UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Departament de Projectes d'Enginyeria

EARTH CLIMATE CHANGE OBSERVATION

Project Management Plan

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Group 02 – 220310 PM – P22015

HORIZON 2020
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

ecco

In this document the Project Management Plan for the Earth Climate Change Observation project is presented.

The ECCO Project Management Plan consists of the following parts:

Contents of the ECCO PMP

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

Project Introduction

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1. Project Purpose and Justification

Nowadays we live in an industrial society which requires large amounts of resources in order to be sustainable, resulting in a global contamination of the atmosphere and oceans. It has been demonstrated that over the centuries climate changes have been produced, but today, the question is how humans are taking part of it. This impact is known as global warming and has been one of the strategic priorities for the European Union. Some initiatives have been taken by the European Union to transform Europe to a highly energy-efficient economy, reducing emissions (specified on Kyoto Protocol) and specifying targets up to 2050. In the last years, different programs have sent satellites to analyse and transmit data to study and control human impact, like A-Train constellation by NASA and JAXA or Copernicus programme (in development by the European Union).

For this purpose, we present a new revolutionary design of fractioned satellite, joining the potential of upgradability and reliability, to acquire relevant information about global warming. Fractionated satellites use the new wireless technology to transfer information and power through different modules, each one with a specific sensor. This system improves flexibility to launch independent modules (with a specific function) to upgrade or change an operative module, reducing costs and introducing the maintenance concept to satellites, increasing the useful life of the overall satellite.

Figure 1. Example of fractionated satellite of system F6 from Darpa

All the information captured would be useful to check the targets specified by the European Union for the next years, be aware of climate evolution and be able to contrast information with other programmes like Copernicus.

2. Vision

Our vision is to be the worldwide leaders in acquiring relevant information about global warming and to be the tool to improve global economic efficiency and achieve a sustainable development of the world.

3. Objectives

The key objectives for this project are:

- Develop a new system to enable and control the communication between each module, and the ground station.
- Use the advantages of fractionated satellites in order to improve robustness and reliability, developing new technology related to upgradability.
- Create new software to control the formation of the constellation, in order to avoid collisions and keep all modules in a specific range.
- Develop simulation software to test and validate software related to navigation control and data transmission.
- Design an innovative power transmission system that increases the power transfer efficiency.
- Set an incremental deployment of modules to be connected to the infrastructure module, reducing update and maintenance costs and allowing better flexibility for future projects.

Table 1. Project objectives, success criteria and approval

Project Objectives	Success Criteria	Approval Responsible
Scope		
Navigation, Control and Communication between payload satellites and the main satellite	It will be a success if the sub-satellites are connected and they work properly with the main satellite.	Project Manager
Time		
3 years and 1 month	It has been determined that 2 years' time will be a good approximation for the development of this project.	Project Manager
Cost		
4.1 Million Euros	It will be delivered 4.1 million euros in order to prove that this project new technology works.	Administration Services Manager
Quality		
Organization Planning Detailing	The project will be highly focused on presenting a good quality presentation as well as useful and important content information.	Quality Responsible indicated in: Document: Quality and Risk Table number 1

4. Scope

The scope for this project is to:

- Design a system to establish communication between satellite and ground station, as well as gather information of module attitude and condition.
- Develop the software to control formation flying, interfacing between modules and sub-systems of each module.
- Create software able to simulate and verify the interface created between the modules to control navigation and communication.
- Develop a new way to use existing sensors in order to get more relevant data, including three dimensional mapping of atmosphere, ocean, ground and demography.
- Design an innovative system of power generation and transmission to reduce losses and a revolutionary interface to enable real-time communication between modules to command navigation and attitude control.

The following items are considered to be out of the scope of this project:

- Development of complete module prototypes.
- Design the satellite launch system.
- Design or manufacturing rockets for attitude and navigation control.
- Sensor design.
- Study and design long-range satellite-satellite communication.
- Design and construction of ground infrastructures needed to enable ground-satellite communication.
- Post-processing data software development.
- Physical creation of the final satellite.

5. Project Description

Throughout the necessity to study the impact of the global warming of the earth, constellations of satellites have been sent over the last years with the latest technology applied on sensors and communications. One example is the A-Train constellation, designed and launched by NASA and JAXA, which is composed by six satellites where each one has a specific role into the constellation. Since 2002 (when the first satellite was deployed), an improvement in technology has been done, and new sensors have been developed. Due to the difficulty of access to systems that are in space, there are no possibilities of maintaining or upgrading the actual satellites, making necessary to send an entire satellite to improve the sensors or to restore lost functionalities, assuming the high costs of it.

The aim of this project is to create a constellation of instruments for tracking information related to global warming, and using the new concept of fractionated satellite to enable upgradability and maintainability by modules exchanging. It means taking advantage of work with a modular satellite to replace only one module, reducing costs of launchings and enable the capacity to upgrade specific sensors. In order to achieve the objectives, control systems must be designed and improved. Few modules must be used to control the constellation behaviour, for instance the formation of all modules to avoid collisions and keep them all into a specific range, the communication between them and ground station, and the power generation and its transmission. The results obtained through the development of the project could be applied to other satellites, taking the advantage of using fractionated designs and reducing costs related to investment.

The ultimate intended outcome of the project will be the successful testing of the hardware and software designed.

6. High-Level Requirements

The high-level requirements are:

- Satellites will be put into a low sun-synchronous orbit, to track information of the overall Earth.
- Use sensors to acquire properties of the atmosphere, including concentrations of ozone, chlorine, water vapour, CFCs and other trace gases.
- Use sensors to acquire information related to the ocean (for instance cloud distribution and precipitations, sea level temperature and ice and snow surface).
- Use sensors to acquire information related to ground, including deforestation, ground temperature, humidity, etc.
- Use sensors to acquire data about demography, including grow and dispersion of the population.

7. Acceptance Criteria

All documents must be approved before the final deliberation to ensure that objectives and scope are accomplished. The following acceptance criteria are defined to check the documents:

Table 2. Acceptance criteria for the documents

Acceptance Criteria	Condition to be Accepted
Research and Innovation	The project must be ambitious, has innovation potential and beyond the state of the art, including trans-disciplinary considerations.
Quality and Presentation	All documents must be done with the highest quality, presenting all the ideas, developments and conclusions linked, explained clearly. All documents must be printable.
Performance Requirements	The efficiency and functionality of all systems designed must be enough to realise all the objectives indicated and the purpose of the proposal too.
Technical Documentation	The documentation must be complete, specifying the development procedure, the final characteristics and the method to use the hardware and software developed.
Test and Validations	All tests and validations must be indicated and successfully passed using the available regulations. All this information must be correctly written, with all the modifications done to improve functionality and allow its verification (and of course the results of the tests and validations).

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

Stakeholders Identification

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1. Stakeholder Identification

1.1. Customers

The following customers are defined for this project:

Table 1. List of customers groups

Customer group	Customer representative
European Commission	Pierre Huguenet
ESA Earth Observation Market Development (EOMD)	Marie Tourant
Airbus Defense and Space	Mateo Sevilla
Greenpeace	Financial responsible Greenpeace Europe
Indra	Dolores Albiol
Spanish government	Spanish economy and competitively ministry
WWF	Financial responsible WWF Spain

1.2. Stakeholders

The following groups and organization are the key stakeholders in this project:

Table 2. List of stakeholders, roles and responsibilities

Stakeholder Name	Roles/Responsibilities
Airbus Defence & Space	Investor
Allianz	Potential future customer
Alstom	Potential future customer
Amptek	Collaborator
Angelantoni Test Technologies (ATT)	Collaborator
Ball Aerospace	Collaborator
Bulgarian Chamber of Commerce and Industry (BCCI)	Collaborator
Business Units	Employees
CHS	Potential future customer
Crandfield University	Collaborator
DELMAS	Potential future customer
Epistemática	Collaborator
ESA Earth Observation Market Development (EOMD)	Investor
E-TIS Euroconsultores	Collaborator
European Association of Remote Sensing Companies (EARSC)	Interested
European Commission	Main Investor

Stakeholder Name	Roles/Responsibilities
European Council	Regulators
European Envinronment Agency	Potential future customer
European Environment Information and Observation Network (EIONET)	Potential future customer
European Parliment	Regulators
Gamesa	Potential future customer
Gisat	Collaborator
Greenpeace	Investor
Indra	Investor
Member States	Potential future customer
Non-European Space Agencies	Competitor
Orbital ATK	Collaborator
Owners	Main Developer
PEPSICO	Potential future customer
Politechnic University of Catalonia	Collaborator
Politechnic University of Valencia	Collaborator
Satellitefinance	Interested
SENER, Ingeniería y Sistemas	Collaborator
SILVANET (UPM Agrónomos)	Collaborator
Spacenews	Interested
Spanish Government	Investor
Sspi	Interested
Surrey Satellite Technology ltd	Collaborator
Technical University of Stuttgart	Collaborator
University of Southampton	Collaborator
WWF	Investor
Zurich	Potential future customer

1.3. Roles and Responsibilities

The following key roles have been defined for this project:

