**Small or medium-scale focused research project (STREP) proposal**

**ICT Call 5**

H2020-ICT-27-2018-2020

**Autopilot cars for roads in Serbia**

**APS**

**Small or medium scale focused research project (STREP)**

**Date of preparation**: 13.11.2017.

**Version number**: 1.0

**Work programme topic addressed**

Internet of Things - ICT-27-2018-2020

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**Proposal abstract**

*In Serbia, driving a motor vehicles is extremely difficult due to the numerous holes on the roads, inadequate marking, road signs and poor lighting of individual sections. This greatly complicates the use of autopilot vehicles. The current technologies have been designed to recognize only quality and unimpaired signalling, so they have proved to be incompatible with such conditions on the roads of Serbia. The objective of the proposed project is to adapt autopilot software for roads in Serbia and implement it on vehicles imported from Korea (KIA,* *Hyundai*, *SsangYong and Daewoo). This can be done by improving the system for identifying the holes on the road and changing the system that tracks the lines on the roads, by emphasizing distance from the edge of the road and vehicles in front and behind. This can provide a possibility to a large number of people to use autopilot vehicles, and also provide a possibility to people incapable of driving to use vehicles at all. This idea may also be a stimulus for other countries to follow this example. Detailed testing is planned on a statistically large number of vehicles from 4 producers.*

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**Section 1: Scientific and/or technical quality, relevant to the topics addressed by the call**

**1.1 Concept and objectives**

The major concept behind this proposal is to connect the following fields:

* AMI (Automotive industry)
* ECE (electrical and computer engineering)
* WSN (wireless sensor networks)
* INT (Internet technology)
* SEM (software engineering methodology)
* DMS (data mining systems)

in order to achieve using autopilot cars more comfortable.

This major strategy is fully compatible with major goals expressed in call: Internet of Things - ICT-27-2018-2020.

Our approach in this proposal is a continuation (follow-up) of other existing project: Pattern matching for recognising car licence plates. Essentially, while working on previous project, idea was generated, to give an even greater contribute to the automotive industry and helping people with special needs.

The main idea of this project is to adjust software for cars imported from South Korea, in order to make it compatible to roads in Serbia.

The following are the main project objectives:

**Objective 0: Project management**

The goal of this objective is to make sure that absolutely each and every detail of this proposal, if it is awarded, be properly taken care of, which means:

(a) All deliverables delivered in time

(b) All deliverables delivered at quality levels that satisfy the highest H2020 standards

(c) All deliverables delivered in a form which is consistent and understandable.

Success criteria:

* Optimization of the reporting processes involved in the project (deadlines)
* Optimization of the control processes involved in the project
* Optimizing finances of the project

**Objective 1: Generating use cases**

Use cases will be generated through a series of brainstorming meetings, with the purpose of taking into account a variety of applications of interest for the Automotive industry (this includes both, the generation of new ideas and improvements of the existing ones). An active two-way exchange of results between all partners and the EU researchers will be done through seminars and workshops. All application use cases will be properly documented.

Success criteria:

* Opinion of beneficiaries on the need for the generated applications
* Opinion of beneficiaries about the functionalities provided

**Objective 2: Import vehicles from South Korea**

The main objective is to develop a collaboration with KIA, Daewoo, Hyndai and SsangYong. Licence is required in order to change their product.

Success criteria:

* Imports are done in arranged deadlines
* Needed licences are obtained

**Objective 3: Obtain software from Tesla**

The main objective is to develop a collaboration with Tesla. Licence is required in order to base our software on theirs.

Success criteria:

* Needed licences are obtained

**Objective 4: Detailed study on road conditions in Serbia**

The main objective is to make a detailed study on conditions of Serbian roads, because of many damages, inadequate signalisation and inappropriate visibility. The goal is to have a complete analysis on all possible problems, which will be covered by software.

Success criteria:

* List of all possible problems on Serbian roads made

**Objective 5: Software implementation**

The main objective is to adjust Tesla`s software for cars imported from South Korea, by improving damage recognition system, side-line following system and car distance system.

Success criteria:

* System for damage recognition can detect and avoid road damages off any size and types.
* System for side-line following can maintain required distance from each side-line in straight driving and in both left and right curves and turning.
* System for car distance can measure distance from both cars in front and behind and optimize speed to keep it constant.
* Software covers statistically significant number of different road issues.

**Objective 6: Testing**

The main objective is to test one representing car of eachdeveloper in different types of roads. Adjusted cars from each car manufacturer (KIA, Daewoo, Hyndai and SsangYong) we will test on highways, mountain roads and city streets.

Success criteria:

* Test cases developed according to the needs of the beneficiary industry
* All 12 test combinations passed successfully.

**Objective 7: To do constantly a public dissemination about this project**

The special sessions, seminars and car shows will be open events to achieve the maximum dissemination impact and spread knowledge to cognate industries and institutions for maximal regional benefit. Suitable media events will be used to further spread information about the benefits of applications. This will enable us, to gain a more competitive position on the world market and consequently boost the local economy.

Success criteria:

* Number of papers presented at most famous international car magazines (one per each month dissemination is done, 8 in total)
* Number of participants at automotive seminars and sessions (one of each kind, in each dissemination section, 4 participations in total)

**1.2 Progress beyond the state-of-the-art**

What follows is an analysis of existing approaches worldwide. The analysis to follow concludes the following: although the latest and most advanced researches nowadays, do contribute a number of innovative approaches, none of them is compatible with roads in Serbia, which is where this proposal goes beyond state of the art. Problems are described in Objective 4: Detailed study on road conditions in Serbia.

The main producer of autopilot cars is Tesla. Even though, having the most advanced technologies, being in top 5 selling autopilot cars and has achieved remarkable properties of cars with autopilot, Tesla has proven itself extremely unreliable and dangerous[1] even on more quality roads then the ones in Serbia. That is why we want to improve its software and sensors. The main idea is to base on a software with great possibilities, and improve its defects regarding safety and compatibility in order to create world-class autopilot software.

