciplines**. Specifically, RELAX will contribute and consolidate two major shifts in scientific research: (i) to make the semantics of data analytics explicit in the design of data pipelines, algorithms, and systems; (ii) to design methodologies, techniques, and tools to elaborate, modify or adapt these semantics in view of achieving improved system-level performance metrics. The literature contains seeds of ideas towards realising these goals; the **lasting legacy** of RELAX will be to consolidate these fledgling efforts and advance the concept of relaxed semantics **from initial idea to established research area** by integration across the relevant specialisations in data analytics.

RELAX is designed with a strong orientation towards generating **significant economic and technological impacts**. A key economic impact is to deliver **more efficient data analytic platforms**, which includes efficiency in terms of time-to-results, efficiency in terms of the number of computational resources required, and efficiency in terms of energy consumption. These gains will be achieved by tuning the amount of computation to achieve the required semantics, without indulging in computations and synchronisation that are not required to achieve those semantics. The techniques and algorithms designed by the RELAX Fellows will find their way to **economic exploitation through collaboration with platform providers** Ryax, who deliver analytics platforms as a service, and MDBS, who design analytics solutions around their in-house analytics database. A second strand of economic impact centres around the capability **to scale analytics to problem instances that were not feasible before**. The unique contributions envisioned by the Fellows will directly aid, and find their way to commercialisation, through UBO, who push the boundaries on delivering deep learning applications in compute-constrained environments such as satellites; and through BSEC and AE who deliver cutting-edge data analytics solutions in a variety of circumstances, mostly in urban computing scenarios and healthcare. The RELAX Fellows will explore with VAIX how to push their machine learning systems to exceed the currently achievable boundaries of data volume and speed. Finally, economic impact is expected through **enabling novel applications**. The RELAX Fellows will collaborate with VOL to create analytics-based applications for automating tasks in hazardous environments (more information below). With MDBS they will design automated knowledge gathering systems that can explain knowledge and its provenance. These diverse economic impacts are possible through knowledge transfer and/or joint commercialisation activities with the industry partners. Alternatively, Fellows may choose a distinct commercialisation route based on creating their own unique startup. Either way, Fellows and industry partners will be supported through the bespoke training programme and the beneficiaries' technology transfer offices.

Expected Societal Impacts: As outlined in Section 1, this project is motivated by the need to **rein in the exponential growth in usage of computing power** with data centres consuming an increasing share of the carbon footprint within Europe and globally. Achieving this impact is paramount towards achieving the aspirations of the European Green Deal[57] and the United Nations Sustainable Development Goals (SDGs).[58] With the relaxed semantics approach that RELAX takes, it will be possible to accomplish the

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[57] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[58] https://sdgs.un.org/goals

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same technological needs of the modern society with less power consumption, directly contributing to reducing the carbon footprint. The relaxed semantics approach will also help enhance the ability to undertake automation in a variety of new scenarios which were hitherto impractical due to scalability issues. This aspect has a concrete societal impact angle in that it would enable automation in sectors which currently involve personnel engaging in manual labour within hazardous situations; our partnership with Volvo autonomic systems in RELAX will specifically address automation within environments containing mines which pose a significant safety challenge. The RELAX trajectory analytics use case specifically addresses sustainability within the urban transportation sector, one which has been the specific focus of QUB in its sustainability action plan.[59] The outreach events and participation in events such as All-Ireland innovation programme and NI Science Festival (Section 2.3) will help the RELAX participants build substantial mindshare within analytics, and help them to instill enthusiasm into analytics among young adults and the broader public.

3. Quality and Efficiency of the Implementation

3.1 Quality and effectiveness of the work plan, assessment of risks and appropriateness of the effort assigned to work packages

3.1.1 Fellows' Individual Projects, Including Secondment Plans

Table 3.1d Individual Research Projects

Fellow	Host institution	PhD enrolment	Start date	Duration	Deliverables
DC1	CTH	Yes	M7	36 months	D2.1, D2.2, D2.3

Title: Continuous/concurrent data summarization (WP2)

Objectives: We target algorithmic constructs and data structures to maintain synopses in parallel, supporting concurrent updates and queries in varying window frames; knowledge and new advances on combinable summaries, allowing state partitioning. We will study adaptive semantic relaxation of concurrent data-structures in both (coarse-grained) batch and fine-grained streaming scenarios of large data processing and analytics, as well as we will develop consistency models that are appropriate for the above in the presence of concurrency and ways to achieve them in the aforementioned constructs, while tuning trade-offs among consistency/accuracy, time-efficiency and cost (in parallelism, memory)

Expected Results: Algorithms and implementations, as part of streaming and batch big data processing environments, of relaxed, elastic, concurrent synopses data structures and application-oriented use-cases.

Planned secondment(s): VOL, M22 (3M) training on practical data processing environments and benchmarking over real-world data workloads.

PhD: CTH. Primary supervisor: M. Papatriantafilou secondary: D. Tsoumakos (ICCS); industrial mentor: G. Georgiadis

DC2	CTH	Yes	M7	36 months	D3.1, D3.2, D3.3

Title: Staleness and Asynchrony for performance gains in in deep learning and iterative large data processing (WP3)

Objectives: Investigate process coordination models/algorithms to trade staleness of state for gaining performance without losing accuracy in deep learning and iterative large data processing algorithms

Expected Results: Asynchronous parallel algorithms for deep learning and iterative data processing (from SGDs to clustering and graph algorithms).

Planned secondment(s): VOL, M22 (3M), application of relaxed semantics in real-world analytics platforms and workloads with stringent deadlines.

PhD: CTH. Primary supervisor: P. Tsigas; secondary: H. Vandierendonck (QUB); industrial mentor: G. Georgiadis

DC3	CTH	Yes	M7	36 months	D3.1, D3.2, D3.3

Title: Integrating event stream processing in ML and analytics systems (WP3)

Objectives: Investigate how to bring in an efficient way data analytics model building and serving tightly together in a shared execution while allowing incremental (stream processing) and bulk-iterative workloads to operate in unison.

Expected Results: Algorithms and system implementations of streaming components of data analytics and ML integrated on data analytics and ML frameworks.

Planned secondment(s): Ryax (Georgiou), M22 (3M), understanding challenges and industry practice of large-scale live data analytics

PhD: Primary supervisor: V, Gulisano (P. Tsigas); secondary: D. Tsoumakos; industrial mentor: Y, Georgiou

DC4	ICCS	Yes	M7	36 months	D2.1, D2.2, D2.3

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[59] https://www.qub.ac.uk/News/Allnews/QueensUniversitypledgesmulti-millionpoundsustainabilityactionplan.html

Title: Data-centric analytics modelling for complex tasks (WP2)		Associated with document Ref. Ares(2022)5107230 - 13/07/2022			

Objectives: Many analytics tasks require multiple input datasets, the number of possible combinations and the subsequent search space for the most profitable ones increase exponentially. Moreover, real-life tasks usually require long, complex or ad-hoc compositions of simpler tasks into workflows. This renders the estimation of the right input data that qualitatively optimize an arbitrary workflow a very obscure task. In this task we plan on addressing the aforementioned challenges: Study the problem of creating accurate models that connect structural, semantic and operational data features with the performance of complex analytics tasks and workflows, especially given that data sources are distributed, created and updated.

Expected Results: Develop algorithms and tools that create performance models for analytics workflows as well as multi-input tasks. Efficient design and implementation for data which reside in different physical locations.

Planned secondment(s): MDBS, M22 (3M), exposure in diverse and real-life analytics scenarios and application of the designed techniques to boost performance and cost trade-offs

PhD: ICCS. Primary supervisor: D. Tsoumakos; secondary: D. Gregg (TCD); industrial mentor: Y. Zhang

DC5	ICCS	Yes	M7	36 months	D1.1, D1.2, D1.3

Title: Analytics modelling over uncertain and variable data inputs (WP1)

Objectives: Data sources may regularly exhibit varying levels of uncertainty such as noise and missing attributes. The relationship between data uncertainty and its impact on analytics performance is still cryptic. Similarly, data velocity is a regular source of complexity in analytics. In this task, we plan on addressing the challenging aspects of data uncertainty and data churn in view of a content-centric approach; namely, we wish to define and implement appropriate methods and tools that model, maintain in real time and help analysts select multiple data inputs that change in different aspects and/or contain varying degrees of uncertainty.

