



Horizon Europe Programme

Standard Application Form (HE RIA, IA)

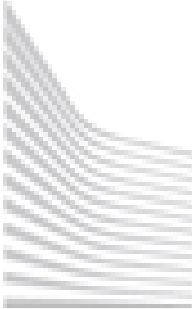
## Application form (Part A)

Project proposal – Technical description (Part B)

Version 5.0

8 September 2022

Application form (Part A)



**Horizon Europe Programme**

**Standard Application Form (HE RIA, IA)**

**Application form (Part A)**

**Version 2.0**

**21 January 2022**

**Disclaimer**

This document is aimed at informing potential applicants for Horizon Europe funding. It serves only as an example. The actual Web forms and templates, provided in the online submission system under the Funding and Tenders Portal, might differ from this example.



**Structure of the Proposal**

The proposal contains two parts:

* **Part A** of the proposal **is generated by the IT system. It is based on the information entered by the participants through the submission system in the Funding & Tenders Portal.** The participants can update the information in the submission system at any time before final submission.
* **Part B** of the proposal is the narrative part that includes three sections that each correspond to an evaluation criterion. Part B needs to be uploaded as a PDF document following the templates downloaded by the applicants in the submission system for the specific call or topic. The templates for a specific call may slightly differ from the example provided in this document.

The electronic submission system is an online wizard that guides you step-by-step through the preparation of your proposal. The submission process consists of 6 steps:

* Step 1: Logging in the Portal
* Step 2: Select the call, topic and type of action in the Portal
* Step 3: Create a draft proposal: Title, acronym, summary, main organisation and contact details
* Step 4: Manage your parties and contact details: add your partner organisations and contact details.
* Step 5: Edit and complete web forms for proposal part A and upload proposal part B
* Step 6: Submit the proposal
* **Instructions and footnotes in green will not appear in the text generated by the IT system.**
* **For options *[*in square brackets*]*: the option that applies will be automatically shown in the IT system (Part A) or included in the template of Part B offered by the IT system or you must select the appropriate value from a predefined list.**
* **For fields in [grey in square brackets] (even if they are part of an option as specified in the previous item): enter the appropriate data in the IT system.**
* **Data in coloured fields will be prefilled by the IT tool.**

|  |  |  |
| --- | --- | --- |
| **HISTORY OF CHANGES** | | |
| **Version** | **Publication date** | **Changes** |
| 1.0 | 10.11.2024 | * Initial version |

Application Forms

*Please check our* [*wiki*](https://webgate.ec.europa.eu/fpfis/wikis/x/kr21D) *for help on navigating the form.*

**Horizon Europe Application forms (Part A)**

**Topic:**

**The proper way of solving SAT**

**Type of action: Applying for model Grant**

**Type of Model Grant Agreement:**

**Proposal number: 13921219**

**Proposal acronym: PWSAT**

### Table of contents

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| --- | --- | --- |
| *Section* | *Title* | *Action* |
| 1 | General information |  |
| 2 | Participants |  |
| 3 | Budget |  |
| 4 | Ethics and security |  |
| 5 | Other questions |  |

*The forms must be filled in for each proposal using the templates available in the Submission System. Some data fields in the forms are pre-filled based on the previous steps in the Submission wizard.*

# – General information

*Section 1 provides basic data on the proposal. It can be filled in by contacts of the coordinator. Other participants may view this section only. Read-only parts are marked in blue.*

Topic

Type of action

Call

Type of Model Grant Agreement

Acronym

PWSAT

Proposal title

The proper way of solving SAT

*Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &*

Duration in months

6

Fixed keywords

SAT, Logic, solver, MiniSat, ManySat, stochastic search, parallel

Free keywords

Conflict driven learning, advanced heuristics, Industrial SAT solver

*Abstract*

*The abstract should provide the reader with a clear understanding of the objectives of the proposal, how they will be achieved, and their relevance to the Work Programme. This summary will be used as the short description of the proposal in the evaluation process and in communications to the programme management committees and other interested parties. It must therefore be short and precise and should not contain confidential information. Use plain typed text, avoiding formulas and other special characters. If the proposal is written in a language other than English, please include an English version of this abstract in the Part B (technical description) of the proposal.*

SAT is a decision problem where we need to determine whether is a given Boolean formula in conjunctive normal form (CNF) is satisfiable. The problem is NP-complete, which means that there is not a known algorithm which could efficiently solves SAT problem. The goal of our research was to find an algorithm which can solve the SAT problem polynomial time, if possible in θ(n2 ). Most Sequential SAT solvers are based on the David-Putnam-Loveland-Logemann (DPLL) algorithm. Later improvements lead to CDCL (Conflict Driven Clause Learning) and to the ”restart” technique Our approach combines two importart solver, MiniSAT and ManySAT. ManySAT is a parallel SAT-Solver which is based on the portfolio method, it runs many instances on partitioned search space. Weakness of ManySAT is the problem with sharing between slaves. MiniSAT works in a grid model, but has no sharing. Our method improves on previous methods by solving the issues of sharing. We combine the sharing and grid based methods. We archive this by sharing graphs that share information on conflicting clauses. The testing results of the algorithm demonstrate its efficiency and accuracy on various benchmark SAT problems. The new approach significantly reduced the runtime compared to classical methods. The potential of the algorithm is further proven by its ability to handle more complex instances.

|  |  |  |
| --- | --- | --- |
| Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under any EU programme, including the current call? *A `similar' proposal or contract is one that differs from the current one in minor ways, and in which some of the present consortium members are involved.* | Yes | No |
| Please give the proposal reference or contract number |  | |

*Declarations*

*These declarations can be filled in by any coordinator contact(s). All declarations are mandatory.*

|  |  |
| --- | --- |
| 1) We declare to have the explicit consent of all applicants on their participation and on the content of this proposal. | a |
| 2) We confirm that the information contained in this proposal is correct and complete and that none of the project activities have started before the proposal was submitted (unless explicitly authorised in the call conditions). | a |
| 1. We declare:    * to be fully compliant with the eligibility criteria set out in the call    * not to be subject to any exclusion grounds under the [EU Financial Regulation 2018/1046](https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32018R1046&qid=1535046024012)    * to have the financial and operational capacity to carry out the proposed project. | a |
| 4) We acknowledge that all communication will be made through the Funding & Tenders Portal electronic exchange system and that access and use of this system is subject to the [Funding &](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/ftp/tc_en.pdf)  [Tenders Portal Terms & Conditions](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/ftp/tc_en.pdf). | a |
| 5) We have read, understood and accepted the [Funding & Tenders Portal Terms & Conditions](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/ftp/tc_en.pdf) and [Privacy Statement](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/ftp/privacy-statement_en.pdf) that set out the conditions of use of the Portal and the scope, purposes, retention periods, etc. for the processing of personal data of all data subjects whose data we communicate for the purpose of the application, evaluation, award and subsequent management of our grant, prizes and contracts (including financial transactions and audits). | a |
| 6) We declare that the proposal complies with ethical principles (including the highest standards of research integrity as set out in the [ALLEA European Code of Conduct for Research Integrity,](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/european-code-of-conduct-for-research-integrity_horizon_en.pdf) as well as applicable international and national law, including the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols. [Appropriate procedures, policies and structures](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/guideline-for-promoting-research-integrity-in-research-performing-organisations_horizon_en.pdf) are in place to foster responsible research practices, to prevent questionable research practices and research misconduct, and to handle allegations of breaches of the principles and standards in the Code of Conduct. | a |
| 7) We declare that the proposal has an exclusive focus on civil applications (activities intended to be used in military application or aiming to serve military purposes cannot be funded). If the project involves dual-use items in the sense of [Regulation 2021/821,](http://data.europa.eu/eli/reg/2021/821/oj) or other items for which authorisation is required, we confirm that we will comply with the applicable regulatory framework (e.g. obtain export/import licences before these items are used). | a |
| 1. We confirm that the activities proposed do not    * aim at human cloning for reproductive purposes;    * intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or    * 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.    * lead to the destruction of human embryos (for example, for obtaining stem cells)   These activities are excluded from funding. | a |
| 9) We confirm that for activities carried out outside the Union, the same activities would have been allowed in at least one EU Member State | a |
| 10) *[Additional option for LUMP SUM Grants:* For Lump Sum Grants with a detailed budget table: We understand and accept that the EU lump sum grants must be reliable proxies for the actual costs of a project and confirm that the detailed budget for the proposal has been established in accordance with our usual cost accounting practices and in compliance with the basic eligibility conditions for EU  actual cost grants (see [*AGA ― Annotated Grant Agreement, art 6*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/aga_en.pdf)) and exclude costs that are ineligible under the Programme. Purchases and subcontracting costs must be done taking into | a |

|  |  |
| --- | --- |
| account best value for money and must be free of conflict of interest. *]* |  |

The coordinator is only responsible for the information relating to their own organisation. Each applicant remains responsible for the information declared for their organisation. If the proposal is retained for EU funding, they will all be required to sign a declaration of honour.

**False statements** or incorrect information may lead to administrative sanctions under the EU Financial Regulation.

# – Participants

List of participating organisations

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | Eötvös Loránd University | Hungary |
| 2 | Eidgenössische Technische Hochschule Zürich | Switzerland |
| 3 | Katholieke Universiteit Leuven | Belgium |
| 4 | Microsoft | United States |

*Coordinator contacts have the rights to:*

* + *add, delete, edit and re-order partners in the consortium*
  + *add, delete, edit and re-order contact points for those organisations*
  + *edit all sections of the administrative forms*
  + *upload, delete, view and download Part B and Annexes (when required for the call)*
  + *submit the proposal Participant contacts may:*
  + *view all the information in this screen, but not edit it*
  + *edit only the section for their organisation in the administrative forms (including budget)*
  + *view the entire administrative forms*
  + *view/download the Part B and other Annexes*

*You can manage the list of organisations and access rights of persons at Step 4 of the submission process. You may identify and give access to as many contact persons of the selected organisations as you wish. The identification is based upon the e-mail address of the person. When you add a contact person, you will be prompted to supply the contact details: name, e-mail, phone.*

*Person in charge of the proposal (main contact person): Each organisation needs to have one main contact person identified; the main contact person will have to fill in full contact details in the administrative form. The 'Main Contact Person' for the coordinating organisation (Participant no. 1) will become the primary contact person for the Services. Other contact persons may also be identified and may receive read-only or full access rights. Contact persons with full access rights of the coordinator (Participant no. 1) will be called 'Coordinator contacts' in the Funding & Tenders Portal, while for the other participants 'Participant Contacts'; contact persons with read-only rights will be called 'Team Members'. Other contact persons are listed with basic details in the administrative form.*

*Access rights: The main contact person and contact persons of the coordinator with full access rights have the same level of rights: they can manage the list of participants and contacts, edit any part of the administrative part of the proposal and upload any attachments (eg. Part B - technical description), and submit the proposal. Contact persons with read-only rights can only view/download the information. Participant contacts with full access rights can only edit their section of the administrative form and view all proposal data.*

*Access rights can be revoked by the Coordinating Organisation contacts. The person who created the proposal cannot be deleted.*

*Invitation: All contacts will receive an e-mail and a notification to the Portal about the invitation to the proposal upon saving the data at Step 4 of the submission process.*