References:

1. YADRON, Danny; TYNAN, Dan. Tesla driver dies in first fatal crash while using autopilot mode. The Guardian, 2016, 1.
2. LARI, Adeel; DOUMA, Frank; ONYIAH, Ify. Self-driving vehicles and policy implications: current status of autonomous vehicle development and Minnesota policy implications. Minn. JL Sci. & Tech., 2015, 16: 735
3. KESSLER, Aaron M. Elon Musk Says Self-Driving Tesla Cars Will Be in the US by Summer. The New York Times, 2015, B1.
4. BRADLEY, Ryan. Tesla autopilot, the electric-vehicle maker sent its cars a software update that suddenly made autonomous driving a reality. 2016.

**1.3 S/T methodology and associated work plan**

**1.3.1 Describing the overall strategy of the work plan**

In order to achieve the overall project objectives, the following items are considered as crucial:

* Competent researchers well aware of the state of the art in the research field and able to take the research forward;
* State of the art research infrastructure;
* Ability to work, communicate and collaborate with researchers from various backgrounds, in various circumstances and environments;
* Large network of contacts in the research community;
* Public awareness of the benefits of the research in a chosen field and promotion of research results and achievements.

The project is organized in 8 work packages as follows:

* WP0: Project management
* WP1: Generating use cases
* WP2: Import vehicles from South Korea
* WP3: Obtain software from Tesla
* WP4: Detailed study on road conditions in Serbia
* WP5: Software implementation
* WP6: Testing
* WP7: Dissemination

The main body of work is included in three work packages (WP1, WP2, WP3, WP4 and WP5). The activities planned in these work packages correspond to the main strands of the project as described above. It is the responsibility of the project management team (WP0) to coordinate these activities to maximize the impact and benefits for everyone involved. Work packages WP6 and WP7 are treated as pillars that support the main body of work.

**1.3.2 Work packages - Gantt chart**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Months | | | | | | | | | | | | | | | | | | | | | | | |
| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| WP0  Project management |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP1  Generating use cases |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP2  Import vehicles  from South Korea |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP3  Obtain software  from Tesla |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP4  Detailed study on  road conditions in Serbia |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP5  Software implementation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP6  Testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| WP7  Dissemination |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**1.3.3.a Work package list**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package No[[1]](#footnote-1)** | **Work package title** | **Type of activity[[2]](#footnote-2)** | **Lead  partic no.[[3]](#footnote-3)** | **Lead partic. short name** | **Person-months[[4]](#footnote-4)** | **Start month****[[5]](#footnote-5)** | **End month** |
| WP0 | Project management | MGT | 2 | RT-RK | 48 | M1 | M21 |
| WP1 | Generating use cases | RTD | 1 | MATF | 8 | M2 | M3 |
| WP2 | Import vehicles from South Korea | RTD | 5 | TTTECH | 4 | M4 | M5 |
| WP3 | Obtain software from Tesla | RTD | 3 | ETF | 8 | M4 | M5 |
| WP4 | Detailed study on road conditions in Serbia | RTD | 5 | TTTECH | 70 | M6 | M12 |
| WP5 | Software implementation | RTD | 1 | MATF | 160 | M10 | M18 |
| WP6 | Testing | RTD | 4 | OBLO | 50 | M13 | M19 |
| WP7 | Dissemination | DEM | 2 | RT-RK | 24 | M13 | M24 |
|  | TOTAL |  |  |  | 372 |  |  |

**1.3.3.b List of Deliverables**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Del. no.[[6]](#footnote-6)** | **Deliverable name** | **WP no.** | **Nature[[7]](#footnote-7)** | **Dissemi-nation  level[[8]](#footnote-8)** | **Delivery date[[9]](#footnote-9)**  **(proj.**  **month)** |
| D0.1 | Progress report for the three months of work | 0 | R | PU | M3 |
| D0.2 | Progress report for the nine months of work | 0 | R | PU | M9 |
| D0.3 | Progress report for the fifteen months of work | 0 | R | PU | M15 |
| D0.4 | Progress report of whole project | 0 | R | PU | M24 |
| D1 | Documentation of use cases | 1 | R | CO | M4 |
| D2 | Confirmation on import success | 2 | R | PP | M6 |
| D3 | Confirmation on Tesla’s software receiving success | 3 | R | PP | M6 |
| D4 | Report on detailed study on Serbian roads | 4 | R | CO | M13 |
| D5.1 | Documented code | 5 | R | CO | M14 |
| D5.2 | Final version of software implementation | 5 | P | CO | M18 |
| D6.1 | Documented testing procedures | 6 | R | CO | M14 |
| D6.2 | Report on testing results | 6 | R | PU | M20 |
| D7.1 | Number of participants at automotive seminars and sessions | 7 | D | PU | M24 |
| D7.2 | Number of car shows organized | 7 | D | PU | M24 |
| D7.3 | Number of arcticles in international car magazines | 7 | D | PU | M24 |

**1.3.3.c Milestones**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Milestone number** | **Milestone name** | **Work package(s) involved** | **Expected date [[10]](#footnote-10)** | **Means of verification[[11]](#footnote-11)** |
| M0.1 | Checking on optimization of the reporting processes involved in the project (deadlines) | WP0 | M6 |  |
| M0.2 | Checking on optimization of the control processes involved in the project | WP0 | M12 |  |
| M0.3 | Checking on optimizing finances of the project | WP0 | M12 |  |
| M1.1 | Checking on opinion of beneficiaries on the need for the generated applications | WP1 | M3 |  |
| M1.2 | Checking on opinion of beneficiaries about the functionalities provided | WP1 | M4 |  |
| M2.1 | Checking if imports are done in arranged deadlines | WP2 | M5 |  |
| M2.2 | Checking if needed licences are obtained | WP2 | M5 |  |
| M3.1 | Checking if needed licences are obtained | WP3 | M5 |  |
| M4.1 | Checking if list of all possible problems on Serbian roads is made properly | WP4 | M13 |  |
| M5.1 | Checking on system for damage recognition | WP5 | M18 | System can detect and avoid road damages off any size and types. |
| M5.2 | Checking on system for side-line following | WP5 | M18 | System can maintain required distance from each side-line in straight driving and in both left and right curves and turning. |
| M5.3 | Checking on system for car distance | WP5 | M18 | System can measure distance from both cars in front and behind and optimize speed to keep it constant. |
| M5.4 | Checking if software covers statistically significant number of different road issues | WP5 | M18 |  |
| M6.1 | Checking if test cases are developed according to the needs of the beneficiary industry | WP6 | M13 |  |
| M6.2 | Checking if all 12 test combinations passed successfully. | WP6 | M20 |  |
| M7.1 | Checking on number of papers presented at most famous international car magazines | WP7 | M24 | Number must match plan:  one per each month dissemination is done, 8 in total |
| M7.2 | Checking on number of participants at automotive seminars and sessions | WP7 | M24 | Number must match plan:  one of each kind, in each dissemination section, 4 participations in total |