Expected Results: Develop algorithms and tools that create performance models for analytics tasks over multiple possible inputs that exhibit varying degrees of i) churn and ii) uncertainty

Planned secondment(s): VAIX, M22 (3M), exposure in real-world analytics loads that require accurate training and analytics predictions under stringent deadlines.

PhD: ICCS. Primary supervisor: D. Tsoumakos; secondary: I. Assent; industrial mentor: K. Bitsakos

DC6	TCD	Yes	M7	36 months	D1.1, D1.2, D1.3

Title: Numeric Accuracy and Reproducibility in Deep Learning Training and Inference (WP1)

Objectives: Different versions of machine-learning hardware and software typically yield slightly different answers due to differences in floating point order of evaluation. The result is often poorer accuracy, or the same overall accuracy but different classifications between the two implementations, with unpredictable results. The goal of this work is to develop methods for trained models with sharper distinctions between classifications so that the model is more resilient to minor changes.

Expected Results: Statistical methods, algorithms and implementation for multi-objective optimization; notations to describe the order of evaluation and bounds on the range of results from each implementation; adversarial and adversarial measures of sensitivity to perturbation.

Planned secondment(s): UBO, M22 (3M), optimising visual speech recognition (audio+video) on hand-held devices by using reduced precision arithmetic and specialisation of DNN to data sets

PhD: TCD. Primary supervisor: D. Gregg; secondary: D. Padmanabhan; industrial mentor: J. Byrne

DC7	TCD	Yes	M7	36 months	D3.1, D3.2, D3.3

Title: Arithmetic and Number Systems for Deep Learning (WP3)

Objectives: Developing numeric types that match value distributions and operations of training better than existing default types. Identify number systems that make better use of limited encodings for both inference and training. Investigate domain-specific and application-specific number systems and encodings for improved compactness and customize the level of precision of data to the movement of the data within the parallel/distributed computing system.

Expected Results: Improved representations that better match value distributions and changes in values during training. Domain-specific and problem-specific number systems that improve encoding density and reduce data movement. Principled analytic approach to customizing precision to the level the memory hierarchy and the movement of distributed data.

Planned secondment(s): UBO, M22 (3M), optimising image and pattern recognition in low-power embedded systems using reduced-precision data representation

PhD: TCD. Primary supervisor: D. Gregg; secondary: H. Vandierendonck; industrial mentor: J. Byrne

DC8	AU	Yes	M7	36 months	D1.1, D1.2, D1.3

Title: Transparent Data Management and Verification (WP1)

Objectives: Advanced transparency and verification methods beyond XAI (Explainable Artificial Intelligence) approaches for core data analytics functionality only. We create holistic end-to-end descriptions and interactions with data-intensive applications, contributing new concepts, methods and algorithms for transparent data science that allow users to verify and transparently explore the impact of data quality as well as of data science design and modelling decisions on system results.

Expected Results: Transparency and explanation models and algorithms for data-intensive systems that integrate with XAI approaches, but cover the entire design and development process of data-intensive applications.

Planned secondment(s): DMJX, M22 (3M), practical evaluation and contribution to explainable artificial intelligence tools and content in journalism and general audience dissemination

PhD: AU. Primary supervisor: I. Assent; secondary: T. S. Mai (QUB); industrial mentor: H. Aggerholm

DC9	AU	Yes	M7	36 months	D1.1, D1.2, D1.3

Title: Interaction techniques for adaptable models and streaming data systems (WP1)

Objectives: Maintenance, changing tasks, dynamically varying and streaming data, collaborative tasks

Unlike existing solutions for XAI that assume standardized systems in stable environments, we devise methods that semi-automatically adapt to dynamic changes in batch and streaming data, and that provide the means for interactive updates, suitable interfaces and active learning mechanisms for modern data analysis and XAI.
Expected Results: Active learning models for interactive analytics and XAI models, incremental update mechanisms and adaption strategies for dynamically changing data (streams)

Planned secondment(s): FZJ M22 (4M), interactive analysis application in a dynamic scientific environment with needs for XAI techniques; interdisciplinary data science challenges

PhD: AU. Primary supervisor: I. Assent; secondary: V. Gulisano; industrial mentor: FZJ

DC10	QUB UK-funded	Yes	M7	36 months	D2.1, D2.2, D2.3

Title: Real-time Streaming Analytics for Urban Mobility (WP2)

Objectives: Develop high-throughput analytics for high-velocity streams of heterogeneous data from urban mobility scenarios, in order to develop application-specific trade-offs between accuracy and performance to underpin mobility applications such as traffic routing and real-time spatial provisioning of shared resources.

Expected Results: Algorithms and indexing structures for high-throughput analytics, which would be published in top data science avenues.

Planned secondment(s): BSEC, M22 (3M), training on practical data scenarios and benchmarking over real-world datasets for urban data

PhD: QUB. Primary supervisor: D. Padmanabhan; secondary: M. Papatriantafilou (CTH); industrial mentor: A. Conlon

DC11	QUB UK-funded	Yes	M7	36 months	D3.1, D3.2, D3.3

Title: Interactive and Intelligent exploration of big complex data (WP3)

Objectives: Investigate novel data explorations techniques to cope with very large and dynamic complex data such as graphs, trajectories or texts including (i) anytime approximation techniques for efficient data explorations, (ii) efficient techniques to deal with dynamic data such as transaction data or streaming data, (iii) scalable parallel processing approaches for data exploration on modern hardware architectures with high-throughput and low workload.

Expected Results: Intelligent data exploration methods that automatically learn the intrinsic structure of the data to derive results more efficient and effective; anytime approximation techniques that can work under arbitrary time constraints; work-efficient parallel processing methods on shared memory and distributed systems; and incremental data exploration techniques to cope with dynamic data.

Planned secondment(s): Ryax, M21 (4M), explore real-world applications and large-scale graph data benchmarks; application of research to knowledge graph processing

PhD: QUB. Primary supervisor: T. S. Mai (Vandierendonck); secondary: I. Assent (AU); industrial mentor: Y. Georgiou

DC12	QUB UK-funded	Yes	M7	36 months	D3.1, D3.2, D3.3

Title: Application-Aware Relaxed Synchronisation for Distributed Graph Processing (WP3)

Objectives: Investigating and improving relaxed synchronisation in distributed graph processing; designing relaxed synchronisation algorithms based on monotonicity of graph analytic algorithms; designing communication schemes that minimise redundant work; deriving properties of graph analytics problems that enhance relaxation.

Expected Results: Relaxed scheduling and communication algorithms; prototype implementation

Planned secondment: AE, M22 (3M), real-world analytics data and problems for the vehicular and transportation areas.

PhD: QUB. Primary supervisor: H. Vandierendonck; secondary: Ph. Tsigas (CTH); industrial mentor: S. Fischaber

3.2   Appropriateness of the management structures and procedures

3.2.1 Network Organization and Management Structure

The **Coordinator** (CTH) is responsible for project management and implementation. He is in charge of communication with the PO and will be supported by the Research Support Office and Finance Office at CTH.

The **Supervisory Board** (SB) is in charge of all important decisions and contains representation from all participating organisations and the DCs. Details are described in Section 3.2.2.

A number of sub-committees of the SB, each lead by a partner nominated in the CA, will lead different aspects of the RELAX DN:

● The **Scientific Committee (SC),** responsible for achieving the scientific goals of the project and the coherence between work packages, and assisted by the WP leads.

● The **Training and Doctoral Studies Committee (TDSC),** leading the planning and quality monitoring

of the training activities and secondments.

