



Project DEOS-UD

Disruptive Earth Observation Sensing for Urban Development

Deliverable 2

Scope, Time and Cost Management

Authors:

Calderón Rosario, Borja
De Benedicto Barba, Maria
Escartín Vivancos, Guillermo
Fontanes Molina, Pol
Franch I Ruiz, Sergi
González García, Sílvia
Herrando Moreira, Albert
Lopezbarrena Arenas, Santiago

Nachett, Hamza
Pérez Sánchez, David
Pla Olea, Laura
Pons Daza, Marina
Ramón Costa, Fernando
Sellart Combalia, Ana Maria
Serra Moncunill, Josep Maria
Urbano González, Eva María

National Contact Point: Pérez Llera, Luís Manuel

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1 | Project scope statement

1.1 Product Scope Description

Earth observation is a field with a great potential that has not been taken into account until the last decade. Important space agencies like the European Space Agency are promoting the enhancement of capabilities with respect to Earth Observation due to the fact the society and the planet itself would benefit from the many application it has. Hence, an improvement of the state-of-the-art technologies used for EO sensing is a key factor to promote and advance in this field. In other words, this project is not in charge of developing new launching systems or designing satellites, its objective is to provide the existing and the next generation of space technologies with disruptive sensors. One of the priorities of this project is to ensure the complementarity with other activities or programs such as Copernicus funded by the EU and lead to a strengthening of Europe's position and competitiveness in this field.

To achieve the project goal and implement much better sensors than the already existing ones, a state-of-the-art of the current space requirements of several optical and radar systems will be done. The limitations and the possibilities of the different technologies such as LiDAR, RADAR, Gravimetry, Hyperspectral, Superspectral and more will be determined, and then a decision will be taken in order to work with the most promising ones. Furthermore, the preliminary design will take into account several criteria to obtain competitive sensors. Launching any payload to space has very high costs, then it is essential to ensure the endurance of the overall systems in order to maintain the payload in space for a long time and avoid any replacements. To accomplish it, the materials used to build the components of the sensor including antennas, photo-detector, optics, laser and, electronics have to be accurately chosen.

Besides, Earth Observation can have much application, so it is crucial to focus on the enrichment of some of them to guarantee the development of the desired sensor abilities. Indeed, as the goal is to apply EO sensing for Urban Development to integrate space into society, the abilities to enhance are the following ones:

- Detection of greenhouse gases.

- Detection of weather patterns.
- High precision performance of terrain 3D mapping.

On the one hand, systems like LiDAR, which combines technologies like laser and radar, enable to target a wide range of materials including clouds and molecules. Consequently, it is possible to develop a sensor that identifies the composition of the air to secure our environment by having a monitoring of either the greenhouse gases or the weather patterns for proper weather forecasting applications. On the other hand, 3D mapping of the terrain is useful to control the land and guarantee an optimum growth and development of the city. All in all, one of the most important aspects that have to be taken into account is that the sensors resulting from this project have to ensure at least a 15% increase of the reliability and precision compared to the current ones.

In addition, a step that is necessary for this kind of projects is the testing of the product. Once the preliminary design is finished and accomplishes all the requirements of the project, a first prototype will be built and tested in a space simulated environment to make sure that it performs as expected. Notice that the testing is not done in the space itself because launching the prototype to the space is too expensive and out of this project budget; fortunately, there are other methods that are cheaper and simulate properly the space conditions. Finally, once the prototype designed fulfils all the expectations, it is considered that the results are attained and the product design is ready for closure.

1.2 Project Deliverables

All the deliverables specified in the Table 1.2.1 will be submitted to the European Commission during the development of the project.

| Deliverable Name | Description |
|-------------------------|--|
| Project Management Plan | Document with detailed explanation of the project management strategies, including the Project Charter, stakeholder register, risk, quality and financial plans. |
| Business Plan | Document containing the market approach details including the selected suppliers and the potential costumers as well as the exploitation strategy. |

| Deliverable Name | Description |
|---|---|
| Communication Plan | Document containing all the planned dissemination strategies, such as the online communication (including website development and social media management), the offline communication (participation in meetings and conferences) and the dissemination materials (technology demonstrators). |
| Payload State of the Art | Report containing the state of the art of current EO remote sensors as well as the sensors to improve selection and the first requirements definition. |
| Modular System State of the Art | Report containing the state of the art of current modular systems with space applications and its first requirements definition. |
| Space Applications State of the Art | Report containing the state of the art of current urban development space applications and first interaction platforms requirements definition. |
| Payload Preliminary Design | Report determining the payload preliminary design. It contains the research, requirements and preliminary performances parameters of each sensor. |
| Modular System Preliminary Design | Report detailing the modular system preliminary design. It includes a first review of the sensors blocks physical framework and sensors data fusion software requirements as well as the initial definition of the SATCOM application domains. |
| Interaction Platform Preliminary Design | Report detailing the interaction platform preliminary design. It includes the predesign of data sharing servers and platforms as well as the definition of the initial implementation of data processing algorithms. |
| Payload Final Design | Report detailing the final design and technical specifications of each developed sensor. |
| Modular System Final Design | Report detailing the final design and technical specifications of the modular system. |
| Sensors Data Fusion Software Report | Report containing the final sensors data fusion software specifications. |

| Deliverable Name | Description |
|--------------------------------------|---|
| Interaction Platform Final Design | Report containing the final design and technical specifications of the interaction platforms. |
| Data Processing Software Report | Report containing the final data processing algorithms specifications which will allow processing the acquired satellite data. |
| Validation | Report that gathers the tests and validations with the obtained results of all the payload sensors, the modular system and the interaction platform, as well as the full system performing. |
| Final Report | Final document that includes all the development done through the execution of the project and proper conclusions. |

Table 1.2.1: Project Deliverables

1.3 Project milestones

The milestones of the project are shown in Table 1.3.1. It is possible to see that some of them are directly related to the deliverables due to the importance of some of the tasks such as final design and validation.

| Milestones Name | Description |
|-----------------------------|--|
| Kick-Off Meeting | First meeting of the project, formation of the development team and first contact with the stakeholders. |
| Project management plan | Specification of the objectives and scope of the project, organization of the team and distribution of tasks. Stakeholders register and financial, quality and risk plans. |
| Business plan | Obtaining a potential suppliers list, and negotiating procurement conditions with them, as well as identify and communicate with potential customers. |
| Communication plan | Development of a website and a social media strategy, as well as looking into participation in meetings and conferences. |
| State of the art completion | Definition of requirements for the system based on the current state of the art space applications of the payload sensors. |

| Milestones Name | Description |
|---|--|
| Payload preliminary design | First phase of the design, an optimization of each sensor is done in order to define the preliminary minimum performance parameters. |
| Modular system preliminary design | Development of the initial parameters of the modular system, as well as the software that will be in charge of the fusion of the sensors data. |
| Interaction platform preliminary design | Preliminary implementation of the functionalities of the interaction platform. |
| Payload final design | Final design of the entire payload, including the specifications and estimated performance in operation of each sensor. |
| Modular system final design | Final design of the modular system and the software that will process and register the information received by the payload. |
| Interaction platform final design | Final design of the interaction platform according to the guidelines established on the preliminary design. |
| Prototype manufacturing | Manufacturing of the prototype according to the final designs, in order to test its function in the next steps. |
| Individual systems testing | Performance analysis of each module (payload, modular system, and interaction platform) of the overall system under operational conditions. |
| Full system testing | Performance analysis of the overall system in operational conditions in order to test the interaction between components. |
| Project completion | Final report that includes the complete development of the project. |

Table 1.3.1: Project Milestones

1.4 Project Acceptance Criteria

The acceptance criteria establish the requirements that must be met for the client to accept the project. These criteria are quantifiable, demonstrable and verifiable in such a way as to demonstrate that the project has been carried out properly, that is why, if these criteria are

not met, a deliverable of the project cannot be considered valid.

| Item | Description |
|-------------------|--|
| Management | |
| Quality | <p>The content of the project documentation must be clear, complete and understandable. Furthermore, it must be well structured, dividing the information into approach, development, and conclusions.</p> <p>All the documentation included in the project must first pass through an inspection of the quality department.</p> |
| Schedule | <p>The organization must be well structured and the deadlines must be met in a timely manner so that the development of the product is appropriate.</p> |
| Clarity | <p>The tasks of the project must be well defined, both individually and as a group, in such a way that each of the contributors knows their duty and the duty of their team.</p> |
| Viability | <p>The project must be viable economically and technically so that its realization is possible.</p> <p>The different parts of the project must be submitted at the individual level to a study that checks if it is possible to do them and, if not, search for an alternative.</p> <p>The budget of the project must comply with the financial requirements of the European Union. Hence, a balance is to be made to ensure that the allowed limit is not exceeded.</p> |
| Collaboration | <p>It is interesting to obtain a better result to collaborate with legal entities from different countries, like universities and research groups. Moreover, some collaborations with SMEs should be tried, so that they can benefit and grow in the market.</p> |
| Transparency | <p>In case information about the project is required by part of official organizations of the European Union or by the different stakeholders that participate in it, transparency has to be considered when sharing information.</p> |

| Item | Description |
|-------------------------|--|
| Legal requirements | The applications and products of this project must have if required, the certification and approval of the different legislative and ethical frameworks. |
| Technical | |
| Research and innovation | The project must be ambitious and use all the available resources to obtain the best result. In this way, it must include the most appropriate technology that there is so far and, if it is in the development phase, add a section of research. |
| Test and validations | <p>The evaluation and validation tests must be carried out periodically and be registered in the project documentation, in such a way that there is a record of the different versions of the application throughout the development.</p> <p>The information of these tests must be presented clearly and refer to the regulations concerned, in addition, to be verifiable.</p> <p>The results of these tests should be used to analyze the service level of the application and improve on later versions.</p> |
| Technical documents | <p>The application must have a user manual both internally and externally and attach the necessary information for its development.</p> <p>The performance of the final product must be reflected in a data sheet. It must also be included in the documentation the datasheet of the different components that are part of the application.</p> |
| Performance | |
| Size | The total volume of the module must not exceed the space allocated to it. Considering that the system can be integrated into several satellites, this volume should not exceed 500 dm^3 . |

| Item | Description |
|-----------------------|---|
| Weight | The system must be light enough to allow it to be put into orbit with ease and not affect the subsequent operation of the satellite in which it will remain during the data collection. In this way and making an estimation of the density of the materials and the maximum volume of the system, a limit weight of 950 kg is defined, which must not be exceeded for the system to be accepted as valid. |
| Power consumption | Modular system maximum power consumption must be lower than the 50% available onboard. |
| Accuracy | The accuracy of the equipment should allow the samples to be taken in a way that provides discretized information in the space. Due to the homogeneity of the climatology, the precision for this will be of 1 m^3 , whereas in the 3D mapping in which there can be more considerable variations, it will be of 25 cm^3 . |
| Back-up | Back-up system prepared to handle up to two major failures in the system. A major failure can be defined as the loss of a sensor module of the same type. |
| Transmission velocity | Transmission velocity between modular system and the main satellite communication (SATCOM) system should be able to handle at least 250 Mbit/s of data rate. |
| Processing time | The time that elapses since the information is captured by the sensors until it is processed and prepared to send to the ground station to be analyzed should not exceed 10 seconds. |
| Latency | The latency, since the information is prepared in the system located on the satellite to be sent to the ground station until this station is finally processed, should not exceed 300 seconds. The information collected by the system must be available via the Internet in less than 8 minutes. This means that after the processing of information it must be sent in less than 3 minutes for the system to be considered valid. |
| Social | |

| Item | Description |
|---------------------|--|
| Sustainability | The product must be sustainable using renewable energy as much as possible and avoiding excessively polluting emissions. The materials used in the project must be reliable and guarantee the agreed useful life of the product. |
| Social contribution | The product must be able to solve a current problem and improve the quality of life of people using technology. |
| Gender equality | The selection process must be fair, based on the knowledge and personal competencies of each person regardless of gender or condition. |

Table 1.4.1: Acceptance criteria

1.5 Project Exclusions

There are some facts that are out of the scope of the project which, generally, are designated as exclusions. Hence, in this section, the exclusions of the project are determined and defined.

| Item | Description |
|----------------------|---|
| Satellites design | It is out of the scope of this project to design a new satellite that will use the sensors as payload. |
| Launching | The objective of the project do not include either the design of the launch system of the satellites nor the costs and scheduling of launching the satellite using the sensors designed. |
| Deployment | No deployment mechanism nor the strategy of the satellites that integrate these new technologies are going to be developed. |
| Satellite monitoring | The satellite monitoring system that permits to scan different surfaces and regions of the earth is not included in this project scope. |
| Data transfer | Neither communication between satellites nor between the satellite and the ground station are part of this project. |
| Final production | The project will only focus on the development of prototype models in order to test the new technologies implemented. Hence, commercial production of these ones will not be carried out. |

| Item | Description |
|------|-------------|
|------|-------------|

Table 1.5.1: Project Exclusions

1.6 Project Constraints

Project constraints can be defined as all the limitations that curb the activities of the project team and restrict project's outcome. It is necessary to define them with caution and common sense to avoid determining constraints that lead us to an impossible project, especially in terms of cost, time and resources. They can be internal limitations (scope, budget, etc.) or external limitations (environmental impact, stakeholders, government regulations, etc.)

In this project, we have decided to adopt a classification consisting of six groups [2] where constraints can be clearly interpreted and organized.

SIX PROJECT CONSTRAINTS GROUPS

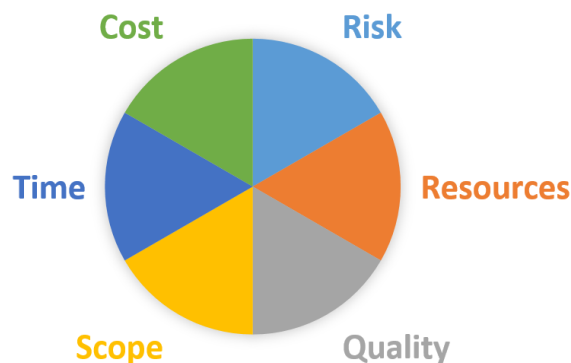


Figure 1.6.1: The 6 Project Constraints [2].

It is important to highlight that groups are interrelated in a way that if one of them changes, then, one or more of the others will be affected.

Scope

- **State of the art:** The starting point of the project has to be based on a study of the optical and radar cutting-edge technologies, not on outdated ones.
- **Technologies selection:** The technologies to be developed must be the most promising systems to profit Earth Observation, air composition, and terrain analysis.

- **Technologies improvement:** The project is required to enhance the selected technologies in order to accomplish the European Commission requirements.
- **Final design:** The resulting design has to be a compact product which contains the chosen sensors, sharing a data collection software.

