



Project DEOS-UD

Disruptive Earth Observation Sensing for Urban Development

Deliverable 2

Scope, Time and Cost Management

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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
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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.

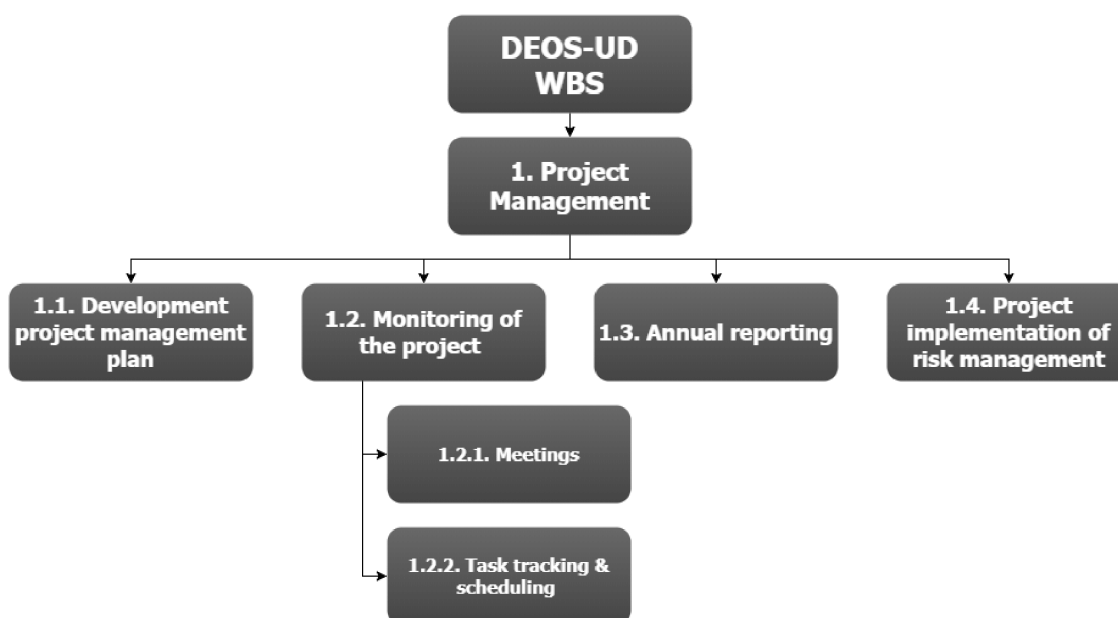


Figure 2.0.1: Project management breakdown diagram.



Figure 2.0.2: Quality and administration breakdown diagram.



Figure 2.0.3: State of the art breakdown diagram.