# Organisation data

*The section shows the administrative data of the participating organisation as registered and/or validated in the central registry of organisations of the European Commission, linked to the given PIC number. Data in blue is read-only, modification is not possible in the proposal forms. For more information on how to modify this information, please visit the* [*online manual*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/om_en.pdf) *on the participant register.*

|  |  |  |
| --- | --- | --- |
|  | ***PIC Legal name*** | |
| *Short name* |  |
| *Address of the organisation* |
| Street |
| Town |
| Postcode |
| Country |
| Webpage |
| *Specific legal statuses* |
| *Read more about* [*legal statuses.*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/rules-lev-lear-fca_en.pdf) |
| Public .................................................................... unknown Legal person .................................................  unknown |
| Non-profit unknown |
| International organisation unknown |
| International organisation of European interest unknown |
| Secondary or Higher education establishment unknown |
| Research organisation unknown |
| *SME status* |
| *The enterprise data of the organisation is taken from the Participant Register. Changes to the self-declared or self-assessed SME data can be performed by the self-registrant or by the LEAR (Legal Entity Appointed Representative) in the Participant Register.* |
| SME self declared status unknown |
| SME self-assessment unknown |
| SME validation sme unknown |
| **Based on the above details of the Participant Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.** |

|  |  |  |  |
| --- | --- | --- | --- |
| *Departments carrying out the proposed work*  *The information serves mainly statistical purposes. For determining the eligibility of the proposal, the official address of the organisation is taken into account.*  **Department 1** | | | |
| Department name |  |  not applicable |  |
| a Same as organisation address | | | |
| Street | *Please enter street name and number* | |  |
|  |  | |  |
| Town |  |  |  |
|  |  |  |  |
| Postcode |  |  |  |
|  |  |  |  |
| Country |  |  |  |
| *Links with other participants*  *Please indicate if there are dependencies with other participants of the proposal.*  *Two participants (legal entities) are dependent on each other where there is a controlling relationship between them:*   * *A legal entity is under the same direct or indirect control as another legal entity;or* * *A legal entity directly or indirectly controls another legal entity;or* * *A legal entity is directly or indirectly controlled by another legal entity.Control:*   *Legal entity A controls legal entity B if:*   * *A, directly or indirectly, holds more than 50% of the nominal value of the issued share capital or a majority of the voting rights of the shareholders or associates of B, or* * *A, directly or indirectly, holds in fact or in law the decision-making powers in B.*   *The following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:*   1. *the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50 % of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;* 2. *the legal entities concerned are owned or supervised by the same public body.* | | | |
| ***Type of link*** | | ***Participant*** |  |
| *[*Same group*] [*Controls*]*  *[*Is controlled by*]* | | *Select one participant from the list of participants* |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Main contact person*  *This will be the person the EU services will contact concerning this proposal (e.g. for additional information, invitation to hearings, sending of evaluation results, convocation to start grant preparation). The data in blue is read-only. Details (name, first name and e-mail) of Main Contact persons should be edited in step ‘Participants’ of the submission wizard.* | | | | |
| Title | Gender | Woman | Man | Non binary |
| First name  E-mail |  | Last name |  |  |
| Position in org. | *Please indicate the position of the person* | |  |  |
|  |  | |  |  |
| Department |  |  |  |  Same as organisation |
|  Same as organisation address | | | | |
| Street |  |  |  |  |
|  |  |  |  |  |
| Town |  | Post code |  |  |
|  |  |  |  |  |
| Country |  |  |  |  |
|  |  |  |  |  |
| Website |  |  |  |  |
|  |  |  |  |  |
| Phone 1 | Phone 2 |  |  |  |
| *Other contact persons* |  |  |  |  |
| **First name** | **Last name** | **e-mail** | | **Phone** |
|  |  |  | |  |
|  |  |  | |  |

Participant short name: **AGOAT**

Acronym **PWSAT**

Proposal ID **13921219**

Application Forms

Participant short name: **AGOAT**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Researchers involved in the proposal*  *Include only the researchers involved in the proposal, (see below definition of ‘researcher’). You do not need to include in the table the identity of other persons involved in the proposal who are not researchers.*  *‘Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods. (Frascati Manual 2015)’*  *Include also person in charge of the proposal if a researcher.* | | | | | | | | | |
| **Title** | **First Name** | **Last Name** | **Gender** | **Nationality** | **E-mail** | **Career stage1** | **Role of researcher (in**  **the project)** | **Reference Identifier** | **Type of identifier** |
|  |  |  | *[*Woman*] [*Man*]*  *[*Non-binary*]* |  |  | *[*Category A – Top grade researcher*]*  *[*Category B – Senior researcher*]*  *[*Category C – Recognised researcher*]*  *[*Category D – First stage researcher*]* | *[*Leading*] [*Team member*]* |  | *[*ORCID*]*  *[*Researcher Id*]*  *[*Other - specify*]* |
| Mr | Martin | Fülöp | Man | Hungary | h1vv9d@inf.elte.hu | Category D – First Stage researcher | Team member | 24102826 | 0010-0004-1975-0083 |
| Mr | Péter | Korpa | Man | Hungary | qkfn4m@inf.elte.hu | Category D – First stage researcher | Leading | 2203440 | 0001-5424-4552-4559 |
| Mr | Benedek | Csullog | Man | Hungary | [benedekcsullog@inf.elte.hu](mailto:benedekcsullog@inf.elte.hu) | Category D – First stage researcher | Team member | 13921219 | 0000-0002-1825-0097 |
| Ms | Zsófia | Laczkó | Woman | Hungary | [jizacc@inf.elte.hu](mailto:jizacc@inf.elte.hu) | Category D – First stage researcher | Team member | 12344321 | 0220-3434-5665-7888 |

1 Career stages as defined in Frascati 2015 manual:

Category A – Top grade researcher: the single highest grade/post at which research is normally conducted. Example: ‘Full professor’ or ‘Director of research’.

Category B – Senior researcher: Researchers working in positions not as senior as top position but more senior than newly qualified doctoral graduates (IsCED level 8). Examples:

‘associate professor’ or ‘senior researcher’ or ‘principal investigator’.

Category C – Recognised researcher: the first grade/post into which a newly qualified doctoral graduate would normally be recruited. Examples: ‘assistant professor’, ‘investigator’ or

‘post-doctoral fellow’.

Category D – First stage researcher: Either doctoral students at the IsCED level 8 who are engaged as researchers, or researchers working in posts that do not normally require a doctorate degree. Examples: ‘PhD students’ or ‘junior researchers’ (without a PhD).

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|  |  |  |
| --- | --- | --- |
| *Role of participating organisation in the project*  *Applicants may select more than one option.* | | *Definitions* |
| Project management | a | *Click if your organisation will do project management activities (i.e. assigning the tasks, reporting and interface with the EC). These tasks are normally carried out by the coordinator, but other participants can also contribute.* |
| Communication, dissemination and engagement | a | *Click if your organisation will be in charge of communication, dissemination and engagement. This can be centralised by one partner or split across the partners.* |
| Provision of research and technology infrastructure | a | *Click if your organisation is providing a research facility or research equipment.* |
| Co-definition of research and market needs | a | *Click if your organisation will be involved in the co-defining the research and market needs. Usually it is a company that intends to later use the research results, or a NGO that will use the solution. This will help the project further tailor its results to respond to specific*  *needs of the end user.* |
| Civil society representative |  | *Click if your organisation belongs to civil society (NGO, association, organisation, consumer group, community group, charity, etc.).* |
| Policy maker or regulator, incl. standardisation body | a | *Click if your organisation is a policy maker (local, regional, national, European level), regulator or a standardisation body.* |
| Research performer | a | *Click if your organisation is in charge of performing the research during the project.* |
| Technology developer |  | *Click if your organisation is in charge of developing the technology during or after the project.* |
| Testing/validation of approaches and ideas |  | *Click if your organisation is in charge of testing/validating the approach and ideas.* |
| Prototyping and demonstration |  | *Click if your organisation is in charge of developing the prototypes and performing demonstrations.* |
| IPR management incl. technology transfer |  | *Click if your organisation is in charge of IPR management including technology transfer at the end of the grant.* |
| Public procurer of results |  | *Click if your organisation (public authority, hospital, university, local government, etc) will be using the results afterwards.* |
| Private buyer of results |  | *Click if your organisation (from the private sector) will be using the results afterwards.* |
| Finance provider (public or private) | a | *Click if your organisation will be providing the financing for the exploitation during or after the end of the project.* |
| Education and training | a | *Click if your organisation is in charge of educating and training researchers.* |
| Contributions from the social sciences or/and the humanities |  | *Click if your organisation is in charge of contributing to the social sciences or/and the humanities dimension to the research projec.t* |
| Other  Specify (50 character limit): |  |  |

|  |  |
| --- | --- |
| *List of up to 5 publications, widely-used datasets, software, goods, services, or any other achievements relevant to the call content.* | |
| **Type of achievement** | **Short description** |
| Publication | In Computer Science, the Boolean Satisfiability Problem(SAT) is the problem of determining if there exists an interpretation that satisfies a given Boolean formula. SAT is one of the first problems that was proven to be NP-complete, which is also fundamental to artificial intelligence, algorithm and hardware design. |

|  |  |
| --- | --- |
| Publication | The first SAT Solvers were sequential ones. These based on the Davis-Putnam-Loveland-Logemann (DPLL) algorithm. This algorithm includes rules which help to generate and traverse a binary search tree. Each part of the search tree is equal to a partial interpretation. |
| Publication | Stochastic Boolean Satisfiability presents a connection point between a satisfiability problem and a probabilistic model. It Demonstrates how to adapt a view of satisfiability on the field of probability. SSAT in focus, a general stochastic satisfiability problem, which plays a similar role in probabilistic domains like SAT in deterministic ones. |
| Publication | In recent years the multicore architectures are becoming more and more widespread. The SAT solvers should take advantage of this. Therefore, researchers have put a lot of focus on parallel algorithms. In the An overview of parallel SAT solving article we can read a great summary of the results in this field. |
| Publication | At the dawn of the Parallel SAT Solvers, the first Solver only used single-core CPU, and communicated via network. When the memory sharing architectures became available, the scientists made studies on which is faster and supplemented the Parallel SAT Solver with more CPU cores and memory. The first impressions were really great, but later they found out, that if you use too many CPU cores and memory sharing, the efficiency decreases, because of the latency with the shared memory parts and the search for the optimal core slows down the software |

|  |  |
| --- | --- |
| *List of up to 5 most relevant previous projects or activities, connected to the subject of this proposal* | |
| **Name of Project or**  **Activity** | **Short description** |
| DPLL | In 1962 the DPLL (Davis-Putnam-Logemann-Loveland) algorithm was published. It was the first efficient SAT solver, that searches for solutions systematically to the logical formula with tracing back and ramification. |
| VSIDS | The modern SAT solvers often use heuristic methods to reduce the seeking space, to find satisfying solutions quickly. For instance the VSIDS (Variable State Independent Decaying Sum)m introduced in [10] is an often used decision heuristic. |
| CDCL | Conflict-Driven Clause Learning, CDCL is one of the most important innovations, that made possible to solve more complex problems. First introduced in [7], the algorithm tries to learn from conflicts, that occur during execution to avoid unnecessary searches. This greatly speeds up the algorithm, and makes it much more usable in practice. |
| LSA | In the late 90s, the Stochastic Local Search algorithm is used to solve the problem with a heuristic approach. This works efficiently in practical SAT cases. |