Time

- **Deadlines:** All deliverables have to be completed in their scheduled dates:
 - **05/10/2018** – Project Management, Business and Communication Plans
 - **28/12/2018** – State of the Art completion
 - **14/06/2019** – Payload preliminary report
 - **06/09/2019** – Modular system preliminary design
 - **29/11/2019** – Interaction platform preliminary design
 - **12/06/2020** – Payload final design
 - **04/09/2020** – Modular system final design
 - **27/11/2020** – Interaction platform final design
 - **16/04/2021** – Prototype manufacturing
 - **09/07/2021** – Individual systems testing
 - **29/10/2021** – Full system testing
 - **21/01/2022** – Project completion
- **Schedule:**
 - **Follow Gantt chart organization:** Tasks must be developed in the initially accorded order, avoiding undesired overlapping or delays and bringing the requirements of each task to their completion.

Cost

- **Budget:**
 - All the incomes have to come from the European Commission.
 - The project cannot exceed the quantity of 4 million euros.
 - The money distribution must be done as it was described in the estimated budget.

Resources

- **Facilities:** No tasks will be planned without the certainty that the team (or a stakeholder) has the necessary facilities to complete it.
- **Human resources:** All the labor hours made by the staff in charge of the project must be justified. Every task will have assigned a different number of workers depending on the difficulty and duration.
- **Infrastructures:** The work to be done by the team is restricted by the capacity, limitations, and efficiency of the owned infrastructures.
- **Procurement:** Goods and services will be obtained following optimized processes to achieve minimum cost while at the same time requirements are properly fulfilled.
- **Technical constraints:** The development of the new technologies that the product will use will be restricted by technical, physical and scientific limitations.

Risks

- **Risk tolerance:** The amount of risk that the project must handle has to be low. It means that if some risky event has a low probability to happen, the impact can be low or moderate. On the other hand, if the event has a high probability to happen, the impact must be low.
- **Actions:** When some risk becomes a real problem for the project, the necessary measures have to be taken. These must affect as little as possible to the other constraints, such as cost or time.

Quality

- **Legal constraints:** All the systems developments and tests must be carried out under the corresponding standards.
- **Methodology:** The project must be developed following a methodology based on the use of state of the art technologies, research, and improvement of the current capabilities of the earth observation systems.
- **Organization:** To obtain the required quality, communication between departments, communication with stakeholders, and the use of project management software assistance is a must.
- **Stakeholders' expectations:** External constraints imposed by stakeholders must be accounted in the project. In addition, the agreements with each of them must be accomplished.

- **Customer satisfaction:** The final product must fulfill the established requirements to obtain the customer satisfaction.

2 | Work Breakdown Structure (WBS)

In this chapter the tasks and work packages needed to perform the project will be specified. To do so, a WBS is developed.

1. PROJECT MANAGEMENT

- 1.1. Development project management plan
- 1.2. Monitoring of the project
 - 1.2.1. Meetings
 - 1.2.2. Task tracking and scheduling
- 1.3. Annual reporting
- 1.4. Project implementation of risk management

2. QUALITY AND ADMINISTRATION

- 2.1. Human Resources
 - 2.1.1. Employment of the necessary staff
 - 2.1.2. Human resources management
- 2.2. Financial Plan
 - 2.2.1. Costs
 - 2.2.1.1. Fix costs
 - 2.2.1.2. Variable costs
 - 2.2.2. Funding
 - 2.2.3. Economic feasibility
 - 2.2.4. Evolution monitoring
 - 2.2.5. Additional and follow-up funding seek
- 2.3. Documentation Management

- 2.3.1. Guidelines preparation
 - 2.3.2. Document revision
 - 2.3.3. Document rectification
 - 2.3.4. Document approval
- 2.4. Periodic Monitoring
- 3. STATE OF THE ART
 - 3.1. Payloads
 - 3.1.1. Search for current space applications
 - 3.1.2. Requirements definition
 - 3.2. Modular System
 - 3.2.1. Search for current modular systems with space applications
 - 3.2.2. Requirements definition
 - 3.3. Urban Development Applications with Space Technologies
 - 3.3.1. Search for current space applications
 - 3.3.1.1. Weather forecast
 - 3.3.1.2. Urban planning (3D models)
 - 3.3.1.3. Greenhouse emissions reduction (pollution)
 - 3.3.2. Requirements definition
- 4. PRODUCT DEVELOPMENT
 - 4.1. Preliminary Design
 - 4.1.1. Payloads
 - 4.1.1.1. Research
 - 4.1.1.2. Development
 - 4.1.2. Modular system
 - 4.1.2.1. Development of physical framework for sensor blocks
 - 4.1.2.2. Development of systems interaction and applications
 - 4.1.2.3. Development of sensors data fusion software
 - 4.1.2.4. Definition of SATCOM applications domains
 - 4.1.3. Interaction platform
 - 4.1.3.1. Implement web-based servers for sharing sensors data
 - 4.1.3.2. Implement processing algorithms based on applications
 - 4.1.3.3. Pre-design a full services stakeholders platform
 - 4.2. Final design
 - 4.2.1. Payloads

- 4.2.1.1. Sensors final design
- 4.2.1.2. Sensors final technical specifications
- 4.2.2. Modular System
 - 4.2.2.1. Modular system final design
 - 4.2.2.2. Sensors data fusion software final design
 - 4.2.2.3. Modular system's final technical specifications
- 4.2.3. Interaction Platform
 - 4.2.3.1. Web based servers for data sharing final implementation
 - 4.2.3.2. Processing algorithms based on applications final design
 - 4.2.3.3. Full services stakeholders platform implementation
 - 4.2.3.4. Final technical specifications

5. SIMULATION, TESTING, VALIDATION AND QUALITY

- 5.1. Technology Demonstrator Prototype Manufacturing
 - 5.1.1. Manufacturing of payload sensors
 - 5.1.2. Manufacturing of modular system
 - 5.1.3. Implementation of interaction platform
- 5.2. Payload Validation
- 5.3. Modular System Validation
- 5.4. Interaction Platform Validation
- 5.5. Full System Prototype Validation
- 5.6. Quality of the Product

6. BUSINESS PLANNING AND EXPLOITATION OF RESULTS

- 6.1. Market Approach
 - 6.1.1. Study of stakeholders
 - 6.1.2. Procurement conditions negotiation
 - 6.1.3. Resources purchase
- 6.2. Exploitation and Business Plans

7. COMMUNICATION AND DISSEMINATION STRATEGIES

- 7.1. Dissemination and Communication Plan
- 7.2. On-line Dissemination/Communication Activities
 - 7.2.1. Web site development
 - 7.2.2. Social media management

7.3. Off-line Dissemination/Communication Activities

7.3.1. Conferences

7.3.2. Meetings

7.4. Production of Dissemination Materials

7.4.1. Technology demonstrators

7.4.2. Audio visual material production

In the following pages this WBS will be exposed in a more graphical manner. In order to see it properly it has been split into different blocks.

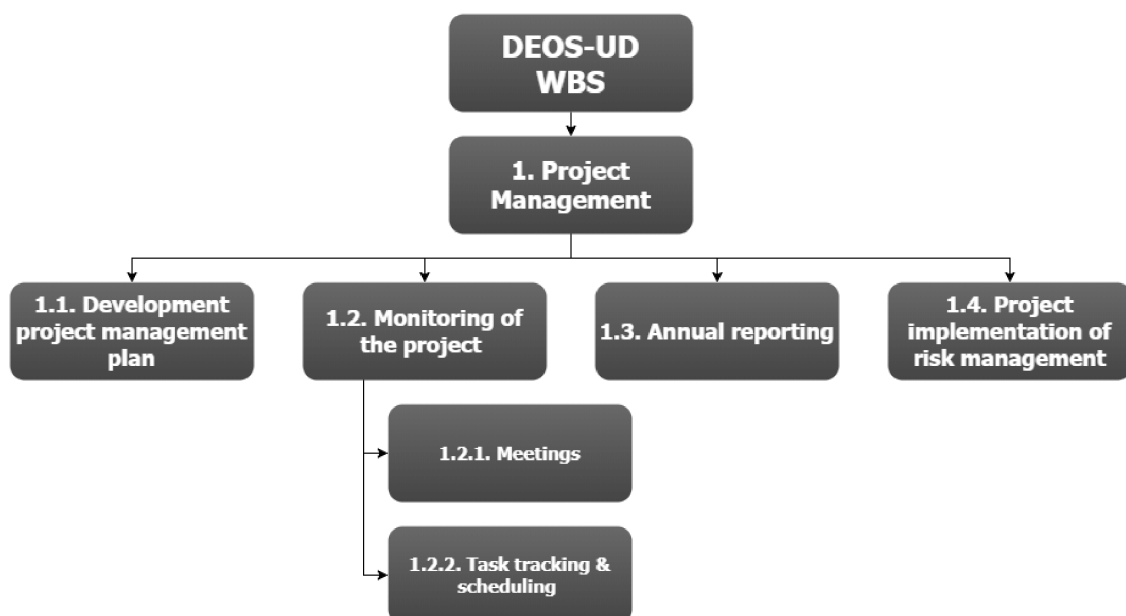


Figure 2.0.1: Project management breakdown diagram.



Figure 2.0.2: Quality and administration breakdown diagram.



Figure 2.0.3: State of the art breakdown diagram.

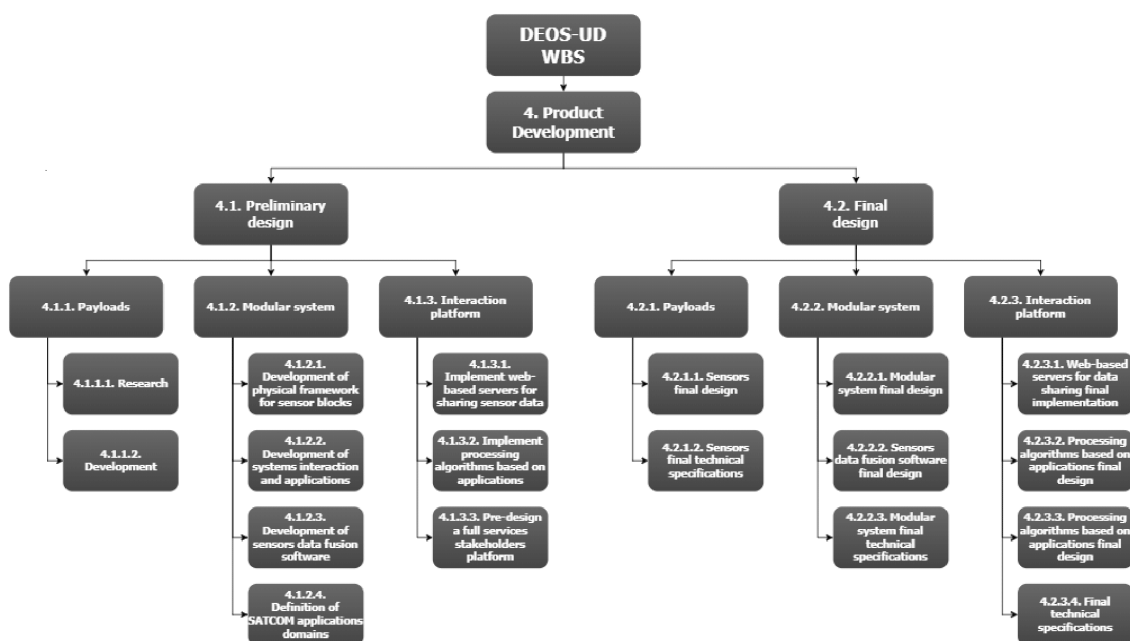


Figure 2.0.4: Product development breakdown diagram.

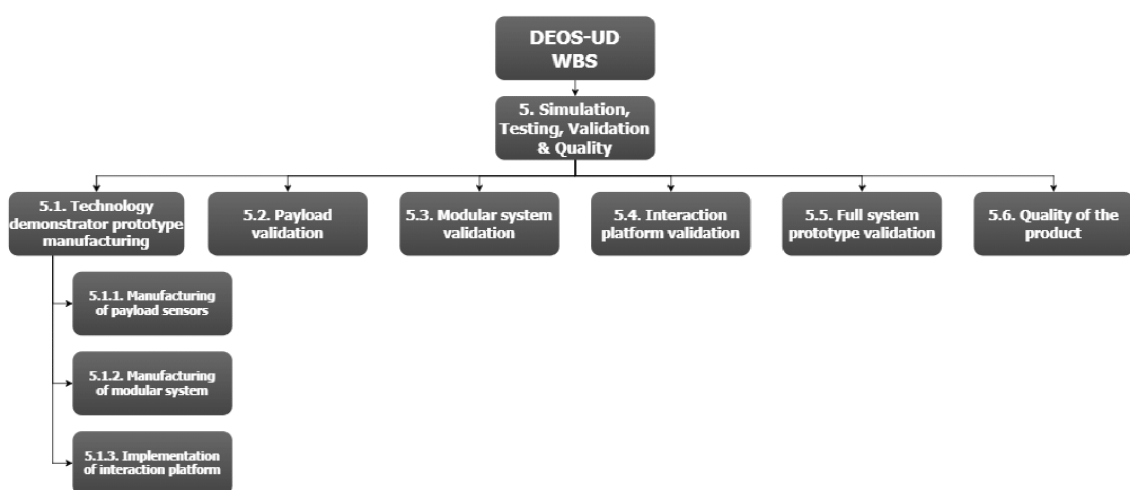


Figure 2.0.5: Simulation, testing, validation and quality breakdown diagram.



Figure 2.0.6: Business planning and exploitation of results breakdown diagram.