**1.3.3.d Description of each work package**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package number** | WP0 | | **Start date or starting event:** | | | | M1 | | |
| **Work package title** | Project management | | | | | | | | |
| **Activity type[[12]](#footnote-12)** | MGT | | | | | | | | |
| **Participant number** | 2 | 5 | | 1 |  |  | |  | Total |
| **Participant short name** | RT-RK | TTTech | | MATF |  |  | |  |  |
| **Person-months per participant** | 24 | 12 | | 12 |  |  | |  | 48 |
| **Objectives**  The objectives of WP0 are the overall management, progress monitoring and stakeholders management of the project. WP0 aims at:  Setting up, operating and maintaining the project administrative and scientific management infrastructure.  Ensuring the overall scientific and technical coordination of the project.  Ensuring collaboration and coordination with relevant government bodies regarding research programmes.  Performing a self-assessment of the project progress.  Conducting progress reviews on M3, M9, M15 and M24 | | | | | | | | | |
| **Description of work**  WP Leader: RT-RK  The Project Manager (PM) will be the permanent responsible person for interface towards the partners of the Consortium for all administrative, contractual and financial matters and handle the overall management of the project. The duties, methodologies, conflict resolution and management strategies that will be followed in the project are described in detail elsewhere in this proposal. The project manager will submit all Deliverables. The project manager will maintain the project plan. The exchange of researchers is a crucial issue, both in the initial phases when final set of use cases and related details have to be created, and later on during the implementation and testing. All these exchange visits have to be carefully planned, and their costs carefully minimized. The purchase of each and every detail needed for the success of this project has to be monitored carefully, to avoid errors from some other past projects in which resources were wasted on non-adequate purchases. Also, all purchases have to be selected so that they are usable and after the project is over, for educational purposes at universities involved.  The Scientific and technical co-ordination of the project will be under the responsibility of the Scientific and technical manager and under the guidance of the project’s Operational Steering Group (OSG). The S&T manager will maintain the Project handbook which will contain the schedule and scientific content of all project events (seminars, research exchanges, car shows, …). The duties and S&T management strategies that will be followed in the project are described in detail elsewhere in this proposal.  T0.1- T0.3 – Progress reports (TL: RT-RK): TL will submit a progress report at the end of 3rd , 9th and 15th month.  T0.7 – Final report (TL: RT-RK): TL will submit a final report on the overall progress of the project at the end of 24th month. | | | | | | | | | |
| **Deliverables**  D0.1 – D0.3 (M0.1 – M0.3) – Progress report for the three/six months of work  D0.4 – Progress report of whole project | | | | | | | | | |

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| **Work package number** | WP1 | | **Start date or starting event:** | | | | M2 | | |
| **Work package title** | Generating use cases | | | | | | | | |
| **Activity type[[13]](#footnote-13)** | RTD | | | | | | | | |
| **Participant number** | 1 | 3 | |  |  |  | |  | Total |
| **Participant short name** | MATF | ETF | |  |  |  | |  |  |
| **Person-months per participant** | 6 | 2 | |  |  |  | |  | 8 |
| **Objectives**  To define use case scenarios. To facilitate transfer of the S&T competence and knowledge among partners. To enable information exchange and sharing between all project partners, including external experts. To establish a joint supervision program focusing on the success of the project. | | | | | | | | | |
| **Description of work**  WP Leader: MATF  This work package will focus on knowledge transfer primarily among project participants with involvement of external experts, as well as covering all significant scenarios, with different use cases.  T1.1 Investigation and consulting (TL: ETF) – Using inter-team communication with all members and interviews with relevant experts to narrow down possible scenarios regarding our project.  T1.2 Definition of use cases (TL: MATF) – Generating documentation (diagram and description) of each use case. This use cases will be later used to help generating test cases. | | | | | | | | | |
| **Deliverables**  D1 (M1.1, M1.2) Documentation of use cases | | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package number** | WP2 | | **Start date or starting event:** | | | | M4 | | | |
| **Work package title** | Import vehicles from South Korea | | | | | | | | | |
| **Activity type[[14]](#footnote-14)** | RTD | | | | | | | | | |
| **Participant number** | 5 | 4 | |  |  |  | |  | Total | |
| **Participant short name** | TTTech | OBLO | |  |  |  | |  |  | |
| **Person-months per participant** | 2 | 2 | |  |  |  | |  | 4 | |
| **Objectives**  To establish communication with all partners from South Korea. To obtain all licenses required to import their vehicles. To obtain all licenses required to modify software on their vehicles. To establish communication with representative, which will available for all issues that can come up during process of import and later during software modifications. | | | | | | | | | |
| **Description of work**  WP Leader: TTTech  This work package will focus on establishing communication and collaboration between us and South Korean partners: KIA, Hyundai, SsangYong and Daewoo. All partners will contribute this project with their best autopilot car models, except from SsangYong, that will participate with SUV (Sport Utility Vehicles) models.  T2.1 Establish communication (TL: TTTech) – Get in touch with all partners from South Korea. Share out project idea and pursue them to involve in this project. Explain both financial and global significance of this collaboration. Propose and sign the necessary contracts. Inform about possible collaboration with Tesla motors.  T2.2 Obtain importing license (TL: OBLO) – Obtain license for import. Import vehicles from South Korea. Handle all possible customs problems that can cause latency of the project.  T2.3 Obtain modifying license (TL: OBLO) – Obtain license for modifying autopilot software on South Korean vehicles. Obtain all documentation on existing software, its characteristics, advantages and flaws. Establish contact with at least one software engineer of each autopilot car model.  T2.4 Regular communication with representatives.  (TL: TTTech) – Schedule regular meetings (one per week during this WP and one per month after this WP) with representatives and experts from partner companies from South Korea. | | | | | | | | | |
| **Deliverables**  D2 (M2.1, M2.2) Confirmation on import success | | | | | | | | | |