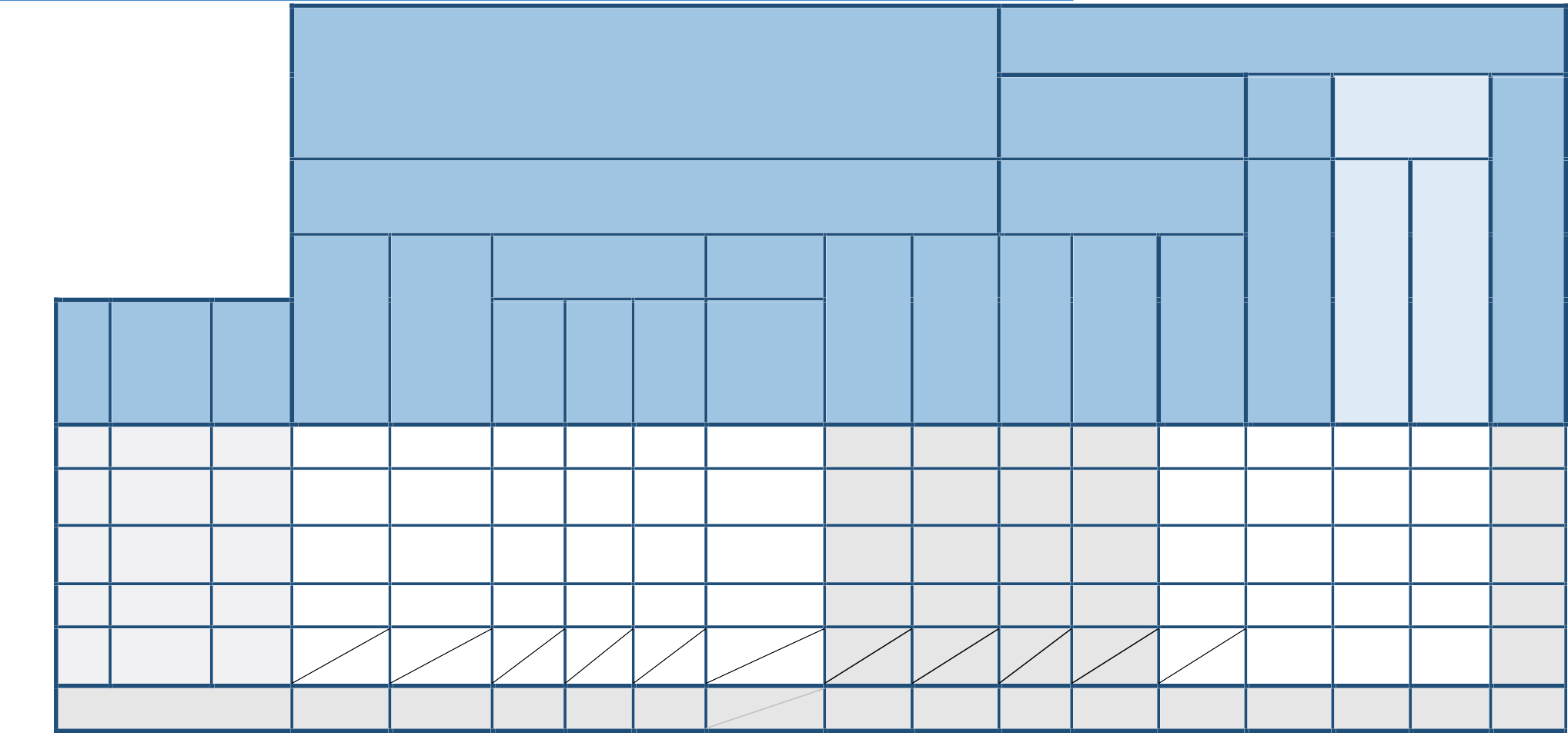
|  |  |
| --- | --- |
| *Description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work* | |
| **Name of infrastructure or**  **equipment** | **Short description** |
| MiniSAT | A sat solver with conflict-clause minimization. 2005. |
| ManySAT | A parallel sat solver. J. Satisf. Boolean Model. Comput., 2009. |

Gender equality plan

|  |  |  |
| --- | --- | --- |
| *Having a gender equality plan is an eligibility criterion for Public bodies, Higher education establishments and Research organisations from Member States and Associated Countries. Be aware that if the proposal is selected, having a Gender Equality Plan will be necessary before the grant agreement signature (applicable on calls with deadlines in 2022 and beyond).*  Does the organisation have a Gender Equality Plan (GEP) covering the elements listed below?  **Minimum process-related requirements (building blocks) for a GEP**   * **Publication:** formal document published on the institution’s website and signed by the top management * **Dedicated resources:** commitment of human resources and gender expertise to implement it. * **Data collection and monitoring:** sex/gender disaggregated data on personnel (and students for establishments concerned) and annual reporting based on indicators. * **Training:** Awareness raising/trainings on gender equality and unconscious gender biases for staff and decision-makers.   **Content-wise, recommended areas** to be **covered** and addressed via concrete measures and targets are:   * + work-life balance and organisational culture;   + gender balance in leadership and decision-making;   + gender equality in recruitment and career progression; | Yes | No |

|  |  |  |
| --- | --- | --- |
| * integration of the gender dimension into research and teaching content; * measures against gender-based violence including sexual harassment. |  |  |

# – Budget for the proposal

Estimated income

Estimated expenditure

Requested EU contribution

Revenues

Other sources of financing

Estimated eligible costs

EU contribution to eligible costs

Total estimate d income

Personnel costs/€

Subcontracti ng costs/€

1. Purchase costs
   1. C.2

C.3

1. Other cost categories

D.X

1. Indirect costs/€

(e) = 25% \* [(a1) + (c1)

+ (c2) + (c3)

Total eligible costs

(h) = (a1) +

(b) + (c1) +

Funding rate

(U)

Maximum EU

contributio n to eligible

costs

Requested EU

contributio n to eligible

costs/€

Income generated by the action

Financial contributi ons

Own resource s

(s)=(n)

+(o)+(p)+

(q) + (r)

No Participant name

Country

(a1)

(b)

Travel and subsiste nce/€

(c1)

Equipm ent/€

(c2)

Other goods, works and services

/€

(c3)

[specific cost category] /€

(dx)

+ (d7)]

(c2) + (c3) +

(d) + (e)

(l) = (U) \* (h)

(Requeste d grant amount)

1. (n)

(o)

(q)

(r)

* 1. Participant 1 NL
  2. Participant 2 LB

Affiliated LB

Entity

* 1. Participant 3 DE

Associated AR Partner

Total

Possible ‘Other cost categories’ for Horizon Europe

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | Estimated project expenditure | | | | | | | | | |
| Estimated eligible costs | | | | | | | | | |
| D. Other cost categories | | | | | | | | | |
| No | Participant name | Count ry | D.1  Financial support to third parties  (Actual costs)  (d1) | D.2 Internally invoiced goods and services  (Unit costs - usual accounting  practices) | *[*D.3  Transnation al access to research infrastructure s  (Unit costs) | *[*D.4 Virtual access to research infrastructure s  (Unit costs)  (d4) *]* | *[*D.5 PCP/PPI  procurement costs  (Actual costs)  (d5) *]* | *[*D.6 Euratom Cofund staff mobility costs  (Unit costs)  (d6) *]* | *[*D.7 ERC  additional funding  (Actual costs)  (d7) *]* | *[*D.8 ERC  additional funding (subcontracti ng, FSTP  and internally invoiced goods and  services) |  |  |
|  |  |  |  |  | (d3) *]* |  |  |  |  |  |
|  |  |  |  | (d2) |  |  |  |  |  | (Actual  costs) |
|  |  |  |  |  |  |  |  |  |  | (d8) *]* |
| 1 | Participant 1 | NL |  |  |  |  |  |  |  |  |  |  |
| 2 | Participant 2 | LB |  |  |  |  |  |  |  |  |  |  |
|  | Affiliated Entity | LB |  |  |  |  |  |  |  |  |  |  |
| 3 | Participant 3 | DE |  |  |  |  |  |  |  |  |  |  |
|  | Associated Partner | AR |  |  |  |  |  |  |  |  |  |  |
| Total | | |  |  |  |  |  |  |  |  |  |  |

# – Ethics and Security

*Ethics issues table*

*This table should be completed as an essential part of your proposal. Please go through the table and indicate which elements concern your proposal by answering ‘Yes’ or ‘No’. If you answer ‘Yes’ to any of the questions,*

* *indicate in the adjacent box at which page in your full proposal further information relating to that ethics issue can be found, and*
* *provide additional information on that ethics issue in the Ethics Self-Assessment section.*

*For more information on each of the ethics issues and how to address them, including detailed legal references, see the guidelines* [*‘How to*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf)[*Complete your Ethics Self-Assessment’.*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. HUMAN EMBRYONIC STEM CELLS AND HUMAN EMBRYOS | |  | | Page |
| Does this activity involve Human Embryonic Stem Cells (hESCs)? | | Yes | No |  |
| If **YES**: | Will they be directly derived from embryos within this project? | Yes | No |  |
| Are they previously established cells lines? | Yes | No |  |
| Are the cell lines registered in the European registry for human embryonic stem cell lines? | Yes | No |  |
| Does this activity involve the use of human embryos? | | Yes | No |  |
| If **YES**: | Will the activity lead to their destruction? | Yes | No |  |
| 2. HUMANS | |  | | Page |
| Does this activity involve human participants? | | Yes | No |  |
| If **YES**: | Are they volunteers for nonmedical studies (e.g. social or human sciences research)? | Yes | No |  |
| Are they healthy volunteers for medical studies? | Yes | No |  |
| Are they patients for medical studies? | Yes | No |  |
| Are they potentially vulnerable individuals or groups? | Yes | No |  |
| Are they children/minors? | Yes | No |  |
| Are they other persons unable to give informed consent? | Yes | No |  |
| Does this activity involve interventions (physical also including imaging technology, behavioural treatments, etc.) on the study participants? | | Yes | No |  |
| If **YES**: | Does it involve invasive techniques? | Yes | No |  |
| Does it involve collection of biological samples? | Yes | No |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Does this activity involve conducting a clinical study as defined by the Clinical Trial [Regulation (EU 536/2014)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0536)? (using pharmaceuticals, biologicals, radiopharmaceuticals, or advanced therapy medicinal products) | | | Yes | No |  |
| If **YES**: | Is it a clinical trial? | | Yes | No |  |
| Is it a low-intervention clinical trial? | | Yes | No |  |
| 3. HUMAN CELLS / TISSUES (not covered by section 1) | | |  | | Page |
| Does this activity involve the use of human cells or tissues? | | | Yes | No |  |
| If **YES**: | Are they human embryonic or foetal cells or tissues? | | Yes | No |  |
| Are they available commercially? | | Yes | No |  |
| Are they obtained within this project? | | Yes | No |  |
| Are they obtained from another project, laboratory or institution? | | Yes | No |  |
| Are they obtained from biobank? | | Yes | No |  |
| 4. PERSONAL DATA | | |  | | Page |
| Does this activity involve processing of personal data? | | | Yes | No |  |
| If **YES**: | Does it involve the processing of special categories of personal data (e.g.: sexual lifestyle, ethnicity, genetic, biometric and health data, political opinion, religious or philosophical beliefs)? | | Yes | No |  |
| If **YES**: | Does it involve processing of genetic, biometric or health data? | Yes | No |  |
| Does it involve profiling, systematic monitoring of individuals, or processing of large scale of special categories of data or intrusive methods of data processing (such as, surveillance, geolocation tracking etc.)? | | Yes | No |  |
| Does this activity involve further processing of previously collected personal data (including use of preexisting data sets or sources, merging existing data sets)? | | | Yes | No |  |
| Is it planned to export personal data from the EU to non-EU countries? | | | Yes | No |  |
| If **YES**: | Specify the type of personal data and countries involved: | |  | |  |
| Is it planned to import personal data from non-EU countries into the EU or from a non-EU country to another non-EU country? | | | Yes | No |  |
| If **YES**: | Specify the type of personal data and countries involved | |  | |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Does this activity involve the processing of personal data related to criminal convictions or offences? | | Yes | No |  |
| 5. ANIMALS | | | | Page |
| Does this activity involve animals? | | Yes | No |  |
| If **YES**: | Are they vertebrates? | Yes | No |  |
| Are they non-human primates (NHP)? | Yes | No |  |
| Are they genetically modified? | Yes | No |  |
| Are they cloned farm animals? | Yes | No |  |
| Are they endangered species? | Yes | No |  |
| 6. NON-EU COUNTRIES | | | | Page |
| Will some of the activities be carried out in non-EU countries? | | Yes | No |  |
| If **YES**: | Specify the countries: |  | |  |
| In case non-EU countries are involved, do the activities undertaken in these countries raise potential ethics issues? | | Yes | No |  |
| If **YES**: | Specify the countries: |  | |  |
| Is it planned to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)? | | Yes | No |  |
| Is it planned to import any material (other than data) from non-EU countries into the EU or from a non-EU country to another non-EU country? For data imports, see section 4. | | Yes | No |  |
| If **YES**: | Specify material and countries involved: |  | |  |
| Is it planned to export any material (other than data) from the EU to non-EU countries? For data exports, see section 4. | | Yes | No |  |
| If **YES**: | Specify material and countries involved: |  | |  |
| Does this activity involves [low and/or lower-middle income countries](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf)? (if yes, detail the benefit- sharing actions planned in the self-assessment) | | Yes | No |  |
| Could the situation in the country put the individuals taking part in the activity at risk? | | Yes | No |  |
| 7. ENVIRONMENT, HEALTH and SAFETY | |  | | Page |