- The **Communication, Dissemination and Exploitation Committee (CDEC)**, leading the planning, execution and quality monitoring of communication and public engagement activities, scientific dissemination, and exploitation.
- The **DC committee**, providing a platform for gathering DC input and feedback, and for organising DC-lead activities, including joint research, public engagement, and exploitation. The PM will check and record outreach and dissemination activities.
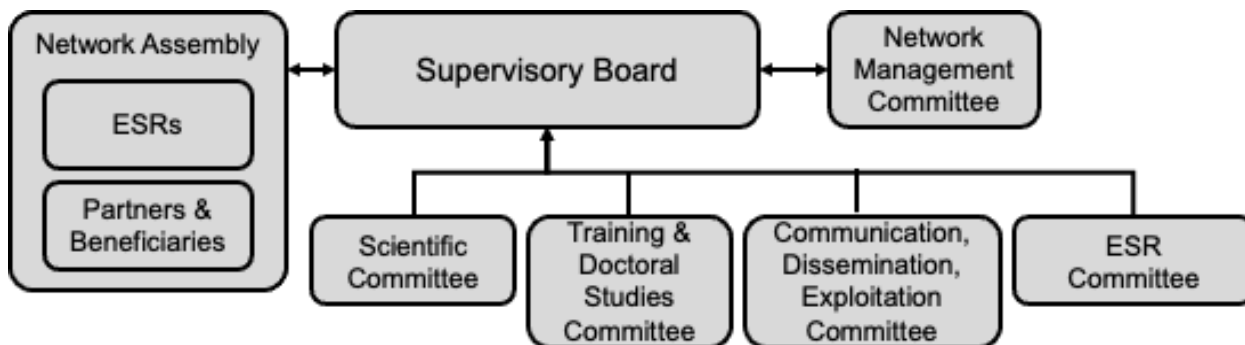

Figure 3.2a: Network management committees

A **Quality Management** Plan is drafted by the Coordinator and will be circulated in advance of the first Network Assembly meeting for approval. The Quality Management Plan will be **maintained throughout the period of the programme** and will ensure a common team language and protocol and facilitate **risk management**. It will contain as a minimum, procedures for DC project management, reporting, and communication.

The **Network Management Committee** consists of the Coordinator's PI, Philippas Tsigas and a dedicated project manager at Chalmers' Grants Office (GO). Grants Office consists of experienced staff specialized in EU-framework programmes, project management, financial management and legal issues. This guarantees that competent support will be available for any issues that might arise during the implementation of the project. The project manager will ensure that all beneficiaries, partners and DCs will be informed about their rights and obligations, mainly in relation to the recruitment and employment conditions of the DCs. A project management Handbook with templates for Deliverables and reports, guidelines for internal communication and collaboration will be handed out to the project participants. This will also serve as base for the **Quality Management Plan** (including risk management) that will be approved by the SB. In addition, an independent **Ethics Advisor** will join the network management committee.

A **conflict resolution strategy** will be outlined in the Consortium Agreement and disputes will be notified to the Supervisory Board. All disagreements arising from the implementation of the CA, which cannot be amicably resolved by the SB, will be referred to arbitration in Brussels under the rules of the International Chamber of Commerce.

3.2.2 Supervisory Board (SB)
The SB consists of one representative per beneficiary, one representative per partner, and two DCs. The SB will be constituted at the kick-off of the project. The DCs will elect two representatives as soon as all DCs are recruited.

The task of the SB is to **oversee the quality of the research and training programmes**. The SB will ratify the DCs' Personal Development Plans, plan and approve secondments, plan dissemination and outreach activities, perform quality control and invite visiting researchers. The SB will **meet in-person twice per year** and will use teleconferences and e-mail at other times.

The SB is chaired and convened by the coordinator when **joint decisions** need to be made. Decisions of the SB will be **based on agreement as much as possible**.

The DCs and SB is responsible to bring any issues related to ethics and/or scientific misconduct to the attention of the independent ethics advisor.

3.2.3 Recruitment Strategy

The project will apply a **coherent recruitment strategy** across all beneficiaries that is consistent with the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers[60] to ensure the best candidates are recruited in an open, fair, supportive and efficient process. Equal opportunities and gender balance will be prioritised as we aim to hire **talented researchers from a diverse background**, with **40% female researchers**. The coordinator will monitor the process.

Job specifications highlighting the role, the required qualifications and experience, the selection criteria and application process will be developed by beneficiaries during M1. Adverts will highlight the **attractive working conditions**, family friendly policies and zero tolerance for discrimination. This approach will contribute to an open and transparent labour market for researchers, which is a key goal of the European Code of Conduct for the Recruitment of Researchers.

A **joint advertising strategy** will be deployed based on a common information leaflet and website such that all information is coherent and available in one place. Positions will be advertised using relevant forums such as EURAXESS and LinkedIn, individual participants' websites, mailing lists, direct contact with collaborators etc. Dedicated forums such as ACM's Women in Computing (ACM-W)[61] will be used to encourage more female applicants.

Selection committees and interview panels will be **balanced for gender**. The most promising applicants will be invited for Skype, telephone or face-to-face interview, and their performance scored against agreed selection criteria. For each research project, a full-time 36 month employment contract will be offered to the highest ranked candidate. A reserve list of applicants will be compiled to speed up the recruitment process in case one of the main candidates decides to withdraw.

3.2.4 Progress Monitoring and Evaluation of Individual Projects

Each academic beneficiary has its own unique processes for monitoring progress of PhD students. These include at least an annual progress review by an academic or a panel. A major intermediary milestone is required by all beneficiaries at which the PhD student is confirmed to be eligible to proceed. The terminology and timing of these processes is unique to each beneficiary, hence, integrating them in the progress monitoring of RELAX is infeasible in practice. In addition to these institutional processes, the **Supervisory Board** will track progress against the specific network goals and review all key milestones and deliverables. All DCs will convene twice per year for "Training Days", during which they will **present their research**. These presentations form the basis of a formal progress review. The key aim of this progress review is to ensure that the network goals are met, that DCs remain on track to obtain a PhD degree, and that high-quality research is conducted. Where the individual research project does not meet these goals, corrective actions will be taken by the supervisory board. The priority of these actions is to ensure successful outcomes for RELAX and for the DCs. As such, the progress review is in first instance focused on providing constructive feedback and designing actions to alleviate any discovered problems. As a matter of last resort, where no feasible route to success can be developed, the network will liaise with the institutional progress review panels to determine whether the DC can progress on the PhD programme.

The progress presentations made by the DCs moreover contribute to the training in itself (presentation skills, formulating

Key Performance Indicators
Personal Development Plan produced by DC and approved by SB
Courses and training programmes taken (type, duration, outcome)
Number of publications submitted and accepted
Joint publications across WP
Joint publications with partners
Software prototypes disseminated
Communication activities
Dissemination activities
Outreach activities
Patent applications and exploitable foreground

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[60] https://cdn2.euraxess.org/sites/default/files/brochures/am509774cee_en_e4.pdf

[61] https://women.acm.org

peer feedback, engaging in scientific discourse), promote collaboration and joint supervision, and enable the assessment of progress in research and training. **The research, dissemination and exploitation plans, and Personal Development Programmes will be reviewed rigorously** by the Supervisory Board based on the presentations and a question and answer session. These evaluations will feed into the formal evaluation performed for mid-term and final reporting on the network. The evaluations will combine academic judgement with monitoring of Key Performance Indicators (see Table).
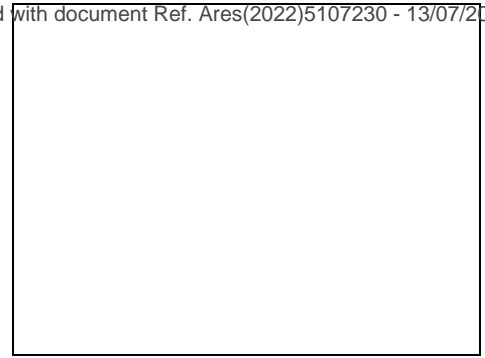
3.2.5 Risk Management at Consortium Level

Risk management is an integral part of the execution process of RELAX. Significant risks have been identified and understood during project preparation, and have been considered when selecting partners, preparing our work plan and adopting a cyclic, review-based execution process (see 3.2.1-3.2.4 above). By the quality of the consortium, the careful work plan and the management structure described above, it will be possible to detect signs of problems early and thereby have time for necessary steps to be taken. All beneficiaries are large, successful organisations with a **track record in European-funded research**, which minimises recruitment and management risks. An **initial risk register** has been constructed (see Part A of the Description of Action) and will be **reviewed every 6 months** by the Network Management Committee to monitor known risks and to log any new risks. A major update will be undertaken by month 12, at which time agreements on training delivery, secondments, co-supervision, mentor assignment, etc, will have been confirmed. Consortium members undertake to notify the Project Coordinator as soon as they are aware of any event that could impact the success of the project. Any significant deviations will be agreed in advance with the Project Officer.

3.2.7 Gender Aspects

This DN aims to recruit 40% female DCs. To this end, it will design gender-neutral adverts, set up gender-balanced selection panels and promote female- and family-friendly initiatives

RELAX DCs will also receive specific training to raise awareness for gender issues and to get a better understanding of potential gender issues in the research area. The Consortium will pay specific attention that all DCs get equal opportunities to actively participate in project activities and increase their visibility at conferences and workshops (i.e., by presenting project results).