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| **Work package number** | WP3 | | **Start date or starting event:** | | | | M4 | | |
| **Work package title** | Obtaining software from Tesla | | | | | | | | |
| **Activity type[[15]](#footnote-15)** | RTD | | | | | | | | |
| **Participant number** | 3 | 1 | |  |  |  | |  | Total |
| **Participant short name** | ETF | MATF | |  |  |  | |  |  |
| **Person-months per participant** | 6 | 2 | |  |  |  | |  | 8 |
| **Objectives**  To establish communication with Tesla. To obtain all licenses required to modify their software for roads in Serbia. To establish communication with representative, that will available for all issues that can come up during software modifications. | | | | | | | | | |
| **Description of work**  WP Leader: ETF  This work package will focus on establishing communication and collaboration between us and Tesla. Tesla will contribute this project with its autopilot software. We plan to modify it, so it becomes more suitable for roads in Serbia.  T3.1 Establish communication (TL: ETF) – Get in touch with Tesla. Share out project idea and pursue them to involve in this project. Explain both financial and global significance of this collaboration. Propose and sign the necessary contracts. Inform about established collaboration with South Korea partners.  T3.2 Obtain modifying license (TL: MATF) – Obtain license for modifying Tesla’s autopilot software. Obtain all documentation on existing software, its characteristics, advantages and flaws. Establish contact with at least one software engineer.  T3.3 Regular communication with representative.  (TL: ETF) – Schedule regular meetings (one per week during this WP and one per month after this WP) with representative and chosen expert from Tesla. | | | | | | | | | |
| **Deliverables**  D3 (M3.1) Confirmation on Tesla’s software receiving success | | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package number** | WP4 | | **Start date or starting event:** | | | | M6 | | |
| **Work package title** | Detailed study on road conditions in Serbia | | | | | | | | |
| **Activity type[[16]](#footnote-16)** | RTD | | | | | | | | |
| **Participant number** | 5 | 4 | | 2 |  |  | |  | Total |
| **Participant short name** | TTTech | OBLO | | RT-RK |  |  | |  |  |
| **Person-months per participant** | 35 | 21 | | 14 |  |  | |  | 70 |
| **Objectives**  To perform a detail study on conditions on roads in Serbia. Study will include: road damages, road marking, road signs, lighting of individual sections. Goal of this WP is to determine all possible types of road inequalities, and for each type to estimate it’s frequency, problem it can generate to autopilot vehicles, and similar. Methods used include: interviews, questionnaires, test drives, … All data gathered will be analysed and proper statistics and reports will be generated. | | | | | | | | | |
| **Description of work**  WP Leader: TTTech  This work package will focus on establishing communication with road experts, doing test drives and analyzing gathered data in order to form a both big and detailed (rich) picture on road conditions in Serbia.  T4.1 Gather data on road conditions in Serbia, from road experts (TL: OBLO) – Design interviews and questionnaires for road experts. Get in touch with several road experts from Serbia. Use before mentioned methods to gather data from them.  T4.2 Test drives (TL: TTTech) – Perform several test drives on all types of roads (highways, city roads, mountain roads, …). Gather required data for analysis.  T4.3 Analyze gathered data.  (TL: RT-RK) – Make a database that will contain all data gathered from tasks: T4.1 and T4.2.  and make statistical and descriptive reports to cover all types of possible obstacles that can degrade performance and efficiency of autopilot software.. These reports will be later used to determine adequate behavior of autopilot software, when it is faced with an obstacle of that type. | | | | | | | | | |
| **Deliverables**  D4 (M4.1) Report on detailed study on Serbian roads | | | | | | | | | |

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| **Work package number** | WP5 | | **Start date or starting event:** | | | | M10 | | |
| **Work package title** | Software implementation | | | | | | | | |
| **Activity type[[17]](#footnote-17)** | RTD | | | | | | | | |
| **Participant number** | 1 | 3 | | 2 |  |  | |  | Total |
| **Participant short name** | MATF | ETF | | RT-RK |  |  | |  |  |
| **Person-months per participant** | 80 | 40 | | 40 |  |  | |  | 160 |
| **Objectives**  The main objective is to adjust Tesla`s software, by improving damage recognition system, side-line following system and car distance and speed  system | | | | | | | | | |
| **Description of work**  WP Leader: MATF  This work package will focus on designing algorithms, implementation, performance analysis and optimization and generating documentation, for all three systems mentioned above.  T5.1 Design algorithm for damage recognition system (TL: MATF)  T5.2 Implementation of damage recognition system (TL: ETF)  T5.3 Performance analysis and optimization of damage recognition system  (TL: MATF)  T5.4 Generating documentation for damage recognition system (TL: RT-RK)  T5.1 - T5.4: To define algorithm which will upgrade sensors to overcome damages specific for Serbian roads. Expectations of this algorithm are higher than existing, because the condition on Serbian roads are worse than in countries for which original algorithm were designed. This will reduce damages on car components. Implement system upgrades, according to designed algorithm, and optimize it according to results of performance analysis. Use Doxygen to generate proper documentation for the entire system.  T5.5 Design algorithm for side-line following system (TL: MATF)  T5.6 Implementation of side-line following system  (TL: ETF)  T5.7 Performance analysis and optimization of side-line following system (TL: MATF)  T5.8 Generating documentation for side-line following system (TL: RT-RK)  T5.5 - T5.8: To define algorithm which will upgrade sensors to be able to follow poorly colored lines or none-existing lines. In case when some part of line doesn’t exist, system will use width of roads and drive “right-aligned”. Sensor must be able to maintain required distance from each side-line in straight driving and in both left and right curves and turning. Expectations of this algorithm are higher than existing, because the condition on Serbian roads are worse than in countries for which original algorithm were designed. This will reduce possibility of car crush caused by driving in wrong lane. Implement system upgrades, according to designed algorithm, and optimize it according to results of performance analysis. Use Doxygen to generate proper documentation for the entire system.  T5.9 Design algorithm for  car distance and speed  system (TL: MATF)  T5.10 Implementation of  car distance and speed  system (TL: ETF)  T5.11 Performance analysis and optimization of car distance and speed  system  (TL: MATF)  T5.12 Generating documentation for car distance and speed  system (TL: RT-RK)  T5.9 - T5.12: To define algorithm which will upgrade sensors to be able to measure distance from both cars in front and behind and optimize speed to keep it constant. Sensor must be able to work perfectly fine in special cases like when cars are poorly enlightened, have unordinary shape (missing or damaged parts) or have similar quality disabilities. Expectations of this algorithm are higher than existing, because cars present on Serbian roads are older and have worse quality than in countries for which original algorithm were designed. This will reduce possibility of car crush caused by inadequate speed. Implement system upgrades, according to designed algorithm, and optimize it according to results of performance analysis. Use Doxygen to generate proper documentation for the entire system. | | | | | | | | | |
| **Deliverables**  D5.1. Documented code  D5.2 Final version of software (M5.1. – M5.4.) | | | | | | | | | |