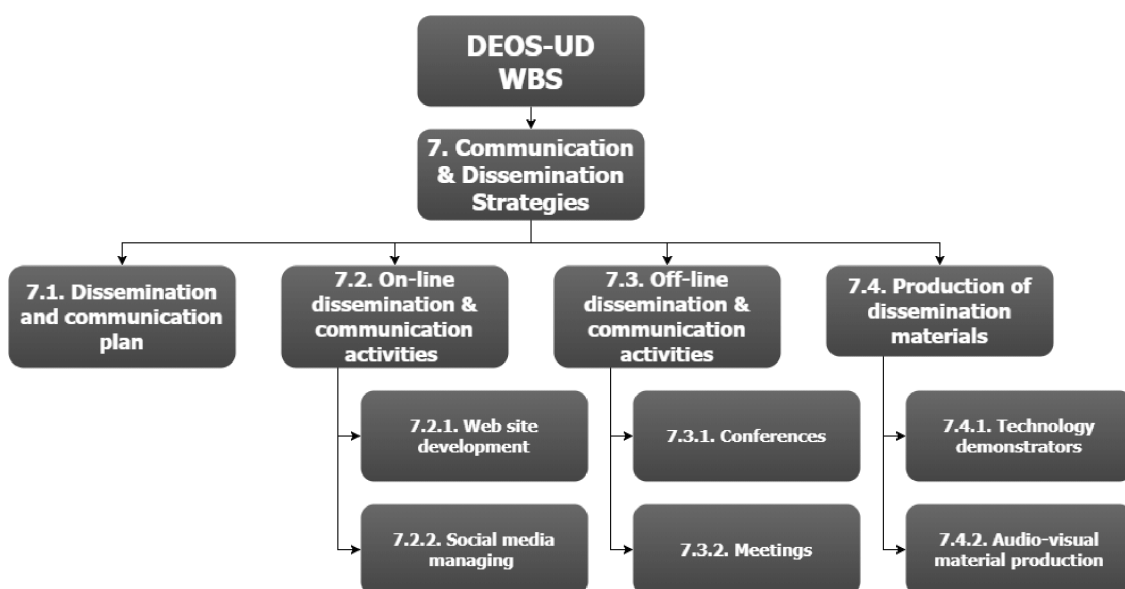


Figure 2.0.7: Communication and dissemination strategies breakdown diagram.

2.1 Activity list

In this table the activities defined in the WBS will be explained in order to have an overall vision of the project development plan.

| WBS-ID | Activity | Description of Work |
|----------|--|--|
| 1.1. | Development of the project management plan | Elaboration of all the documentation that states the strategy of the management and organization of the project through its duration. |
| 1.2.1. | Meetings | Gathering of the members of the project to inform each other of the progress. |
| 1.2.2. | Task tracking and scheduling | Tracking of the active tasks and scheduling. |
| 1.3. | Annual reporting | Every year that the project lasts will call for the elaboration of an internal report with the aim of keeping up to date with the progress done. |
| 1.4. | Project implementation of risk management | Study of all the potential risks and how will they be managed so that their affectation to the project stays to a minimum. |
| 2.1.1. | Employment of the necessary staff | Definition of the number of employees necessary. |
| 2.1.2. | Human resources management | Administration of all the employees needed to fulfill the different tasks of the project. |
| 2.2.1.1. | Fix costs | Lay down of all the fix costs of the project. |
| 2.2.1.2. | Variable costs | Lay down of all the variable costs of the project. |
| 2.2.2. | Funding | Lay down of all the expected funding of the project. |
| 2.2.3. | Economic feasibility | Study on the economic feasibility of the project. |
| 2.2.4. | Evolution monitoring | Monitoring of the evolution of the project finances. |
| 2.2.5. | Additional and follow-up funding seek | Search for the additional funding for the project. |
| 2.3.1. | Guidelines preparation | Establishment of the guidelines for the relation of all documents. |

| WBS-ID | Activity | Description of Work |
|----------|--|--|
| 2.3.2. | Documented revision | Revision of all the documents of the project. |
| 2.3.3. | Document rectification | Rectification of the documents that do not meet the project requirements. |
| 2.3.4. | Document approval | Approval of the reviewed and rectified documents. |
| 2.4. | Periodic monitoring | To ensure the quality of the project, a periodic monitoring of all the activities will be carried out. |
| 3.1.1. | Search for current space applications | Search for the current space applications. |
| 3.1.2. | Requirements definition | Definition of the requirements for the the sensors. |
| 3.2.1. | Search for the current modular systems with space applications | Search for the current modular systems with space applications. |
| 3.2.2. | Requirements definition | Definition of the requirements for modular system developed in this project. |
| 3.3.1.1. | Weather forecast | Search for current applications similar to those that want to be implemented with this project in the weather forecast area. |
| 3.3.1.2. | Urban planning (3D models) | Search for the current applications to those that want to be implemented with this project in the urban planning area. |
| 3.3.1.3. | Greenhouse emissions reduction (pollution) | Search for the current applications to those that want to be implemented with this project in the greenhouse emissions reduction area. |
| 3.3.2. | Requirements definition | Definition of the requirements for the applications. |
| 4.1.1.1. | Research | Research for the payloads preliminary design. |
| 4.1.1.2. | Development | Development of the payloads preliminary design. |

| WBS-ID | Activity | Description of Work |
|----------|---|--|
| 4.1.2.1. | Development of physical framework for sensor block | Modular system preliminary design and development of physical framework for sensor block. |
| 4.1.2.2. | Development of systems interaction and applications | Modular system preliminary design and development of systems interactions and applications. |
| 4.1.2.3. | Development of sensors data fusion software | Modular system preliminary design and development of sensor data fusion software. |
| 4.1.2.4. | Definition of SATCOM applications domains | Modular system preliminary design and definition of SATCOM application domains. |
| 4.1.3.1. | Implement web-bases servers for sharing sensors data | Preliminary design of the interaction platform. Implement web-based servers for sharing sensors data. |
| 4.1.3.2. | Implement processing algorithms based on applications | Preliminary design of the interaction platform. Implement processing algorithms based on applications. |
| 4.1.3.3. | Pre-design a full services stakeholders platform | Pre-design of interaction platform. |
| 4.2.1.1. | Sensor final design | Final design of the payload sensor. |
| 4.2.1.2. | Sensor final technical specifications | Final decision of the technical specifications of the payload sensor. |
| 4.2.2.1. | Modular system's final design | Final design of the modular system. |
| 4.2.2.2. | Sensor data fusion software final design | Final design of the modular system, specifically of the sensor data fusion software. |
| 4.2.2.3. | Modular system final technical specifications | Final decision of technical specifications of the modular system. |
| 4.2.3.1. | Web based servers for data sharing final implementation | Final design and implementations of the interaction platform, specifically the web servers for data sharing. |

| WBS-ID | Activity | Description of Work |
|----------|--|--|
| 4.2.3.2. | Processing algorithms based on applications final design | Final design and implementation of the interaction platform, specifically the processing algorithms. |
| 4.2.3.3. | Full service stakeholders platform implementation | Final design and implementation of the interaction platform. |
| 4.2.3.4. | Final technical specifications | Decision of the final technical specifications of the interaction (stakeholders) platform. |
| 5.1.1. | Manufacturing of payload sensors. | Manufacturing of the sensors of the prototype, in order to be tested in the following activities. |
| 5.1.2. | Manufacturing of modular system. | Manufacturing of the module of the prototype, in order to be tested in the following activities. |
| 5.1.3. | Implementation of interaction platform. | Manufacturing of the interaction platform of the prototype, in order to be tested in the following activities. |
| 5.2. | Payload validation | Validation of the performance of the sensors mounted on the system. |
| 5.3. | Modular system validation | Validation of the modular system performance, of the systems interaction, of the sensors' data fusion software, of the satellite communications applications domains and also of the physical framework for sensor blocks. |
| 5.4. | Interaction platform validation | Validation of the interaction platform to check if it develops all its functions properly. |
| 5.5. | Full system prototype validation | Validation of the whole system using the prototype in order to test its performance. |
| 5.6. | Quality of the product | Quality control of all the subsystems of the product and all the methodologies applied on its manufacturing and validation. |
| 6.1.1. | Study of stakeholders | Study of the possible companies interested on the project. |

| WBS-ID | Activity | Description of Work |
|--------|--------------------------------------|---|
| 6.1.2. | Procurement conditions negotiation | Negotiation of the conditions of the procurement of the resources. |
| 6.1.3. | Resources purchase | Purchase of the resources required in the project. |
| 6.2. | Exploitation and business plans | Includes the business plan of the product to exploit its economic potential. |
| 7.1. | Dissemination and communication plan | Definition of the strategies planned to the dissemination of the final product. |
| 7.2.1. | Web site development | Development of the web site to promote the product. |
| 7.2.2. | Social media management | Management of the social media used in the dissemination plan of the project. |
| 7.3.1. | Conferences | Attendance to conferences in order to disseminate to possible stakeholders the product. |
| 7.3.2. | Meeting | Meeting to promote the product inside the market. |
| 7.4.1. | Technology demonstrators | Production of technology demonstrators needed to the dissemination of the product. |
| 7.4.2. | Audio visual material production | Production of all the visual material needed to the promotion of the product. |

Table 2.1.1: Activity list and description

2.2 Activities leadership and participants

In the following table, the committee members that are leaders of tasks and activities and the ones that are expected to participate is shown. The aim of this table is to be capable of distributing human resources and time constraints of the activities. It is also useful because the most important facilities are to be provided by the committee members, so this distribution will allow the management of this facilities properly.

| WBS-ID | Activity | Leadership | Participants |
|----------|--|------------|---|
| 1.1. | Development of the project management plan | HIRO | - |
| 1.2.1. | Meetings | HIRO | - |
| 1.2.2. | Task tracking and scheduling | HIRO | - |
| 1.3. | Annual reporting | HIRO | - |
| 1.4. | Project implementation of risk management | HIRO | - |
| 2.1.1. | Employment of the necessary staff | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.1.2. | Human resources management | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.2.1.1. | Fix costs | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.2.1.2. | Variable costs | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.2.2. | Funding | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.2.3. | Economic feasibility | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.2.4 | Evolution monitoring | HIRO | BHO Legal Rechtsanwälte Partnership |

| WBS-ID | Activity | Leadership | Participants |
|--------|--|-------------------------------|---|
| 2.2.5 | Additional and follow-up funding seek | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.3.1. | Guidelines preparation | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.3.2. | Document revision | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.3.3. | Document rectification | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.3.4. | Documentat approval | HIRO | BHO Legal Rechtsanwälte Partnership |
| 2.4. | Periodic monitoring | HIRO | - |
| 3.1.1. | Search for current space applications | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |
| 3.1.2. | Requirements definition | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |
| 3.2.1. | Search for current modular systems with space applications | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |

| WBS-ID | Activity | Leadership | Participants |
|----------|---|-------------------------------|---|
| 3.2.2. | Requirements definition | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 3.3.1.1. | Weather forecast | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 3.3.1.2. | Urban planning (3D models) | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 3.3.1.3. | Greenhouse emissions reduction (pollution) | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 3.3.2. | Requirements definition | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.1.1.1. | Research | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |
| 4.1.1.2. | Development | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |
| 4.1.2.1. | Development of physical framework for sensor blocks | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |

| WBS-ID | Activity | Leadership | Participants |
|----------|---|-------------------------------|---|
| 4.1.2.2. | Development of system interaction and applications | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.1.2.3. | Development of sensors data fusion software | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.1.2.4. | Definition of SATCOM application domains | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.1.3.1. | Implement web-based servers for sharing sensors data | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.1.3.2. | Implement processing algorithms based on applications | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.1.3.3. | Pre-design a full services stakeholders platform | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.2.1.1. | Sensors final design | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |

| WBS-ID | Activity | Leadership | Participants |
|----------|---|-------------------------------|---|
| 4.2.1.2. | Sensors final technical specifications | Airbus Defence and Space GmbH | Deimos Space S.L.U Thales Alenia Space S.A.S HIRO |
| 4.2.2.1. | Modular system final design | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.2.2.2. | Sensors data fusion software final design | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.2.2.3. | Modular system final technical specifications | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 4.2.3.1. | Web based servers for data sharing final implementation | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.2.3.2. | Processing algorithm based on applications final design | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.2.3.3. | Full services stakeholders platform implementation | ICUBE-SERTIT | VITO nv ReSAC HIRO |
| 4.2.3.4. | Final technical specifications | ICUBE-SERTIT | VITO nv ReSAC HIRO |

| WBS-ID | Activity | Leadership | Participants |
|--------|--|---------------------------|--|
| 5.1.1. | Manufacturing of payload sensors | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 5.1.2. | Manufacturing of modular system | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 5.1.3. | Implementation of interaction platform | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 5.2. | Payload validation | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 5.3. | Modular system validation | Thales Alenia Space S.A.S | Airbus Defence and Space GmbH Deimos Space S.L.U HIRO |
| 5.4. | Interaction platform validation | ReSAC | HIRO VITO nv ICUBE-SERTIT |
| 5.5. | Full system prototype validation | HIRO | Airbus Defence and Space GmbH Thales Alenia Space ReSAC. |

| WBS-ID | Activity | Leadership | Participants |
|--------|--------------------------------------|---|--|
| 5.6. | Quality of the product | HIRO | Airbus Defence and Space GmbH Thales Alenia Space ReSAC. |
| 6.1.1. | Study of stakeholders | BHO Legal Rechtsanwälte Partnership | HIRO |
| 6.1.2. | Procurement conditions negotiation | BHO Legal Rechtsanwälte Partnership | HIRO |
| 6.1.3. | Resources purchase | BHO Legal Rechtsanwälte Partnership | HIRO |
| 6.2. | Exploitation and business plans | BHO Legal Rechtsanwälte Partnership | HIRO |
| 7.1. | Dissemination and communication plan | HIRO | All partners |
| 7.2.1. | Web site development | HIRO | All partners |
| 7.2.2. | Social media management | HIRO | All partners |
| 7.3.1. | Conferences | HIRO | All partners |
| 7.3.2. | Meetings | HIRO | All partners |
| 7.4.1. | Technology demonstrators | HIRO | All partners |
| 7.4.2. | Audio visual material production | HIRO | All partners |

Table 2.2.1: Activities leadership and participants

3 | Sequence activities

3.1 Dependencies or logical relationship between activities

On the following table, the relationship between activities is shown. The activities with a zero on their WBS-ID (for example: 1.0.) and marked with grey colour are milestones.