|  |  |  |  |
| --- | --- | --- | --- |
| Does this activity involve the use of substances or processes that may cause harm to the environment, to animals or plants (during the implementation of the activity or further to the use of the results, as a possible impact)? | Yes | No |  |
| Does this activity deal with endangered fauna and/or flora / protected areas? | Yes | No |  |
| Does this activity involve the use of substances or processes that may cause harm to humans, including those performing the activity (during the implementation of the activity or further to the use of the results, as a possible impact)? | Yes | No |  |
| 8. ARTIFICIAL INTELLIGENCE |  | | Page |
| Does this activity involve the development, deployment and/or use of Artificial Intelligence based systems? (if yes, detail in the self-assessment whether that could raise ethical concerns related to human rights and values and detail how this will be addressed). | Yes | No |  |
| 9. OTHER ETHICS ISSUES |  | | Page |
| Are there any other ethics issues that should be taken into consideration? | Yes | No |  |
| *Please specify: (Maximum number of characters allowed: 1000)* | | |  |

|  |  |
| --- | --- |
| I confirm that I have taken into account all ethics issues above and that, if any ethics issues  apply, I will complete the ethics self-assessment as described in the guidelines [‘How to](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf) [Complete your Ethics Self-Assessment’](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf). |  |

*ETHICS SELF-ASSESSMENT*

*If you have entered any issues in the ethics issue table, you must perform an ethics self-assessment in accordance with the guidelines* [*"How to Complete your Ethics Self-Assessment"*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf) *and complete the table below.*

|  |
| --- |
| **Ethical dimension of the objectives, methodology and likely impact** |
| Explain in detail the identified issues in relation to:   * objectives of the activities (e.g. study of vulnerable populations, etc.) * methodology (e.g. clinical trials, involvement of children, protection of personal data, etc.) * the potential impact of the activities (e.g. environmental damage, stigmatisation of particular social groups, political or financial adverse consequences, misuse, etc.) |
| **Compliance with ethical principles and relevant legislations** |
| Describe how the issue(s) identified in the ethics issues table above will be addressed in order to adhere to the ethical principles and what will be done to ensure that the activities are compliant with the E U / national legal and ethical requirements of the country or countries where the tasks are to be carried out. It is reminded that for **activities performed in a non-EU countries**, they should also be allowed in at least one EU Member State. |

*Security issues table*

*Please go through the table and indicate which elements concern your proposal by answering YES or NO. If you answer YES to any of the questions:*

* *indicate in the adjacent box at which page in your full proposal further information relating to that security issue can be found, and*
* *provide additional information on this security issue in the Security self-assessment section below.*

*For more information on potential security issues and how to address them, see the guidance* [*How to handle security-sensitive projects*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-handle-security-sensitive-projects_en.pdf) *and the programme-specific guidelines* [*Classification of information in Horizon Europe projects.*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/classification-of-information-in-he-projects_he_en.pdf)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. EU classified information (EUCI)2 | |  | | Page |
| Does this activity involve information and/or materials requiring protection against unauthorised disclosure (EUCI)? | | Yes | No |  |
| If **YES**: | Is the activity going to use classified information as background3 information? | Yes | No |  |
| Is the activity going to generate EU classified foreground4 information as results? | Yes | No |  |
| Does this activity involve participants from non-EU countries which need to have access to EUCI? | | Yes | No |  |
| If **YES**: | Do the non-EU countries concerned have a security of information agreement with the EU? | Yes | No |  |
| 2. MISUSE | |  | | Page |
| Does this activity have the potential for misuse of results? | | Yes | No |  |
| If **YES**: | Does the activity provide knowledge, materials and technologies that could be channelled into crime and/or terrorism? | Yes | No |  |
| Could the activity result in the development of chemical, biological, radiological or nuclear (CBRN) weapons and the means for their delivery? | Yes | No |  |
| 3. OTHER SECURITY ISSUES | |  | | Page |
| Does this activity involve information and/or materials subject to national security restrictions? | | Yes | No |  |
| If yes, please specify: *(Maximum number of characters allowed: 1000)* | | | |  |

2 According to the Commission Decision (EU, Euratom) 2015/444 of 13 March 2015 on the security rules for protecting EU classified information, “European Union classified information (EUCI) means any information or material designated by an EU security classification, the unauthorised disclosure of which could cause varying degrees of

prejudice to the interests of the European Union or of one or more of the Member States”.

3 Classified background information is information that is already classified by a country and/or international organisation and/or the EU and is going to be used by the project. In this case, the project must have in advance the authorisation from the originator of the classified information, which is the entity (EU institution, EU Member State, third state or international organisation) under whose authority the classified information has been generated.

4 EU classified foreground information is information (documents/deliverables/materials) planned to be generated by the project and that needs to be protected from unauthorised disclosure. The originator of the EUCI generated by the project is the European Commission.

|  |  |  |  |
| --- | --- | --- | --- |
| Are there any other security issues that should be taken into consideration? | Yes | No |  |
| *If yes, please specify: (Maximum number of characters allowed: 1000)* | | |  |

|  |
| --- |
| SECURITY SELF-ASSESSMENT  *If you have answered YES for one or more of the questions indicated above, describe the measures you intend to take to solve/avoid them. For more information, see the guidelines* [*Classification of information in Horizon Europe projects,*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/classification-of-information-in-he-projects_he_en.pdf)[*Classification of information in Digital Europe projects,*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/digital/guidance/classification-of-information-in-dep-projects_dep_en.pdf)[*Classification of information in EDF projects.*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/edf/guidance/classification-of-information-in-edf-projects_edf_en.pdf) |
| Please specify *(Maximum number of characters allowed: 5000)* |

# – Other questions

#### Two-stage calls

*The full stage-2 proposal must be consistent with the short outline proposal submitted to the stage 1 – in particular with respect to the proposal characteristics addressing the concepts of excellence and impact.*

|  |  |  |
| --- | --- | --- |
| Are there substantial differences compared to the stage-1 proposal? | Yes | No |

*Questions showed only in answer is Yes:*

Please list the substantial differences, and indicate the reasons

|  |  |  |
| --- | --- | --- |
| □ | Partnership | *List the substantial differences and indicate the reasons* |
| □ | Budget | *List the substantial differences and indicate the reasons* |
| □ | Approach | *List the substantial differences and indicate the reasons* |

#### [Calls with clinical trials: Essential information to be provided for proposals including clinical trials / studies / investigations

*Clinical study means, for the purpose of this document, any systematic prospective or retrospective collection and analysis of health data obtained from individual patients or healthy persons in order to address scientific questions related to the understanding, prevention, diagnosis, monitoring or treatment of a disease, mental illness, or physical condition. It includes but it is not limited to clinical studies as defined by* [*Regulation 536/2014*](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02014R0536-20140527) *(on medicinal products), clinical investigation and clinical evaluation as defined by* [*Regulation 2017/745*](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02017R0745-20200424) *(on medical devices), performance study and performance evaluation as defined by* [*Regulation 2017/746*](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02017R0746-20170505) *(on in vitro diagnostic medical devices.*

|  |  |  |
| --- | --- | --- |
| Are clinical studies / trials / investigations included in the work plan of this project? | Yes | No |

*Please upload the dedicated annex ‘Essential information for clinical studies / trials / investigations’ (a Word template is provided under*

*‘download templates’ in the up-load section for Part B and Annexes).*

*This document should include the relevant information of each clinical study / trial / investigation included in the work plan of this project.*

|  |  |
| --- | --- |
| Please give a short title, an acronym or a unique identifier to each clinical study / trial / investigation, to be used as a reference / identifier in the other parts of the proposal |  |

*]*

Project proposal – Technical description (Part B)





Horizon Europe Programme

Standard Application Form (HE RIA and IA)

## Project proposal – Technical description (Part B)

Version 3.1

08 September 2022

**Structure of the Proposal**

The proposal contains two parts:

* **Part A** of the proposal **is generated by the IT system. It is based on the information entered by the participants through the submission system in the Funding & Tenders Portal.** The participants can update the information in the submission system at any time before final submission.
* **Part B** of the proposal is the narrative part that includes three sections that each correspond to an evaluation criterion. Part B needs to be uploaded as a PDF document following the templates downloaded by the applicants in the submission system for the specific call or topic. The templates for a specific call may slightly differ from the example provided in this document.

The electronic submission system is an online wizard that guides you step-by-step through the preparation of your proposal. The submission process consists of 6 steps:

* Step 1: Logging in the Portal
* Step 2: Select the call, topic and type of action in the Portal
* Step 3: Create a draft proposal: Title, acronym, summary, main organisation and contact details
* Step 4: Manage your parties and contact details: add your partner organisations and contact details.
* Step 5: Edit and complete web forms for proposal part A and upload proposal part B
* Step 6: Submit the proposal

|  |  |  |
| --- | --- | --- |
| **HISTORY OF CHANGES** | | |
| **Version** | **Publication date** | **Changes** |
| 1.0 | 10.03.2021 | * Initial version |

**Proposal template Part B: technical description**

###### (for full proposals: single stage submission procedure and 2nd stage of a two-stage submission procedure)

This template is to be used in a single-stage submission procedure or at the 2nd stage of a two-stage submission procedure.