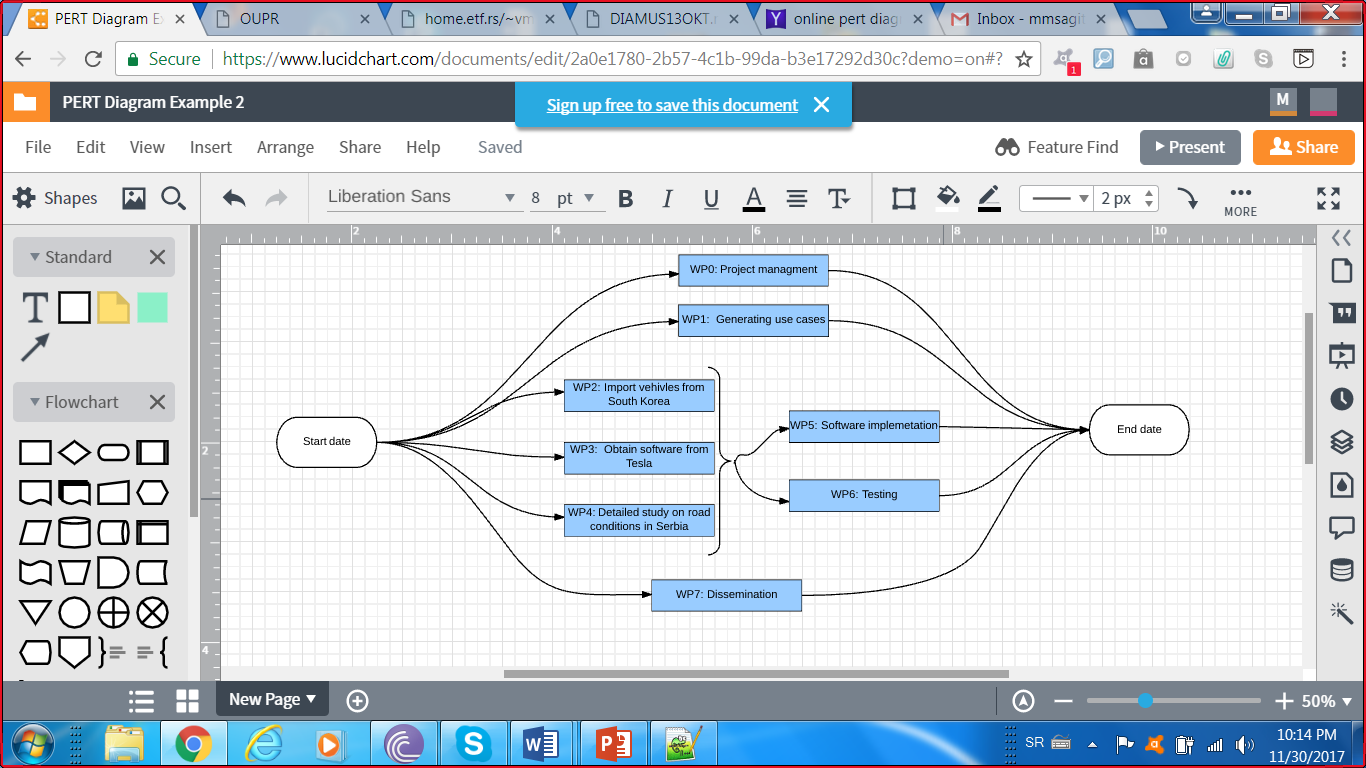
|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package number** | WP6 | | **Start date or starting event:** | | | | M13 | | |
| **Work package title** | Testing | | | | | | | | |
| **Activity type[[18]](#footnote-18)** | RTD | | | | | | | | |
| **Participant number** | 4 | 5 | | 2 |  |  | |  | Total |
| **Participant short name** | OBLO | TTTech | | RT-RK |  |  | |  |  |
| **Person-months per participant** | 30 | 10 | | 10 |  |  | |  | 50 |
| **Objectives**  Define testing strategy of modified autopilot system in real-life situations. Define test cases (every combination of road type and car model). Perform testing of each test case. Inform on success ratings. | | | | | | | | | |
| **Description of work**  WP Leader: OBLO  This work package will focus on designing and performing testing that will show if designed software fulfilled expectations described in this proposal. It must be designed to cover high number of different real-life situations, and also cover a statistically large number of possible scenarios.  T6.1 Define testing strategy (TL: OBLO) - Design a proper strategy that will cover a significantly large number of possible scenarios with minimum test cases.  T6.2 Define test cases (TL: RT-RK) - Provide full description (environment in which testing is performed, expectations, steps to execute test and methods use for  measurement of success ratings)  T6.3 Perform testing (TL: TTTech) - Perform testing for every combination of road type and car model.  T6.4 Generate success rating report (TL: OBLO) - Analyze data about success ratings of all 12 tests and generate combined report. | | | | | | | | | |
| **Deliverables**  D6.1. Documented testing procedures (M6.1)  D6.2. Reporting on testing results (M6.2.) | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Work package number** | WP7 | | **Start date or starting event:** | | | | M13 | | |
| **Work package title** | Dissemination | | | | | | | | |
| **Activity type[[19]](#footnote-19)** | DEM | | | | | | | | |
| **Participant number** | 2 | 1 | | 3 |  |  | |  | Total |
| **Participant short name** | RT-RK | MATF | | ETF |  |  | |  |  |
| **Person-months per participant** | 16 | 4 | | 4 |  |  | |  | 24 |
| **Objectives**  To do constantly a public dissemination about this project. To periodically participate in car shows and seminars. To publish a significant number of articles in international car magazines. To prepare market for acquisition of this system. To define strategic research areas of common interest to project participants for the future research. | | | | | | | | | |
| **Description of work**  WP Leader: RT-RK  The main goal of this WP is to achieve the maximum dissemination on special sessions, seminars and car shows.  To use suitable media events for further spread of information about the benefits of applications. To gain a more competitive position on the world market and consequently boost the local economy.  T7.1 Attend seminars organized by automotive industry (TL: RT-RK) - Write scientific papers on beneficiaries of this software. Attend first seminar in 15th month of the project, get noticed and publish first paper. Write scientific on contribution provided by the project. Attend first seminar in 22th month of the project, get noticed and publish second paper.  T7.2 Attend car shows (TL: ETF) - Prepare for and attend two big car shows: WOODWARD DREAM CRUISE in 13th and INTERNATIONAL GENEVA MOTOR SHOW 23th month of the project.  T7.3. Publish articles in international car magazines (TL: MATF) - Write and publish articles in most famous international car magazines. Goal is to publish at least one per month during dissemination period. Main focus is on: Top Gear, Road & Track and Hemming Motor News. | | | | | | | | | |
| **Deliverables**  D7.1 D7.2 (M1.2) Number of participants at automotive seminars and sessions. Number of car shows organized  D7.3 (M1.1) Number of articles in international car magazines | | | | | | | | | |