Relationship types are:

- FF: Finish-to-Finish
- FS: Finish-to-Start
- SS: Start-to-Start
- SF: Start-to-Finish

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|-----------|--|--------------|--------------|---------|
| 0. | Kick-Off meeting | START | - | 0 |
| 1. | PROJECT MANAGEMENT | | | |
| | | 0. | FS | 1 month |
| 1.0. | Project management plan | 1.1. | FF | 0 |
| | | 2.2.5. | FF | 0 |
| 1.1. | Development of the project management plan | 0. | SS | 0 |
| 1.2.1. | Meetings | 0. | SS | 0 |
| 1.2.2. | Task tracking and scheduling | 0. | SS | 0 |
| 1.3. | Annual reporting | 0. | SS | 0 |
| 1.4. | Project implementation of risk management | 0. | SS | 0 |

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|--------------------------------------|--|--------------|--------------|----------|
| 2. QUALITY AND ADMINISTRATION | | | | |
| 2.1.1. | Employment of the necessary staff | 1.0. | FS | 0 |
| 2.1.2. | Human resources management | 2.1.1. | FS | 0 |
| 2.2.1.1. | Fix costs | 0. | SS | 0 |
| 2.2.1.2. | Variable costs | 2.2.1.1. | FS | 0 |
| 2.2.2. | Funding | 2.2.1.2. | FS | 0 |
| 2.2.3. | Economic feasibility | 2.2.2. | FS | 0 |
| 2.2.4. | Evolution monitoring | 2.2.3. | FS | 0 |
| 2.2.5. | Additional and follow-up funding seek | 2.2.4. | FS | 0 |
| 2.3.1. | Guidelines preparation | 0. | SS | 0 |
| 2.3.2. | Document revision | 0. | SS | 0 |
| 2.3.3. | Document rectification | 0. | SS | 0 |
| 2.3.4. | Document approval | 0. | SS | 0 |
| 2.4. | Periodic monitoring | 0. | SS | 0 |
| 3. STATE OF THE ART | | | | |
| 3.0. | State of the Art completion | 0. | FS | 4 months |
| | | 3.1.2. | FF | 0 |
| | | 3.2.2. | FF | 0 |
| | | 3.3.2. | FF | 0 |
| 3.1.1. | Search for current space applications | 1.0. | FS | 0 |
| 3.1.2. | Requirements definition | 3.1.1. | FS | 0 |
| 3.2.1. | Search for current modular systems with space applications | 1.0. | FS | 0 |
| 3.2.2. | Requirements definition | 3.2.1. | FS | 0 |
| 3.3.1.1. | Weather forecast | 1.0. | FS | 0 |
| 3.3.1.2. | Urban planning (3D models) | 1.0. | FS | 0 |

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|-----------|---|--------------|--------------|-----------|
| 3.3.1.3. | Greenhouse emissions reductions (pollution) | 1.0. | FS | 0 |
| 3.3.2. | Requirements definition | 3.3.1. | FS | 0 |
| 4. | PRODUCT DEVELOPMENT | | | |
| 4.1.1.0. | Payload preliminary report | 0. | FS | 10 months |
| | | 4.1.1.2. | FF | 0 |
| 4.1.1.1. | Research | 3.0. | FS | 0 |
| 4.1.1.2. | Development | 4.1.1.1. | FS | 0 |
| 4.1.2.0. | Modular system preliminary design | 0. | FS | 13 months |
| | | 4.1.2.1. | FF | 0 |
| | | 4.1.2.4. | FF | 0 |
| 4.1.2.1. | Development of physical framework for sensor blocks | 4.1.1.0. | FS | 0 |
| 4.1.2.2. | Development of systems interaction and applications | 4.1.1.0. | FS | 0 |
| 4.1.2.3. | Development of sensors data fusion software | 4.1.2.2. | FS | 0 |
| 4.1.2.4. | Definition of SATCOM applications | 4.1.2.3. | FS | 0 |
| 4.1.3.0. | Interaction platform preliminary design | 0. | FS | 16 months |
| | | 4.1.3.3. | FF | 0 |
| | | | FF | |
| 4.1.3.1. | Implement web-based servers for sharing sensors data | 4.1.2.0. | FS | 0 |
| 4.1.3.2. | Implement processing algorithms based on applications | 4.1.2.0. | FS | 0 |
| 4.1.3.3. | Pre-design a full services stakeholders platform | 4.1.3.1. | FS | 0 |
| | | 4.1.3.2. | FS | 0 |
| 4.2.1.0. | Payloads final design | 0. | FS | 23 months |
| | | 4.2.1.2. | FF | 0 |
| 4.2.1.1. | Sensors final design | 4.1.1.0. | FS | 0 |

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|---|--|----------------------------|----------------|---------------------|
| 4.2.1.2. | Sensors final technical specifications | 4.2.1.1. | FS | 0 |
| 4.2.2.0. | Modular system final design - milestone | 0. 4.2.2.3. | FS FF | 26 months 0 |
| 4.2.2.1. | Modular system final design | 4.1.2.0. | FS | 0 |
| 4.2.2.2. | Sensors data fusion software final design | 4.1.2.0. | FS | 0 |
| 4.2.2.3. | Modular system's final technical specifications | 4.2.2.1. 4.2.2.2. | FS FS | 0 0 |
| 4.2.3.0. | Interaction platform final design | 0. 4.2.3.4. 4.2.3.2. | FS FF FF | 29 months 0 0 |
| 4.2.3.1. | Web based servers for data sharing final implementation | 4.1.3.0. | FF | 0 |
| 4.2.3.2. | Processing algorithms based on applications final design | 4.1.3.0. | FF | 0 |
| 4.2.3.3. | Full services stakeholders platform implementation | 4.2.3.1. | FF | 0 |
| 4.2.3.4. | Final technical specifications | 4.2.3.3. | FF | 0 |
| 5. SIMULATION, TESTING, VALIDATION AND QUALITY | | | | |
| | | 0. | FS | 34 months |
| 5.0. | Prototype manufacturing | 5.1.1. 5.1.2. 5.1.3. | FF FF FF | 0 0 0 |
| 5.1.1. | Manufacturing of payload sensors | 4.2.1.0. | FS | 0 |
| 5.1.2. | Manufacturing of modular system | 4.2.2.0. | FS | 0 |
| 5.1.3. | Implementation of interaction platform | 4.2.3.0. | FS | 0 |
| 5.2. | Payload validation | 5.1.1. | FS | 0 |
| 5.3. | Modular system validation | 5.1.2. | FS | 0 |
| 5.4. | Interaction platform validation | 5.1.3. | FS | 0 |

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|-----------|--|--------------|--------------|-----------|
| 5.01. | Individual System testing | 0. | FS | 34 months |
| | | 5.2. | FF | 0 |
| | | 5.3. | FF | 0 |
| | | 5.4. | FF | 0 |
| 5.5. | Full system prototype validation | 5.01. | FS | 0 |
| 5.02. | Full system testing | 0. | FS | 41 months |
| | | 5.5. | FF | 0 |
| 5.6. | Quality of the product | 5.02. | FS | 0 |
| 5.03. | Project completion | 0. | FS | 44 months |
| | | 1.2.1. | FF | 0 |
| | | 1.2.2. | FF | 0 |
| | | 1.3. | FF | 0 |
| | | 1.4. | FF | 0 |
| | | 2.1.2. | FF | 0 |
| | | 2.3.1. | FF | 0 |
| | | 2.3.2. | FF | 0 |
| | | 2.3.3. | FF | 0 |
| | | 2.3.4. | FF | 0 |
| | | 2.4. | FF | 0 |
| | | 5.6. | FF | 0 |
| | | 7.2.2. | FF | 0 |
| | | 7.3.1. | FF | 0 |
| | | 7.3.2. | FF | 0 |
| | | 7.4.1.1. | FF | 0 |
| | | 7.4.2. | FF | 0 |
| 6. | BUSSINES PLANNING AND EXPLOITATION OF RESULTS | | | |
| 6.0. | Business plan | 0. | FS | 1 month |
| | | 6.2. | FF | 0 |
| 6.1.1. | Study of stakeholders | 0. | FS | 0 |
| 6.1.2. | Procurement conditions negotiation | 0. | FS | 0 |
| 6.1.3. | Resources purchase | 0. | FS | 0 |
| 6.2. | Exploitation and business plans | 6.1. | FS | 0 |
| 7. | BUSSINES PLANNING AND EXPLOITATION OF RESULTS | | | |

| WBS-ID | Activity | Predecessors | Relationship | Lag |
|--------|--------------------------------------|--------------|--------------|---------------|
| 7.0. | Communication plan | 0. 7.1. | FS FF | 1 month FF |
| 7.1. | Dissemination and communication plan | 0. | FS | 0 |
| 7.2.1. | Web site development | 7.0. | FS | 0 |
| 7.2.2. | Social media management | 7.2.1. | FS | 0 |
| 7.3.1. | Conferences | 1.0. | FS | 0 |
| 7.3.2. | Meetings | 1.0. | FS | 0 |
| 7.4.1. | Technology demonstrators | 1.0. | FS | 0 |
| 7.4.2. | Audiovisual material production | 1.0. | FS | 0 |

Table 3.1.1: Dependencies or logical relationship between activities.

3.2 Network Diagram (Precedence Diagram Method)

Two sets of diagrams have been set. The first one, in Figure 3.2.1 shows the interconnections between tasks and a brief description. The second one, in Figure 3.2.2 in order to see interconnections between activities, only using the ID. This has been done in order to make easier the tasks visualization and understanding.

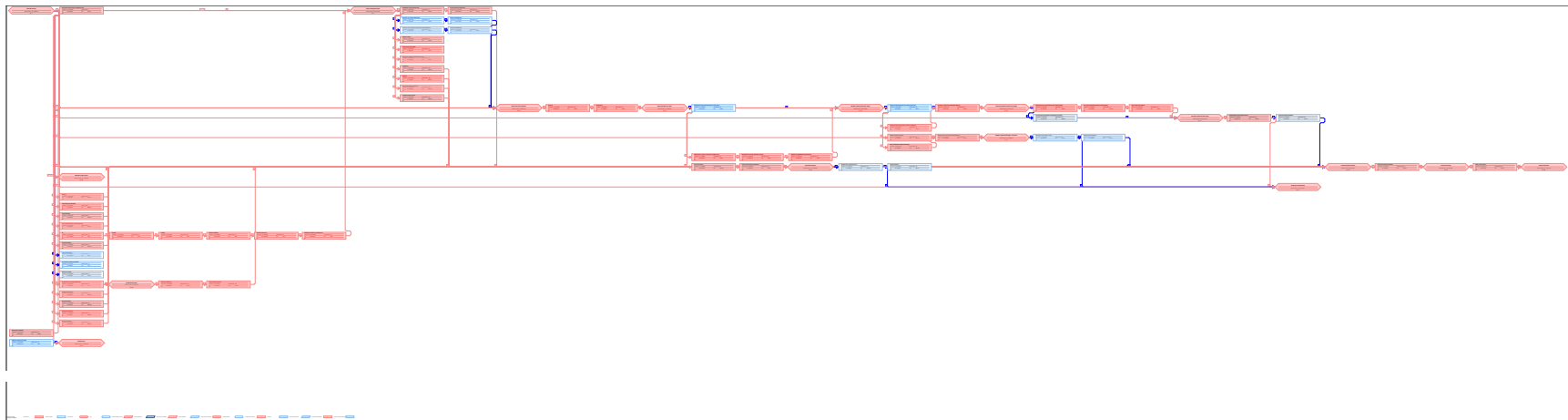


Figure 3.2.1: Network Precedence Method chart with full detail modules.



HIRO

4 | Estimate activity resources

4.1 Resource identification

In this section, the resources available/needed to perform the project are exposed. These resources are classified into three different categories:

- **Employees:** People needed to achieve the objectives of the project. The employees will be provided by the members of the consortium.
- **Materials:** Hardware and software elements that will be used to achieve the project objectives.
- **Facilities:** Special places and services where activities take place. They will also be provided by members of the consortium.

A brief explanation of the resources needed will be done and a collection of all of them, including a Resource ID, will be shown in Table 4.1.1.

Regarding human resources, i.e. employees, these can be classified into three sub-groups as not all of them are in the same point on the learning curve.

- **Senior:** High on the learning curve. They are able to provide guidance on technical and management issues and offer a critical point of view of the actions of the project.
- **Average:** They are able to perform activities in their knowledge field and arrive at conclusions without supervision.
- **Junior:** Little experience in the field, the work done needs to be supervised by an average employee.

The employees will be chosen taking into account the roles and responsibilities and technical knowledge needed to perform the project.

Materials/hardware are also important in this project as a sensor and its modular system wants to be built and tested. Although not all the hardware can be clearly specified in this early stage of the project, blocks can be defined. Hardware is also needed to support the database and interaction platform in order to perform the objective of the project: urban development. The blocks are:

- Payload building blocks: Hardware needed to build the sensor itself. It will depend on the type of sensor that needs to be built.
- Hardware support system: Physical connection between the parts of the sensor and its modular system. It can consist of a multi-layer PCB.
- Controllers: Chip, expansion card or stand-alone device to interface with the sensor and the other parts of the modular system. It can be a microcontroller or a hybrid technology such as the combination of logic blocks with FPGA (Field-Programmable Gate Array).
- Memory modules: Additional SRAM/ROM memory blocks to complete the performance of the system.
- Hosting package: Servers needed to host the end user and stakeholder platform for urban development.
- Backup system: Archive of the interaction platform computer data.

Regarding the facilities that will be used during the project, these are:

- Office: Needed to perform desktop tasks. All stakeholders can use their own offices.
- Meeting rooms: To host meetings between the members of the consortium, employees of the same partner and between members of the consortium and clients. They will be provided by the consortium members.
- Research laboratory: Laboratories needed to do the research of the payload, modular system, and interaction platform. They will be provided by the consortium members related to these tasks.
- Development centre: Centre where the development of payload, modular system, and interaction platform will be carried out. They will be provided by the consortium members related to these tasks.
- Testing room: Laboratories where the testing of the system in relevant environment will be done. They will be provided by the consortium members related to the testing.
- Quality laboratory: Laboratories where the quality evaluation will be carried out. They will be provided by the consortium members related to quality assessment.

| Resource ID | Resource Description | Type of resource |
|-------------|---|------------------|
| PM.M | Project Manager | Employee-Senior |
| PM.S | Project Manager Secretary | Employee-Average |
| FM.M | Financial Manager | Employee-Senior |
| FM.A | Financial Manager Assessor | Employee-Average |
| SPM.M | Stakeholders and Procurement Manager | Employee-Senior |
| SPM.A | Stakeholders and Procurement Manager Assessor | Employee-Average |
| ScTM.M | Scope and Time Manager | Employee-Senior |
| ScTM.A | Scope and Time Manager Assessor | Employee-Average |
| RM.M | Risk Manager | Employee-Senior |
| RM.A | Risk Manager Assessor | Employee-Average |
| QM.M | Quality Manager | Employee-Senior |
| QM.A | Quality Manager Assessor | Employee-Average |
| MCM.M | Marketing and Communications Manager | Employee-Senior |
| MCM.A | Marketing and Communications Manager Assessor | Employee-Average |
| TM | Technical Manager | Employee-Average |
| RD.A | Research and development assessor | Employee-Average |
| LB.A | Legal and Business Assessor | Employee-Average |
| SD.S | System development engineer | Employee-Senior |
| SD.A | System development engineer | Employee-Average |
| SD.J | System development engineer | Employee-Junior |
| ST.S | System testing engineer | Employee-Senior |
| ST.A | System testing engineer | Employee-Average |
| ST.J | System testing engineer | Employee-Junior |
| AD.S | Application development manager | Employee-Senior |
| AD.A | Application development technician | Employee-Average |
| AD.J | Application development technician | Employee-Junior |
| SOFT.1 | Microsoft Office | Material |
| SOFT.2 | LaTex | Material |
| SOFT.3 | GitHub | Material |
| SOFT.4 | Trello | Material |
| SOFT.5 | Solidworks | Material |
| SOFT.6 | PostgreSQL | Material |
| SOFT.7 | Live Plan | Material |
| SOFT.8 | Wix | Material |
| SOFT.9 | Jitsi | Material |
| SOFT.10 | Final Cut Pro | Material |
| HARDW.1 | Payload building blocks | Material |
| HARDW.2 | Hardware support system | Material |
| HARDW.3 | Sensor interface | Material |

| Resource ID | Resource Description | Type of resource |
|-------------|----------------------|------------------|
| HARDW.4 | Controllers | Material |
| HARDW.5 | Memory modules | Material |
| HARDW.6 | Hosting package | Material |
| HARDW.7 | Backup system | Material |
| OFF | Office | Facilities |
| MR | Meeting room | Facilities |
| CH | Conference Hall | Facilities |
| RL | Research laboratory | Facilities |
| DC | Development centre | Facilities |
| TR | Testing room | Facilities |
| QL | Quality laboratory | Facilities |

Table 4.1.1: Resources identification

4.2 Activity resource requirement

In this section the resources needed for the development of each of the activities specified in the WBS will be stated.