The structure of this template must be followed when preparing your proposal. It has been designed to ensure that the important aspects of your planned work are presented in a way that will enable the experts to make an effective assessment against the evaluation criteria. Sections 1, 2 and 3 each correspond to an evaluation criterion.

Please be aware that proposals will be evaluated as they were submitted, rather than on their potential if certain changes were to be made. This means that only proposals that successfully address all the required aspects will have a chance of being funded. There will be no possibility for significant changes to content, budget and consortium composition during grant preparation.

**Page limit**: The title, list of participants and sections 1, 2 and 3, together, should not be longer than 45 pages. All tables, figures, references and any other element pertaining to these sections must be included as an integral part of these sections and are thus counted against this page limit. The number of pages included in each section of this template is only **indicative**.

The page limit will be applied automatically. **At the end of this document you can see the structure of the actual proposal that you need to submit, please remove all instruction pages that are watermarked.**

If you attempt to upload a proposal longer than the specified limit before the deadline, you will receive an automatic warning and will be advised to shorten and re-upload the proposal. After the deadline, excess pages (in over-long proposals/applications) will be automatically made invisible, and will not be taken into consideration by the experts. The proposal is a self-contained document. Experts will be instructed to ignore hyperlinks to information that is specifically designed to expand the proposal, thus circumventing the page limit.

Please, do not consider the page limit as a target! It is in your interest to keep your text as concise as possible, since experts rarely view unnecessarily long proposals in a positive light.

The following formatting conditions apply.

The reference font for the body text of proposals is Times New Roman (Windows platforms), Times/Times New Roman (Apple platforms) or Nimbus Roman No. 9 L (Linux distributions).

The use of a different font for the body text is not advised and is subject to the cumulative conditions that the font is legible and that its use does not significantly shorten the representation of the proposal in number of pages compared to using the reference font (for example with a view to bypass the page limit).

The minimum font size allowed is 11 points. Standard character spacing and a minimum of single line spacing is to be used. This applies to the body text, including text in tables.

Text elements other than the body text, such as headers, foot/end notes, captions, formula's, may deviate, but must be legible.

The page size is A4, and all margins (top, bottom, left, right) should be at least 15 mm (not including any footers or headers).

This document is tagged. Be careful not to delete the tags; they are needed for processing.

|  |  |
| --- | --- |
| **DEFINITIONS** | |
| **Critical risk** | Inability to handle large-scale or highly complex SAT (Satisfiability) problems leading to solver inefficiency or failure.  Level of likelihood to occur (Low/medium/high): High Despite improvements in SAT solver algorithms, the risk remains high due to the nature of NP-complete problems.  Level of severity (Low/medium/high): High The impact is high since failure to solve SAT problems efficiently can derail project objectives, especially in systems where SAT solvers are critical components. It could also result in higher computational costs and missed deadlines. |
| **Deliverable** | This report provides a comprehensive analysis of the performance of the SAT solver in handling various problem sets, with a focus on efficiency, scalability, and correctness. It will include details of the solver's architecture, optimization techniques applied, and benchmarks against industry-standard problem instances. The report aims to ensure effective monitoring of the SAT solver's development, identify performance bottlenecks, and propose potential improvements. |
| **Impacts** | The SAT problem solution has many fields of application, such as: Hardware and software verification: The logical electric circuits and the programs formal control. Code optimization and automated planning: Solutions often used in optimization tasks such as automated planning. Cryptography: SAT solver algorithms play key roles in cryptography algorithms security analysis |
| **Milestone** | This milestone marks the successful completion of the first phase of testing for the SAT solver. It will focus on verifying the solver's ability to handle small to medium-sized SAT problems efficiently and will establish baseline performance metrics, including processing time, memory usage, and correctness. This validation will be a critical decision point to ensure that the project is on track and that the solver is capable of scaling to more complex problem sets in subsequent phases. |
| **Objectives** | The primary objective of this project is to research, develop, and validate an advanced SAT (Satisfiability) solver capable of efficiently handling large-scale, complex SAT problems. This involves addressing key challenges in scalability, performance, and optimization, while ensuring the solver can be applied across diverse industries and problem domains. |
| **Outcomes** | The expected medium-term outcomes of this project focus on the successful adoption, deployment, and utilization of the advanced SAT solver technology developed during the project. These outcomes aim to enhance the performance of decision-making, optimization, and verification processes across various sectors, such as hardware design, artificial intelligence, cryptography, and logistics. |
| **Pathway to impact** | The pathway to impact outlines the logical steps from the project's results, including dissemination, exploitation, and communication, to achieving the desired medium- and long-term outcomes. This trajectory ensures that the project's advancements in SAT solver technology lead to tangible scientific, economic, and societal impacts beyond the project's completion. |
| **Research output** | The research outputs from this project will consist of a combination of scientific publications, software, algorithms, and methodologies that push the boundaries of SAT solver technology. These outputs will contribute to both the academic community and industries that rely on efficient problem-solving techniques. |
| **Results** | The overall impression of our method is more than satisfying. We made an optimized algorithm with n2 computational cost. As we discussed before, we have used MiniSAT with ManySAT to earn this result. It made our method better than the concurrent ones. The next steps and our future plans will be described in the Future Work section. |
| **Technology Readiness Level** | Technology Readiness Levels (TRLs) are a method for estimating the maturity of a technology during its development and deployment. They range from TRL 1 (basic principles observed) to TRL 9 (actual system proven in operational environment). Here’s a breakdown of the TRL scale. |

 *Fill in the title of your proposal below.*

**The proper way of solving SAT**

 *The consortium members are listed in part A of the proposal (application forms). A summary list should also be provided in the table below.*

[This document is tagged. Do not delete the tags; they are needed for processing.] #@APP-FORM-HERIAIA@#

**List of participants** *[e.g. 1 page]*

|  |  |  |
| --- | --- | --- |
| **Participant No. \*** | **Participant organisation name** | **Country** |
| 1 (Coordinator) | Eötvös Loránd University | HU |
| 2 | Eidgenössische Technische Hochschule Zürich | CH |
| 3 | Katholieke Universiteit Leuven | BE |
| 4 | Microsoft | USA |

\* Please use the same participant numbering and name as that used in the administrative proposal forms.

1. **Excellence** #@REL-EVA-RE@#

***Excellence – aspects to be taken into account.***

* Clarity and pertinence of the project’s objectives, and the extent to which the proposed work is ambitious, and goes beyond the state of the art.
* Soundness of the proposed methodology, including the underlying concepts, models, assumptions, interdisciplinary approaches, appropriate consideration of the gender dimension in research and innovation content, and the quality of open science practices, including sharing and management of research outputs and engagement of citizens, civil society and end users where appropriate.
* *The following aspects will be taken into account only to the extent that the proposed work is within the scope of the work programme topic.*
  1. **Objectives and ambition** #@PRJ-OBJ-PO@# *[e.g. 4 pages]*
     + Briefly describe the objectives of your proposed work. Why are they pertinent to the work programme topic? Are they measurable and verifiable? Are they realistically achievable?
     + Describe how your project goes beyond the state-of-the-art, and the extent the proposed work is ambitious. Indicate any exceptional ground-breaking R&I, novel concepts and approaches, new products, services or business and organisational models. Where relevant, illustrate the advance by referring to products and services already available on the market. Refer to any patent or publication search carried out.
     + Describe where the proposed work is positioned in terms of R&I maturity (i.e. where it is situated in the spectrum from ‘idea to application’, or from ‘lab to market’). Where applicable, provide an indication of the Technology Readiness Level, if possible distinguishing the start and by the end of the project.

* *Please bear in mind that advances beyond the state of the art must be interpreted in the light of the positioning of the project. Expectations will not be the same for RIAs at lower TRL, compared with Innovation Actions at high TRLs.*

#§PRJ-OBJ-PO§#

* 1. **Methodology** #@CON-MET-CM@# #@COM-PLE-CP@# *[e.g. 14 pages]*

In this section we discribe our solution. In a high level we combine the innovations of MiniSAT [11] and ManySAT [5] into one parallel SAT solving algorithm. The proposed framework integrates ManySAT cooperative search strategy with MiniSat conflict-clause minimization techniques. In this hybrid approach, multiple instances of MiniSat operate in parallel, each tasked with exploring different regions of the solution space. As these instances encounter conflicts, they utilize conflict analysis to generate learned clauses. However, rather than maintaining isolation, the instances share these learned clauses dynamically among themselves, allowing for a more comprehensive exchange of information. This cooperation between instances enhance the learning process by ensuring that the already accessed clauses are accessible, thus eliminating potential useless work. Additionally, the shared knowledge of conflicts facilitates quicker convergence towards solutions, as instances can benefit from the shared clauses. The overall architecture aims to harness the scalability of ManySAT while incorporating the efficiency gains from MiniSat clause minimization, resulting in a more robust and performant SAT solving technique. First we describe the algorithm in detail, then we give an high level proof of correctness and the faster convergence.

Our algorithm. The f(x) function is freely choosable, but testing has shows that the best result come from log.

* Initialization: We first initialize a set of parallel solver instances (based on MiniSAT), denoted as S = S1, S2, . . . , Sn. Each instance is assigned a distinct portion of the problem P, represented as a collection of clauses C.
* Heuristic Tuning: Introduce a heuristic H that determines the decision-making process of each instance. The heuristic includes parameters such as: – Clause Activity: Prioritize clauses based on their recent activity levels, directing the solver to explore clauses that have contributed to recent conflicts more frequently. – Variable Frequency: Adjust the selection of variables based on their frequency of appearance across learned clauses, thus guiding the search towards more promising regions of the solution space.
* Cooperative Search: Each instance Si independently explores its assigned search space Vi while maintaining a local record of learned clauses Ci . The instances operate concurrently, applying MiniSat decision heuristics and backtracking mechanisms.
* Conflict Handling and Clause Sharing: Upon encountering a conflict, instance Si executes conflict analysis to derive a learned clause c. This clause is then shared with all other instances in S in real-time. The incorporation of shared clauses enhances the collective knowledge of the solver and serves to prune the search space for all instances.
* Search Space Pruning: Each instance updates its remaining search space Ri based on the newly acquired clauses. This dynamic adjustment allows instances to work with a more constrained search environment, thereby reducing the overall number of decisions and conflicts.
* Iterative Improvement: The process continues iteratively, with instances continuously exploring, learning, and sharing information. The synergy between cooperative search and conflict minimization results in accelerated convergence towards solutions.
* Termination: The algorithm terminates when at least one instance Si finds a satisfying assignment for the problem P or when all instances collectively exhaust their search spaces without success.

The proposed algorithm effectively merges the parallelization strengths of ManySAT with the efficiency of MiniSat conflict-clause minimization. By fostering a collaborative environment, the solver is positioned to tackle a broader range of SAT instances with improved performance and faster convergence.

Let P be a Boolean satisfiability problem represented as a set of clauses in CNF form. Denote the set of parallel MiniSat instances as S = S1, S2, . . . , Sn, where each instance explores a subset of the solution space Vi . The proof of convergence then looks like the following.