Table 3. Roles and responsibilities

Role	Resource Name	Organization	Responsibilities
Responsible	Project Management department	ECCO	Manage the project
Responsible (Supervisor)	Administrative services department	ECCO	Supervise the department work
Responsible (Supervisor)	Dissemination department	ECCO	Supervise the department work
Responsible (Supervisor)	Partnerships and networks department	ECCO	Supervise the department work
Responsible (Technical Officer)	Engineering department	ECCO	Supervise the department work

Role	Resource Name	Organization	Responsibilities
Supplier	Payload department	Amptek	Required sensor supplier
Testing responsible	Testing and manufacturing department	Angelantoni Test Technologies (ATT)	Conduce tests with the prototype
Developer collaborator	Structures design department	Ball Aerospace	Collaborate in the design and testing of the modules
Supplier	Dissemination department	Bulgarian Chamber of Commerce and Industry (BCCI)	Dissemination of the project
Developer collaborator	Communication department	Crandfield University	Collaborate in the mentioned department
Supplier	Project Management department	E-TIS Euroconsultores	Collaborate in the mentioned department
Developer collaborator	Communication department	Orbital ATK	Power system supplier
Developer collaborator	Data management and processing department	Politechnic University of Catalonia	Collaborate in the mentioned department
Developer collaborator	Testing and manufacturing department	Politechnic University of Valencia	Collaborate in the mentioned department
Developer collaborator	Preliminary design department	SENER, Ingeniería y Sistemas	Collaborate in the mentioned department
Supplier	Payload department	SILVANET (UPM Agrónomos)	Collaborate in the mentioned department
Supplier	Payload department	Surrey Satellite Technology ltd	Collaborate in the mentioned department
Developer collaborator	Mission Design department	Technical University of Stuttgart	Collaborate in the design, built and test of a sensor
Developer collaborator	Communications department	University of Southampton	Required sensor supplier

1.4. Stakeholder Analysis Matrix

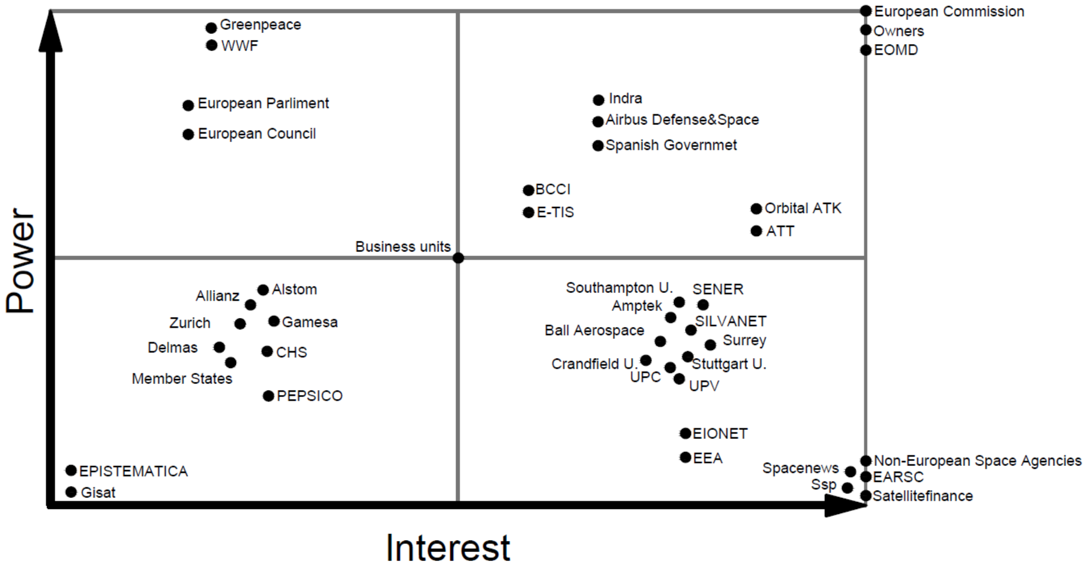

Figure 1. Stakeholder analysis matrix

In the next paragraph any stakeholder is classified according to their implication in the project success.

1.5. Stakeholder Register

In the following table is exposed the register of all the stakeholders of the project. In the table are detailed the expectations of any stakeholder with the project and their requirements from ECCO. Any mentioned stakeholder is classified according to their support of the project.

Table 4. Stakeholder register

Name	Position	Role	Contact Information	Requirements	Expectations	Influence	Classification
Airbus Defence & Space	-	Investor	Mateo Sevilla	Buy the new revolutionary satellite intercommunication technology	Develop a new revolutionary satellite intercommunication technology	Manage closely	Influencer
Allianz	-	Potential future customer	Cristian Tüsing	To be interested in our future products	Information about probability of a disaster, so they can increase the insurance cost in advanced	Monitor	Supporter
Alstom	-	Potential future customer	Pau Nualart	To be interested in our future products	Information about wind field so they can optimize their wind parks	Monitor	Neutral
Amptek	Payload department	Developer responsible	CEO of the company	Responsibility in the development of one of the payloads	Obtain expertise about the specific working area	Keep informed	Supporter
Angelantoni Test Technologies (ATT)	Testing and manufacturing department	Testing responsible	Cinzia Iacono	Partnership from the H2020 portal. Responsibility of testing of the prototype	Obtain expertise about the specific working area	Manage closely	Neutral
Ball Aerospace	Structures design department	Developer collaborator	Martin Kaufeler	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Influencer
Bulgarian Chamber of Commerce and Industry (BCCI)	Communications department	Subcontracted	Mariana Tanchena	Partnership from the H2020 portal. Communication and dissemination responsibilities		Manage closely	Supporter

Name	Position	Role	Contact Information	Requirements	Expectations	Influence	Classification
Business Units	Project teams	Employees	-	To do as much as they can for the project	To get recognition and salary	Manage closely	Internal
CHS	-	Potential future customer	David Scott	To be interested in our future products	Information about crop monitoring and water quality	Monitor	Resistor
Cranfield University	Mission design department	Developer collaborator	Simon Medley	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Influencer
DELMAS	-	Potential future customer	Willy Boat	To be interested in our future products	Information about oceanic currents for the optimization of the transportation by ship	Monitor	Neutral
Epistemática	-	Potential future collaborator	Luca Severini	To post process our data	Get part of benefit of the sales	Monitor	Supporter
ESA Earth Observation Market Development (EOMD)	-	Investor	Marie Tourant	Get 300.000 € of funding for research	To answer the topic of their specific call, which is also included in the current scope	Manage closely	Supporter
E-TIS Euroconsultores	Project Management department	Subcontracted	Juan Hernández	Partnership from the H2020 portal. Project management and quality responsibilities		Manage closely	Neutral
European Association of Remote Sensing Companies (EARSC)	-	Interested	Antoine Nessim	Ideas and opinion of the project evolution	Our failure, because we represent a strong competition to the companies inside the association	Keep informed	Blocker

Name	Position	Role	Contact Information	Requirements	Expectations	Influence	Classification
European Commission	-	Main Investor	Pierre Huguenet	Get 2.500.000 € of funding for research	The deliverables that were presented in the previous sections	Manage closely	Supporter
European Council	-	Regulators	Environmental concerns responsible	To provide the legal environment for the development of the project	Fulfil the regulations and laws	Keep satisfied	Resistor
European Envinronment Agency	-	Potential future customer	International cooperation responsible	To be interested in our future products	All kind of information regarding global warming and environment	Keep informed	Influencer
European Environment Information and Observation Network (EIONET)	-	Potential future customer	International cooperation responsible	To be interested in our future products	All kind of information regarding global warming and environment	Keep informed	Influencer
European Parliament	-	Regulators	International cooperation responsible	To provide the legal environment for the development of the project	Fulfil the regulations and laws	Keep satisfied	Resistor
Gamesa	-	Potential future customer	Francesc Bofill	To be interested in our future products	Information about wind field so they can optimize their wind parks	Monitor	Neutral
Gisat	-	Potential future collaborator	Anne Deschamps	To post process our data	Get part of benefit of the sales	Monitor	Resistor
Greenpeace	-	Investor	Finantial responsible Greenpeace Europe	Get 60.000 € of funding for research	A more eco-friendly earth	Keep satisfied	Supporter

Name	Position	Role	Contact Information	Requirements	Expectations	Influence	Classification
Indra	-	Investor	Dolores Albiol	Buy the fractionated satellite environment simulation	Develop a fractionated satellite environment simulation	Manage closely	Supporter
Member States	-	Potential future customer	Responsible from each country	To buy our products	Information about global warming, so they can measure their pollution and reduce it	Monitor	Neutral
Non-European Space Agencies	-	Competitor	Contact member for the Space Agency	Keeping track of our project	To keep updated about the project evolution	Keep informed	Blocker
Orbital ATK	Power generation department	Subcontracted	Daniel Humbolt	Collaborate in the design of a specific part of the project		Manage closely	Neutral
Owners	Owners	Main Developer	-	To do as much as they can for the project	To get recognition and a successful project	Manage closely	Internal
PEPSICO	-	Potential future customer	Manuel Park	To be interested in our future products	Information about probability of a disaster, so they can increase the insurance cost in advanced	Monitor	Neutral
Politechnic University of Catalonia	Data management and processing department	Developer collaborator	Enrique García Berro	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Supporter
Politechnic University of Valencia	Testing and manufacturing department	Developer collaborator	Ignacio Tortajada	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Supporter
Satellitefinance	-	Interested	Kazun Hiyou	Dissemination of the project	Get interesting information about project updates	Keep informed	Neutral