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|---|
| 1.1. | PM.M | 1 | Although only PM.M and PM.S are assigned to this activity, all partners involved in the project should give its opinion and provide necessary input if required for the elaboration of the project management plan. |
| | PM.S | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 1.2.1. | PM.M | 1 | All partners and the staff considered necessary are expected to assist to the meetings. |
| | PM.S | 1 | |
| | ScTM.M | 1 | |
| | ScTM.A | 1 | |
| | MR | 1 | |
| | SOFT.9 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|---|
| 1.2.2. | PM.M | 1 | All partners should contribute to the correct development of this task. |
| | PM.S | 1 | |
| | ScTM.M | 1 | |
| | ScTM.A | 1 | |
| | MR | 1 | |
| | SOFT.4 | 1 | |
| 1.3. | PM.M | 1 | All partners should contribute to the correct development of this task. |
| | PM.S | 1 | |
| | ScTM.M | 1 | |
| | ScTM.A | 1 | |
| | OFF | 1 | |
| | CH | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 1.4. | RM.M | 1 | |
| | RM.A | 1 | |
| | OFF | 1 | |
| 2.1.1. | SPM.M | 1 | |
| | SPM.A | 1 | |
| | OFF | 1 | |
| 2.1.2. | SPM.M | 1 | |
| | SPM.A | 1 | |
| | OFF | 1 | |
| 2.2.1.1. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.7 | 1 | |
| 2.2.1.2. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.7 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|------------|
| 2.2.2. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.7 | 1 | |
| 2.2.3. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.7 | 1 | |
| 2.2.4. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| 2.2.5. | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| 2.3.1. | QM.M | 1 | |
| | QM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 2.3.2. | QM.M | 1 | |
| | QM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|--|
| 2.3.3. | QM.M | 1 | |
| | QM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 2.3.4. | QM.M | 1 | |
| | QM.A | 1 | |
| | MR | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 2.4. | ScTM.M | 1 | All partners should contribute in this activity if required by ScT.M or ScT.A. |
| | ScTM.A | 1 | |
| | MR | 1 | |
| | SOFT.4 | 1 | |
| 3.1.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 3.1.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 3.2.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 3.2.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 3.3.1.1. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 3.3.1.2. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 3.3.1.3. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 3.3.2. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 4.1.1.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 1 | |
| | RL | 5 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.1.1.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 5 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 4.1.2.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.1.2.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.1.2.3. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.1.2.4. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 4.1.3.1. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |
| 4.1.3.2. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |
| 4.1.3.3. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 4.2.1.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 5 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.2.1.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.2.2.1. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 4.2.2.2. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.2.2.3. | TM | 1 | |
| | RD.A | 1 | |
| | SD.S | 1 | |
| | SD.A | 2 | |
| | SD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.5 | 1 | |
| 4.2.3.1. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|----------|-------------|----------|------------|
| 4.2.3.2. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |
| 4.2.3.3. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |
| 4.2.3.4. | TM | 1 | |
| | RD.A | 1 | |
| | AD.S | 1 | |
| | AD.A | 2 | |
| | AD.J | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.6 | 1 | |
| 5.1.1. | SD.A | 1 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | HARDW.1 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|------------|
| 5.1.2. | SD.A | 1 | |
| | SD.J | 2 | |
| | DC | 1 | |
| | HARDW.2 | 1 | |
| | HARDW.3 | 1 | |
| | HARDW.4 | 1 | |
| | HARDW.5 | 1 | |
| 5.1.3. | AD.A | 1 | |
| | AD.J | 2 | |
| | DC | 1 | |
| | HARDW.6 | 1 | |
| | HARDW.7 | 1 | |
| 5.2. | ST.S | 1 | |
| | ST.A | 1 | |
| | ST.J | 2 | |
| | TR | 5 | |
| | HARDW.1 | 1 | |
| 5.3. | ST.S | 1 | |
| | ST.A | 1 | |
| | ST.J | 2 | |
| | TR | 1 | |
| | HARDW.2 | 1 | |
| | HARDW.3 | 1 | |
| | HARDW.4 | 1 | |
| | HARDW.5 | 1 | |
| 5.4. | AD.S | 1 | |
| | AD.A | 1 | |
| | TR | 1 | |
| | HARDW.6 | 1 | |
| | HARDW.7 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|------------|
| 5.5. | ST.A | 2 | |
| | AD.A | 2 | |
| | SD.A | 2 | |
| | TR | 1 | |
| | HARDW.1 | 1 | |
| | HARDW.2 | 1 | |
| | HARDW.3 | 1 | |
| | HARDW.4 | 1 | |
| | HARDW.5 | 1 | |
| | HARDW.6 | 1 | |
| | HARDW.7 | 1 | |
| 5.6. | QM.M | 1 | |
| | QM.A | 1 | |
| | QL | 1 | |
| | HARDW.1 | 1 | |
| | HARDW.2 | 1 | |
| | HARDW.3 | 1 | |
| | HARDW.4 | 1 | |
| | HARDW.5 | 1 | |
| | HARDW.6 | 1 | |
| | HARDW.7 | 1 | |
| 6.1.1. | LB.A | 1 | |
| | SPM.M | 1 | |
| | SPM.A | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| 6.1.2. | LB.A | 1 | |
| | SPM.M | 1 | |
| | SPM.A | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|--|
| 6.1.3. | LB.A | 1 | |
| | FM.M | 1 | |
| | FM.A | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| 6.2. | LB.A | 1 | |
| | FM.M | 1 | |
| | FM.A | 2 | |
| | SPM.M | 1 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.3 | 1 | |
| | SOFT.7 | 1 | |
| 7.1. | MCM.M | 1 | |
| | MCM.A | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.2 | 1 | |
| | SOFT.3 | 1 | |
| 7.2.1. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | OFF | 1 | |
| | SOFT.8 | 1 | |
| 7.2.2. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | OFF | 1 | |
| 7.3.1. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | CH | 1 | |
| | SOFT.9 | 1 | |
| 7.3.2. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | MR | 1 | |

| WBS-ID | Resource ID | Quantity | Assumption |
|--------|-------------|----------|--|
| 7.4.1. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | DC | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.10 | 1 | |
| 7.4.2. | MCM.M | 1 | All partners should provide information and be able to collaborate for communication and dissemination purposes. |
| | MCM.A | 2 | |
| | OFF | 1 | |
| | SOFT.1 | 1 | |
| | SOFT.10 | 1 | |

Table 4.2.1: List of resource requirement

4.3 Resource Breakdown Structure

A resource breakdown structure is now done in order to see the different type of resources and how are they classified. Diagrams have been done to see it graphically. Equally to the case of the WBS, they have been split into different blocks.

1. Employees

1.1. Project management

1.1.1. Project Manager

1.1.2. Project Manager Secretary

1.2. Financial

1.2.1. Financial Manager

1.2.2. Financial Manager Assessor

1.3. Stakeholders and Procurement

1.3.1. Stakeholders and Procurement Manager

1.3.2. Stakeholders and Procurement Manager Assessor

1.4. Scope and Time

1.4.1. Scope and Time Manager

1.4.2. Scope and Time Manager Assessor

1.5. Risk

1.5.1. Risk Manager

- 1.5.2. Risk Manager Assessor
- 1.6. Quality
 - 1.6.1. Quality Manager
 - 1.6.2. Quality Manager Assessor
- 1.7. Marketing and Communications
 - 1.7.1. Marketing and Communications Manager
 - 1.7.2. Marketing and Communications Manager Assessor
- 1.8. Engineering
 - 1.8.1. Technical Manager
 - 1.8.2. Research and Development assessor
 - 1.8.3. Development
 - 1.8.3.1. System development engineer — Senior
 - 1.8.3.2. System development engineer — Average
 - 1.8.3.3. System development engineer — Junior
 - 1.8.4. Testing
 - 1.8.4.1. System testing engineer — Senior
 - 1.8.4.2. System testing engineer — Average
 - 1.8.4.3. System testing engineer — Junior
- 1.9. Application development
 - 1.9.1. Application development manager
 - 1.9.2. Application development technician — Average
 - 1.9.3. Application development technician — Junior
- 2. Materials
 - 2.1. Software
 - 2.1.1. Microsoft Office
 - 2.1.2. LaTeX
 - 2.1.3. GitHub
 - 2.1.4. Trello
 - 2.1.5. Solidworks
 - 2.1.6. PostgreSQL
 - 2.1.7. Live Plan
 - 2.1.8. Wix
 - 2.1.9. Jitsi
 - 2.1.10. Final Cut Pro
 - 2.2. Hardware

- 2.2.1. Payload building blocks
- 2.2.2. Hardware support system
- 2.2.3. Sensor interface
- 2.2.4. Controllers
- 2.2.5. Memory modules
- 2.2.6. Hosting package
- 2.2.7. Backup system

3. Facilities

- 3.1. Office
- 3.2. Meeting room
- 3.3. Conference hall
- 3.4. Research laboratory
- 3.5. Development centre
- 3.6. Testing room
- 3.7. Quality laboratory



Figure 4.3.1: Employees resource breakdown diagram.

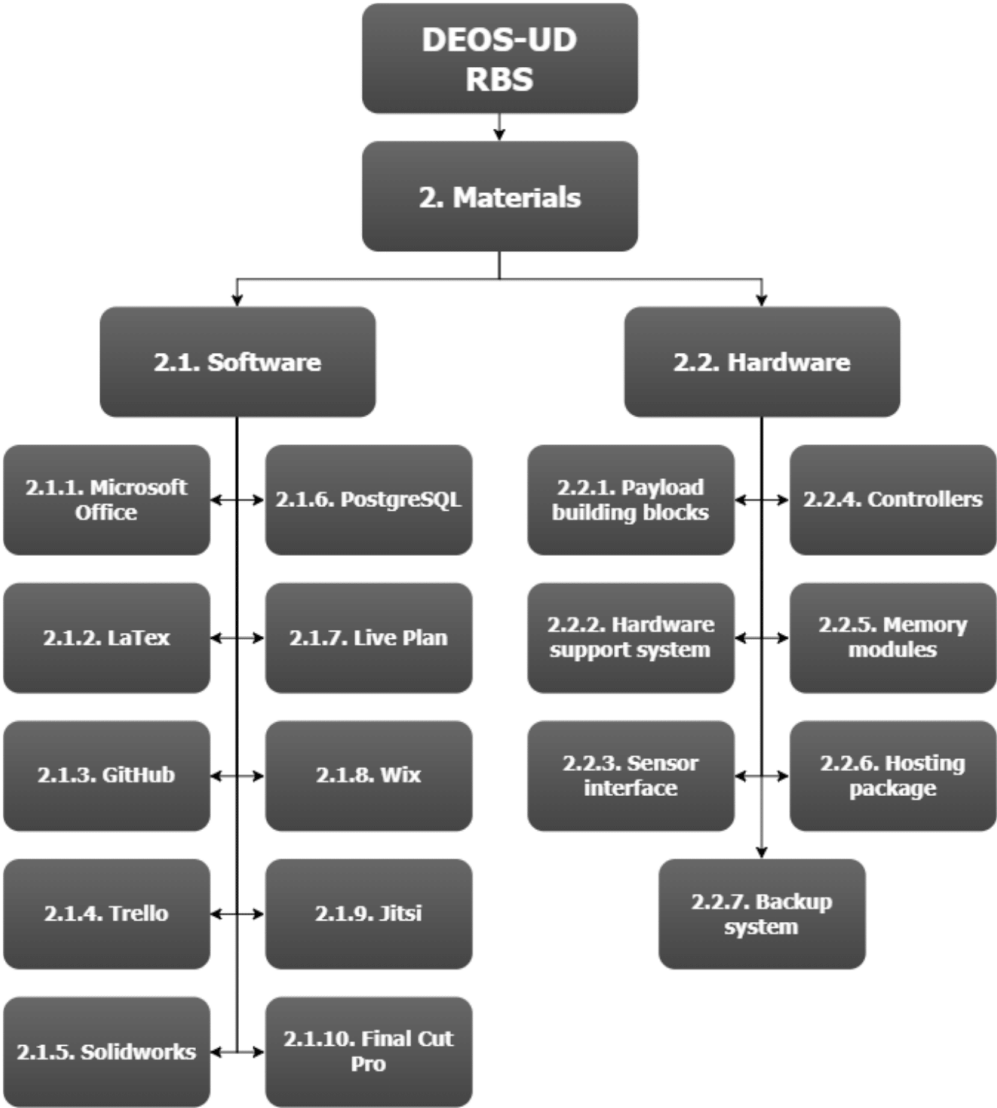


Figure 4.3.2: Materials resource breakdown diagram.



Figure 4.3.3: Facilities resource breakdown diagram.

5 | Estimate activity duration

In this section, an estimate activity duration is done. In order to perform the most accurate estimation possible three different methods, which are explained below, have been applied depending on the characteristics of each task.

A brief explanation of the three mentioned methods including the type of tasks that have been estimated with each one is carried out:

Parametric Estimate

This estimation technique, that has been used to estimate the duration of commercial and administration tasks, uses an algorithm based on historical data and project parameters. The algorithm used consists in:

$$\text{Duration Estimate} = \frac{\text{Effort Days}}{\text{Resource Quantity} \times \text{Available Factor} \times \text{Performance Factor}}$$

The parameters used have been established as follows:

- **Effort Days:** States the necessary days to complete the task.
- **Resource Quantity:** Determines the number of resources (people) assigned to the respective task. This parameter has been already established on section 4.2.
- **Available Factor:** Determines the availability of the resources. This parameter has been established taking into account the overlap of tasks assigned to each resource.
- **Performance Factor:** Determines the ability of the resource assigned to perform the task. This parameter is established taking into account if the resource is a Senior-Employee, an Average-Employee, a Junior-Employee or a combination of them (in section 4.1 each type of employee is defined).