* Initial Conditions: Each instance Si maintains a local set of learned clauses Ci . In the beginning this is empty, but upon encountering a conflict, each instance performs conflict analysis to derive a learned clause c.
* Step 1: Clause Sharing Mechanism. When an instance Si generates a learned clause c from a conflict, it shares this clause with all other instances in S. This sharing mechanism ensures that all instances benefit from the conflicts encountered by any single instance.
* Step 2: Dynamic Search Space Pruning. After receiving the learned clause c, each instance updates its remaining search space Ri . This process can be expressed as: R ′ i = Ri ∩ ¬Ci (where ¬Ci are the negations of the learned clauses). By incorporating the shared learned clauses, each instance effectively reduces its search space, leading to: R′ i ⊂ Ri .
* Step 3: Impact of Heuristic. The heuristic H influences the decision-making process. By prioritizing clauses and variables based on their activity and frequency, instances can reduce the expected number of decisions D made to reach a solution: D′ = D − ∆DH where ∆DH represents the reduction in decisions achieved through heuristic guidance.
* Step 4: Reduction in Decisions and Conflicts The pruning of the search space directly impacts the decision-making process. Let D represent the number of decisions made by an instance to reach a solution. The expected number of decisions after sharing learned clauses becomes: D′ = D − log(∆D) where ∆D represents the reduction in decisions due to improved clause sharing. As ∆D decreases the number of conflicts decears.
* Step 5: Accelerated Convergence. The cumulative effect of shared learned clauses and reduced search spaces leads to faster convergence. As the instances navigate a more constrained search environment, the overall time to reach a satisfying assignment decreases. Thus, we can express convergence towards a solution as: lim t→∞ P(SAT) → 1

(where P(SAT) is the probability of finding a solution). The integration of ManySAT cooperative search with MiniSat conflict-clause minimization results in quicker convergence towards solutions. The collaborative nature of the algorithm enhances the efficiency of the SAT solving process by reducing the search space and minimizing conflict occurrences.

* + - Describe and explain the overall methodology, including the concepts, models and assumptions that underpin your work. Explain how this will enable you to deliver your project’s objectives. Refer to any important challenges you may have identified in the chosen methodology and how you intend to overcome them. *[e.g. 10 pages]*

* *This section should be presented as a narrative. The detailed tasks and work packages are described below under ‘Implementation’.*

* *Where relevant, include how the project methodology complies with the ‘do no significant harm’ principle as per Article 17 of* [*Regulation (EU) No 2020/852*](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32020R0852) *on the establishment of a framework to facilitate sustainable investment (i.e. the so-called 'EU Taxonomy Regulation'). This means that the methodology is designed in a way it is not significantly harming any of the six environmental objectives of the EU Taxonomy Regulation.*

* *If you plan to use, develop and/or deploy artificial intellingence (AI) based systems and/or techniques you must demonstrate their technical robustness. AI-based systems or techniques should be, or be developed to become:*

* + - * *technically robust, accurate and reproducible, and able to deal with and inform about possible failures, inaccuracies and errors, proportionate to the assessed risk they pose*
      * *socially robust, in that they duly consider the context and environment in which they operate*
      * *reliable and function as intended, minimizing unintentional and unexpected harm, preventing unacceptable harm and safeguarding the physical and mental integrity of humans*
    - *able to provide a suitable explanation of their decision-making processes, whenever they can have a significant impact on people’s lives.* Describe any national or international research and innovation activities whose results will feed into the project, and how that link will be established; *[e.g. 1 pages]*
    - Explain how expertise and methods from different disciplines will be brought together and integrated in pursuit of your objectives. If you consider that an inter-disciplinary approach is unnecessary in the context of the proposed work, please provide a justification. *[e.g. 1/2 page]*
    - For topics where the work programme indicates the need for the integration of social sciences and humanities, show the role of these disciplines in the project or provide a justification if you consider that these disciplines are not relevant to your proposed project. *[e.g. 1/2 page]*
    - Describe how the gender dimension (i.e. sex and/or gender analysis) is taken into account in the project’s research and innovation content *[e.g. 1 page]. If* you do not consider such a gender dimension to be relevant in your project, please provide a justification.

* *Note: This section is mandatory except for topics which have been identified in the work programme as not requiring the integration of the gender dimension into R&I content.*

* *Remember that that this question relates to the content of the planned research and innovation activities, and not to gender balance in the teams in charge of carrying out the project.*

 *Sex and gender analysis refers to biological characteristics and social/cultural factors respectively. For guidance on methods of sex / gender analysis and the issues to be taken into account, please refer to* <https://ec.europa.eu/info/news/gendered-innovations-2-2020-nov-24_en>

In the context of our project, the gender dimension (i.e., sex and/or gender analysis) has been carefully considered. However, based on the nature of the research and innovation activities planned, we conclude that gender-specific factors are not directly relevant to the project’s core objectives or methodology. The project’s focus is on [insert specific technical/scientific focus, e.g., software development, chemical processes, data analysis, etc.], which inherently does not involve biological or social/cultural factors related to gender.

Given this scope, integrating a sex or gender analysis would not substantively impact the research outcomes or innovation processes we intend to pursue. Should future stages of the project reveal any unforeseen implications for gender, we are committed to reassessing this position and incorporating relevant gender perspectives accordingly.

* + - Describe how appropriate open science practices are implemented as an integral part of the proposed methodology. Show how the choice of practices and their implementation are adapted to the nature of your work, in a way that will increase the chances of the project delivering on its objectives *[e.g. 1 page]*. If you believe that none of these practices are appropriate for your project, please provide a justification here.

* *Open science is an approach based on open cooperative work and systematic sharing of knowledge and tools as early and widely as possible in the process. Open science practices include early and open sharing of research (for example through preregistration, registered reports, pre- prints, or crowd-sourcing); research output management; measures to ensure reproducibility of research outputs; providing open access to research outputs (such as publications, data, software, models, algorithms, and workflows); participation in open peer-review; and involving all relevant knowledge actors including citizens, civil society and end users in the co-creation of R&I agendas and contents (such as citizen science).*

* *Please note that this question does not refer to outreach actions that may be planned as part of communication, dissemination and exploitation activities. These aspects should instead be described below under ‘Impact’.*

In our project, we are committed to integrating open science practices as an essential part of our methodology. We have identified several open science practices that align with our objectives and will enhance the project’s transparency, accessibility, and impact. We plan to give a presentation, and we explain our core findings. We also include every test result.

* + - Research **data management and management of other research outputs:** Applicants generating/collecting data and/or other research outputs (except for publications) during the project must provide maximum 1 page on how the data/ research outputs will be managed in line with the FAIR principles (Findable, Accessible, Interoperable, Reusable), addressing the following (the description should be specific to your project): *[1 page]*

**Types of data/research outputs** (e.g. experimental, observational, images, text, numerical) and their estimated size; if applicable, combination with, and provenance of, existing data.

**Findability of data/research outputs:** Types of persistent and unique identifiers (e.g. digital object identifiers) and trusted repositories that will be used.

**Accessibility of data/research outputs:** IPR considerations and timeline for open access (if open access not provided, explain why); provisions for access to restricted data for verification purposes.

**Interoperability of data/research outputs:** Standards, formats and vocabularies for data and metadata.

**Reusability of data/research outputs**: Licenses for data sharing and re-use (e.g. Creative Commons, Open Data Commons); availability of tools/software/models for data generation and validation/interpretation /re-use.

**Curation and storage/preservation costs**; person/team responsible for data management and quality assurance.

* *Proposals selected for funding under Horizon Europe will need to develop a detailed data management plan (DMP) for making their data/research outputs findable, accessible, interoperable and reusable (FAIR) as a deliverable by month 6 and revised towards the end of a project’s lifetime.*

 *For guidance on open science practices and research data management, please refer to the relevant section of the* [*HE Programme Guide*](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf) *on the Funding & Tenders Portal.*

During this project we have not used any other research outputs. However we have used MiniSAT and ManySAT algorithms for making comparisons to our algorithm.

#@CON-MET-CM@# #@COM-PLE-CP@#

1. **Impact** #@IMP-ACT-IA@#

***Impact – aspects to be taken into account.***

* Credibility of the pathways to achieve the expected outcomes and impacts specified in the work programme, and the likely scale and significance of the contributions due to the project.
* Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities.

*The results of your project should make a contribution to the expected outcomes set out for the work programme topic over the medium term, and to the wider expected impacts set out in the ‘destination’ over the longer term.*

*In this section you should show how your project could contribute to the outcomes and impacts described in the work programme, the likely scale and significance of this contribution, and the measures to maximise these impacts.*

The newly developed SAT algorithm introduces a more efficient approach to solving SAT problems, a cornerstone in various computational fields such as optimization, verification. By significantly reducing computation time and resource requirements, this algorithm is poised to impact applications ranging from software verification to complex decision-making systems. The enhanced efficiency will directly contribute to achieving the expected outcomes in the work programme by advancing computational techniques critical to industry and research, potentially setting a new benchmark for SAT-solving capabilities.

* 1. **Project’s pathways towards impact *[****e.g. 4 pages]*
     + Provide a **narrative** explaining how the project’s results are expected to make a difference in terms of impact, beyond the immediate scope and duration of the project. The narrative should include the components below, tailored to your project.

1. Describe the unique contribution your project results would make towards (1) the **outcomes** specified in this topic, and (2) the **wider impacts**, in the longer term, specified in the respective destinations in the work programme.

* *Be specific, referring to the effects of your project, and not R&I in general in this field.*

* *State the target groups that would benefit. Even if target groups are mentioned in general terms in the work programme, you should be specific here, breaking target groups into particular interest groups or segments of society relevant to this project.*

* *The outcomes and impacts of your project may:*

* + *Scientific, e.g. contributing to specific scientific advances, across and within disciplines, creating new knowledge, reinforcing scientific equipment and instruments, computing systems (i.e. research infrastructures);*
  + *Economic/technological, e.g. bringing new products, services, business processes to the market, increasing efficiency, decreasing costs, increasing profits, contributing to standards’ setting, etc.*
  + *Societal , e.g. decreasing CO2 emissions, decreasing avoidable mortality, improving policies and decision making, raising consumer awareness.*

*Only include such outcomes and impacts where your project would make a significant and direct contribution. Avoid describing very tenuous links to wider impacts. However, include any potential negative environmental outcome or impact of the project including when expected results are brought at scale (such as at commercial level). Where relevant, explain how the potential harm can be managed.*

Our SAT algorithm project is expected to drive significant advancements in computational efficiency across various disciplines, with lasting impacts that extend beyond the immediate scope and duration of the project. By offering a faster, more resource-efficient approach to solving satisfiability problems, the project stands to influence the following areas:

From a technological and economic perspective, our SAT algorithm can help drive efficiency across industries, reducing computational costs and resource consumption for high-demand tasks:

* By lowering the time and resource requirements of complex calculations, the algorithm supports industries in achieving greater efficiency, potentially decreasing operational costs and enhancing profitability.
* It will also promote the development of new products, services, and business processes reliant on advanced problem-solving algorithms, such as those used in verification processes for hardware and software or in cryptographic security.

Target groups: Industries relying on optimization and verification processes (e.g., electronics, manufacturing, cybersecurity, and finance) and software developers who can integrate this algorithm to improve the efficiency of commercial and industrial applications.

1. Give an indication of the scale and significance of the project’s contribution to the expected outcomes and impacts, should the project be successful. Provide quantified estimates where possible and meaningful.