**1.3.3.e Summary of effort**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Partic. no.** | **Partic. short name** | **WP0** | **WP1** | **WP2** | **WP3** | **WP4** | **WP5** | **WP6** | **WP7** | **Total person months** |
| **1** | **MATF** | 12 | 6 |  | 2 |  | 80 |  | 4 | **104** |
| **2** | **RT-RK** | 24 |  |  |  | 14 | 40 | 10 | 16 | **104** |
| **3** | **ETF** | 12 | 2 |  | 6 |  | 40 |  | 4 | **64** |
| **4** | **OBLO** |  |  | 2 |  | 21 |  | 30 |  | **53** |
| **5** | **TTTech** |  |  | 2 |  | 35 |  | 10 |  | **47** |
| **Total** |  | **48** | **8** | **4** | **8** | **70** | **160** | **50** | **24** | **372** |

**1.3.4. A graphical presentation of the components showing their interdependencies (Pert diagram or similar)**



**1.3.5. Describe any significant risks, and associated contingency plans**

The research project is continuously monitored by project management and thoroughly evaluated twice per year at special risk analysis meetings. All identified risks will be ranked in terms of a potential impact on the project and probability of a risk actually taking place (impact multiplied by probability). The project will focus on 3 top risks:

* Completing in time and with appropriate quality all tasks specified in this proposal.
* Ensuring that all teams do communicate with each other in an effective manner.
* Ensuring efficiency of communication with other associates (KIA, Tesla, …).

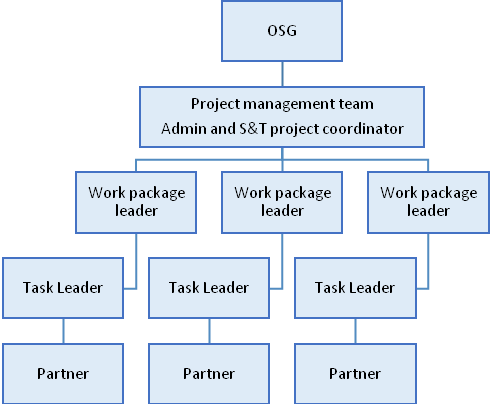
Specific measures to counteract the risks will be defined for each risk and action point assigned to people responsible for following them up. The progress will be followed up regularly until the risk is neutralized. Between the risk analysis meetings, it will be an ongoing responsibility of the project management to identify potential risks.

**Section 2. Implementation**

**2.1 Management structure and procedures**

Describe the organisational structure and decision-making mechanisms of the project. Show how they are matched to the complexity and scale of the project.

The basic project management approach for the project is to have a scientific coordinator focus on the technology and to have an administrative coordinator handle the overall operational and day-to-day business. A clearly defined project management structure will be set up, including precise management processes and decision rules. This will ensure that the project meets its objectives and delivers the results in time and with high quality, using the following project management structure:



**The project operational steering board (OSG)** will be in charge of evaluation and approval of the overall project objectives, targets and general directions, approaches and progress reports.

**Project manager The Project Manager (PM)** will be in charge of overall co-ordination of the project execution and inter-partner co-operation Maintenance of project plan, risk analysis, liaison with all partners, deliverables financial distribution, public relations and dissemination of project results through professional channels.

**S&T Manager** will be in charge of coordination of the scientific and technical activities of the project, driving the project’s S&T strategy**,** avoiding any technical risk or resolving any conflict and maintaining regular communications with the PM.

**Work package leaders** will be in charge of communication with S&T Manager and Task Leaders, proposing: methodology for carrying out the work in the corresponding WP and S&T Manager dissemination activities, perform full reviews of the deliverables and submit final Deliverables to the Project Manager.