Name	Position	Role	Contact Information	Requirements	Expectations	Influence	Classification
SENER, Ingeniería y Sistemas	GNC and formation flying department	Developer collaborator	Iñigo Gurrea	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Supporter
SILVANET (UPM Agrónomos)	Payload department	Developer collaborator	José Antonio Manzanera	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Supporter
Spacenews	-	Interested	Salim Benadouda	Dissemination of the project	Get interesting information about project updates	Keep informed	Neutral
Spanish Government	-	Investor	Spanish economy and competitivity ministry	Get 120.000 € of funding for research	Justification of the expenditures of the budget they provide	Manage closely	Neutral
Sspi	-	Interested	Patrick O'neil	Dissemination of the project	Get interesting information about project updates	Keep informed	Neutral
Surrey Satellite Technology ltd	Payload department	Developer responsible	Pol Guixé	Responsibility in the development of one of the payloads	Obtain expertise about the specific working area	Keep informed	Influencer
Technical University of Stuttgart	Thermal control department	Developer collaborator	Dennis Hardenacke	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Influencer
University of Southampton	Intermodule communicatio ns department	Developer collaborator	Michael Woodbridge	Collaborate in the design of a specific part of the project	Obtain expertise about the specific working area	Keep informed	Influencer
WWF	-	Investor	Finantial responsible WWF Spain	Get 100.000 € of funding for research	A more eco-friendly earth	Keep satisfied	Supporter

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EARTH CLIMATE CHANGE OBSERVATION

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Scope and Time Management

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1. Project Scope Statement

1.1. Product Scope Description

A new revolutionary design of a constellation of fractionated satellites is proposed to help the European Community to raise awareness of global warming. While combining the best characteristics of the classical satellites, this new technology allows an unprecedented maintainability, scalability, flexibility and responsiveness among others that customers will appreciate. Before explaining the services that ECCO can provide, it is fundamental to explain why this new concept for satellites is far better than the traditional existing ones, and how it could change the future of space missions.

The main difference between traditional and fractionated satellite is the distribution of the payload and subsystems. In fractionated satellites all sub-systems are in an isolated module transmitting data and power by wireless methods, instead of being assembled together into a common structure. The most evident impact of using highly modular satellites is on the development of each module, due to the fact that modules can be developed, manufactured, integrated and tested in parallel because no highly inter-connections are needed. This allows a faster development of the satellite, and thus, a strategic strength for the company with respect to the competitors.

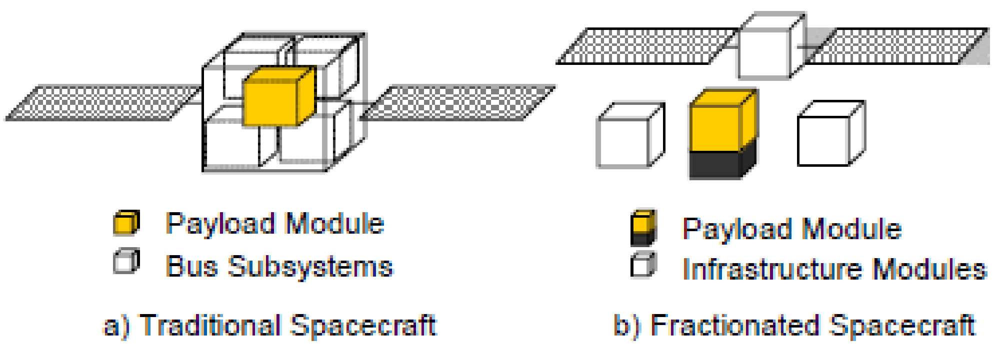


Figure 1. Traditional spacecraft versus fractionated spacecraft concepts from Fractionated Spacecraft Architectures Seeding Study

Moreover, the functional partitioning combined with the small size of modules allows reducing costs on designs and building cycles, sending leading technology to space without the high lags between design and launch. Also, an incremental deployment system leads to upgrading technology or simply to restore functionalities due to maintenance, taking profit of lower costs per module and the ease to put it into orbit due to its lower mass and volume. It must be emphasized that by using a highly modular satellite, an eventual failure of a module would not affect the others, increasing the overall robustness of the system.

There are two types of modules: infrastructure and payload modules. The payload modules include one instrument and the receptors for the communication with the infrastructure modules. The last ones are responsible for the data communication, guidance and navigation and power generation, among others.

The optimum number of infrastructure modules that will be used in the ECCO project has been obtained with the aim to minimize the overall weight of the satellite while maintaining the performance:

- Payload modules
- Communication an data handling
- Power unit supply
- Propulsion and navigation control

This configuration keeps fractionated satellite concept and join some similar sub-systems, for instance communication and data handling, or propulsion and navigation control, to reduce the overall mass. The Payload modules could be standardized, in terms of mass and power requirements, being able to launch small commercial modules with new necessities and exchange it in the future for an existing payload module, reusing the infrastructure modules. Moreover, the existence of different payload modules leads to acquire multiple data from the same objective, increasing precision of data and creating three-dimensional data maps, or from different objectives due to the different attitude control of each module. This is in fact an improvement in flexibility versus traditional satellites.

The specific sensors that ECCO will use cannot be completely specified in this phase of the project, however, there is a clear idea of the services that the ECCO satellites will be able to provide to the interested parts if the project is developed. Sensors would be integrated in three payload modules, each one containing only one of the following:

- Track temperature of the ground and ocean to determine the behaviour of the global temperature and be aware of climate changes.
- An image sensor to observe deforestation, desertification, ice melting rate, demography and water currents.
- Track principal greenhouse gasses, for instance, CO_2, water vapour and methane. This information, combined with the image tracking, will be useful to determine pols of greenhouse gasses production, how it distributes over the world and the repercussion on temperature.

In order to validate the project, different tests and validations will be carried out. All the stakeholders should be interested in this part of the project, but INDRA and Airbus Defence & Space are in particular. The new developed simulation program used to perform the major part of GNC simulations is an expectation for INDRA enterprise that gives us financial support. Another stakeholder expectation is the communication systems that are financially supported by Airbus Defence & Space.

1.2. Project Deliverables

All the documents cited below will be in due time.

Table 1. List of project deliverables

Deliverable Name	Description
Project Management Plan	A document that defines a more detailed and technical vision of the project, specifying resources, their distribution in time to accomplish the project objectives, a detailed version of the project Charter, control and monitoring actions and level of implementation among others
Project Communication Plan	Develop a dissemination plan, design an own webpage to explain the overall objectives, organize congresses to spread the project and design instruments to reach the society
Mission Design	The mission design deliverable is related to the orbit elements, specifying type of orbit, height, ascending node, inclination… and the requirements to enable incremental deployment too
Communication Preliminary Design	Deliver of communication PD includes the state of the art related to communication, a first design of the communication hardware and a first approach to the simulator program
Navigation Preliminary Design	Deliver of navigation PD includes a first review to the navigation and attitude requirements, and a first design of the control software
Propulsion Preliminary Design	Deliver of propulsion PD includes a summary of the available propulsions systems and power supply requirements. A first design of propulsions and power unit, including its software is presented
Mechanical Preliminary Design	Deliver of mechanical PD includes all tasks developed to integrate all the systems designed and to create a preliminary design of the structure and thermal insulation of each module
Electronics Preliminary Design	Deliver of electronics PD includes the study of the environmental effects to the electronic systems, and a preliminary design of electronics to fit all the requirements of other departments
Intermediate Report	Intermediate report to check the state of the project and be validated by the all the participants, including stakeholders

Deliverable Name	Description
Communication Detailed Design	Deliver of communication DD includes the final design of the communication hardware and the software (simulator program too)
Navigation Detailed Design	Deliver of navigation PD includes the final software and the physical devices to enable attitude and navigation control
Propulsion Detailed Design	Deliver of propulsion PD includes the final propulsion design (related to navigation requirements) and power unit, including its software
Mechanical Detailed Design	Deliver of mechanical PD includes the final integration of all systems designed and the final structure and thermal insulation of each module
Electronics Detailed Design	Deliver of electronics PD includes the final design of electronics to fit all the requirements of other departments
Tests and Validations	A document that contains all tests and validations with the obtained results
Final Report	Final delivery that includes all development done in the project

1.3. Project Acceptance Criteria

All documents must be approved before the delivery date to ensure that objectives and scope have been accomplished. The following acceptance criteria are defined to accept the documents.