* ‘*Scale’ refers to how widespread the outcomes and impacts are likely to be. For example, in terms of the size of the target group, or the proportion of that group, that should benefit over time; ‘Significance’ refers to the importance, or value, of those benefits. For example, number of additional healthy life years; efficiency savings in energy supply.*

* *Explain your baselines, benchmarks and assumptions used for those estimates. Wherever possible, quantify your estimation of the effects that you expect from your project. Explain assumptions that you make, referring for example to any relevant studies or statistics. Where appropriate, try to use only one methodology for calculating your estimates: not different methodologies for each partner, region or country (the extrapolation should preferably be prepared by one partner).*

 *Your estimate must relate to this project only - the effect of other initiatives should not be taken into account.*

If successful, the new SAT algorithm has the potential to significantly impact a broad range of industries and scientific fields due to its versatility and applicability across computational challenges. Here’s an estimation of the reach and effect of the project:

* In the academic field, SAT solvers are central to computer science and related research areas, with over 200 universities and research institutions globally engaged in SAT research and applications. By offering an open-access version, the algorithm could potentially be adopted by a third of these institutions in the first three years post-release, reaching approximately 70 universities or research centers, accelerating research efforts in fields like cryptography, and optimization.

1. Describe any requirements and potential barriers - arising from factors beyond the scope and

duration of the project - that may determine whether the desired outcomes and impacts are achieved. These may include, for example, other R&I work within and beyond Horizon Europe; regulatory environment; targeted markets; user behaviour. Indicate if these factors might evolve over time. Describe any mitigating measures you propose, within or beyond your project, that could be needed should your assumptions prove to be wrong, or to address identified barriers.

* *Note that this does not include the critical risks inherent to the management of the project itself , which should be described below under ‘Implementation’.*

We have no requirements for this research project, that why We also could not identify any relevant barriers.

##### Measures to maximise impact - Dissemination, exploitation and communication #@COM-DIS-VIS-CDV@#

*[e.g. 5 pages, including section 2.3]*

* + - Describe the planned measures to maximise the impact of your project by providing a first version of your ‘plan for the dissemination and exploitation including communication activities’. Describe the dissemination, exploitation and communication measures that are planned, and the target group(s) addressed (e.g. scientific community, end users, financial actors, public at large).

* *Please remember that this plan is an admissibility condition, unless the work programme topic explicitly states otherwise. In case your proposal is selected for funding, a more detailed ‘plan for dissemination and exploitation including communication activities’ will need to be provided as a mandatory project deliverable within 6 months after signature date. This plan shall be periodically updated in alignment with the project’s progress.*

* *Communication*[*1*](#_bookmark0) *measures should promote the project throughout the full lifespan of the project. The aim is to inform and reach out to society and show the activities performed, and the use and the benefits the project will have for citizens. Activities must be strategically planned, with clear objectives, start at the outset and continue through the lifetime of the project. The description of the communication activities needs to state the main messages as well as the tools and channels that will be used to reach out to each of the chosen target groups.*

* *All measures should be proportionate to the scale of the project, and should contain concrete actions to be implemented both during and after the end of the project, e.g. standardisation activities. Your plan should give due consideration to the possible follow-up of your project, once it is finished. In the justification, explain why each measure chosen is best suited to reach the target group addressed. Where relevant, and for innovation actions, in particular, describe the measures for a plausible path to commercialise the innovations.*

* *If exploitation is expected primarily in non-associated third countries, justify by explaining how that exploitation is still in the Union’s interest.*

* *Describe possible feedback to policy measures generated by the project that will contribute to designing, monitoring, reviewing and rectifying (if necessary) existing policy and programmatic measures or shaping and supporting the implementation of new policy initiatives and decisions.*

* + - Outline your strategy for the management of intellectual property, foreseen protection measures, such as patents, design rights, copyright, trade secrets, etc., and how these would be used to support exploitation.

* *If your project is selected, you will need an appropriate consortium agreement to manage (amongst other things) the ownership and access to key knowledge (IPR, research data etc.).*

1 For further guidance on communicating EU research and innovation for project participants, please refer to the [Online Manual](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/om_en.pdf) on the Funding & Tenders Portal

*Where relevant, these will allow you, collectively and individually, to pursue market opportunities arising from the project.*

* *If your project is selected, you must indicate the owner(s) of the results (results ownership list) in the final periodic report.*

We are patenting the algorithmic model. The research could be used for scientific goals, but it would be our interest to have the rights over algorithm.

Most of those researchers could use our algorithm who works on domains of Hardware and Software verification, Code optimization, Automated planning and Cryptography. Mainly academic researchers and members through the industry could find the algorithm useful.

The research could be promoted with demonstrations and presentations. These events can be held in universities where most researchers would be able to learn about our project. Also, live podcasts can be held where for instance academic researchers could ask about the topic.

Presentations could also be held in some company campuses. Researchers in company domains could get on with the algorithm and they may use it, evolve it or join our research group.

On our official website anyone could give our research team feedback. Our email address is available and an online form as well.

Throughout the research no copyright content was needed.

#§COM-DIS-VIS-CDV§#

##### Summary

Provide a summary of this section by presenting in the canvas below the key elements of your project impact pathway and of the measures to maximise its impact.

### KEY ELEMENT OF THE IMPACT SECTION

|  |
| --- |
| **SPECIFIC NEEDS** |
| *What are the specific needs that triggered this project?*  Example 1  Efficient way of solving SAT problem, which is an NP-complete problem. Our first thoughts, can we make a more resource efficient algorithm. |

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| **EXPECTED RESULTS** |
| What do you expect to generate by the end of the project?  Example 1  **A fast n2 computation cost algorithm**  that more efficient than the existing SAT solvers, such as DPLL or CDCL.  Example 2  Our other goal is the development an algorithm that despite **NP-completeness**  it solves big SAT instances in a reasonable amount of time. |

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| **D & E & C MEASURES** |
| What dissemination, exploitation and communication measures will you apply to the results?  Example 1  **Exploitation:** Patenting the algorithmic model.  **Dissemination towards the scientific community and industry:** Participating at conferences; Developing a platform of material compositions for industry |

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| **IMPACTS** |
| *What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?*  Example 1  **Scientific:** New breakthrough scientific discovery on **NP-complete** problems.  **Economic:** Using less energy and time.  **Research domains**: Hardware and Software verification, Code optimization, automation and cryptography. |

#§IMP-ACT-IA§#

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| **TARGET GROUPS** |
| *Who will use or further up-take the results of the project? Who will benefit from the results of the project?*  Example 1  **Academic researchers**  **Researchers in the industry**  **Other college members** |

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| **OUTCOMES** |
| *What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?*  Example 1  **High use of the scientific discovery published**  Using **less energy** for SAT solving via planet Earth |

1. **Quality and efficiency of the implementation** #@QUA-LIT-QL@# #@WRK-PLA-WP@#

***Quality and efficiency of the implementation – aspects to be taken into account***

‒ *Quality and effectiveness of the work plan, assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall*

‒ *Capacity and role of each participant, and extent to which the consortium as a whole brings together the necessary expertise.*

* 1. **Work plan and resources** *[e.g. 14 pages – including tables]*

Please provide the following:

* + - brief presentation of the overall structure of the work plan;
    - timing of the different work packages and their components (Gantt chart or similar);
    - graphical presentation of the components showing how they inter-relate (Pert chart or similar).
    - detailed work description, i.e.:
* a list of work packages (table 3.1a);
* a description of each work package (table 3.1b);
* a list of deliverables (table 3.1c);

* *Give full details. Base your account on the logical structure of the project and the stages in which it is to be carried out. The number of work packages should be proportionate to the scale and complexity of the project.*

* *You should give enough detail in each work package to justify the proposed resources to be allocated and also quantified information so that progress can be monitored, including by the Commission*

* *Resources assigned to work packages should be in line with their objectives and deliverables. You are advised to include a distinct work package on ‘project management’, and to give due visibility in the work plan to ‘data management’ ‘dissemination and exploitation’ and ‘communication activities’, either with distinct tasks or distinct work packages.*

* *You will be required to update the ‘plan for the dissemination and exploitation of results including communication activities’, and a ‘data management plan’, (this does not apply to topics where a plan was not required.) This should include a record of activities related to dissemination and exploitation that have been undertaken and those still planned.*

* *Please make sure the information in this section matches the costs as stated in the budget table in section 3 of the application forms, and the number of person months, shown in the detailed work package descriptions.*

* + - a list of milestones (table 3.1d);
    - a list of critical risks, relating to project implementation, that the stated project's objectives may not be achieved. Detail any risk mitigation measures. You will be able to update the list of critical risks and mitigation measures as the project progresses (table 3.1e);
    - a table showing number of person months required (table 3.1f);
    - a table showing description and justification of subcontracting costs for each participant (table 3.1g);
    - a table showing justifications for ‘purchase costs’ (table 3.1h) for participants where those costs exceed 15% of the personnel costs (according to the budget table in proposal part A);
    - if applicable, a table showing justifications for ‘other costs categories’ (table 3.1i);
    - if applicable, a table showing in-kind contributions from third parties (table 3.1j)
  1. **Capacity of participants and consortium as a whole** #@CON-SOR-CS@# #@PRJ-MGT-PM@# *[e.g. 3 pages]*

 *The individual participants of the consortium are described in a separate section under Part A. There is no need to repeat that information here.*

* + - Describe the consortium. How does it match the project’s objectives, and bring together the necessary disciplinary and inter-disciplinary knowledge. Show how this includes expertise in social sciences and humanities, open science practices, and gender aspects of R&I, as appropriate. Include in the description affiliated entities and associated partners, if any.
    - Show how the partners will have access to critical infrastructure needed to carry out the project activities.
    - Describe how the members complement one another (and cover the value chain, where appropriate)
    - In what way does each of them contribute to the project? Show that each has a valid role, and adequate resources in the project to fulfil that role.
    - If applicable, describe the industrial/commercial involvement in the project to ensure exploitation of the results and explain why this is consistent with and will help to achieve the specific measures which are proposed for exploitation of the results of the project (see section 2.2).
    - **Other countries and international organisations**: If one or more of the participants requesting EU funding is based in a country or is an international organisation that is not automatically eligible for such funding (entities from Member States of the EU, from Associated Countries and from one of the countries in the exhaustive list included in the Work Programme General Annexes B are automatically eligible for EU funding), explain why the participation of the entity in question is essential to successfully carry out the project.