3.3 Quality, capacity and role of each participant, including hosting arrangements and extent to which the consortium as a whole brings together the necessary expertise

3.3.1 Appropriateness of the infrastructure of the participating organisations

The participating organisations possess the required facilities and computing infrastructure to execute this project, as indicated in Section 5, Part B. The financial, administrative, contractual activities and career development of Fellows of the RELAX project will be supported by the different offices of the coordinator (Research Support, Contracts, Research Development and Personnel). A dedicated project manager will be the main contact point liaising with other Beneficiaries. The CTH Grants Office will provide advice and guidance for the management of the project including the reporting. The CTH Grants Office has a dedicated EU Finance Officer who will assist in managing the financial aspects of the project according to the EC rules.

3.3.2 Consortium Composition and Exploitation of Participants' Complementarity

A holistic approach to relaxation of semantics, covering the full stack, is essential when trying to relax the semantics of applications and their components beyond the confines of their interfaces. The complexity and breadth of the "big data" problem cannot possibly be covered through a single effort. The RELAX consortium therefore focuses on **four complementary areas of specialisation** across which the participating organisations have complementary expertise: data science, data management, distributed computing, and arithmetic with compact data types. Table 3.4a summarises the contributions made by all participating organisations.

Table 3.4a Expertise and commitment of beneficiaries and partner organisations

Beneficiary	Research Activities	Training Activities
CTH	Data staleness in distributed coordination, tunable approximating aggregation and summarisation primitives (DC 4, 5)	Entrepreneurship and venture capital Lock-Free Concurrent Data Structures
ICCS	Right data prediction and selection, approximate query processing and aggregation of streams (DC 6, 7)	1-day Open School/Workshop on data analytics and tools
TCD	Robust statistics to address shortcomings of DNNs, compact and efficient computer arithmetic, portability of DNNs (DC 8, 9)	Academic integrity Data structures and algorithms for locality and SIMD parallelism
AU	Explainability and transparency for data-intensive systems with AI-based components, spanning the entire design and deployment process (DC 10)	Science Teaching, Project Management, Scientific Writing and Communication, Data Science in Python
Partner	**Expertise contributed to RELAX**	**Training Activities**
QUB	Incremental and anytime algorithms, approximation and summarisation, graph processing (DC 1, 2, and 3)	IMPACT programme; STEM Ambassador training; Gender in Research; Research methodology and literature review; Unconscious bias; Social media strategy; Python and R for Machine Learning; High-performance graph processing
VOL	Real-time data processing. Analytics in manufacturing and in the context of autonomous vehicles (on-board, off-board)	Practical data analysis, application of relaxed semantics and benchmarking over real-world data workloads
RYAX	Smart data platforms, edge computing	Scheduling analytics workflows in cloud and edge environments
MDBS	Column-oriented databases for analytics; database-as-a-service; cloud provisioning and elasticity	Scalability and elasticity of streaming in IoT/edge/cloud environments
VAIX	Domain-specific personalisation based on recommendation systems, customer behaviour prediction, chat management	Scalable data pipelines and machine learning models
UBO	Computer vision for robotic systems (Industry 4.0) based on artificial intelligence (including DNN); Deployment and optimisation of DNN for low-power mobile and embedded devices	Data processing for robotics Embedded and low-power AI
AE	Big data consultancy based on in-house platform	Big data platforms, analytics, and visualisation
DMJX	Applications of AI in journalism	AI-enhanced tools in journalism
FZJ	Efficient data management and data analysis tools support scientists in their studies.	Data-intensive research activities with direct impact on scientific practice in other research disciplines

3.3.3 Commitment of Beneficiaries and Partner Organisations to the Programme

All Beneficiaries and Partners are committed to executing the RELAX project, as indicated by the committed actions and Letters of Commitment. This commitment has grown through their participation in the development of the proposal and is based on prior collaboration or interactions. Most beneficiaries run 4-year PhD programmes and commit to acquiring funding to cover the 4th year of PhD study that is not supported by the DN programme.

4 Ethics Issues

The consortium will ensure that relevant national and EU legislation will be respected during the implementation of the research activities.

An independent Ethics Advisor will be appointed before month 6 to advise on aspects of concern in relation to ethics and 2 ethics reports will be delivered, one after each reporting period. Specific attention will be paid to potential issues that might not have been identified during the drafting of the research activities. The ethics advisor will ensure that the ethical concerns raised during the evaluation of the project will be followed rigorously. This includes the handling of personal data and protection of privacy and the design of algorithms to avoid biases or discrimination.

Compliance with ethical principles and applicable international, EU and national law in the implementation of research activities not originally envisaged (or not described in detail) in the DoA will be ensured. Any ethical concerns raised by those activities will be handled following rigorously the recommendations provided in the European Commission Ethics Self-Assessment Guidelines.

If ethical issues are identified in the planned research activities, the coordinator will ensure that approvals are applied for in the country where the research is carried out. Sensitive research activities may only start upon approval by the relevant authorities. If needed, the coordinator will, in cooperation with the ethics advisor, undertake corrective measures to fully adhere to the national and EU regulations.

To raise awareness and increase the understanding of good research practice and the ALLEA scientific conduct of conduct, the DCs will receive specific training on ethics and research integrity in one of the network-wide training sessions.

ESTIMATED BUDGET FOR THE ACTION

Forms of funding	Estimated EU contribution							Total	Maximum grant amount[1]
	Estimated eligible unit contributions (per budget category)								
	A. Contributions for recruited researchers					B. Institutional contributions			
	A.1 Living allowance	A.2 Mobility allowance	A.3 Family allowance	A.4 Long-term leave allowance	A.5 Special needs allowance	B.1 Research, training and networking contribution	B.2 Management and indirect contribution		
	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	$h = a + b + c + d + e + f + g$	i
	a	b	c	d	e	f	g		
1 - CTH	460 468.80	64 800.00	53 460.00	0.00	0.00	172 800.00	129 600.00	881 128.80	881 128.80
2 - ICCS	199 756.80	43 200.00	35 640.00	0.00	0.00	115 200.00	86 400.00	480 196.80	480 196.80
3 - TCD	292 536.00	43 200.00	35 640.00	0.00	0.00	115 200.00	86 400.00	572 976.00	572 976.00
4 - AU	323 136.00	43 200.00	35 640.00	0.00	0.00	115 200.00	86 400.00	603 576.00	603 576.00
5 - VOL									
6 - RYAX									
7 - MDBS									
8 - VAIX									
9 - UBO									
10 - AE									
11 - DMJX									
12 - BSEC									
13 - QUB									
14 - FZJ									
Σ consortium	1 275 897.60	194 400.00	160 380.00	0.00	0.00	518 400.00	388 800.00	2 537 877.60	2 537 877.60

[1] The 'maximum grant amount' is the maximum grant amount fixed in the grant agreement (on the basis of the sum of the beneficiaries' estimated units).
[2] See Annex 2a 'Additional information on the estimated budget' for the details (units, amount per unit).

<u>**ANNEX 2a**</u>

ADDITIONAL INFORMATION ON UNIT COSTS AND CONTRIBUTIONS

<u>HE MSCA Doctoral Networks/Post-doctoral Fellowships and HE ERA Fellowships</u>[1]

Contributions for recruited researchers — Living allowance

<u>Type</u>: unit contributions

<u>Units</u>: months spent by the researcher(s) on the research training activities (person-months)

<u>Amount per unit</u>*: see Annex 2

> * Amount calculated as follows:
>> {the monthly living allowance for researchers in MSCA-PF/MSCA-DN and ERA Fellowship actions
>> multiplied by
>> country-specific correction coefficient of *[OPTION by default:* the country in which the researcher is recruited*][OPTION for PF-Global Fellowships:* the country where the associated partner hosting the researcher during the outgoing phase is located and the country in which the researcher is recruited (for the return phase and placements)*]*}

The monthly living allowance and the country-specific correction coefficients are set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call:
- for the monthly living allowance:
  - PF and ERA Fellowships: EUR 5 080
  - DN: EUR 3 400
- for the country-specific correction coefficients: see Work Programme (available on the Funding & Tenders Portal Reference Documents page).