Analogous Estimate

The analogous estimation technique is based on the knowledge about the activity duration of previous similar projects. Hence, the duration of the current project completely relies on the duration of the previous one and the weight this current activity has compared to the previous one.

$$\text{Duration Estimate} = \text{Previous activity Duration} \times \text{Multiplier}$$

Analogous estimating can be less accurate than other estimation methods when the previous activities are not similar enough. Therefore, it has been used to estimate the duration of the management activities because it is possible to obtain a reliable estimation from the management timings of previous projects.

Three Point Estimate

The third method used to estimate the duration of the activities is the three-point estimation. This method takes into account the uncertainties and risks in order to provide an expected duration of each activity.

The expected duration is calculated by using a Beta Distribution which gives more weight to the most likely duration of the activity than the other parameters have because it is the most realistic one.

$$\text{Beta Distribution} = \frac{\text{Optimistic} + \text{Most Likely} \times 6 + \text{Pessimistic}}{6}$$

In fact, the parameters from which each activity duration is calculated are defined as:

- **Most Likely:** this estimate is based on the duration of the activity in a realistic way, by taking into account resources available and productivity for the corresponding activity.
- **Optimistic:** this estimate is based on the best-scenario for the activity.
- **Pessimistic:** this estimate is based on the worst-case scenario for the activity.

This method has been used to estimate the duration of the activities that are technical because there is no data about previous projects due to the fact it is a state of the art project. However, it is a good method because by knowing the resources available and the productivity of the team, realistic expectations of the availability to the activity and its workload are done.

Estimate activity duration

| Parametric Estimates | | | | | |
|----------------------|-------------|-------------------|-------------|--------------------|--------------------------|
| WBS-ID | Effort Days | Resource Quantity | % Available | Performance Factor | Duration Estimate (days) |
| 2.1.1. | 54 | 2 | 100 | 0.9 | 30 |
| 2.1.2. | 1500 | 2 | 100 | 0.9 | 830 |
| 2.2.1. | 4 | 2 | 60 | 0.9 | 4 |
| 2.2.2. | 3 | 2 | 60 | 0.9 | 3 |
| 2.2.3. | 7 | 2 | 80 | 0.9 | 5 |
| 2.2.4. | 6 | 2 | 70 | 0.9 | 5 |
| 2.2.5. | 5 | 2 | 100 | 0.9 | 3 |
| 2.3. | 1500 | 2 | 90 | 0.95 | 880 |
| 6.1.1. | 12 | 3 | 60 | 0.85 | 8 |
| 6.1.2. | 11 | 4 | 60 | 0.85 | 5 |
| 6.1.3. | 12 | 3 | 50 | 0.85 | 10 |
| 6.2. | 27 | 5 | 80 | 0.85 | 8 |
| 7.1. | 51 | 3 | 100 | 0.85 | 20 |
| 7.2.1. | 180 | 3 | 80 | 0.85 | 90 |
| 7.2.2. | 1475 | 3 | 75 | 0.85 | 770 |
| 7.3. | 2200 | 6 | 50 | 0.85 | 860 |
| 7.4.1. | 1650 | 3 | 75 | 0.85 | 860 |
| 7.4.2. | 1650 | 3 | 75 | 0.85 | 860 |

Table 5.0.1: List of Parametric Estimates

| Analogous Estimates | | | | | |
|---------------------|----------------------------------|-------------------|-------------------------|------------|-------------------|
| WBS-ID | Previous Activity | Previous Duration | Current Activity | Multiplier | Duration Estimate |
| 1.1. | Previous project Management Plan | 23 | Project management plan | 0.9 | 20 |

| Analogous Estimates | | | | | |
|---------------------|---|-------------------|---|------------|-------------------|
| WBS-ID | Previous Activity | Previous Duration | Current Activity | Multiplier | Duration Estimate |
| 1.2. | Previous project Monitoring | 980 | Monitoring of the project | 0.9 | 880 |
| 1.3. | Previous project Annual reporting | 1250 | Annual Reporting | 0.7 | 880 |
| 1.4. | Previous project Risk Management implementation | 1100 | Project implementation of risk management | 0.8 | 880 |

Table 5.0.2: List of Analogous Estimates

| Three Point Estimates | | | | | |
|-----------------------|---------------------|----------------------|----------------------|--------------------|----------------------------|
| WBS-ID | Optimistic Duration | Most Likely Duration | Pessimistic Duration | Weighting Equation | Expected Duration Estimate |
| 3.1.1. | 20 | 30 | 40 | $(o+4m+p)/6$ | 30 |
| 3.1.2. | 15 | 23 | 40 | $(o+4m+p)/6$ | 25 |
| 3.2.1. | 20 | 24 | 35 | $(o+4m+p)/6$ | 25 |
| 3.2.2. | 22 | 28 | 45 | $(o+4m+p)/6$ | 30 |
| 3.3.1. | 15 | 18 | 30 | $(o+4m+p)/6$ | 20 |
| 3.3.2. | 32 | 40 | 50 | $(o+4m+p)/6$ | 40 |
| 4.1.1.1. | 58 | 68 | 88 | $(o+4m+p)/6$ | 70 |
| 4.1.1.2. | 40 | 48 | 65 | $(o+4m+p)/6$ | 50 |
| 4.1.2. | 45 | 60 | 75 | $(o+4m+p)/6$ | 60 |
| 4.1.3.1. | 15 | 18 | 30 | $(o+4m+p)/6$ | 20 |
| 4.1.3.2. | 30 | 39 | 55 | $(o+4m+p)/6$ | 40 |
| 4.1.3.3. | 15 | 18 | 30 | $(o+4m+p)/6$ | 20 |
| 4.2.1. | 230 | 255 | 310 | $(o+4m+p)/6$ | 260 |
| 4.2.2. | 230 | 255 | 310 | $(o+4m+p)/6$ | 260 |

| Three Point Estimates | | | | | |
|-----------------------|---------------------|----------------------|----------------------|--------------------|----------------------------|
| WBS-ID | Optimistic Duration | Most Likely Duration | Pessimistic Duration | Weighting Equation | Expected Duration Estimate |
| 4.2.3. | 230 | 255 | 310 | $(o+4m+p)/6$ | 260 |
| 5.1.1. | 180 | 195 | 240 | $(o+4m+p)/6$ | 200 |
| 5.1.2. | 130 | 145 | 185 | $(o+4m+p)/6$ | 150 |
| 5.1.3. | 80 | 97 | 130 | $(o+4m+p)/6$ | 100 |
| 5.2. | 40 | 62 | 72 | $(o+4m+p)/6$ | 60 |
| 5.3. | 46 | 58 | 80 | $(o+4m+p)/6$ | 60 |
| 5.4. | 30 | 45 | 60 | $(o+4m+p)/6$ | 45 |
| 5.5. | 60 | 76 | 110 | $(o+4m+p)/6$ | 80 |
| 5.6. | 45 | 58 | 80 | $(o+4m+p)/6$ | 60 |

Table 5.0.3: List of Three Point Estimations

6 | Project Schedule

In this section the project schedule is shown. It has been implemented from a Gantt chart, attached on the next page.

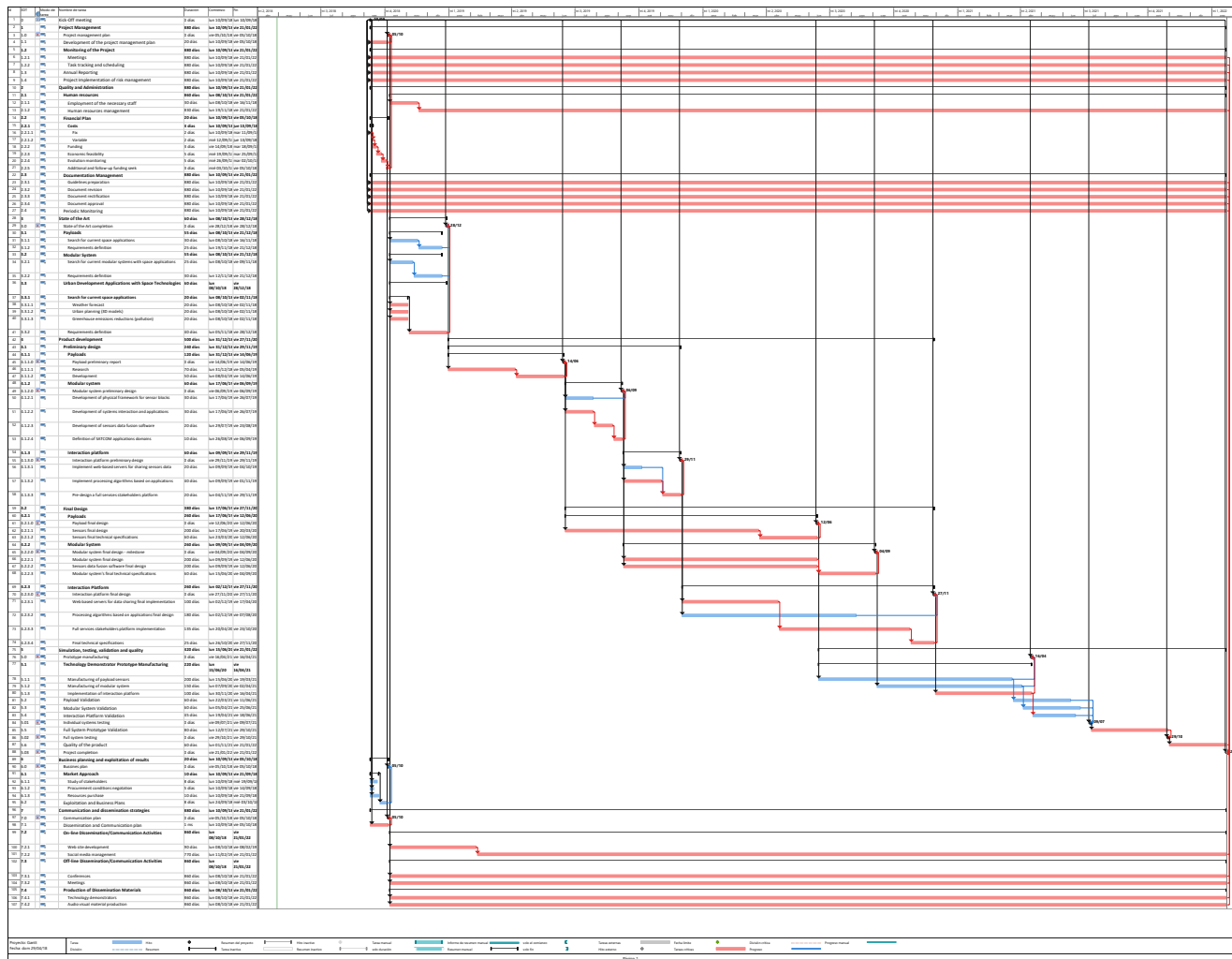


Figure 6.0.1: Gantt chart

7 | Activity Attributes (at Work Package level)

This section contains an overview of the activity attributes. In the following tables the different activities are shown together with a description of the work that has to be done, their predecessors, the relationships between the activities, the resources needed to complete them, the efforts, the locations in which they are performed and the constraints that have to be taken into account.

| | | |
|--|---|---|
| WBS-ID: 1.1. | | Activity: Development of the project management plan |
| Description of Work: Elaboration of all the documentation that states the strategy of the management and organization of the project through its duration. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Project Manager 1 Project Manager Secretary | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 05/10/18 Due date Milestone Project management plan: 05/10/18 | | |
| Assumptions: Although only the Project Manager and the Project Manager Secretary are assigned to this activity, all partners involved in the project should give its opinion and provide necessary input if required for the elaboration of the project management plan. | | |

Table 7.0.1: Activity 1.1. attributes

| | | |
|---|---|---|
| WBS-ID: 1.2.1. | | Activity: Meetings |
| Description of Work: Gathering of the members of the project to inform each other of the progress. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Project Manager 1 Project Manager Secretary 1 Scope and Time Manager 1 Scope and Time Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Meeting room 1 Jitsi |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: All partners and the staff considered necessary are expected to assist to the meetings. | | |

Table 7.0.2: Activity 1.2.1. attributes

| | | |
|---|---|--|
| WBS-ID: 1.2.2. | | Activity: Task tracking and scheduling |
| Description of Work: Tracking of the active tasks and scheduling. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Project Manager 1 Project Manager Secretary 1 Scope and Time Manager 1 Scope and Time Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Meeting room 1 Trello |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: All partners should contribute to the correct development of this task. | | |

Table 7.0.3: Activity 1.2.2. attributes

| | | |
|---|---|--|
| WBS-ID: 1.3. | | Activity: Annual reporting |
| Description of Work: Every year that the project lasts will call for the elaboration of an internal report with the aim of keeping up to date with the progress done. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Project Manager 1 Project Manager Secretary 1 Scope and Time Manager 1 Scope and Time Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Conference Hall 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: All partners should contribute to the correct development of this task. | | |

Table 7.0.4: Activity 1.3. attributes

| | | |
|---|---|---|
| WBS-ID: 1.4. | | Activity: Project implementation of risk management |
| Description of Work: Study of all the potential risks and how they will be managed so that their affectation to the project stays to a minimum. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Risk Manager 1 Risk Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.5: Activity 1.4. attributes

| | | |
|---|---|---|
| WBS-ID: 2.1.1. | | Activity: Employment of the necessary staff |
| Description of Work: Definition of the number of employees necessary. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Stakeholders and Procurement Manager 1 Stakeholders and Procurement Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 16/11/18 | | |
| Assumptions: - | | |