#§CON-SOR-CS§# #§PRJ-MGT-PM§#

##### Tables for section 3.1

 *Use plain text for the tables in section 3.1. If the proposal is invited to start Grant Agreement preparation, these tables will have to be encoded in the grant management IT tool, where no graphics or special formats are supported.*

##### Table 3.1a: List of work packages

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Work package No** | **Work Package Title** | **Lead Participant No** | **Lead Participant Short Name** | **Person- Months** | **Start Month** | **End month** |
| WP1 | Project Management | 1 | ELTE | 4 | 1 | 6 |
| WP2 | Background Research and Information Collection | 1 | ELTE | 4 | 1 | 1 |
| WP3 | Algorithm Development | 1 | ELTE | 10 | 2 | 3 |
| WP4 | Validation and Testing | 1 | ELTE | 8 | 4 | 5 |
| WP5 | Communication and Dissemination | 1 | ELTE | 4 | 6 | 6 |

**Table 3.1b: Work package description For each work package:**

|  |  |
| --- | --- |
| **Work package number** | WP1 |
| **Work package title** | Project Management |

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| --- |
| **Objectives**  The objective of this work package is to manage the project, the human and physical resources, and to monitor the progress of the project. |

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| --- |
| **Description of work**  Only ELTE is responsible for this work package.  The purpose of the work package is to ensure that all phases of the project are completed on time and within the specified deadlines. Communication between participants must be ensured. Human resources management, which includes the selection of the necessary specialists (e.g. researchers, developers) and the optimal distribution of their workload. Providing the necessary tools and technological infrastructure for the project (e.g. research tools, office premises). |

|  |  |
| --- | --- |
| **Work package number** | WP2 |
| **Work package title** | Background Research and Information Collection |

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| **Objectives**  Explore the results achieved so far in the field of SAT solving and parallel algorithms. Plan the research. |

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| **Description of work**  Only ELTE is responsible for this work package.  Explore the history of SAT problem, get to know the fields of application of SAT solvers. Examine the algorithms known so far, like DPLL, CDCL algorithms, MiniSAT and ManySAT. Explore parallel algorithms and learn how these split the search across multiple processors to reduce the execution time. Examine the weaknesses of the existing algorithms.  Moreover, this work package contains the planning of the research, and the algorithm based on the collected information. |

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| --- | --- |
| **Work package number** | WP3 |
| **Work package title** | Algorithm Development |

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| **Objectives**  Create our algorithm. |

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| --- |
| **Description of work**  ELTE cooperates with ETH in this work package. The algorithm has to be specified, for this the following tasks required:   * create the algorithm with transfer the given formula for the correct form to analyse it, * create the splitting strategies, * decide the number of threads, * decide what information will be shared between threads, * collect heuristics * runtime optimalization * hardware usage optimalization. |

|  |  |
| --- | --- |
| **Work package number** | WP4 |
| **Work package title** | Validation and Testing |

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| --- |
| **Objectives**  Validate the correction of our algorithm and test it while running. |

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| **Description of work**  ELTE cooperates with KU in validation and Microsoft helps ELTE to test the algorithm. During algorithm validation, we check whether the algorithm solves the given problem, as well as whether it is error-free and optimality from the perspective of performance. Runtime, computational cost and hardware usage need to be tested. Documentation also has to be written in this work package. |

|  |  |
| --- | --- |
| **Work package number** | WP5 |
| **Work package title** | Communication and Dissemination |

|  |
| --- |
| **Objectives**  Introduce our results to the world. |

|  |
| --- |
| **Description of work**  Only ELTE is responsible for this work package.  Our result has to be available by the researchers of the world. For this, we need to do following tasks:   * promote the research with demonstrations and presentations, for example in universities, * hold live podcasts for instance academic researchers could ask about the topic, * hold presentations in some company campuses, * create our official website where anyone could give our research team feedback (public email address and online form). |

##### Table 3.1c: List of Deliverables[2](#_bookmark1)

Only include deliverables that you consider essential for effective project monitoring.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Deliverable name** | **Short description** | **Work package number** | **Short name of lead participant** | **Type** | **Dissemin ation level** | **Delivery date**  **(in months)** |
| 1 | Data management plan | Contains the plan | WP2 | ELTE | DMP | PU | 1 |
| 2 | Algorithm | The algorithm of the new SAT solver | WP3 | ELTE | Other (Algorithm) | PU | 3 |
| 3 | Software | The software that implements the algorithm | WP3 | ELTE | Other (Software) | PU | 4 |
| 4 | Documentation | The documentation of the algorithm and the software | WP4 | ELTE | R | PU | 5 |
| 5 | Dissemination plan | The plan for dissemination and communication | WP5 | ELTE | R | PU | 6 |

**KEY**

Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>.

For example, deliverable 4.2 would be the second deliverable from work package 4.

**Type:**

Use one of the following codes:

R: Document, report (excluding the periodic and final reports) DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc. DATA: Data sets, microdata, etc.

DMP: Data management plan

ETHICS: Deliverables related to ethics issues. SECURITY: Deliverables related to security issues

OTHER: Software, technical diagram, algorithms, models, etc.

**Dissemination level:**

Use one of the following codes:

PU – Public, fully open, e.g. web (Deliverables flagged as public will be automatically published in CORDIS project’s page)

SEN – Sensitive, limited under the conditions of the Grant Agreement

Classified R-UE/EU-R – EU RESTRICTED under the Commission Decision No2015/444 Classified C-UE/EU-C – EU CONFIDENTIAL under the Commission Decision No2015/444 Classified S-UE/EU-S – EU SECRET under the Commission Decision No2015/444

**Delivery date**

Measured in months from the project start date (month 1)

2 You must include a data management plan (DMP) and a ‘plan for dissemination and exploitation including communication activities as distinct deliverables within the first 6 months of the project. The DMP will evolve during the lifetime of the project in order to present the status of the project's reflections on data management. A template for such a plan is available in the [Online Manual](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/om_en.pdf) on the Funding & Tenders Portal.

##### Table 3.1d: List of milestones

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Milestone**  **number** | **Milestone**  **name** | **Related work**  **package(s)** | **Due date (in month)** | **Means of verification** |
| 1 | Data management plan | WP2 | 1 | All needed data are available. |
| 2 | Algorithm | WP3 | 2 | Prove the correctness of the algorithm. |
| 3 | Software | WP3, WP4 | 4 | Validate the software with tests, |
| 4 | Documentation | WP4 | 5 | Every important increment is documented. |
| 5 | Dissemination plan | WP5 | 6 | The foundation of the research has been spread widely. |

**KEY**

**Due date**

Measured in months from the project start date (month 1)

**Means of verification**

Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype that is ‘up and running’; software released and validated by a user group; field survey complete and data quality validated.

**Table 3.1e: Critical risks for implementation** #@RSK-MGT-RM@#

|  |  |  |
| --- | --- | --- |
| **Description of risk (indicate level of (i)**  **likelihood, and (ii) severity: Low/Medium/High)** | **Work package(s) involved** | **Proposed risk-mitigation measures** |
| Proving the correctness of the algorithm is not possible. Likelihood to occur is high, level of severity is also high, | Creating the algorithm. | Try to make an algorithm, that is correct. Avoid solutions that is not deterministic. |
| The algorithm will not work deterministically in all programing languages. Level of likelihood is low, but severity level is medium. | Software implementation. | Try to avoid programing language specific solutions. |

**Definition critical risk:**

A critical risk is a plausible event or issue that could have a high adverse impact on the ability of the project to achieve its objectives.

**Level of likelihood to occur: Low/medium/high**

The likelihood is the estimated probability that the risk will materialise even after taking account of the mitigating measures put in place.

**Level of severity: Low/medium/high**

The relative seriousness of the risk and the significance of its effect.

#§RSK-MGT-RM§#

##### Table 3.1f: Summary of staff effort

*Please indicate the number of person/months over the whole duration of the planned work, for each work package, for each participant. Identify the work-package leader for each WP by showing the relevant person- month figure in bold.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **WP1** | **WP2** | **WP3** | **WP4** | **WP5** | **Total Person-**  **Months per Participant** |
| **1 ELTE** | **4** | **4** | **4** | **2** | **4** | 4 |
| **2 ETH** | 0 | 0 | 6 | 0 | 0 | 6 |
| **3 KU** | 0 | 0 | 0 | 3 | 0 | 3 |
| **4 Microsoft** | 0 | 0 | 0 | 3 | 0 | 3 |
| **Total Person Months** | 4 | 4 | 10 | 8 | 4 |  |

##### Table 3.1g: ‘Subcontracting costs’ items

For each participant describe and justify the tasks to be subcontracted (please note that core tasks of the project should not be sub-contracted).

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Description of tasks and justification** |
| **1 ELTE** | 3200 | Create, validate and test the algorithm, and dissemination. |
| **2 ETH** | 1600 | Create the algorithm. |
| **3 KU** | 1600 | Validate the algorithm. |
| **4 Microsoft** | 1600 | Test the algorithm, |

##### Table 3.1h: ‘Purchase costs’ items (travel and subsistence, equipment and other goods, works and services)

Please complete the table below for each participant if the purchase costs (i.e. the sum of the costs for ’travel and subsistence’, ‘equipment’, and ‘other goods, works and services’) exceeds 15% of the personnel costs for that participant (according to the budget table in proposal part A). The record must list cost items in order of costs and starting with the largest cost item, up to the level that the remaining costs are below 15% of personnel costs.

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 80 | Local public transportation is required to transport the members. |
| **Equipment** | 2000 | Personal computers are needed for the implementation part. |
| **Other goods, works and**  **services** | 120 | Food supply is needed for the team. |
| **Remaining purchase costs (<15% of pers.**  **Costs)** | 60 |  |
| **Total** | 2260 |

##### Table 3.1i: ‘Other costs categories’ items (e.g. internally invoiced goods and services)

Please complete the table below for each participants that would like to declare costs under other costs categories (e.g. internally invoiced goods and services), irrespective of the percentage of personnel costs.

|  |  |  |
| --- | --- | --- |
| **1 Péter** | | |
|  | **Cost (€)** | **Justification** |
| **Internally invoiced**  **goods and services** | 1000 | Renting the workplace. |
| **Internally invoiced**  **goods and services** | 100 | Overhead of the workplace. |
| **…** |  |  |

##### Table 3.1j: ‘In-kind contributions’ provided by third parties

Please complete the table below for each participants that will make use of in-kind contributions (non-financial resources made available free of charge by third parties). In kind contributions provided by third parties free of charge are declared by the participants as eligible direct costs in the corresponding cost category (e.g. personnel costs or purchase costs for equipment).

|  |  |  |  |
| --- | --- | --- | --- |
| **Pa1 Péter** | | | |
| **Third party name** | **Category** | **Cost (€)** | **Justification** |
| Eötvös Loránd University | Seconded personnel **Select between** Seconded personnel Travel and subsistence Equipment  Other goods, works and services  Internally invoiced goods and services | 20 | Maintain workplace. |
| Microsoft | Equipment | 200 | Renting equipment, such as laptops. |

#§QUA-LIT-QL§# #§WRK-PLA-WP§#

##### ANNEXES TO PROPOSAL PART B

For the proposal of our SAT solver algorithm, we have considered the potential need for annexes to Proposal Part B, as outlined in the Horizon Europe guidelines. These annexes are essential for providing supplementary details in areas where the main proposal sections may have space limitations or where specific, detailed information is required.

In the context of our research:

* **Ethics**: Although our ethics self-assessment will be included in Proposal Part A, we recognize that additional information may be needed. If the character limit in Part A is insufficient to convey all ethical considerations related to our research, we will provide a comprehensive annex in Part B. This annex will address any potential ethical implications of the algorithm's development and application, ensuring adherence to Horizon Europe’s ethics standards.
* **Security Considerations**: If flagged as necessary, we will include an annex detailing any security-sensitive aspects of the project, outlining measures to mitigate potential risks and ensure compliance with security protocols.
* **Financial Support to Third Parties and Clinical Trials**: While these areas are not directly relevant to our current proposal focused on algorithmic research, should future project phases involve partnerships or funding distribution, the relevant annexes will be prepared in accordance with Horizon Europe requirements.

These additional documents will be uploaded as separate annexes in the submission system, ensuring the proposal meets all compliance and evaluation standards.