Contributions for recruited researchers — Mobility allowance

<u>Type</u>: unit contributions

<u>Units</u>: months spent by the researcher(s) on the research training activities (person-months)

<u>Amount per unit</u>[2]: see Annex 2

Contributions for recruited researchers — Family allowance

<u>Type</u>: unit contributions

<u>Units</u>: months spent by the researcher(s) on the research training activities (person-months)

<u>Amount per unit</u>[3]: see Annex 2

Contributions for recruited researchers — Long-term leave allowance

<u>Type</u>: unit contributions

<u>Units</u>: months spent by the researcher(s) on long-term leave (person-months)

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[1]   Decision of 16 March 2021 authorising the use of lump sum contributions and unit contributions for Marie Skłodowska-Curie actions under the Horizon Europe Programme.
[2]   Same amount for all beneficiaries.
    Amount for the mobility allowance set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).
[3]   Same amount for all beneficiaries.
    Average based on the amount for the family allowance set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (75% of the number of units with family, 25% without).

Amount per unit*: see Annex 2

> *Amount calculated as follows:
> {long-term leave allowance (i.e. the sum of the applicable living allowance and mobility allowance)
> multiplied by
> percentage of long-term leave allowance incurred by the beneficiary (i.e. costs incurred by the beneficiary divided by the long-term leave allowance)
> multiplied by
> number of months}

Contributions for recruited researchers — Special needs allowance

Type: unit contributions

Units: number of special needs units (per recruited researcher) that were needed for implementing the action (person-months)

Amount per unit*: see Annex 2

> *Amount calculated as follows:
> {requested special needs unit
> multiplied by
> (1/number of months)}

The pre-defined special needs units are: EUR 3 000, EUR 4 500, EUR 6 000, EUR 9 500, EUR 13 000, EUR 18 500, EUR 27 500, EUR 35 500, EUR 47 500 and EUR 60 000.

Institutional contributions — Research, training and networking contribution

Type: unit contributions

Units: months spent by the researcher(s) on the research training activities (person-months)

Amount per unit[4]: see Annex 2

Institutional contributions — Management and indirect contribution

Type: unit contributions

Units: months spent by the researcher(s) on the research training activities (person-months)

Amount per unit[5]: see Annex 2

HE MSCA Staff Exchanges[6]

Contributions for seconded staff — Top-up allowance

Type: unit contributions

Units: months spent by the seconded staff member(s) on the research and innovation activities (person-months)

Amount per unit[7]: see Annex 2

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[4] Same amount for all beneficiaries.
Amount for research, training and networking contribution set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).

[5] Same amount for all beneficiaries.
Amount for management and indirect contribution set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).

[6] Decision of 16 March 2021 authorising the use of lump sum contributions and unit contributions for Marie Skłodowska-Curie actions under the Horizon Europe Programme.

[7] Same amount for all beneficiaries.
Amount for the top-up allowance set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).

Contributions for seconded staff — Special needs allowance

Type: unit contributions

Units: number of special needs units (per seconded staff member) that were needed for implementing the action (person-months)

Amount per unit*: see Annex 2

> *Amount calculated as follows:
> {requested special needs unit
> multiplied by
> (1/number of months)}

The pre-defined special needs units are: EUR 3 000, EUR 4 500, EUR 6 000, EUR 9 500, EUR 13 000, EUR 18 500, EUR 27 500, EUR 35 500, EUR 47 500 and EUR 60 000.

Institutional contributions — Research, training and networking contribution

Type: unit contributions

Units: months spent by the seconded staff member(s) on the research and innovation activities (person-months)

Amount per unit[8]: see Annex 2

Institutional contributions — Management and indirect contribution

Type: unit contributions

Units: months spent by the seconded staff member(s) on the research and innovation activities (person-months)

Amount per unit[9]: see Annex 2

HE MSCA COFUND[10]

COFUND contributions — COFUND allowance

Type: unit contributions

Units: months spent by the researchers on the research training activities (person-months)

Amount per unit[11]: see Annex 2

COFUND contributions — Long-term leave allowance

Type: unit contributions

Units: months spent by the researcher(s) on long-term leave ('person-months')

Amount per unit*: see Annex 2

> *Amount calculated as follows:
> {long-term leave allowance (i.e. the applicable COFUND allowance)

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[8] Same amount for all beneficiaries.
   Amount for research, training and networking contribution set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).
[9] Same amount for all beneficiaries.
   Amount for management and indirect contribution set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).
[10] Decision of 16 March 2021 authorising the use of lump sum contributions and unit contributions for Marie Skłodowska-Curie actions under the Horizon Europe Programme.
[11] Same amount for all beneficiaries.
   Amount for the COFUND allowance set out in the Horizon Europe Work Programme (MSCA Work Programme part) in force at the time of the call (available on the Funding & Tenders Portal Reference Documents page).

multiplied by
percentage of long-term leave allowance incurred by the beneficiary (i.e. costs incurred by the beneficiary divided by the long-term leave allowance)
multiplied by
number of months}

COFUND contributions — Special needs allowance

Type: unit contributions

Units: number of special needs units (per recruited researcher) that were needed for implementing the action ('person-months')

Amount per unit*: see Annex 2

> *Amount calculated as follows:
> {requested special needs unit
> multiplied by
> (1/number of months)}

The pre-defined special needs units are: EUR 3 000, EUR 4 500, EUR 6 000, EUR 9 500, EUR 13 000, EUR 18 500, EUR 27 500, EUR 35 500, EUR 47 500 and EUR 60 000.

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS (ICCS), PIC 999654356, established in Patission Str. 42, ATHINA 10682, Greece,

hereby agrees

to become beneficiary

in Agreement No 101072456 — RELAX ('the Agreement')

between CHALMERS TEKNISKA HOGSKOLA AB (CTH) **and** the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

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 terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN (TCD), PIC 999845446, established in COLLEGE GREEN TRINITY COLLEGE, DUBLIN 2 D02 CX56, Ireland,

hereby agrees

to become beneficiary

in Agreement No 101072456 — RELAX ('the Agreement')

between CHALMERS TEKNISKA HOGSKOLA AB (CTH) **and** the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

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 terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AARHUS UNIVERSITET (AU), PIC 999997736, established in NORDRE RINGGADE 1, AARHUS C 8000, Denmark,

hereby agrees

to become beneficiary

in Agreement No 101072456 — RELAX ('the Agreement')

between CHALMERS TEKNISKA HOGSKOLA AB (CTH) **and** the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

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 terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 4 HORIZON EUROPE MSCA UNIT MGA — MULTI + MONO

FINANCIAL STATEMENT FOR [PARTICIPANT NAME] FOR REPORTING PERIOD [NUMBER]

	EU contribution								
	Eligible unit contributions (per budget category)							Total	Requested EU contribution
	[OPTION for all MSCA ToA except COFUND: **A. . Contributions for** *[recruited researchers] [seconded staff members]][OPTION for COFUND:* **A. COFUND contributions]**					*[OPTION for all MSCA ToA except COFUND:* **B. Institutional contributions]**			
	[OPTION for DN and PF : A.1 Living allowance] *[OPTION for SE:* A.1 Top - up allowance] *[OPTION for COFUND:* A.1 COFUND allowance]	*[OPTION for DN and PF:* A.2 Mobility allowance]	*[OPTION for DN and PF:* A.3 Family allowance]	*[OPTION for all MSCA ToA except SE:* A.4 Long-term leave allowance]	A.5 Special needs allowance	*[* B.1 Research, training and networking contribution]	*[* B.2 Management and indirect contribution]		
Forms of funding	Unit contribution [1]	*[* Unit contribution [1] *]*	*[* Unit contribution [1] *]*	*[* Unit contribution [1] *]*	Unit contribution [1]	*[* Unit contribution [1] *]*	*[* Unit contribution [1] *]*	h = a *[* + b *][* + c] *[* + d] + e *[* + f] *[* + g]	i
	a	*[* b]	*[* c]	*[* d]	e	*[* f]	*[* g]		
XX – [short name beneficiary/affiliated entity]									

The beneficiary/affiliated entity hereby confirms that:
The information provided is complete, reliable and true.
The unit contributions declared are eligible (see Article 6).
The contributions 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 19, 20 and 25).

[1] See Annex 2a 'Additional information on the estimated budget' for the details (units, amount per unit).

SPECIFIC RULES

<u>**CONFIDENTIALITY AND SECURITY (— ARTICLE 13)**</u>

Sensitive information with security recommendation

Sensitive information with a security recommendation must comply with the additional requirements imposed by the granting authority.

Before starting the action tasks concerned, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task. The documents must be kept on file and be submitted upon request by the coordinator to the granting authority. If they are not in English, they must be submitted together with an English summary.

For requirements restricting disclosure or dissemination, the information must be handled in accordance with the recommendation and may be disclosed or disseminated only after written approval from the granting authority.