**Task Leaders (TL)** will be in charge of compiling the Table of Contents of the corresponding deliverables, collecting contributions from participating partners and edit the deliverables, allocating work to the involved partners in the specific task and submitting the deliverable to the WP leader for review and approval.

**All Partners** will be in charge of preparing individual management reports and submitting them to the PM, following closely the project plan and respect project’s defined procedures and fulfilling the required financial procedures (e.g., audit certificates).

**2.2** **Individual participants**

1. **Faculty of Mathematics, University of Belgrade (MATF)** officially exists as independent science and education institution since 1995. Since its founding, the Faculty has graduated out more than 6000 graduate students, 700 holders of M.S. degree and more than 400 holders of doctoral degrees who occupy important positions in various institutions, government offices, research institutions, companies and schools in the country and abroad and these are quality indicators by which the Faculty of Mathematics is most recognizable all around the world. Ten members of the Serbian Academy of Sciences and Arts were elected from teaching staff of this Faculty.

**Miroslav Misljenovic** has graduated in January 2018 at Faculty of Mathematics, University of Belgrade. He is currently working as a computer architecture programmer. Recent projects include “Pattern recognition” and “License-plates recognition software”.

1. **RT-RK Institute for Computer Based Systems** is a R&D company and national research institute that delivers development services and own products in the arena of real time embedded systems, with strong focus on consumer electronics, communications and multimedia.

**Marina Nikolic** graduated in Jun 2017 at Faculty of Mathematics, University of Belgrade. She is currently working as an embedded software engineer in Automotive, RT-RK. Recent projects include “Instrumentation of functions in sensor developing” and “IoT in road vehicles”.

1. **Faculty of Electrical Engineering, University of Belgrade, Serbia** is an important part of University. Currently there are 3809 undergraduate students and approximately 1000 graduate students at this school. School consists of ten departments including Telecommunications, Computer Engineering and Computer Science, Power Systems, Microelectronics and Physics, etc. Computer Engineering and Computer Science department is one of the largest with 830 students. Internet and telecommunication services research are the core activity of the CECS department for several years.

**Prof. Veljko Milutinovic** is a Fellow of the IEEE - recognition awarded for his introduction of the vertical migration computer architecture, which was used as the basis for his efforts to create (for DARPA, in 80s) a 200MHz microprocessor (about a decade before all major commercial vendors). Now, his major research is in the field of extraction of knowledge from the Internet, using Data Mining and Semantic Web, ad-hoc networks, neural networks, and P2P networks. He taught regular grad courses at various universities in the World, in 7 different languages. He was the General Chair or a Program Committee Member for several IEEE and other conferences.

**Milos Stojanovic** graduated in September 2017 at Electrical Engineering, University of Belgrade. She is currently working as an embedded software engineer in Automotive, RT-RK. Recent projects include “MIPS sensor developing” and “IoT in road vehicles”.

1. **OBLO Living** provides world-class solutions for home automation (HA) to service operators, consumer electronics distributors/retailers and installers.

**Djordje Pesic** graduated in Jun 2015 at Electrical Engineering, University of Belgrade. He is currently working as an embedded software engineer in OBLO Living department in RT-RK. Recent projects include “Smart-car” and “Advanced locking”.

1. **TTTech Computertechnik AG** is a global leader in the field of robust networking and safety controls. TTTech solutions improve the safety and reliability of electronic systems in the industrial and transportation sectors, with a portfolio of products that are helping to make the Industrial Internet of Things and autonomous driving a reality. Thanks to the proven platform-based architecture, TTTech solutions enable simple system integration with shorter time-to-market and significant cost reductions for customers.

**Jovan Petrovic** got PhD in May 2012 at Electrical Engineering, University of Belgrade. He is currently working as a software architect in TTTech Computertechnik AG. Recent projects include “Pattern matching in facial recognition for measurement of driver’s tiredness” and “Safety in auto-driving”.

**2.3 Consortium as a whole**

An excellent mix of competencies, research interests and approaches is present in the consortium. This versatility and mix of complementary skills combined with the mutual understanding gained in previous collaborations will be utilized to the greatest possible extent to cross fertilize the best practices and increase research potential of everyone involved. The resources needed for research support and management activities are integrated from a variety of academic organizations and a large multinational company.

Research focus and expertise covered by the involved organizations spans the complete problem area covered by this proposal. In addition to that, both academic and industry oriented views of the research problems and challenges and consequently approaches are present in the project which ensures a holistic view of the research domain and is an additional added value of the consortium.

Also, where and when necessary, sub-contracting and engagement of experts will be done. Budget for this comes from the S&T coordinator’s budget.

* Sub-contracting: For the amount of money up to 4% of the value of the project, coordinator institution can sub-contract (from its share) external organization, for implementing any activity for which the whole consortium determines that is mission critical. All subcontracting activities must be approved by the project leader and the entire consortium.
* Expert-engagement: Three external experts from the Austria will be engaged in the project. These experts are experienced and well-known researchers. They will present the state-of-the-art research in the Austria, as well as future research directions and will significantly contribute to the overall project objectives.

**2.4 Resources to be committed**

**Mobilization of resources**

The resources needed for the project activities are integrated from a variety of academic organizations and one large industrial partner. The resources profile and the participating partners are complementary in many respects. The project targets both shorter term and longer term activities that will set the basis for sustainable collaboration between the partner organizations and takes great care of particular regional strategic needs. External experts that agreed to take active part in project activities will bring additional expertise into the project and will improve the impact of the project both in terms of the project and its partners’ promotion as well as in more extensive people networking opportunities.

**Import expenses**

The resources needed for importing cars from South Korea: customs, transportation and similar expenses are difficult to estimate precisely at this point, and the suggestion is that they be allocated on the level of E260K (and extra money returned, if not used).

**Licence obtaining resources**

The resources needed for obtaining licence from Tesla, for upgrading their software. Estimated on: E100K.

**Software implementation resources**

The resources needed for work places and hardware required for programmers. Estimated on: E200K.

**Testing equipment resources**

The resources needed for testing hardware and software is in the widest sense are difficult to estimate precisely at this point, and the suggestion is that they be allocated on the level of E350K (and extra money returned, if not used).