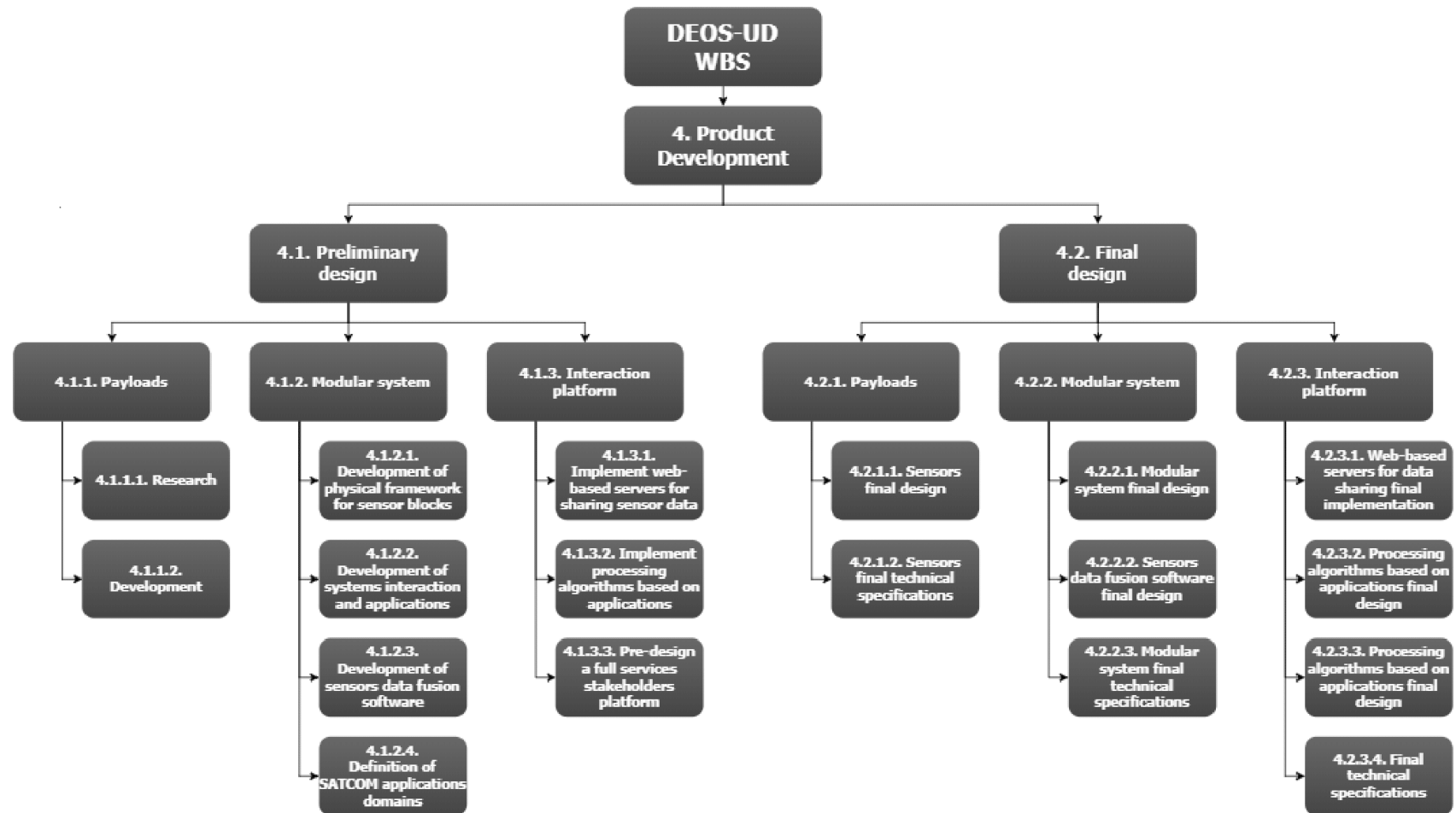


Figure 2.0.4: Product development breakdown diagram.