EU classified information

If EU classified information is used or generated by the action, it must be treated in accordance with the security classification guide (SCG) and security aspect letter (SAL) set out in Annex 1 and Decision 2015/444[1] and its implementing rules — until it is declassified.

Deliverables which contain EU classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving EU classified information may be subcontracted only with prior explicit written approval from the granting authority and only to entities established in an EU Member State or in a non-EU country with a security of information agreement with the EU (or an administrative arrangement with the Commission).

EU classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

<u>**ETHICS (— ARTICLE 14)**</u>

Ethics and research integrity

The beneficiaries must carry out the action in compliance with:

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

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[1] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

and

- applicable EU, international and national law, including the EU Charter of Fundamental Rights and the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Supplementary Protocols.

No funding can be granted, within or outside the EU, for activities that are prohibited in all Member States. No funding can be granted in a Member State for an activity which is forbidden in that Member State.

The beneficiaries must pay particular attention to the principle of proportionality, the right to privacy, the right to the protection of personal data, the right to the physical and mental integrity of persons, the right to non-discrimination, the need to ensure protection of the environment and high levels of human health protection.

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:

- aim at human cloning for reproductive purposes

- intend to modify the genetic heritage of human beings which could make such modifications heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed)

- 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, or

- lead to the destruction of human embryos (for example, for obtaining stem cells).

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

- they are set out in Annex 1 or

- the coordinator has obtained explicit approval (in writing) from the granting authority.

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out in the European Code of Conduct for Research Integrity[2].

This implies compliance with the following 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

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[2] European Code of Conduct for Research Integrity of ALLEA (All European Academies).

- 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 including ensuring, where possible, openness, reproducibility and traceability and refrain from the research integrity violations described in the Code.

Activities raising ethical issues must comply with the additional requirements formulated by the ethics panels (including after checks, reviews or audits; see Article 25).

Before starting an action task raising ethical issues, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task, notably from any (national or local) ethics committee or other bodies such as data protection authorities.

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

VALUES (— ARTICLE 14)

Gender mainstreaming

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action and, where applicable, in line with the gender equality plan. 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.

INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS — ACCESS RIGHTS AND RIGHTS OF USE (— ARTICLE 16)

Definitions

Access rights — Rights to use results or background.

Dissemination — The public disclosure of the results by appropriate means, other than resulting from protecting or exploiting the results, including by scientific publications in any medium.

Exploit(ation) — The use of results in further research and innovation activities other than those covered by the action concerned, including among other things, commercial exploitation such as developing, creating, manufacturing and marketing a product or process, creating and providing a service, or in standardisation activities.

Fair and reasonable conditions — 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.

FAIR principles — 'findability', 'accessibility', 'interoperability' and 'reusability'.

Open access — Online access to research outputs provided free of charge to the end-user.

Open science — An approach to the scientific process based on open cooperative work, tools and diffusing knowledge.

Research data management — The process within the research lifecycle that includes the organisation, storage, preservation, security, quality assurance, allocation of persistent identifiers (PIDs) and rules and procedures for sharing of data including licensing.

Research outputs — Results to which access can be given in the form of scientific publications, data or other engineered results and processes such as software, algorithms, protocols, models, workflows and electronic notebooks.

Scope of the obligations

For this section, references to 'beneficiary' or 'beneficiaries' do not include affiliated entities (if any).

Agreement on background

The beneficiaries must identify in a written agreement the background as needed for implementing the action or for exploiting its results.

Where the call conditions restrict control due to strategic interests reasons, background that is subject to control or other restrictions by a country (or entity from a country) which is not one of the eligible countries or target countries set out in the call conditions and that impact the exploitation of the results (i.e. would make the exploitation of the results subject to control or restrictions) must not be used and must be explicitly excluded from it in the agreement on background — unless otherwise agreed with the granting authority.

Ownership of results

Results are owned by the beneficiaries that generate them.

However, two or more beneficiaries own results jointly if:

- they have jointly generated them and

- it is not possible to:

    - establish the respective contribution of each beneficiary, or

    - separate them for the purpose of applying for, obtaining or maintaining their protection.

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

- at least 45 days advance notice and

- fair and reasonable compensation.

The joint owners may agree — in writing — to apply another regime than joint ownership.

If third parties (including employees and other personnel) may claim rights to the results, the beneficiary concerned must ensure that those rights can be exercised in a manner compatible with its obligations under the Agreement.

The beneficiaries must indicate the owner(s) of the results (results ownership list) in the final periodic report.

Protection of results

Beneficiaries which have received funding under the grant must adequately protect their results — for an appropriate period and with appropriate territorial coverage — if protection is possible and justified, taking into account all relevant considerations, including the prospects for commercial exploitation, the legitimate interests of the other beneficiaries and any other legitimate interests.

Exploitation of results

Beneficiaries which have received funding under the grant must — up to four years after the end of the action (see Data Sheet, Point 1) — use their best efforts to exploit their results directly or to have them exploited indirectly by another entity, in particular through transfer or licensing.

If, despite a beneficiary's best efforts, the results are not exploited within one year after the end of the action, the beneficiaries must (unless otherwise agreed in writing with the granting authority) use the Horizon Results Platform to find interested parties to exploit the results.

If results are incorporated in a standard, the beneficiaries must (unless otherwise agreed with the granting authority or unless it is impossible) ask the standardisation body to include the funding statement (see Article 17) in (information related to) the standard.

Additional exploitation obligations

Where the call conditions impose additional exploitation obligations (including obligations linked to the restriction of participation or control due to strategic assets, interests, autonomy or security reasons), the beneficiaries must comply with them — up to four years after the end of the action (see Data Sheet, Point 1).

Where the call conditions impose additional exploitation obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) grant for a limited period of time specified in the request, non-exclusive licences — under fair and reasonable conditions — to their results to legal entities that need the results to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at

fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Additional information obligation relating to standards

Where the call conditions impose additional information obligations relating to possible standardisation, the beneficiaries must — up to four years after the end of the action (see Data Sheet, Point 1) — inform the granting authority, if the results could reasonably be expected to contribute to European or international standards.

Transfer and licensing of results

Transfer of ownership

The beneficiaries may transfer ownership of their results, provided this does not affect compliance with their obligations under the Agreement.

The beneficiaries must ensure that their obligations under the Agreement regarding their results are passed on to the new owner and that this new owner has the obligation to pass them on in any subsequent transfer.

Moreover, they must inform the other beneficiaries with access rights of the transfer at least 45 days in advance (or less if agreed in writing), unless agreed otherwise in writing for specifically identified third parties including affiliated entities or unless impossible under the applicable law. This notification must include sufficient information on the new owner to enable the beneficiaries concerned to assess the effects on their access rights. The beneficiaries may object within 30 days of receiving notification (or less if agreed in writing), if they can show that the transfer would adversely affect their access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

Granting licences

The beneficiaries may grant licences to their results (or otherwise give the right to exploit them), including on an exclusive basis, provided this does not affect compliance with their obligations.

Exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights.

Granting authority right to object to transfers or licensing — Horizon Europe actions

Where the call conditions in Horizon Europe actions provide for the right to object to transfers or licensing, the granting authority may — up to four years after the end of the action (see Data Sheet, Point 1) — object to a transfer of ownership or the exclusive licensing of results, if:

- the beneficiaries which generated the results have received funding under the grant

- it is to a legal entity established in a non-EU country not associated with Horizon Europe, and

- the granting authority considers that the transfer or licence is not in line with EU interests.

Beneficiaries that intend to transfer ownership or grant an exclusive licence must formally notify the granting authority before the intended transfer or licensing takes place and:

- identify the specific results concerned

- describe in detail the new owner or licensee and the planned or potential exploitation of the results, and

- include a reasoned assessment of the likely impact of the transfer or licence on EU interests, in particular regarding competitiveness as well as consistency with ethical principles and security considerations.

The granting authority may request additional information.

If the granting authority decides to object to a transfer or exclusive licence, it must formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information it has requested).

No transfer or licensing may take place in the following cases:

- pending the granting authority decision, within the period set out above

- if the granting authority objects

- until the conditions are complied with, if the granting authority objection comes with conditions.

A beneficiary may formally notify a request to waive the right to object regarding intended transfers or grants to a specifically identified third party, if measures safeguarding EU interests are in place. If the granting authority agrees, it will formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information requested).

Limitations to transfers and licensing due to strategic assets, interests, autonomy or security reasons of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security reasons, the beneficiaries may not transfer ownership of their results or grant licences to third parties which are established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless they have requested and received prior approval by the granting authority.