Table 7.0.6: Activity 2.1.1. attributes

| | | |
|---|---|--|
| WBS-ID: 2.1.2. | | Activity: Human resources management |
| Description of Work: Administration of all the employees needed to fulfil the different tasks of the project. | | |
| Predecessors: 2.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Stakeholders and Procurement Manager 1 Stakeholders and Procurement Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.7: Activity 2.1.2. attributes

| | | |
|---|---|---|
| WBS-ID: 2.2.1.1. | | Activity: Fix costs |
| Description of Work: Lay down of all the fix costs of the project. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub 1 Live Plan |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.8: Activity 2.2.1.1. attributes

| | | |
|---|---|---|
| WBS-ID: 2.2.1.2. | | Activity: Variable costs |
| Description of Work: Lay down of all the variable costs of the project. | | |
| Predecessors: 2.2.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub 1 Live Plan |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.9: Activity 2.2.1.2. attributes

| | | |
|---|---|---|
| WBS-ID: 2.2.2. | | Activity: Funding |
| Description of Work: Lay down of the expected funding of the project. | | |
| Predecessors: 2.2.1.2. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub 1 Live Plan |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.10: Activity 2.2.2. attributes

| | | |
|---|---|---|
| WBS-ID: 2.2.3. | | Activity: Economic feasibility |
| Description of Work: Study on the economic feasibility of the project. | | |
| Predecessors: 2.2.2. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub 1 Live Plan |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.11: Activity 2.2.3. attributes

| | | |
|---|---|--|
| WBS-ID: 2.2.4. | | Activity: Evolution monitoring |
| Description of Work: Monitoring of the evolution of the project finances. | | |
| Predecessors: 2.2.3. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.12: Activity 2.2.4. attributes

| | | |
|---|---|--|
| WBS-ID: 2.2.5. | | Activity: Additional and follow-up funding seek |
| Description of Work: Search for additional funding for the project. | | |
| Predecessors: 2.2.4. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.13: Activity 2.2.5. attributes

| | | |
|---|---|---|
| WBS-ID: 2.3.1. | | Activity: Guidelines preparation |
| Description of Work: Establishment of the guidelines for the redaction of all documents. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Quality Manager 1 Quality Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.14: Activity 2.3.1. attributes

| | | |
|---|---|---|
| WBS-ID: 2.3.2. | | Activity: Document revision |
| Description of Work: Revision of all the documents of the project. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Quality Manager 1 Quality Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.15: Activity 2.3.2. attributes

| | | |
|--|---|---|
| WBS-ID: 2.3.3. | | Activity: Document rectification |
| Description of Work: Rectification of the documents that do not meet the project requirements. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Quality Manager 1 Quality Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.16: Activity 2.3.3. attributes

| | | |
|---|---|---|
| WBS-ID: 2.3.4. | | Activity: Document approval |
| Description of Work: Approval of the reviewed and rectified documents | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Quality Manager 1 Quality Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Meeting Room 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO and BHO Legal Rechtsanwälte Partnership | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.17: Activity 2.3.4. attributes

| | | |
|--|---|--|
| WBS-ID: 2.4. | | Activity: Periodic monitoring |
| Description of Work: To ensure the quality of the project, a periodic monitoring of all the activities will be carried out. | | |
| Predecessors: 0. | Relationship: SS | Lag: 0 |
| Number and Type of Resources Required: 1 Scope and Time Manager 1 Scope and Time Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Meeting Room 1 Trello |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Project management plan: 21/01/22 | | |
| Assumptions: All partners should contribute to this activity if required by the Scope and Time Manager or the Scope and Time Manager Assessor. | | |

Table 7.0.18: Activity 2.4. attributes

| | | |
|---|---|---|
| WBS-ID: 3.1.1. | | Activity: Search for current space applications |
| Description of Work: Research for the current space applications. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development Assessor 1 System development engineer (senior) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload state of the art: 14/06/19 Due date Milestone Payload state of the art: 14/06/19 | | |
| Assumptions: - | | |

Table 7.0.19: Activity 3.1.1. attributes

| | | |
|---|---|---|
| WBS-ID: 3.1.2. | | Activity: Requirements definition |
| Description of Work: Definition of the requirements for the sensors. | | |
| Predecessors: 3.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload state of the art: 14/06/19 Due date Milestone Payload state of the art: 14/06/19 | | |
| Assumptions: - | | |

Table 7.0.20: Activity 3.1.2. attributes

| | | |
|---|---|---|
| WBS-ID: 3.2.1 | | Activity: Search for current modular systems with space applications |
| Description of Work: Search for current modular systems with space applications. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system state of the art: 21/12/18 Due date Milestone Modular system state of the art: 21/12/18 | | |
| Assumptions: - | | |

Table 7.0.21: Activity 3.2.1. attributes

| | | |
|---|---|---|
| WBS-ID: 3.2.2. | | Activity: Requirements definition |
| Description of Work: Definition of the requirements for modular system developed in this project. | | |
| Predecessors: 3.2.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system state of the art: 21/12/18 Due date Milestone Modular system state of the art: 21/12/18 | | |
| Assumptions: - | | |

Table 7.0.22: Activity 3.2.2. attributes

| | | |
|---|---|---|
| WBS-ID: 3.3.1.1. | | Activity: Weather forecast |
| Description of Work: Search for current applications similar to those that want to be implemented with this project in the weather forecast area. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development technician (junior) | Skill Requirements: Senior Average Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Space applications state of the art: 28/12/18 Due date Milestone Space applications state of the art: 28/12/18 | | |
| Assumptions: - | | |

Table 7.0.23: Activity 3.3.1.1. attributes

| | | |
|---|---|---|
| WBS-ID: 3.3.1.2. | | Activity: Urban planning (3D models) |
| Description of Work: Search for current applications similar to those that want to be implemented with this project in the urban planning area. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development technician (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Space applications state of the art: 28/12/18 Due date Milestone Space applications state of the art: 28/12/18 | | |
| Assumptions: - | | |

Table 7.0.24: Activity 3.3.1.2. attributes

| | | |
|---|---|---|
| WBS-ID: 3.3.1.3. | | Activity: Greenhouse emissions reduction (pollution) |
| Description of Work: Search for current applications similar to those that want to be implemented with this project in the greenhouse emissions reduction area. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development technician (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Space applications state of the art: 28/12/18 Due date Milestone Space applications state of the art: 28/12/18 | | |
| Assumptions: - | | |

Table 7.0.25: Activity 3.3.1.3. attributes

| | | |
|---|---|---|
| WBS-ID: 3.3.2. | | Activity: Requirements definition |
| Description of Work: Definition of the requirements for the applications. | | |
| Predecessors: 3.3.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Space applications state of the art: 28/12/18 Due date Milestone Space applications state of the art: 28/12/18 | | |
| Assumptions: - | | |

Table 7.0.26: Activity 3.3.2. attributes

| | | |
|--|---|--|
| WBS-ID: 4.1.1.1. | | Activity: Research |
| Description of Work: Research for the payload preliminary design. | | |
| Predecessors: 3.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 1 System development engineer (average) | Skill Requirements: Average Senior | Other Required Resources: 5 Research laboratory 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload preliminary design: 14/06/19 Due date Milestone Payload preliminary design: 14/06/19 | | |
| Assumptions: - | | |

Table 7.0.27: Activity 4.1.1.1. attributes

| | | |
|--|---|---|
| WBS-ID: 4.1.1.2. | | Activity: Development |
| Description of Work: Development of the payload preliminary design. | | |
| Predecessors: 4.1.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 5 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload preliminary design: 14/06/19 Due date Milestone Payload preliminary design 14/06/19 | | |
| Assumptions: - | | |

Table 7.0.28: Activity 4.1.1.2. attributes

| | | |
|--|---|---|
| WBS-ID: 4.1.2.1. | | Activity: Development of physical framework for sensor blocks |
| Description of Work: Modular system preliminary design and development of physical framework for sensor block. | | |
| Predecessors: 4.1.1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system preliminary design: 06/09/19 Due date Milestone Modular system preliminary design: 06/09/19 | | |
| Assumptions: - | | |

Table 7.0.29: Activity 4.1.2.1. attributes

| | | |
|--|---|---|
| WBS-ID: 4.1.2.2. | | Activity: Development of systems interaction and applications |
| Description of Work: Modular system preliminary design and development of systems interactions and applications. | | |
| Predecessors: 4.1.1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system preliminary design: 06/09/19 Due date Milestone Modular system preliminary design: 06/09/19 | | |
| Assumptions: - | | |

Table 7.0.30: Activity 4.1.2.2. attributes

| | | |
|--|---|---|
| WBS-ID: 4.1.2.3. | | Activity: Development of sensors data fusion software |
| Description of Work: Modular system preliminary design and development of sensors data fusion software. | | |
| Predecessors: 4.1.2.2. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system preliminary design: 06/09/19 Due date Milestone Modular system preliminary design: 06/09/19 | | |
| Assumptions: - | | |

Table 7.0.31: Activity 4.1.2.3. attributes

| | | |
|---|---|---|
| WBS-ID: 4.1.2.4. | | Activity: Definition of SATCOM applications domains |
| Description of Work: Modular system preliminary design and definition of SATCOM application domains. | | |
| Predecessors: 4.1.2.3. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system preliminary design: 06/09/19 Due date Milestone Modular system preliminary design: 06/09/19 | | |
| Assumptions: - | | |

Table 7.0.32: Activity 4.1.2.4. attributes

| | | |
|---|---|---|
| WBS-ID: 4.1.3.1. | | Activity: Implement web-based servers for sharing sensors data |
| Description of Work: Preliminary design of the interaction platform. Implement web-based servers for sharing sensors data. | | |
| Predecessors: 4.1.2.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform preliminary design: 29/11/19 Due date Milestone Interaction platform preliminary design: 29/11/19 | | |
| Assumptions: - | | |

Table 7.0.33: Activity 4.1.3.1. attributes

| | | |
|---|---|---|
| WBS-ID: 4.1.3.2. | | Activity: Implement processing algorithms based on applications |
| Description of Work: Preliminary design of the interaction platform. Implement processing algorithms based on applications. | | |
| Predecessors: 4.1.2.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform preliminary design: 29/11/19 Due date Milestone Interaction platform preliminary design: 29/11/19 | | |
| Assumptions: - | | |

Table 7.0.34: Activity 4.1.3.2. attributes

| | | |
|---|---|---|
| WBS-ID: 4.1.3.3. | | Activity: Pre-design a full services stakeholders platform |
| Description of Work: Pre-design of interaction platform. | | |
| Predecessors: 4.1.3.1. 4.1.3.2. | Relationship: FS FS | Lag: 0 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform preliminary design: 29/11/19 Due date Milestone Interaction platform preliminary design: 29/11/19 | | |
| Assumptions: - | | |

Table 7.0.35: Activity 4.1.3.3. attributes

| | | |
|--|---|---|
| WBS-ID: 4.2.1.1. | | Activity: Sensors final design |
| Description of Work: Final design of the payload sensor. | | |
| Predecessors: 4.1.1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 5 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload final design: 12/06/20 Due date Milestone Payload final design: 12/06/20 | | |
| Assumptions: - | | |

Table 7.0.36: Activity 4.2.1.1. attributes

| | | |
|--|---|---|
| WBS-ID: 4.2.1.2. | | Activity: Sensors final technical specifications |
| Description of Work: Final decision of the technical specifications of the payload sensor. | | |
| Predecessors: 4.2.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Airbus Defence and Space GmbH, Deimos Space S.L.U, Thales Alenia Space S.A.S and HIRO | | |
| Constraints: Due date Deliverable Payload final design: 12/06/20 Due date Milestone Payload final design: 12/06/20 | | |
| Assumptions: - | | |

Table 7.0.37: Activity 4.2.1.2. attributes

| | | |
|--|---|---|
| WBS-ID: 4.2.2.1. | | Activity: Modular system final design |
| Description of Work: Final design of the modular system. | | |
| Predecessors: 4.1.2.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system final design: 04/09/20 Due date Deliverable Sensor data fusion software report: 04/09/20 Due date Milestone Modular system final design: 04/09/20 | | |
| Assumptions: - | | |

Table 7.0.38: Activity 4.2.2.1. attributes

| | | |
|--|---|---|
| WBS-ID: 4.2.2.2. | | Activity: Sensors data fusion software final design |
| Description of Work: Final design of the modular system, specifically of the sensor data fusion software. | | |
| Predecessors: 4.1.2.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system final design: 04/09/20 Due date Deliverable Sensor data fusion software report: 04/09/20 Due date Milestone Modular system final design: 04/09/20 | | |
| Assumptions: - | | |

Table 7.0.39: Activity 4.2.2.2. attributes

| | | |
|--|---|---|
| WBS-ID: 4.2.2.3. | | Activity: Modular system final technical specifications |
| Description of Work: Final decision of technical specifications of the modular system. | | |
| Predecessors: 4.2.2.1. 4.2.2.2. | Relationship: FS FS | Lag: 0 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 System development engineer (senior) 2 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub 1 Solidworks |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Modular system final design: 04/09/20 Due date Deliverable Sensor data fusion software report: 04/09/20 Due date Milestone Modular system final design: 04/09/20 | | |
| Assumptions: - | | |

Table 7.0.40: Activity 4.2.2.3. attributes

| | | |
|---|---|---|
| WBS-ID: 4.2.3.1. | | Activity: Web based servers for data sharing final implementation |
| Description of Work: Final design and implementation of the interaction platform, specifically the web servers for data sharing. | | |
| Predecessors: 4.1.3.0. | Relationship: FF | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform final design: 27/11/20 Due date Deliverable Data processing software report: 27/11/20 Due date Milestone Interaction platform final design: 27/11/20 | | |
| Assumptions: - | | |

Table 7.0.41: Activity 4.2.3.1. attributes

| | | |
|---|---|---|
| WBS-ID: 4.2.3.2. | | Activity: Processing algorithms based on applications final design |
| Description of Work: Final design and implementation of the interaction platform, specifically the processing algorithms. | | |
| Predecessors: 4.1.3.0. | Relationship: FF | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform final design: 27/11/20 Due date Deliverable Data processing software report: 27/11/20 Due date Milestone Interaction platform final design: 27/11/20 | | |
| Assumptions: - | | |

Table 7.0.42: Activity 4.2.3.2. attributes

| | | |
|---|---|---|
| WBS-ID: 4.2.3.3 | | Activity: Full services stakeholders platform implementation |
| Description of Work: Final design and implementation of the interaction platform. | | |
| Predecessors: 4.2.3.1. | Relationship: FF | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Development centre 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform final design: 27/11/20 Due date Deliverable Data processing software report: 27/11/20 Due date Milestone Interaction platform final design: 27/11/20 | | |
| Assumptions: - | | |

Table 7.0.43: Activity 4.2.3.3. attributes

| | | |
|---|---|---|
| WBS-ID: 4.2.3.4. | | Activity: Final technical specifications |
| Description of Work: Decision of the final technical specifications of the interaction (stakeholders) platform. | | |
| Predecessors: 4.2.3.3. | Relationship: FF | Lag: 0 |
| Number and Type of Resources Required: 1 Technical Manager 1 Research and development assessor 1 Application development manager 2 Application development engineer (average) 2 Application development engineer (junior) | Skill Requirements: Average Senior Junior | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 GitHub 1 PostgreSQL |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: ICUBE-SERTIT, VITO nv, ReSAC and HIRO | | |
| Constraints: Due date Deliverable Interaction platform final design: 27/11/20 Due date Deliverable Data processing software report: 27/11/20 Due date Milestone Interaction platform final design: 27/11/20 | | |
| Assumptions: - | | |