Table 2. List of acceptance criteria

Acceptance Criteria	Condition to be Accepted
Research and Innovation	The project must be ambitious, has innovation potential and beyond the state of the art, including trans-disciplinary considerations
Quality and Presentation	All documents must be done with the highest quality, presenting all the ideas, developments and conclusions linked, explained clearly. All documents must be printable
Performance Requirements	The efficiency and functionality of all systems designed must be enough to realise all the objectives indicated and the purpose of the proposal too
Stakeholders expectations	Deliverables for the stakeholders that has been set must be accomplished and validated
Technical Documentation	The documentation must be complete, specifying the development procedure, the final characteristics and the method to use the hardware and software developed
Test and Validations	All tests and validations must be indicated and successfully passed using the available regulations. All this information must be correctly written, with all the modifications done to improve functionality and allow its verification (and of course the results of the tests and validations)

1.4. Project Exclusions

The exclusions of the project are specified in the table below.

Table 3. List of project exclusions

Project Exclusions	Description
Prototypes	Development of complete module prototypes is excluded from the scope, so they will not be created during this project
Satellite launcher	The objective of this project is to design a new kind on satellite, and it will not focus on the system that put it into orbit
Rockets for attitude and navigation control	All rocket engines that would be needed due to navigation and attitude control requirements will not be designed. Instead of this, a selection of the available rockets on the market will be done
Sensors design	All sensors will be acquired from different developers, and no designs or changes will be applied to them
Long range satellite-satellite communication	Design of satellite-satellite communication system will focus on enabling communication into short distance (Range 100m – 1km), covering the typical distance in an instrument constellation
Ground station	Ground infrastructures needed to enable ground-satellite communication are out of the scope of this project
Post-processing data software	Project will focus on the satellite development and preliminary data treatment, but not on software related with post-processing data. This excludes formatting and interpretation of the results
Final satellite	Create a physical satellite is out of the scope of the project, and only virtual tests will be carried to validate the whole assembly

1.5. Project Constraints

The constraints of the project are specified in the table below.

Table 4. List of project constraints

Project Constraints	Description
Deadline	The deadline of the project must be accomplished, so it affects the distribution of the available resources and budget
Schedule	Is important for the project to follow the developed schedule, in order to reduce possible over costs and time, achieving the milestones on the specified date
Budget	A limited budget is available for the realization of the entire project and acts as a limitation factor
Resources	The available resources are limited and due to budget and schedule, must be distributed correctly
Stakeholder expectations	Expectations from stakeholders have to be checked and accomplished at the end of the project
Simulation software	The simulation program developed must accomplish the required performance to be accepted by the purchasing agent, INDRA in this case
Communication system	The communication system developed must accomplish the required performances to be accepted by the purchasing agent, Airbus Defence & Space in this case

1.6. Project Assumptions

The constraints of the project are specified in the table below:

Table 5. List of project assumptions

Project Assumptions	Description	Impact
Sensors functionality	Bought sensors are supposed to work 100% as expected and no tests or validations will be carried out	If sensors don't work correctly, maybe others must be selected and the software would have to be modified
Simulation software	Simulation software developed and verified, will be enough for tests and validate the other software developed, for instance navigation, propulsion and attitude control software	If simulation software is not enough to obtain reliable data from the tests and validations, some physical test will be carried, increasing the costs and times
Rocket engines functionality	Bought rockets are supposed to work 100% as expected and no tests or validations will be carried out	If rockets don't work correctly, maybe others must be selected and the software will have to be modified
Structure isolation	Thermal isolation designs will be done taking into account existent satellites, and no physical validations will be necessary	If thermal insulation offers less insulation than expected then it will be reinforced, increasing the overall costs
Budget	The budget is enough to achieve all the objectives and finish the project as indicated on the schedule	If the budget becomes insufficient to afford all the costs of development, a contingency plan will be carried out, supported by the stakeholders

2. Work Breakdown Structure (WBS)

The work breakdown structure (WBS) of the ECCO project is presented below. It contains of up to 5 levels of decomposition in some cases.

1. ECCO Project
    - 1.1. Project Management
        - 1.1.1. Project management plan
        - 1.1.2. Monitoring of project evolution
        - 1.1.3. Preliminary design review
    - 1.2. Administrative Services
        - 1.2.1. Human resources initial plan
        - 1.2.2. Monitoring of human resources evolution
        - 1.2.3. Financial plan
        - 1.2.4. Monitoring of financial evolution
    - 1.3. Partnership and Network
        - 1.3.1. Coordination and cooperation control
        - 1.3.2. Stakeholders contact control
    - 1.4. Dissemination
        - 1.4.1. Publishing and meetings
        - 1.4.2. Press communications
        - 1.4.3. Conferences
        - 1.4.4. Public relations, outreach and enquiries
        - 1.4.5. Media, social media and web
    - 1.5. Engineering
        - 1.6. Preliminary Design
        - 1.6.1. Mission Design
            - 1.6.1.1. State of the art
                - 1.6.1.1.1. Analyse mission requirements
                - 1.6.1.1.2. Research and analyse current earth orbit observations

1.6.1.2. Select optimum orbital parameters

1.6.1.3. Specify technological requirements

1.6.1.4. Specify incremental deployment requirements

1.6.1.5. Report of results and conclusions

1.6.2. Communication

1.6.2.1. State of the art

1.6.2.1.1. Analyse work environment

1.6.2.1.2. Analyse modules communication requirements

1.6.2.1.3. Analyse ground – space communications requirements

1.6.2.1.4. Analyse power transmission requirements

1.6.2.2. Hardware

1.6.2.2.1. Select modules communication system

1.6.2.2.2. Develop communication system

1.6.2.2.3. Select ground – space communication system

1.6.2.2.4. Develop ground – space communication system

1.6.2.3. Software

1.6.2.3.1. Communication control software

1.6.2.3.2. Simulation program

1.6.2.4. Report of results and conclusions

1.6.3. Navigation

1.6.3.1. State of the art

1.6.3.1.1. Analyse work environment

1.6.3.1.2. Analyse navigation requirements

1.6.3.1.3. Analyse attitude propulsion requirements

1.6.3.2. Hardware

1.6.3.2.1. Attitude control requirements

1.6.3.3. Software

1.6.3.3.1. Navigation and attitude control software

1.6.3.4. Report of results and conclusions

1.6.4. Propulsion

1.6.4.1. State of the art

1.6.4.1.1. Analyse available propulsion systems

1.6.4.1.2. Analyse power unit requirements

1.6.4.1.3. Analyse power unit transmission requirements

1.6.4.1.4. Analyse power unit receivers requirements

1.6.4.2. Hardware

1.6.4.2.1. Select a suitable propulsion system and its peripherals

1.6.4.2.2. Propulsion systems

1.6.4.2.3. Power unit system

1.6.4.2.4. Power storage system

1.6.4.3. Software

1.6.4.3.1. Power control software

1.6.4.3.2. Propulsion control software

1.6.4.4. Report of results and conclusions

1.6.5. Mechanical

1.6.5.1. State of the art

1.6.5.1.1. Analyse work environment

1.6.5.1.2. Analyse structural effects on Earth observation satellites

1.6.5.1.3. Analyse thermal effects on Earth observation satellites

1.6.5.1.4. Analyse radiation effects on Earth observation satellites

1.6.5.2. Integration of sub-systems

1.6.5.3. Structural design

1.6.5.3.1. Payload modules

1.6.5.3.2. Infrastructure modules

1.6.5.4. Thermal design

1.6.5.4.1. Payload insulation

1.6.5.4.2. Infrastructure insulation

1.6.5.5. Report of results and conclusions

1.6.6. Electronics

1.6.6.1. State of the art

1.6.6.1.1. Analyse work environment

1.6.6.1.2. Analyse electronic requirements

1.6.6.2. Hardware

1.6.6.2.1. Select suitable electronic components

1.6.6.2.2. Payload modules electronic systems

1.6.6.2.3. Infrastructure electronic systems

1.6.6.2.4. Determine sensors requirements

1.6.6.2.5. Contact and specify sensors from developers

1.6.6.3. Report of results and conclusions

1.7. Final Design

1.7.1. Communication Detailed Design

1.7.1.1. Hardware

1.7.1.1.1. Modules communication system

1.7.1.1.2. Ground – space communication system

1.7.1.1.3. Power transmission system

1.7.1.2. Software design

1.7.1.2.1. Protocol communications

1.7.1.2.2. Information control management software

1.7.1.2.3. Power transmission control system

1.7.1.2.4. Communication simulator program

1.7.1.3. Report of results and conclusions

1.7.2. Navigation Detailed Design

1.7.2.1. Hardware design

1.7.2.1.1. Attitude sensors

1.7.2.1.2. Attitude control systems

1.7.2.2. Software design

1.7.2.2.1. Constellation navigation control software

1.7.5.2. Report of results and conclusions

1.8. Test and Validation

1.8.1. Communication

1.8.1.1. Test and validation for communication satellite – satellite

1.8.1.2. Test and validation for communication ground – satellite

1.8.1.3. Test and validation for power transmission

1.8.1.4. Report of results and conclusions

1.8.2. Navigation

1.8.2.1. Test and validation of navigation and attitude control using simulation programs developed

1.8.2.2. Report of results and conclusions

1.8.3. Propulsion

1.8.3.1. Test and validation of the propulsion system using computer simulation programs

1.8.3.2. Report of results and conclusions

1.8.4. Mechanicals

1.8.4.1. Test and validation using computer simulation programs

1.8.4.2. Report of results and conclusions

1.8.5. Electronics

1.8.5.1. Test and validation using computer simulation programs

1.8.5.2. Report of results and conclusions

1.8.6. Data acquisition

1.8.6.1. Validation of signal quality

1.8.6.2. Test and validation for 3D mapping and new acquisition systems developed

1.8.6.3. Report of results and conclusions about possible benefits related to climate change

In the figure below, the work breakdown diagram structure is presented, including different work packages.