**Financial plan**

The Consortium has pulled together total of 372 man months of which 13% is allocated to management and the remaining effort to specific support activities. The total estimated budget for the project is about 4.000.000,00 Euro.

**Section 3. Impact**

**3.1 Expected impacts listed in the work programme**

The project will advance state-of-the-art of the existing autopilot navigation systems in terms of compatibility, reliability, safety, and in addition, there will be a direct positive impact on the economy of all car producers, because of more potential customers.

To people with disabilities regarding sight and movement, is extremely difficult to drive motor vehicles on the roads in Serbia, because of many damages, inadequate signalisation and inappropriate visibility. Statistically, they are very discouraged to use it. Based on data, provided by Association for the Blind and Visually Impaired and The funds of a Special Disability Trust, only 5% of these people engages into using motor vehicles. The main product of this project is expected to become a refreshment in car industry.

The work of this project has a perfect match with the requirements of the Objective for which it was targeted to. The main steps to achieve the goal are careful development of use cases, precise implementation of the support technology, testing of the entire system in versatile environments, and dissemination, both on the commercial and scientific domains. For the final success, a statistically large enough test pattern has to be generated.

This type of technology is of interest to the car manufacturers across the world. Any model and any auto navigation software can be improved using this example. The main impact we expect is by posting an example to other countries, Europe-wide. Due to the fact that concrete use cases will be fully elaborated, and due to the fact that only the feasible aspect of the underlying theory will be implemented, the reusability of this technology will be easy. This means that beneficiaries of this technology will be able quickly to develop their versions based on this technology.

This project will also have a strong impact on each partner. This responsible for technology development will become even more advanced in their domains. This responsible for the development of use case scenario will be offering the developed use case scenario to other environments, too. The institutions that will serve as test beds will become more sophisticated in the technology domain.

**3.2 Dissemination and/or exploitation of project results, and management of intellectual property**

Dissemination is grouped into two major groups of activities: internal and external. The internal activities are targeting researchers from the organizations participating in the project. A series of project workshops, lectures and exchanges of researchers are planned to address this need. The external activities are what is usually referred to when dissemination is discussed. These activities are targeting research community, general public and industry in order to promote results and achievements of the project. The following external dissemination channels and activities are planned:

* The special sessions and seminars
* Car shows
* Access through media (local TV and radio stations, international car magazines, ...)

The project sees a great potential for cooperation with other initiatives with the same strategic objective and beyond.

**Section 4. Ethical Issues**

The proposed project does not directly involve any ethical, legal, social or safety issues. Due to the nature of this project however, in an indirect way, the consortium will also have to deal with ethical, legal, social and safety issues relating to the research projects assisted and coached as consequence of the work foreseen in this proposal. Therefore, training measures for researchers will clearly also cover all relevant ethical, legal, social and safety issues. The consortium will endorse a project Ethical committee to clarify any doubts of their work along all activities, measurement protocols, data collection, data presentation, and data transfer.

**4.1. Ethical Issues Table**

|  |  |  |
| --- | --- | --- |
|  | **YES** | **PAGE** |
| **Informed Consent** |  |  |
| * Does the proposal involve children? | NO |  |
| * Does the proposal involve patients or persons not able to give consent? | YES | 22 |
| * Does the proposal involve adult healthy volunteers? | NO |  |
| * Does the proposal involve Human Genetic Material? | NO |  |
| * Does the proposal involve Human biological samples? | NO |  |
| * Does the proposal involve Human data collection? | NO |  |
| **Research on Human embryo/foetus** |  |  |
| * Does the proposal involve Human Embryos? | NO |  |
| * Does the proposal involve Human Foetal Tissue / Cells? | NO |  |
| * Does the proposal involve Human Embryonic Stem Cells? | NO |  |
| **Privacy** |  |  |
| * Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction) | NO |  |
| * Does the proposal involve tracking the location or observation of people? | NO |  |
| **Research on Animals** |  |  |
| * Does the proposal involve research on animals? | NO |  |
| * Are those animals transgenic small laboratory animals? | NO |  |
| * Are those animals transgenic farm animals? | NO |  |
| * Are those animals cloned farm animals? | NO |  |
| * Are those animals non-human primates? | NO |  |
| **Research Involving Developing Countries** |  |  |
| * Use of local resources (genetic, animal, plant etc) | NO |  |
| * Impact on local community | YES | 22 |
| **Dual Use** |  |  |
| * Research having direct military application | NO |  |
| * Research having the potential for terrorist abuse | NO |  |
| **ICT Implants** |  |  |
| * Does the proposal involve clinical trials of ICT implants? | NO |  |
| **I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL** |  |  |

1. Workpackage number: WP 1 – WP n. [↑](#footnote-ref-1)
2. Please indicate one activity per work package:

   RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium [↑](#footnote-ref-2)
3. Number of the participant leading the work in this work package. [↑](#footnote-ref-3)
4. The total number of person-months allocated to each work package. [↑](#footnote-ref-4)
5. Measured in months from the project start date (month 1). [↑](#footnote-ref-5)
6. 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. [↑](#footnote-ref-6)
7. Please indicate the nature of the deliverable using one of the following codes:

   **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other [↑](#footnote-ref-7)
8. Please indicate the dissemination level using one of the following codes:

   **PU** = Public

   **PP** = Restricted to other programme participants (including the Commission Services).

   **RE** = Restricted to a group specified by the consortium (including the Commission Services).

   **CO** = Confidential, only for members of the consortium (including the Commission Services). [↑](#footnote-ref-8)
9. Measured in months from the project start date (month 1). [↑](#footnote-ref-9)
10. Measured in months from the project start date (month 1). [↑](#footnote-ref-10)
11. Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype completed and running flawlessly; software released and validated by a user group; field survey complete and data quality validated. [↑](#footnote-ref-11)
12. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-12)
13. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-13)
14. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-14)
15. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-15)
16. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-16)
17. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-17)
18. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-18)
19. Please indicate one activity per work package:

    RTD = Research and technological development; DEM = Demonstration; MGT = Management of the consortium. [↑](#footnote-ref-19)