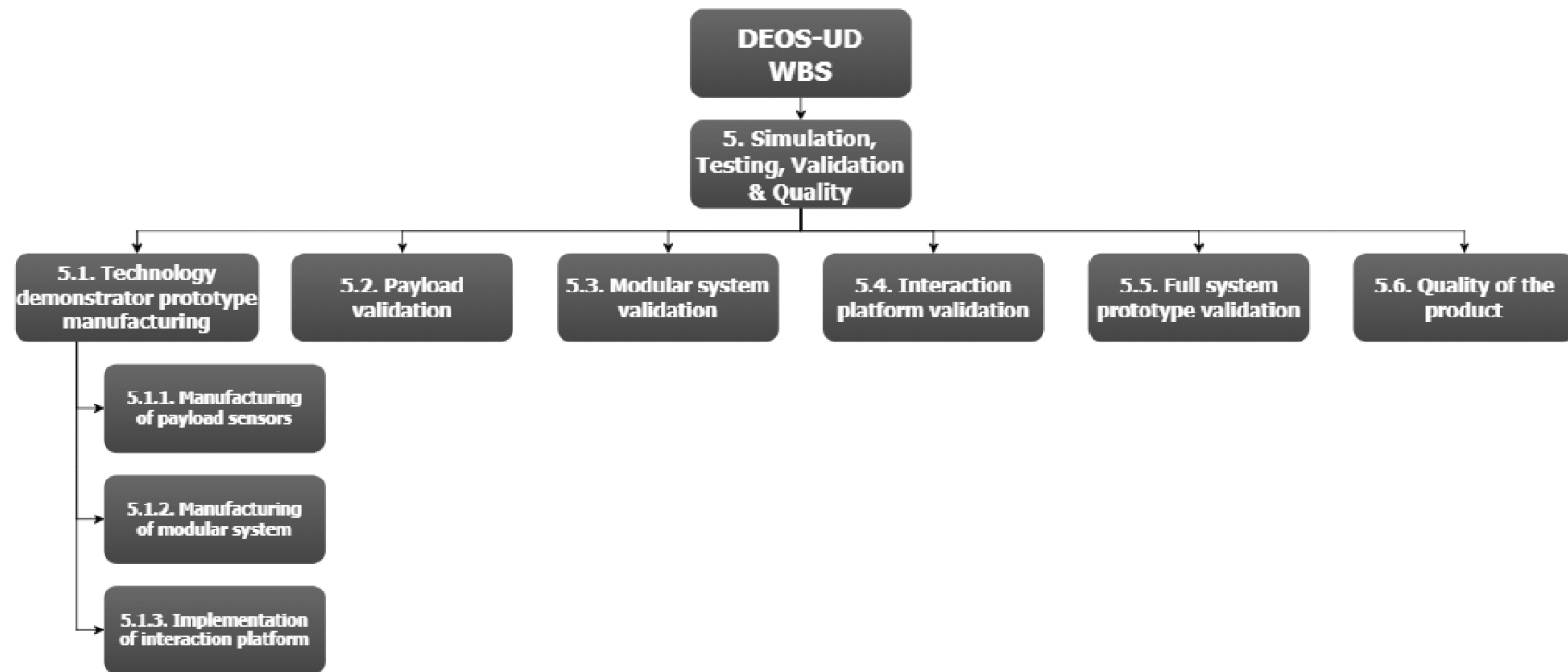


Figure 2.0.5: Simulation, testing, validation and quality breakdown diagram.



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.	FS	26 months
		4.2.2.3.	FF	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.	FS	0
		4.2.2.2.	FS	0
4.2.3.0.	Interaction platform final design	0.	FS	29 months
		4.2.3.4.	FF	0
		4.2.3.2.	FF	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.	FF	0
		5.1.2.	FF	0
		5.1.3.	FF	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.

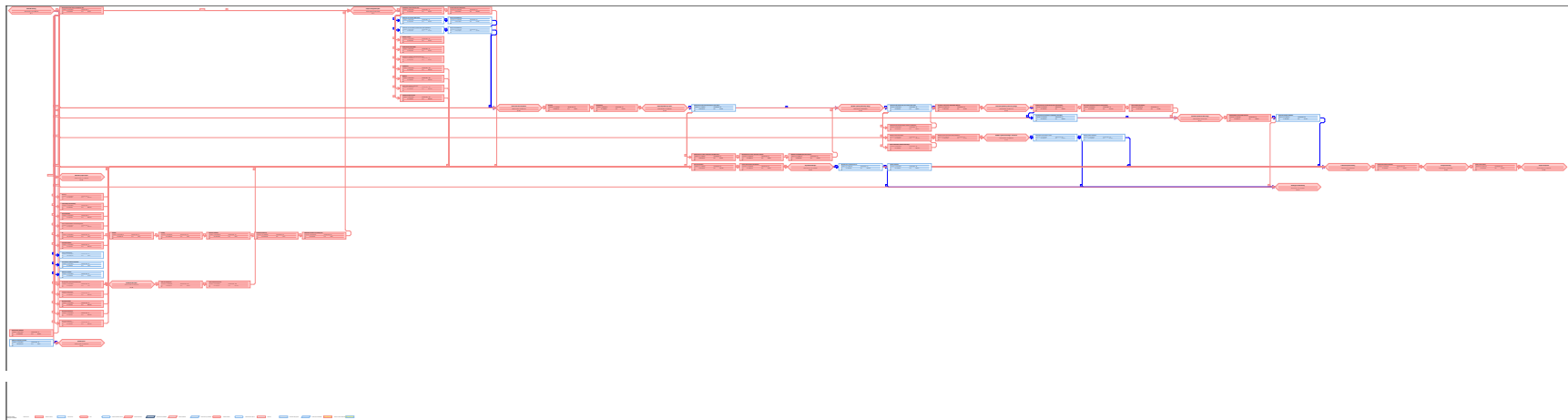


Figure 3.2.1: Network Precedence Method chart with full detail modules.