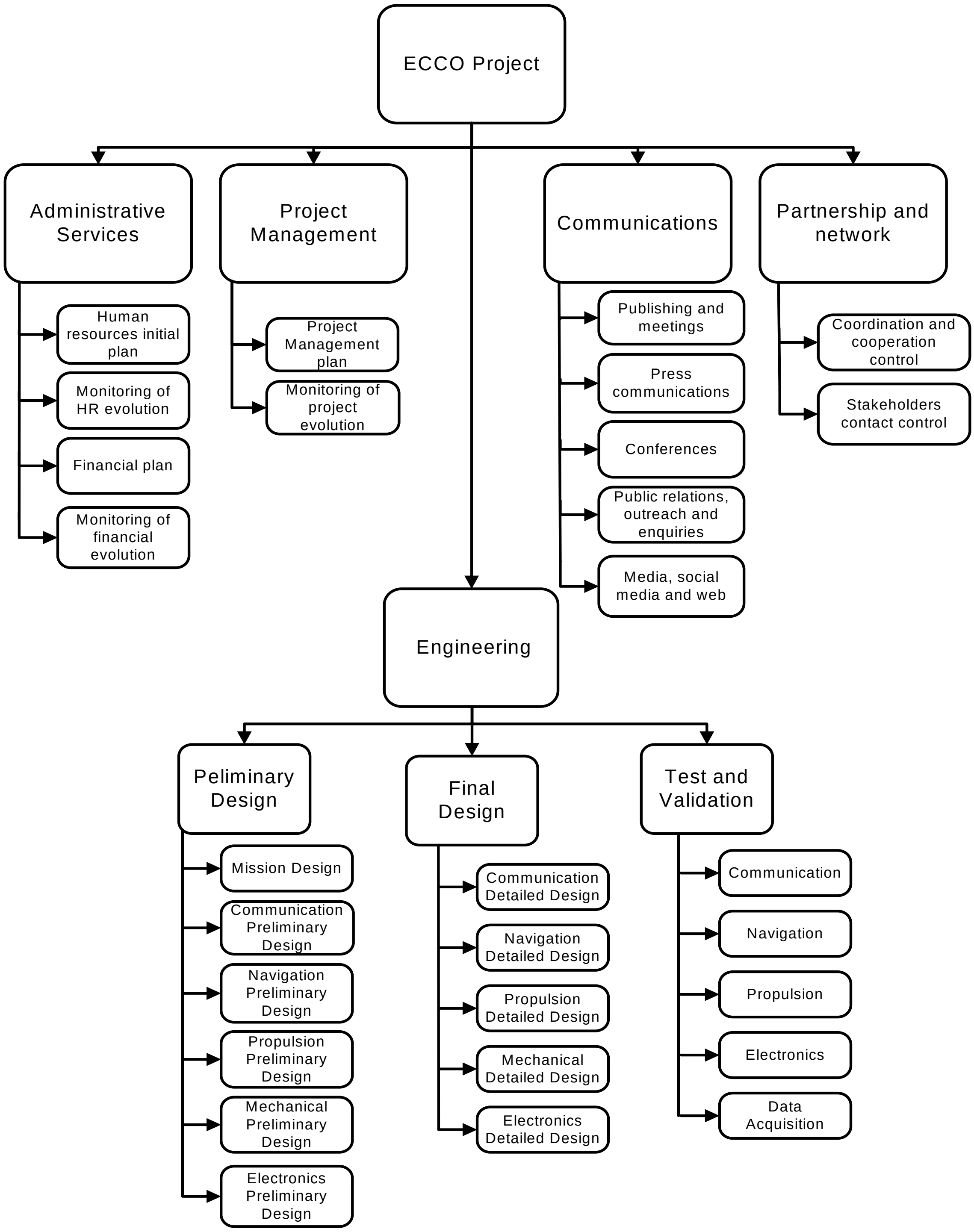


Figure 2. Work breakdown diagram structure

2.1. Activity list

All tasks are described in the table below, including its ID and a brief description of the work that must be done in that task.

Table 6. List of project activities

ID	Activity	Description of Work
PM	**Project Management**	
PM.1	Project Management Plan	A document that defines a more detailed and technical vision of the project, specifying resources, their distribution in time to accomplish the project objectives, a detailed version of the project Charter, control and monitoring actions and level of implementation among others.
PM.2	Monitoring of project evolution	Check and update the state of the project, be aware of any change in budget or deadline ensuring a satisfactory end of it.
PM.3	Preliminary design review	Check the preliminary design document and ensure the expectations, scope and objectives are achieved.
AS	**Administrative Services**	
AS.1	Human resources plan	Estimated plan of the human resources management department so as to evaluate the number and characteristics of the required employees and persons in charge.
AS.2	Monitoring of human resources evolution	Check and update the state of human resources, be aware of any change needed resources ensuring a satisfactory end of the project.
AS.3	Financial plan	Evaluate the cost required by each of the departments in order to carry on the project.
AS.4	Monitoring of financial evolution	Evaluates and control the costs in each phase of the project.
PN	**Partnership and Network**	
PN.1	Coordination and cooperation control	Coordinate and check the evolution of the project, and maintain the common scope between all the project partners
PN.2	Stakeholders contact control	Check and update the interests of the stakeholders and the company during the development of the project.
C	**Dissemination**	
C.1	Publishing and meetings	Make possible the interaction with the media, science and technologic field so as to let know the new advances,

ID	Activity	Description of Work
C.2	Press communications	Start the contact with the written press in order to state the past, the current and the future fractionated satellite technology advances.
C.3	Conferences	Planning and development of future conferences to attract possible stakeholders and keep the interest of the current ones.
C.4	Public relations, outreach and enquiries	Interact with general population so as to introduce the topic, its new technology and the benefits of providing useful data as to live in a better world.
C.5	Media, social media and web	Approach the whole project in a friendly way through many different channels of communication.
PD	**Preliminary Design**	
PD.M	**Mission Design**	
PD.M.SA.1	Analyse mission requirements	Search exhaustively information about the mission of this project in order to stablish a solid base to run the project.
PD.M.SA.2	Research and analyse current Earth orbit observations parameters	Make a careful analysis of the today orbit observations market to place this project in the sector.
PD.M.1	Select optimum orbital parameters	Selection of the optimum orbital parameters to track Earth information and specify operative data, for instance, height or type of orbit in order to start states of the arts of each department.
PD.M.2	Specify technological requirements	Listing specific technological requirements of the mission in order to accomplish the stablished scope
PD.M.3	Specify incremental Deployment requirements	Determine and specify the requirements of incremental deployment system.
PD.C	**Communication**	
PD.C.SA.1	Analyse work environment	Search, summarise and asses specific information about the particular needs of this project in communication systems.
PD.C.SA.2	Analyse modules communication requirements	Search for information to have a clear idea about the specific requirements for the communication between the modules.
PD.C.SA.3	Analyse ground – Space Communications requirements	Search for information to have a clear idea about the specific requirements for the communication between the ground station and the space station.

ID	Activity	Description of Work
PD.C.SA.4	Analyse power transmission requirements	Search for information that will provide a clear idea about the requirements of the power transmission in the conditions of this project
PD.C.HW.1	Select modules communication System	After an exhaustive research and assessment a selection of the communication has to be done, including frequency, bandwidth taking in account noise and possible undesired effects due to external factors.
PD.C.HW.2	Modules communication System	Preliminary design of communication hardware, including mixers, filters and amplifiers between modules has to be done. The design must fulfil all the specifications that have been indicated in related tasks.
PD.C.HW.3	Select ground – space communication system	After an exhaustive research and assessment a selection of the communication has to be done, including frequency, bandwidth taking in account noise and possible undesired effects due to external factors.
PD.C.HW.4	Ground – space communication system	Preliminary design of communication hardware, including mixers, filters and amplifiers between satellite and ground station has to be done. The design must fulfil all the specifications that have been indicated in related tasks.
PD.C.SW.1	Communication control software	Development of the software that controls and enables transmission data through hardware designed.
PD.C.SW.2	Simulation program	For making sure the correct performance of the communication system it will be developed a computational simulation to check communication software developed.
PD.N	**Navigation**	
PD.N.SA.1	Analyse work environment	Search, summarise and asses specific information about the particular needs of this project in navigation systems.
PD.N.SA.2	Analyse navigation requirements	Search, summarise and asses specific information about the particular needs of this project in the navigation system.
PD.N.SA.3	Analyse attitude propulsion requirements	Search for information to have a clear idea about the specific requirements for the attitude propulsion requirements.
PD.N.HW.1	Attitude control requirements	Study the attitude control of a module and determine the requirements in trust that includes position of rockets, thrust and an estimation of fuel consumption during its operative life.