Table 7.0.44: Activity 4.2.3.4. attributes

| | | |
|---|---|--|
| WBS-ID: 5.1.1. | | Activity: Manufacturing of payload sensors |
| Description of Work: Manufacturing of the sensors of the prototype, in order to be tested in the following activities. | | |
| Predecessors: 4.2.1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Junior | Other Required Resources: 1 Development centre 1 Payload building block |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Milestone Prototype manufacturing: 16/04/21 | | |
| Assumptions: - | | |

Table 7.0.45: Activity 5.1.1. attributes

| | | |
|---|---|--|
| WBS-ID: 5.1.2. | | Activity: Manufacturing of modular system |
| Description of Work: Manufacturing of the module of the prototype, in order to be tested in the following activities. | | |
| Predecessors: 4.2.2.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 System development engineer (average) 2 System development engineer (junior) | Skill Requirements: Average Junior | Other Required Resources: 1 Development centre 1 Hardware support system 1 Sensor interface 1 Controllers 1 Memory modules |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Milestone Prototype manufacturing: 16/04/21 | | |
| Assumptions: - | | |

Table 7.0.46: Activity 5.1.2. attributes

| | | |
|--|---|--|
| WBS-ID: 5.1.3. | | Activity: Implementation of interaction platform |
| Description of Work: Manufacturing of the interaction platform of the prototype, in order to be tested in the following activities. | | |
| Predecessors: 4.2.3.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Application development technician (average) 2 Application development technician (junior) | Skill Requirements: Average Junior | Other Required Resources: 1 Development centre 1 Hosting package 1 Backup system |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Milestone Prototype manufacturing: 16/04/21 | | |
| Assumptions: - | | |

Table 7.0.47: Activity 5.1.3. attributes

| | | |
|--|---|--|
| WBS-ID: 5.2. | | Activity: Payload validation |
| Description of Work: Validation of the performance of the sensors mounted on the system. | | |
| Predecessors: 5.1.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 System testing engineer (senior) 1 System testing engineer (average) 2 System testing engineer (junior) | Skill Requirements: Senior Average Junior | Other Required Resources: 5 Testing room 1 Payload building block |
| Type of Effort: Fixed duration. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Validation: 11/06/21 Due date Milestone Individual systems testing: 09/07/21 | | |
| Assumptions: - | | |

Table 7.0.48: Activity 5.2. attributes

| | | |
|---|---|--|
| WBS-ID: 5.3. | | Activity: Modular system validation |
| Description of Work: Validation of the modular system performance, of the systems interaction, of the sensors' data fusion software, of the satellite communications applications domains and also of the physical framework for sensor blocks. | | |
| Predecessors: 5.1.2. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 System testing engineer (senior) 1 System testing engineer (average) 2 System testing engineer (junior) | Skill Requirements: Senior Average Junior | Other Required Resources: 1 Testing room 1 Hardware support system 1 Sensor interface 1 Controllers 1 Memory modules |
| Type of Effort: Fixed duration. | | |
| Location of Performance: Facilities of: Thales Alenia Space S.A.S, Airbus Defence and Space GmbH, Deimos Space S.L.U and HIRO | | |
| Constraints: Due date Deliverable Validation: 25/06/21 Due date Milestone Individual systems testing: 09/07/21 | | |
| Assumptions: - | | |

Table 7.0.49: Activity 5.3. attributes

| | | |
|--|---|--|
| WBS-ID: 5.4. | | Activity: Interaction platform validation |
| Description of Work: Validation of the interaction platform to check if it develops all its functions properly. | | |
| Predecessors: 5.1.3. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Application development manager 1 Application development technician (average) | Skill Requirements: Senior Average | Other Required Resources: 1 Testing room 1 Hosting package 1 Backup system |
| Type of Effort: Fixed duration. | | |
| Location of Performance: Facilities of: ReSAC, HIRO, VITO nv and ICUBE-SERTIT | | |
| Constraints: Due date Deliverable Validation: 18/06/21 Due date Milestone Individual systems testing: 09/07/21 | | |
| Assumptions: - | | |

Table 7.0.50: Activity 5.4. attributes

| | | |
|---|---------------------------------------|--|
| WBS-ID: 5.5. | | Activity: Full system prototype validation |
| Description of Work: Validation of the whole system using the prototype in order to test its performance. | | |
| Predecessors: 5.01. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 2 System testing engineer (average) 2 Application development technician (average) 2 System development engineer (average) | Skill Requirements: Average | Other Required Resources: 1 Testing room 1 Payload building block 1 Hardware support system 1 Sensor interface 1 Controllers 1 Memory modules 1 Hosting package 1 Backup system |
| Type of Effort: Fixed duration. | | |
| Location of Performance: Facilities of: HIRO, Airbus Defence and Space GmbH, Thales Alenia Space and ReSAC | | |
| Constraints: Due date Deliverable Validation: 29/10/21 Due date Deliverable Final report: 21/01/22 Due date Milestone Full system testing: 29/10/21 | | |
| Assumptions: - | | |

Table 7.0.51: Activity 5.5. attributes

| | | |
|--|---|--|
| WBS-ID: 5.6. | | Activity: Quality of the product |
| Description of Work: Quality control of all the subsystems of the product and all the methodologies applied on its manufacturing and validation. | | |
| Predecessors: 5.02. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Quality Manager 1 Quality Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Quality laboratory 1 Payload building block 1 Hardware support system 1 Sensor interface 1 Controllers 1 Memory modules 1 Hosting package 1 Backup system |
| Type of Effort: Fixed amount of work. | | |
| Location of Performance: Facilities of: HIRO, Airbus Defence and Space GmbH, Thales Alenia Space and ReSAC | | |
| Constraints: Due date Deliverable Validation: 21/01/22 Due date Deliverable Final report: 21/01/22 | | |
| Assumptions: - | | |

Table 7.0.52: Activity 5.6. attributes

| | | |
|---|---|--|
| WBS-ID: 6.1.1. | | Activity: Study of stakeholders |
| Description of Work: Study of the possible companies interested on the project. | | |
| Predecessors: 0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Legal and Business Assessor 1 Stakeholders and Procurement Manager 2 Stakeholders and Procurement Assessor | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: BHO Legal Rechtsanwälte Partnership and HIRO | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.53: Activity 6.1.1. attributes

| | | |
|---|---|--|
| WBS-ID: 6.1.2. | | Activity: Procurement conditions negotiation |
| Description of Work: Negotiation of the conditions of the procurement of the resources. | | |
| Predecessors: 0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Legal and Business Assessor 1 Stakeholders and Procurement Manager 2 Stakeholders and Procurement Assessor | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: BHO Legal Rechtsanwälte Partnership and HIRO | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.54: Activity 6.1.2. attributes

| | | |
|---|---|--|
| WBS-ID: 6.1.3. | | Activity: Resources purchase |
| Description of Work: Purchase of the resources required for the project. | | |
| Predecessors: 0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Legal and Business Assessor 1 Financial Manager 1 Financial Manager Assessor | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: BHO Legal Rechtsanwälte Partnership and HIRO | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.55: Activity 6.1.3. attributes

| | | |
|---|---|---|
| WBS-ID: 6.2. | | Activity: Exploitation and business plans |
| Description of Work: Business plan of the product to exploit its economic potential. | | |
| Predecessors: 6.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Legal and Business Assessor 1 Financial Manager 2 Financial Manager Assessor 1 Stakeholders and Procurement Manager | Skill Requirements: Average Senior | Other Required Resources: 1 Office 1 Microsoft Office 1 GitHub 1 Live Plan |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: BHO Legal Rechtsanwälte Partnership and HIRO | | |
| Constraints: Due date Deliverable Business plan: 05/10/18 Due date Milestone Business plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.56: Activity 6.2. attributes

| | | |
|--|---|---|
| WBS-ID: 7.1. | | Activity: Dissemination and communication plan |
| Description of Work: Definition of the strategies planned to the dissemination of the final product. | | |
| Predecessors: 0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 LaTeX 1 Github |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 05/10/18 Due date Milestone Communication plan: 05/10/18 | | |
| Assumptions: - | | |

Table 7.0.57: Activity 7.1. attributes

| | | |
|--|---|---|
| WBS-ID: 7.2.1. | | Activity: Web site development |
| Description of Work: Development of the web site to promote the product. | | |
| Predecessors: 7.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Wix |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.58: Activity 7.2.1. attributes

| | | |
|--|---|--|
| WBS-ID: 7.2.2. | | Activity: Social media management |
| Description of Work: Management of the social media used in the dissemination plan of the project. | | |
| Predecessors: 7.2.1. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.59: Activity 7.2.2. attributes

| | | |
|--|---|--|
| WBS-ID: 7.3.1. | | Activity: Conferences |
| Description of Work: Attendance to conferences in order to disseminate to possible stakeholders the product. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Conference Hall 1 Jitsi |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.60: Activity 7.3.1. attributes

| | | |
|--|---|--|
| WBS-ID: 7.3.2. | | Activity: Meetings |
| Description of Work: Meetings to promote the product inside the market. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Meeting room |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.61: Activity 7.3.2. attributes

| | | |
|--|---|---|
| WBS-ID: 7.4.1. | | Activity: Technology demonstrators |
| Description of Work: Production of technology demonstrators needed to the dissemination of the product. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Development centre 1 Microsoft Office 1 Final Cut Pro |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.62: Activity 7.4.1. attributes

| | | |
|--|---|---|
| WBS-ID: 7.4.2. | | Activity: Audio visual material production |
| Description of Work: Production of all the visual material needed to the promotion of the product. | | |
| Predecessors: 1.0. | Relationship: FS | Lag: 0 |
| Number and Type of Resources Required: 1 Marketing and Communications Manager 2 Marketing and Communications Manager Assessor | Skill Requirements: Senior Average | Other Required Resources: 1 Office 1 Microsoft Office 1 Final Cut Pro |
| Type of Effort: Fixed amount of effort. | | |
| Location of Performance: Facilities of: HIRO | | |
| Constraints: Due date Deliverable Communication plan: 21/01/22 Due date Milestone Communication plan: 21/01/22 | | |
| Assumptions: All partners should provide information and be able to collaborate for communication and dissemination purposes. | | |

Table 7.0.63: Activity 7.4.2. attributes

8 | Cost estimating

8.1 Level of accuracy

According to the resource identification, the different positions from different resources have been rearranged in three groups in order to be more efficient when estimating the personnel costs. The three groups are: senior employees, average employees and junior employees. This classification is based in a Robert Walters consulting study [1] which shows that most of the manager positions are occupied by senior employees, while secretary positions and assessor positions are mostly occupied by average and junior employees respectively. By doing this three-group classification, the cost-estimating process has been highly simplified without compromising its precision. The cost associated to each of these groups has also been extracted from the aforementioned study, more specifically, an average salary from many different European countries has been selected since the project is to be developed at a European extent.

Software costs have been calculated according to the official price given by the developer (in price per user, price per month or price per license). In some cases, where different pricing plans can apply when acquiring the license, the middle cost option has been considered.

When it comes to facilities cost estimation (offices, meeting rooms, research laboratories, etc.), a deep research in real estate and specialized pricing has provided an approximation to what the costs of renting and/or owning the different facilities will be.

The next section contains full detail of what the costs per activity are as well as the number of resources needed by every single one of them.

9 | Cumulative costs

9.1 Cumulative cost curve

The cumulative cost curve shows the added costs of the project along its duration. The following graph has been done taking into account the daily salary of the workers as well as the daily cost of the facilities. Two main steps can be appreciated which represents the investment in hardware in order to do the prototypes and the validations. Moreover, notice that by day 1 the costs are of around 42000€, which represent the initial expenses to pay the software of the project.

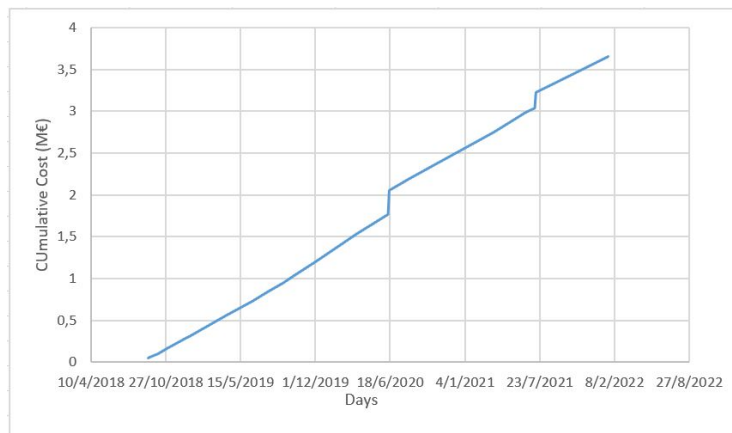


Figure 9.1.1: Cumulative Cost Cuver over time [2].

The information that this curve gives is crucial in order to be able to schedule the project cash flow. Indeed, it is a perfect reference to avoid budget overrun along the follow up of the project. Finally, budget at completion, as indicated before is estimated to be around 3.65M€.

9.2 Budget at completion

Next, it is shown the budget at completion and its distribution according to the typology of the tasks to which it is destined. A distinction between four types of tasks is done: project management tasks, quality and administration tasks, development tasks and commercial tasks.

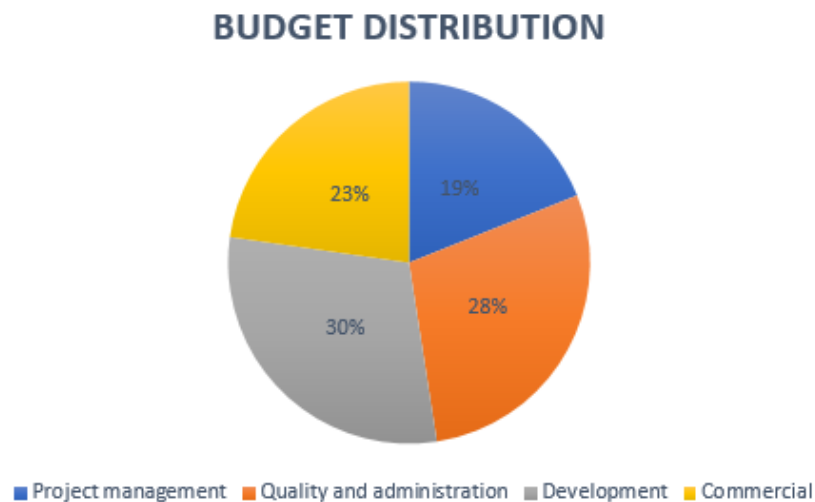


Figure 9.2.1: Budget distribution.

Despite allocating most of the budget to the development of the product, it can be seen that the difference in the cost of other types of tasks is not very large. This shows once again that in a project the product itself is not everything, but it is necessary to cover expenses of all kinds that are not related to the technical part.

10 | Bibliography

- [1] SALARY SURVEY 2018 EUROPE.
- [2] Workfront. The 6 Project Constraints, 2017.