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

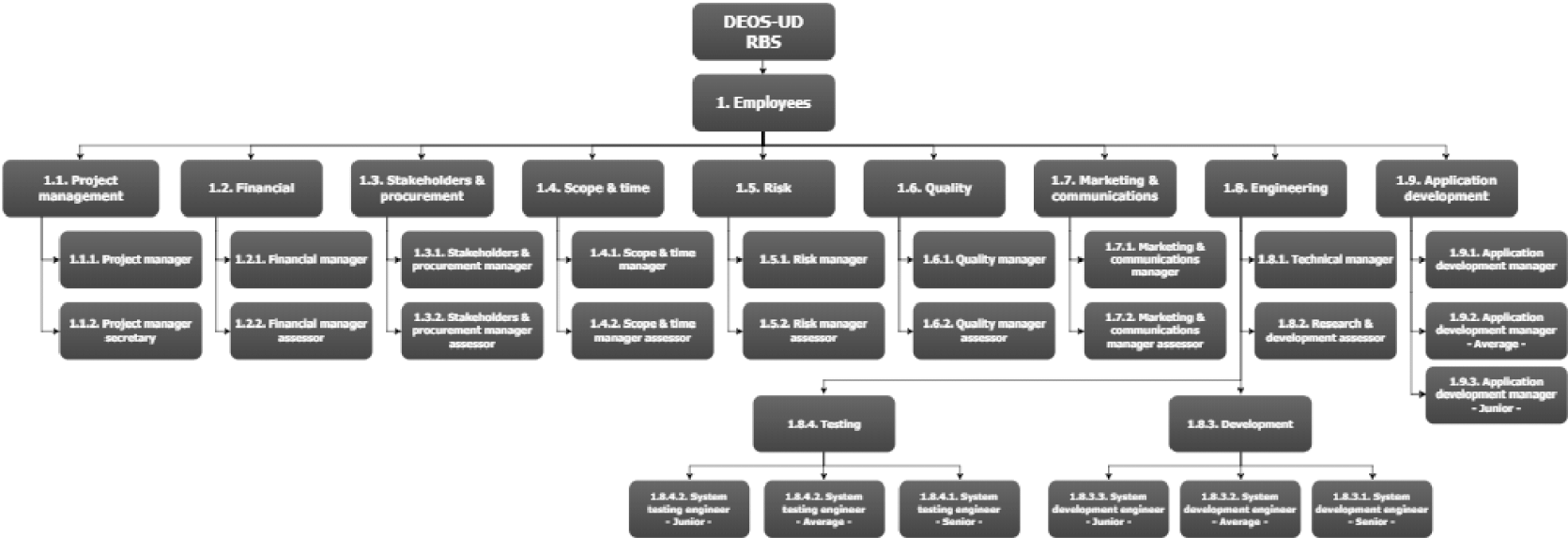


Figure 4.3.1: Employees resource breakdown diagram.