ID	Activity	Description of Work
PD.N.SW.1	Navigation and attitude control software	Development of the attitude and navigation equations, and create a preliminary software to compute real trajectories and determine the reactions needed to change the orbit or attitude to the desired one.
PD.P	**Propulsion**	
PD.P.SA.1	Analyse available propulsion Systems	Search, summarise and asses specific information about the particular needs of this project in the propulsion systems.
PD.P.SA.2	Analyse power unit requirements	Search for information to have a clear idea about the specific requirements for the power unit.
PD.P.SA.3	Analyse power unit transmission requirements	Search, summarise and asses specific information about the particular needs of this project in the power unit transmission requirements.
PD.P.SA.4	Analyse power unit receivers requirements	Search for information to have a clear idea about the specific requirements for the power unit receivers.
PD.P.HW.1	Select a suitable propulsion System and its peripherals	After an exhaustive research and assessment it will be provided a selection of the most suitable modules for the propulsion system and its peripherals.
PD.P.HW.2	Propulsion Systems	A preliminary design of rockets that fulfil all the requirements has to be done.
PD.P.HW.3	Power unit System	It will be given a global approach to the power unit system.
PD.P.HW.4	Power storage System	It will be given a global approach to the power storage requirements and physical systems needed.
PD.P.SW.1	Power control software	Preliminary design of the software that control the power generation, charge/discharge of storage systems and transmission to other modules.
PD.P.SW.2	Propulsion control software	Preliminary design of the software that control and check status of integrated propulsion systems.
PD.ME	**Mechanical**	
PD.ME.SA.1	Analyse work environment	Search, summarise and asses specific information about the particular needs of this project in mechanics.
PD.ME.SA.2	Analyse structural effects on Earth observation satellites	Search, summarise and asses specific information about the particular structural effects of this project on Earth observation satellites.
PD.ME.SA.3	Analyse thermal effects on Earth observation satellites	Search, summarise and asses specific information about the thermal effects of this project on the Earth observation satellites.

ID	Activity	Description of Work
PD.ME.SA.4	Analyse radiation effects on Earth observation satellites	Search, summarise and asses specific information about the radiation effects of this project on Earth observation satellites.
PD.ME.1	Integration of sub-systems	Integration of all sub-systems in one so as to be able to do a general mechanical verification and start the preliminary design of structure, isolation and wire connexions.
PD.ME.ST.1	Structural design of payload modules	The payload modules need a structural support that will be design taking into account the requirements of this project.
PD.ME.ST.2	Structural design of infrastructure modules	The infrastructure modules need a structural support that will be design taking into account the requirements of this project.
PD.ME.T.1	Payload insulation	The insulation of the payload is a very important task in order to protect the information that can be received.
PD.ME.T.2	Infrastructure insulation	The insulation of the infrastructure is a very important task in order to protect the information that can be transmitted.
PD.E	**Electronics**	
PD.E.SA.1	Analyse work environment	Search, summarise and asses specific information about the particular needs of this project in electronic systems.
PD.E.SA.2	Analyse electronic requirements	Search for information to have a clear idea about the specific requirements for the electronic system.
PD.E.HW.1	Select suitable electronic components	The electronic components must be in accordance to the requirements of the projects claimed above, that includes the estimation of compute power, memory and buss bandwidth among others.
PD.E.HW.2	Payload modules electronic Systems	Specify the electronic system integrated in each payload module, including its performance and specifications.
PD.E.HW.3	Infrastructures electronic systems	Specify the electronic system integrated in each infrastructure module, including its performance and specifications.
PD.E.HW.4	Determine the sensors requirements	Determine the information to be tracked and specify the requirements desired taking in account stakeholders.
PD.E.HW.5	Contact and specify sensors from developers	The sensors that have been chosen to be integrated in the modules must be provided through a particular entity.
FD	**Final Design**	
FD.C	**Communication Detailed Design**	
FD.C.HW.1	Modules communication system	The final communication system between the modules must be well defined and implemented.

ID	Activity	Description of Work
FD.C.HW.2	Ground-space communication System	The final communication system between the Ground-Space stations must be well defined and implemented.
FD.C.HW.3	Power transmission system	The final power transmission between modules must be well defined and implemented
FD.C.SW.1	Protocol Communications	It must be developed a protocol in communications to be followed in a regular case or an emergency case.
FD.C.SW.2	Information control management software	A final control management software will be responsible of integrating the whole information that is received by the different modules.
FD.C.SW.3	Power transmission control System	Final stage in the design of the power transmission control system of the communication module.
FD.C.SW.4	Communication Simulator program	Final design of the communication simulator software developed to simulate the communication between modules and module-ground.
FD.N	**Navigation Detailed Design**	
FD.N.HW.1	Attitude sensors	Final stage in the design of the attitude sensors of the navigation system.
FD.N.HW.2	Attitude control Systems	Final stage in the design of the attitude control system.
FD.N.SW.1	Constellation navigation control software	The final control software responsible of navigation must be designed.
FD.N.SW.2	Module attitude control software	The final control software responsible of module attitude must be designed.
FD.N.SW.3	Navigation and attitude Simulator software	Operative software must be designed and checked to simulate the behaviour of the constellation in its working environment, using the navigation and attitude control software.
FD.P	**Propulsion Detailed Design**	
FD.P.HW.1	Propulsion systems	The design of the propulsion system reaches its final stage. It is fully defined and implemented.
FD.P.HW.2	Power unit system	The design of the power unit system reaches its final stage. It is fully defined and implemented.
FD.P.HW.3	Power storage system	The design of the power storage system reaches its final stage. It is fully defined and implemented.
FD.P.SW.1	Power control software	The final control software will be responsible of integrating the power system.
FD.P.SW.2	Propulsion control software	The final control software will be responsible of integrating the propulsion system.

ID	Activity	Description of Work
FD.ME	**Mechanical Detailed Design**	
FD.ME.MD.1	Material selection	Materials selection taking in account temperature, radiation, structural resistance during the launch and other kind of mission and space adverse conditions.
FD.ME.MD.2	Module structure	The module structure, that has to be big enough to enclosure all the sub-systems defined, and to protect them from space debris.
FD.ME.MD.3	Thermal insulation	Thermal insulation to protect sub-systems from the adverse conditions outside the module. Temperature levels inside the module must reach specific temperature to ensure the correct functionality of all electronic devices.
FD.ME.MD.4	Sub-systems Integration	Final integration of the Sub-systems into one.
FD.ME.ID.1	Material selection	Materials selection taking in account temperature, radiation, structural resistance during the launch and other kind of mission and space adverse conditions.
FD.ME.ID.2	Module structure	The module structure, that has to be big enough to enclosure all the sub-systems defined, and to protect them from space debris.
FD.ME.ID.3	Thermal insulation	Thermal insulation to protect sub-systems from the adverse conditions outside the module. Temperature levels inside the module must reach specific temperature to ensure the correct functionality of all electronic devices.
FD.ME.ID.4	Sub-systems Integration	Final integration of the Sub-systems into one.
FD.E	**Electronic Detailed Design**	
FD.E.HW.1	Payload modules electronic Systems	Final design of the payload modules. They must be fully defined and implemented.
FD.E.HW.2	Infrastructures electronic systems	Final stage in the design of the infrastructures of the electronic systems. They are fully defined and implemented.
FD.E.HW.3	Selection and integration of sensors	The sensors that will be installed are finally chosen between all the possible providers.
T	**Tests and Validations**	
T.C	**Communications**	
T.C.1	Test and validation for communication satellite-satellite	The final communication system between satellite-satellite is tested and validated.

ID	Activity	Description of Work
T.C.2	Test and validation for communication ground-satellite	The final communication system between ground-satellite is tested and validated.
T.C.3	Test and validation for power transmission	The power transmission system is tested and validated.
T.N	**Navigation**	
T.N.1	Test and validation of the navigation, attitude and control system using computer simulated programs	The navigation, attitude and control systems are tested and validated using simulation software assisted by computer.
T.P	**Propulsion**	
T.P.1	Test and validation of the propulsion system using computer simulated programs	The propulsion system is tested and validated using simulation software assisted by computer.
T.ME	**Mechanical**	
T.ME.1	Test and validation using computer simulation programs	The mechanical system is tested and validated using simulation software assisted by computer.
T.E	**Electronics**	
T.E.1	Test and validation using computer simulation programs	The electronics system is tested and validated using simulation software assisted by computer.
T.A	**Data acquisition**	
T.A.1	Validation of signal quality	The quality of the final signal received is tested and validated.
T.A.2	Test and validation for the 3D mapping and new acquisition systems developed	The 3D mapping and other new acquisition modes developed are tested and validated.