The request must:

- identify the specific results concerned

- describe in detail the new owner and the planned or potential exploitation of the results, and

- include a reasoned assessment of the likely impact of the transfer or license on the strategic assets, interests, autonomy or security of the EU and its Member States.

7

The granting authority may request additional information.

Access rights to results and background

Exercise of access rights — Waiving of access rights — No sub-licensing

Requests to exercise access rights and the waiver of access rights must be in writing.

Unless agreed otherwise in writing with the beneficiary granting access, access rights do not include the right to sub-license.

If a beneficiary is no longer involved in the action, this does not affect its obligations to grant access.

If a beneficiary defaults on its obligations, the beneficiaries may agree that that beneficiary no longer has access rights.

Access rights for implementing the action

The beneficiaries must grant 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 —:

- informed the other beneficiaries that access to its background is subject to restrictions, or

- agreed with the other beneficiaries that access would not be on a royalty-free basis.

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

Access rights for exploiting the results

The beneficiaries must grant each other access — under fair and reasonable conditions — to results needed for exploiting their results.

The beneficiaries must grant each other access — under fair and reasonable conditions — to background needed for exploiting their 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 restrictions.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for entities under the same control

Unless agreed otherwise in writing by the beneficiaries, access to results and, subject to the restrictions referred to above (if any), background must also be granted — under fair and reasonable conditions — to entities that:

- are established in an EU Member State or Horizon Europe associated country

- are under the direct or indirect control of another beneficiary, or under the same direct or indirect control as that beneficiary, or directly or indirectly controlling that beneficiary and

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- need the access to exploit the results of that beneficiary.

Unless agreed otherwise in writing, such requests for access must be made by the entity directly to the beneficiary concerned.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for the granting authority, EU institutions, bodies, offices or agencies and national authorities to results for policy purposes — Horizon Europe actions

In Horizon Europe actions, the beneficiaries which have received funding under the grant must grant access to their results — on a royalty-free basis — to the granting authority, EU institutions, bodies, offices or agencies for developing, implementing and monitoring EU policies or programmes. Such access rights do not extend to beneficiaries' background.

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

For actions under the cluster 'Civil Security for Society', such access rights also extend to national authorities of EU Member States for developing, implementing and monitoring their policies or programmes in this area. In this case, access is subject to a bilateral agreement to define specific conditions ensuring that:

- the access rights will be used only for the intended purpose and

- appropriate confidentiality obligations are in place.

Moreover, the requesting national authority or EU institution, body, office or agency (including the granting authority) must inform all other national authorities of such a request.

Additional access rights

Where the call conditions impose additional access rights, the beneficiaries must comply with them.

COMMUNICATION, DISSEMINATION, OPEN SCIENCE AND VISIBILITY (— ARTICLE 17)

Dissemination

Dissemination of results

The beneficiaries must disseminate their results as soon as feasible, in a publicly available format, subject to any restrictions due to the protection of intellectual property, security rules or legitimate interests.

A beneficiary that intends to disseminate its results must give at least 15 days advance notice to the other beneficiaries (unless agreed otherwise), together with sufficient information on the results it will disseminate.

Any other beneficiary may object within (unless agreed otherwise) 15 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 results may not be disseminated unless appropriate steps are taken to safeguard those interests.

Additional dissemination obligations

Where the call conditions impose additional dissemination obligations, the beneficiaries must also comply with those.

Open Science

Open science: open access to scientific publications

The beneficiaries must ensure open access to peer-reviewed scientific publications relating to their results. In particular, they must ensure that:

- at the latest at the time of publication, a machine-readable electronic copy of the published version or the final peer-reviewed manuscript accepted for publication, is deposited in a trusted repository for scientific publications

- immediate open access is provided to the deposited publication via the repository, under the latest available version of the Creative Commons Attribution International Public Licence (CC BY) or a licence with equivalent rights; for monographs and other long-text formats, the licence may exclude commercial uses and derivative works (e.g. CC BY-NC, CC BY-ND) and

- information is given via the repository about any research output or any other tools and instruments needed to validate the conclusions of the scientific publication.

Beneficiaries (or authors) must retain sufficient intellectual property rights to comply with the open access requirements.

Metadata of deposited publications must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent, in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: publication (author(s), title, date of publication, publication venue); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the publication, the authors involved in the action and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for any research output or any other tools and instruments needed to validate the conclusions of the publication.

Open science: research data management

The beneficiaries must manage the digital research data generated in the action ('data') responsibly, in line with the FAIR principles and by taking all of the following actions:

- establish a data management plan ('DMP') (and regularly update it)

- as soon as possible and within the deadlines set out in the DMP, deposit the data in a trusted repository; if required in the call conditions, this repository must be federated in the EOSC in compliance with EOSC requirements

- as soon as possible and within the deadlines set out in the DMP, ensure open access — via the repository — to the deposited data, under the latest available version of the Creative Commons Attribution International Public License (CC BY) or Creative Commons Public Domain Dedication (CC 0) or a licence with equivalent rights,

following the principle 'as open as possible as closed as necessary', unless providing open access would in particular:

- be against the beneficiary's legitimate interests, including regarding commercial exploitation, or

- be contrary to any other constraints, in particular the EU competitive interests or the beneficiary's obligations under this Agreement; if open access is not provided (to some or all data), this must be justified in the DMP

- provide information via the repository about any research output or any other tools and instruments needed to re-use or validate the data.

Metadata of deposited data must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: datasets (description, date of deposit, author(s), venue and embargo); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the dataset, the authors involved in the action, and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for related publications and other research outputs.

Open science: additional practices

Where the call conditions impose additional obligations regarding open science practices, the beneficiaries must also comply with those.

Where the call conditions impose additional obligations regarding the validation of scientific publications, the beneficiaries must provide (digital or physical) access to data or other results needed for validation of the conclusions of scientific publications, to the extent that their legitimate interests or constraints are safeguarded (and unless they already provided the (open) access at publication).

Where the call conditions impose additional open science obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) immediately deposit any research output in a repository and provide open access to it under a CC BY licence, a Public Domain Dedication (CC 0) or equivalent. As an exception, if the access would be against the beneficiaries' legitimate interests, the beneficiaries must grant non-exclusive licenses — under fair and reasonable conditions — to legal entities that need the research output to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Plan for the exploitation and dissemination of results including communication activities

Unless excluded by the call conditions, the beneficiaries must provide and regularly update a plan for the exploitation and dissemination of results including communication activities.

SPECIFIC RULES FOR CARRYING OUT THE ACTION (— ARTICLE 18)

Implementation in case of restrictions due to strategic assets, interests, autonomy or security of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security, the beneficiaries must ensure that none of the entities that participate as affiliated entities, associated partners, subcontractors or recipients of financial support to third parties are established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless otherwise agreed with the granting authority.

The beneficiaries must moreover ensure that any cooperation with entities established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) does not affect the strategic assets, interests, autonomy or security of the EU and its Member States.

Specific rules for MSCA actions

When implementing MSCA Doctoral Networks (DN), Postdoctoral Fellowships (PF) and COFUND actions, the beneficiaries must respect the following conditions:

- 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[3] and ensure that the researchers and all participants involved in the action are aware of them

- ensure that the researchers enjoy at the place of the implementation at least the same standards and working conditions as those applicable to local researchers holding a similar position

- ensure that the employment contract, other direct contract or fixed-amount-fellowship agreement (see Article 6) specifies:

    - the name of the supervisor(s) for the research training activities

    - the starting date and duration of the research training activities

    - the monthly support for the researcher under this Agreement (in euro and, if relevant, in the currency in which the remuneration is paid)

    - the obligation of the researcher to work exclusively for the action, unless part-time for professional reasons is allowed and has been approved (and for MSCA-DN and MSCA-PF: not to receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiary or other entities mentioned in Annex 1)

    - the working pattern of the researcher

    - the arrangements related to the intellectual property rights (during implementation of the action and afterwards), in particular full access — on

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[3] 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).

a royalty-free basis — for the researcher to background and results needed for their activities under the action

- the obligation of the researcher to inform as soon as possible about events or circumstances likely to affect the implementation of the action or the compliance with requirements under the Agreement (see Article 19)

- the obligation of the researcher to maintain confidentiality (see Article 13)

- the obligation of the researcher to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Articles 17)

- where set out in the call conditions, the obligation of the researcher to carry out a mandatory return period of 12 months