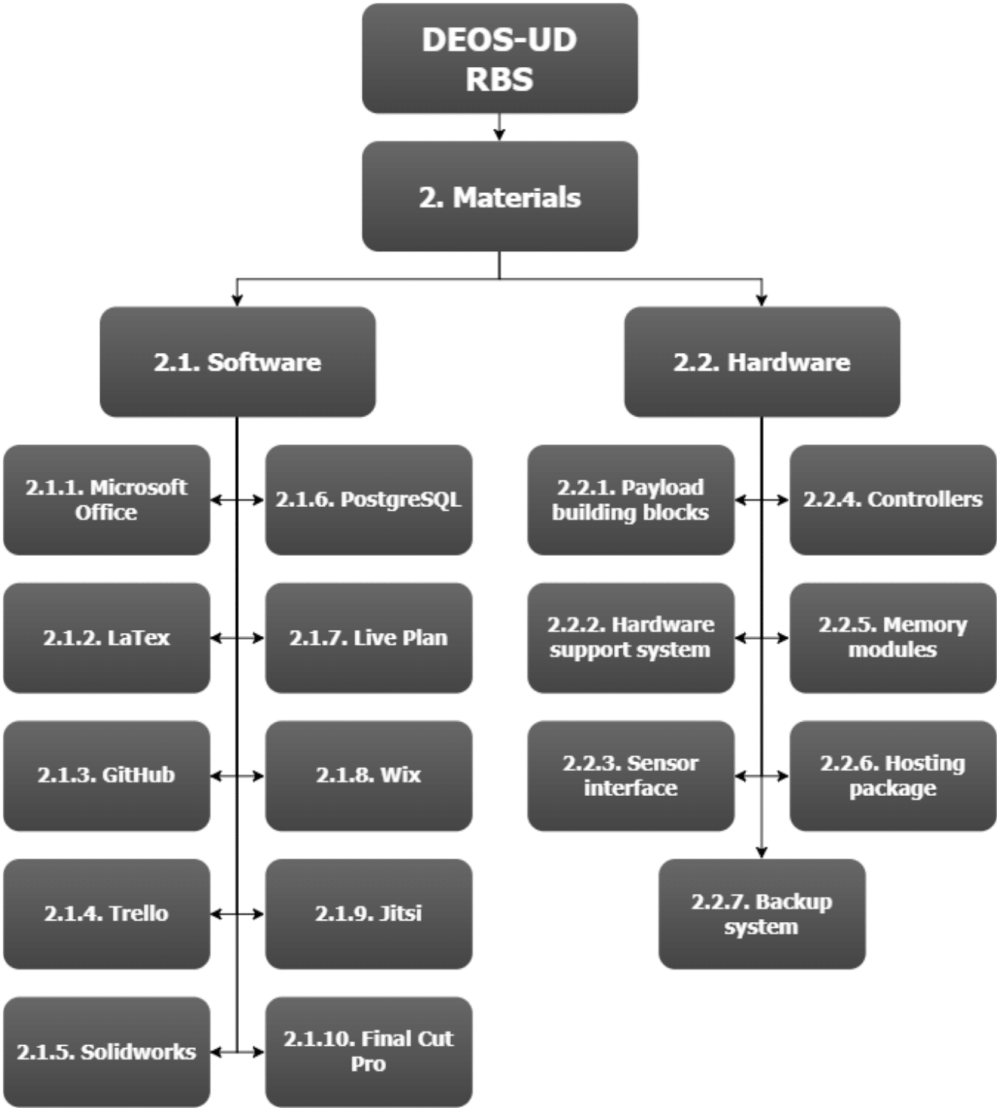


Figure 4.3.2: Materials resource breakdown diagram.



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

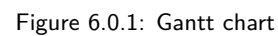
Three Point Estimates					
WBS-ID	Optimistic Duration	Most Likely Duration	Pessimistic Duration	Weighting Equation	Expected Duration Estimate
3.1.1.	20	30	40	$(o+4m+p)/6$	30
3.1.2.	15	23	40	$(o+4m+p)/6$	25
3.2.1.	20	24	35	$(o+4m+p)/6$	25
3.2.2.	22	28	45	$(o+4m+p)/6$	30
3.3.1.	15	18	30	$(o+4m+p)/6$	20
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.



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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 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 Final report: 21/01/22 Due date Milestone Project completion: 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 Final report: 21/01/22 Due date Milestone Project completion: 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 Final report: 21/01/22 Due date Milestone Project completion: 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 Final report: 21/01/22 Due date Milestone Project completion: 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 Final report: 21/01/22 Due date Milestone Project completion: 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 Final report: 21/01/22 Due date Milestone Project completion: 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.

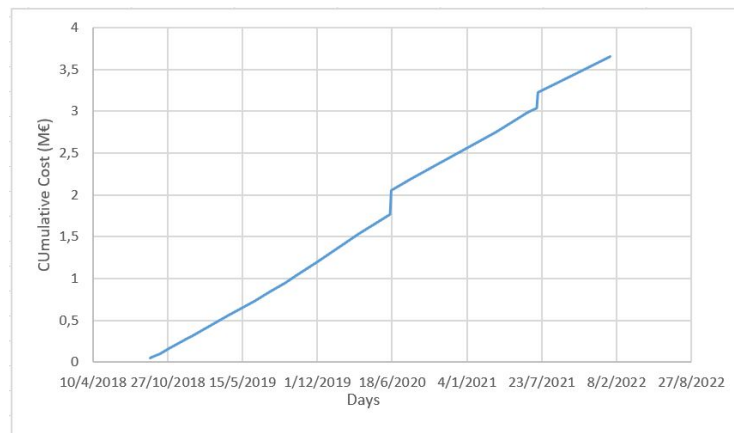


Figure 9.1.1: Cumulative Cost Cuver over time [2].

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.

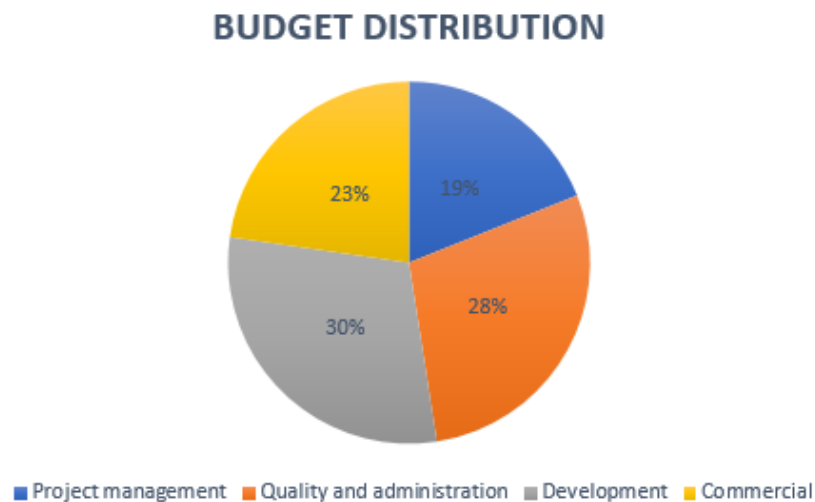


Figure 9.2.1: Budget distribution.

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.