3. Sequence Activities

3.1. Logical Relationship between Activities

Table 7. List of logical relationships between activities

WBS-ID	Activity	Predecessors	Relation[1]	Lag
PM	**Project Management**			
PM.1	Project Management Plan	START	-	0
REP.PM.1	Project Management Plan deliverable	PM.1	FF	0
PM.2	Monitoring of project evolution	PM.1	FS	0
PM.3	Preliminary design review	REP.PD	FS	0
AS	**Administrative Services**			
AS.1	Human resources plan	START	-	0
AS.2	Monitoring of human resources	AS.1	FS	0
AS.3	Financial plan	START	-	
AS.4	Monitoring of financial evolution	AS.3	FS	0
PN	**Partnership and Network**			
PN.1	Coordination and cooperation control	REP.PM.1	FS	0
PN.2	Stakeholders contact control	REP.PM.1	FS	0
C	**Dissemination**			
C.1	Publishing and meetings	PM.1	FS	0
C.2	Press communications	PM.1	FS	0
C.3	Conferences	PM.1	FS	267 d
C.4	Public relations, outreach and enquiries	PM.1	FS	267 d
C.5	Media, social media and web	PM.1	FS	267 d
REP.C.1	Intermediate meeting			267 d
REP.C.2	ECCO International congress	PD	SS	0
PD	**Preliminary Design**	START	SS	0
PD.M	**Mission Design**			
PD.M.SA.1	Analyse mission requirements	PD	SS	0
PD.M.SA.2	Research and analyse current Earth orbit observations parameters	PD.M.SA.1	FS	0
PD.M.1	Select optimum orbital parameters	PD.M.SA	FS	0
PD.M.2	Specify technological requirements	PD.M.1	FS	0
PD.M.3	Specify incremental deployment requirements	PD.M.1	FS	0

[1] FS = Finish – to – Start; FF = Finish – to – Finish; SS = Start – to – Start; SF = Start – to – Finish

WBS-ID	Activity	Predecessors	Relation[1]	Lag
REP.M.1	Report of results and conclusions	PD.M.2 PD.M.3	FF	0
PD.C	**Communication**			
PD.C.SA.1	Analyse work environment	PD.M	FS	0
PD.C.SA.2	Analyse modules communication requirements	PD.C.SA.1	FS	0
PD.C.SA.3	Analyse ground – space communications requirements	PD.C.SA.1	FS	0
PD.C.SA.4	Analyse power transmission requirements	PD.C.SA.2 PD.C.SA.3	FS	0
PD.C.HW.1	Select modules communication system	PD.C.SA	FS	0
PD.C.HW.2	Modules communication system	PD.C.HW.1	FS	0
PD.C.HW.3	Select ground – space communication system	PD.C.SA	FS	0
PD.C.HW.4	Ground – space communication system	PD.C.HW.3	FS	0
PD.C.SW.1	Communication control software	PD.C.HW	FS	0
PD.C.SW.2	Simulation program	PD.C.SW.1	FS	0
REP.C.1	Report of results and conclusions	PD.C.SW	FF	0
PD.N	**Navigation**			
PD.N.SA.1	Analyse work environment	PD.M	FS	0
PD.N.SA.2	Analyse navigation requirements	PD.N.SA.1	FS	0
PD.N.SA.3	Analyse attitude propulsion requirements	PD.N.SA.2	FS	0
PD.N.HW.1	Attitude control requirements	PD.N.SA PD.E.HW.4	FS	0
PD.N.SW.1	Navigation and attitude control software	PD.N.HW.1	FS	0
REP.N.1	Report of results and conclusions	PD.N.SW	FF	0
PD.P	**Propulsion**			
PD.P.SA.1	Analyse available propulsion systems	PD.C.SA PD.E.SA	FS	0
PD.P.SA.2	Analyse power unit requirements	PD.C.SA PD.E.SA	FS	0
PD.P.SA.3	Analyse power unit transmission requirements	PD.P.SA.2	FS	0
PD.P.SA.4	Analyse power unit receivers requirements	PD.P.SA.2	FS	0
PD.P.HW.1	Select a suitable propulsion system and its peripherals	PD.E.HW PD.P.SA	FS	0
PD.P.HW.2	Propulsion systems	PD.P.HW.1 PD.N.HW.1	FS	0

WBS-ID	Activity	Predecessors	Relation[1]	Lag
PD.P.HW.3	Power unit system	PD.E.HW PD.P.SA	FS	0
PD.P.HW.4	Power storage system	PD.P.HW.3	FS	0
PD.P.SW.1	Power control software	PD.P.HW	FS	0
PD.P.SW.2	Propulsion control software	PD.P.HW	FS	0
REP.P.1	Report of results and conclusions	PD.P.SW	FF	0
PD.ME	**Mechanical**			
PD.ME.SA.1	Analyse work environment	PD.C.HW PD.N.HW PD.P.HW PD.E.HW	SS	0
PD.ME.SA.2	Analyse structural effects on Earth observation satellites	PD.ME.SA.1	FS	0
PD.ME.SA.3	Analyse thermal effects on Earth observation satellites	PD.ME.SA.1	FS	0
PD.ME.SA.4	Analyse radiation effects on Earth observation satellites	PD.ME.SA.1	FS	0
PD.ME.1	Integration of sub-systems	PD.ME.SA	FS	0
PD.ME.ST.1	Structural design of payload modules	PD.ME.1	FS	0
PD.ME.ST.2	Structural design of infrastructure modules	PD.ME.1	FS	0
PD.ME.T.1	Payload insulation	PD.ME.1	FS	0
PD.ME.T.2	Infrastructure insulation	PD.ME.1	FS	0
REP.ME.1	Report of results and conclusions	PD.ME.ST PD.ME.T	FF	0
PD.E	**Electronics**			
PD.E.SA.1	Analyse work environment	PM	SS	0
PD.E.SA.2	Analyse electronic requirements	PD.E.SA.1	FS	0
PD.E.HW.1	Select suitable electronic components	PD.E.SA PD.C.HW PD.N.HW	FS	0
PD.E.HW.2	Payload modules electronic systems	PD.E.HW.1	FS	0
PD.E.HW.3	Infrastructures electronic systems	PD.E.HW.1	FS	0
PD.E.HW.4	Determine the sensors requirements	PD.E.SA	FS	0
PD.E.HW.5	Contact and specify sensors from developers	PD.E.HW.4	FS	0
REP.E.1	Report of results and conclusions	PD.E.HW	FF	0
REP.PD	Preliminary Design Report	PD	FF	0