- assist the researchers in the administrative procedures related to the recruitment

- inform the researchers about:

  - the description, conditions, location and timetable for the implementation of the research training activities

  - the rights and obligations toward the researchers under this Agreement

  - the obligation of the researchers to complete and submit — at the end of the research training activities — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the granting authority

- ensure full access — on a royalty-free basis — for the researchers to background and results needed for their activities under the action

- ensure that the researchers do not have to bear any costs for the implementation of the action as described in Annex 1

- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)

- ensure that the researchers are adequately supervised and receive appropriate career guidance

- ensure that personalised career development plans are established, support their implementation and update in view of the needs of the researchers

- ensure an appropriate exposure to the non-academic sector (if applicable)

- respect the maximum limit for secondments set out in the call conditions

- respect the conditions for the outgoing and return phases set out in the call conditions (if any)

- ensure that the researchers are informed that they are 'Marie Skłodowska-Curie fellows'

- for MSCA-DN and MSCA-COFUND:

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- advertise and publish vacancies internationally, including on the web-sites requested by the granting authority, indicating the gross salary (not including employer's social contributions) to be offered to the researcher

- recruit the researchers, following an open, transparent, merit-based, impartial and equitable recruitment procedure (for postdoctoral programmes in MSCA-COFUND: with regular selection rounds and international peer review), on the basis of:

    - their scientific skills and the relevance of their research experience

    - the impact of the proposed training on the researcher's career

    - a fair gender representation (by promoting genuine equal access opportunities throughout the recruitment process)

    The selection committees must bring together diverse expertise, have an adequate gender balance and include members from different countries and with relevant experience to assess the candidates.

- ensure that no conflict of interest exists in or arises from the recruitment

- for MSCA-DN and MSCA-PF:

    - ensure that the researchers do not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiaries (or other entities mentioned in Annex 1)

    - host the researchers at their premises (or at the premises of other participants in the action)

- for MSCA-COFUND where doctoral or post-doctoral programmes are implemented as financial support to third parties through implementing partners:

    - ensure that the implementing partners comply with the same standards and procedures for implementing the research training activities, including the recruitment and working conditions for researchers, the specific rules for MSCA-COFUND actions and the specific rules on ethics and research integrity set out in Annex 5

    - implement effective monitoring and oversight arrangements towards the implementing partners, covering all aspects relating to the action

    - ensure effective and reliable reporting by the implementing partners, covering the activities implemented, information on indicators, as well as the legality and regularity of the expenditure claimed

    - ensure that the implementing partners provide that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the final recipients.

When implementing Horizon Europe MSCA Staff Exchanges (MSCA-SE), the beneficiaries must respect the following conditions:

- 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[4] and ensure that the seconded staff and all participants involved in the action are aware of them

- ensure that the seconded staff enjoys at the place of the implementation at least the same standards and working conditions as those applicable to local staff holding a similar position

- assist the seconded staff with the administrative procedures related to their secondment

- inform the seconded staff about:

    - the description, conditions, location and timetable for the implementation of the secondment

    - the rights and obligations of the beneficiary toward the seconded staff under this Agreement

    - the obligation of the seconded staff to complete and submit — at the end of the secondment — the evaluation questionnaire and — two years later — the follow-up questionnaire provided by the granting authority

    - the arrangements related to the intellectual property rights between the beneficiary and the seconded staff (during the secondment and afterwards), in particular full access — on a royalty-free basis — for the staff to background and results needed for their activities under the action

    - the obligation of the seconded staff to maintain confidentiality (see Article 13)

    - the obligation of the seconded staff to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Article 17)

- ensure that the seconded staff do not have to bear any costs for the implementation of the action as described in Annex 1

- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)

- ensure that the seconded staff are adequately mentored

- ensure that the rights and obligations of the seconded staff remain unchanged during the secondment

- ensure full access — on a royalty-free basis — for the staff to background and results needed for their activities under the action

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[4] 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).

- if appropriate, ensure that seconded staff are reintegrated after the secondment

- ensure that the seconded staff are covered by an adequate medical insurance scheme

- ensure that the seconded staff have the relevant expertise for the action

- use the top-up allowance (see Article 6) to contribute to the subsistence, accommodation and travel of the seconded staff.

**Specific rules for ERA Fellowship actions**

When implementing ERA Fellowships, the beneficiaries must respect the following conditions:

- 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[5] and ensure that the researchers and all participants involved in the action are aware of them

- ensure that the researchers enjoy at the place of the implementation at least the same standards and working conditions as those applicable to local researchers holding a similar position

- ensure that the employment contract, other direct contract or fixed-amount-fellowship agreement (see Article 6) specifies:

  - the name of the supervisor(s) for the research training activities

  - the starting date and duration of the research training activities

  - the monthly support for the researcher under this Agreement (in euro and, if relevant, in the currency in which the remuneration is paid)

  - the obligation of the researcher to work exclusively for the action, unless part-time for professional reasons is allowed and has been approved (and not to receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiary or other entities mentioned in Annex 1)

  - the working pattern of the researcher

  - the arrangements related to the intellectual property rights (during implementation of the action and afterwards), in particular full access — on a royalty-free basis — for the researcher to background and results needed for their activities under the action

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[5] 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 obligation of the researcher to inform as soon as possible about events or circumstances likely to affect the implementation of the action or the compliance with requirements under the Agreement (see Article 19)

- the obligation of the researcher to maintain confidentiality (see Article 13)

- the obligation of the researcher to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Articles 17)

- where set out in the call conditions, the obligation of the researcher to carry out a mandatory return period of 12 months

- assist the researchers in the administrative procedures related to the recruitment

- inform the researchers about:

  - the description, conditions, location and timetable for the implementation of the research training activities

  - the rights and obligations toward the researchers under this Agreement

  - the obligation of the researchers to complete and submit — at the end of the research training activities — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the granting authority

- ensure full access — on a royalty-free basis — for the researchers to background and results needed for their activities under the action

- ensure that the researchers do not have to bear any costs for the implementation of the action as described in Annex 1

- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)

- ensure that the researchers are adequately supervised and receive appropriate career guidance

- ensure that personalised career development plans are established, support their implementation and update in view of the needs of the researchers

- ensure an appropriate exposure to the non-academic sector (if applicable)

- respect the maximum limit for secondments set out in the call conditions

- respect the conditions for the outgoing and return phases set out in the call conditions (if any)

- ensure that the researchers are informed that they are 'ERA fellows'

- ensure that the researchers do not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiaries (or other entities mentioned in Annex 1)

- host the researchers at their premises (or at the premises of other participants in the action)
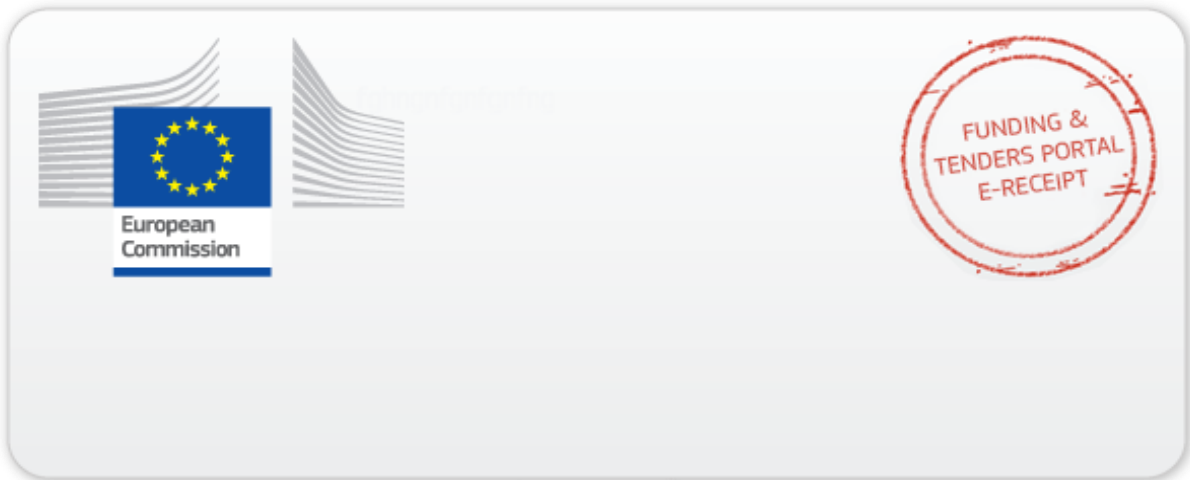
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