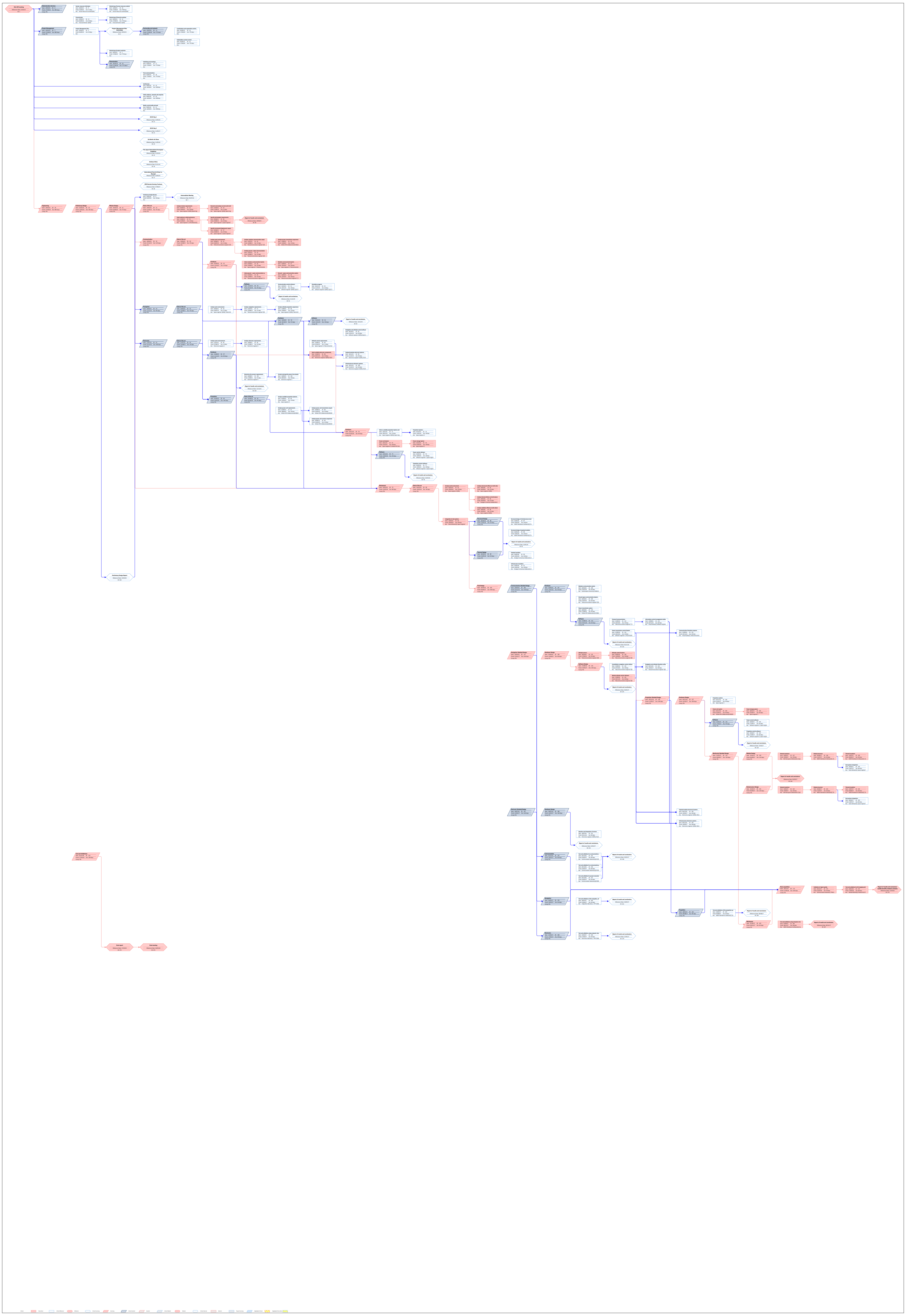
WBS-ID	Activity	Predecessors	Relation[1]	Lag
FD	**Final Design**			
FD.C	**Communication Detailed Design**			
FD.C.HW.1	Modules communication system	PD.ME.1	FS	0
FD.C.HW.2	Ground-space communication system	PD.ME.1	FS	0
FD.C.HW.3	Power transmission system	PD.ME.1	FS	0
FD.C.SW.1	Protocol communications	FD.C.HW	FS	0
FD.C.SW.2	Information control management soft.	FD.C.SW.1	FS	0
FD.C.SW.3	Power transmission control system	FD.C.HW	FS	0
FD.C.SW.4	Communication Simulator program	FD.C.SW.2 FD.C.SW.3	FS	0
REP.C.2	Report of results and conclusions	FD.C.SW	FF	0
FD.N	**Navigation Detailed Design**			
FD.N.HW.1	Attitude sensors	PD.ME.1	FS	0
FD.N.HW.2	Attitude control systems	FD.N.HW.1	FS	0
FD.N.SW.1	Constellation navigation control soft.	FD.N.HW	FS	0
FD.N.SW.2	Module attitude control software	FD.N.HW	FS	0
FD.N.SW.3	Navigation and attitude simulator soft.	FD.N.SW.1 FD.N.SW.2	FS	0
REP.N.2	Report of results and conclusions	FD.N.SW	FF	0
FD.P	**Propulsion Detailed Design**			
FD.P.HW.1	Propulsion systems	FD.N.SW.2	FS	0
FD.P.HW.2	Power unit system	FD.N.SW.2	FS	0
FD.P.HW.3	Power storage system	FD.P.HW.2	FS	0
FD.P.SW.1	Power control software	FD.P.HW	FS	0
FD.P.SW.2	Propulsion control software	FD.P.HW	FS	0
REP.P.2	Report of results and conclusions	FD.P.SW	FF	0
FD.ME	**Mechanical Detailed Design**			
FD.ME.MD.1	Material selection	FD.P.HW	FS	0
FD.ME.MD.2	Module structure	FD.ME.MD.1	FS	0
FD.ME.MD.3	Thermal insulation	FD.ME.MD.2	FS	0
FD.ME.MD.4	Sub-systems Integration	FD.ME.MD.3	FS	0
FD.ME.ID.1	Material selection	FD.P.HW	FS	0
FD.ME.ID.2	Module structure	FD.ME.MD.1	FS	0
FD.ME.ID.3	Thermal insulation	FD.ME.MD.2	FS	0
FD.ME.ID.4	Sub-systems Integration	FD.ME.MD.3	FS	0
REP.ME.2	Report of results and conclusions	FDE.ME.MD FDE.ME.ID	FF	0

WBS-ID	Activity	Predecessors	Relation[1]	Lag
FD.E	**Electronic Detailed Design**	FD.C FD.N	FS	0
FD.E.HW.1	Payload modules electronic systems	FD.C FD.N	FS	0
FD.E.HW.2	Infrastructures electronic systems	FD.C FD.N	FS	0
FD.E.HW.3	Selection and integration of sensors	PD.ME.1	FS	0
REP.E.2	Report of results and conclusions	FD.E.HW	FF	0
T	**Tests and Validations**			
T.C	**Communications**			
T.C.1	Test and validation for communication satellite-satellite	FD.C	FS	0
T.C.2	Test and validation for communication ground-satellite	FD.C	FS	0
T.C.3	Test and validation for power transmission	FD.C	FS	0
REP.C.3	Report of results and conclusions	T.C.1 T.C.2 T.C.3	FF	0
T.N	**Navigation**			
T.N.1	Test and validation of the navigation, attitude and control system using computer simulated programs	FD.N	FS	0
REP.N.3	Report of results and conclusions	T.N.1	FF	0
T.P	**Propulsion**			
T.P.1	Test and validation of the propulsion system using computer simulated programs	FD.P	FS	0
REP.P.3	Report of results and conclusions	T.P.1	FF	0
T.ME	**Mechanical**			
T.ME.1	Test and validation using computer simulation programs	FD.ME	FS	0
REP.ME.3	Report of results and conclusions	T.ME.1	FF	0
T.E	**Electronics**			
T.E.1	Test and validation using computer simulation programs	FD.E	FS	0
REP.E.3	Report of results and conclusions	T.E.1	FF	0

WBS-ID	Activity	Predecessors	Relation[1]	Lag
T.A	**Data acquisition**			
T.A.1	Validation of signal quality	T.C T.N T.P T.ME T.E	FS	0
T.A.2	Test and validation for the 3D mapping and new acquisition systems developed	T.A.1	FS	0
REP.A	Report of results and conclusions about possible benefits related to climate change	T.A.2	FS	0

3.2. Network Diagram (Precedence Diagram Method)

The Network Diagram of the ECCO project contains the relationships among the tasks. Since there are many tasks, the diagram is complex and big. In the next page the network diagram can be found.



Kick-Off meeting
Milestone Date: 23/03/15
ID: 1
Administrative Services
Start: 24/03/15 ID: 8
Finish: 17/04/18 Dur: 805 days
Comp: 0%
Human resources initial plan
Start: 24/03/15 ID: 9
Finish: 13/04/15 Dur: 15 days
Rec: Human Resources worker[50%]
Financial plan
Start: 24/03/15 ID: 11
Finish: 04/05/15 Dur: 30 days
Rec: Financial Worker 1[50%]
Monitoring of financial evolution
Start: 05/05/15 ID: 12
Finish: 17/04/18 Dur: 775 days
Rec: Financial Worker 1[50%]
Project Management
Start: 24/03/15 ID: 2
Finish: 17/04/18 Dur: 805 days
Comp: 0%
Project Management Plan
Start: 24/03/15 ID: 3
Finish: 04/05/15 Dur: 30 days
Rec:
Project Management Plan Deliverable
Milestone Date: 04/05/15
ID: 4
Partnership and network
Start: 05/05/15 ID: 13
Finish: 17/04/18 Dur: 775 days
Comp: 0%
Coordination and cooperation control
Start: 05/05/15 ID: 14
Finish: 17/04/18 Dur: 775 days
Rec:
Stakeholders contact control
Start: 05/05/15 ID: 15
Finish: 17/04/18 Dur: 775 days
Rec:
Monitoring of project evolution
Start: 05/05/15 ID: 5
Finish: 17/04/18 Dur: 775 days
Rec:
Dissemination
Start: 05/05/15 ID: 16
Finish: 17/04/18 Dur: 775 days?
Comp: 0%
Publishing and meetings
Start: 05/05/15 ID: 17
Finish: 17/04/18 Dur: 775 days
Rec:
Press communications
Start: 05/05/15 ID: 18
Finish: 17/04/18 Dur: 775 days
Rec:
Conferences
Start: 06/01/16 ID: 19
Finish: 16/04/18 Dur: 598 days
Rec:
Public relations, outreach and enquiries
Start: 06/01/16 ID: 20
Finish: 16/04/18 Dur: 598 days
Rec:
Media, social media and web
Start: 06/01/16 ID: 21
Finish: 16/04/18 Dur: 598 days
Rec:
ECCO Day 1
Milestone Date: 23/05/16
ID: 22
ECCO Day 2
Milestone Date: 31/05/17
ID: 23
ILA Berlin Air Show
Milestone Date: 31/05/16
ID: 24
The Japan International Aerospace Exhibition
Milestone Date: 12/10/16
ID: 25
Airshow China
Milestone Date: 01/11/16
ID: 26
International Paris Air Show Le Bourget
Milestone Date: 20/06/16
ID: 27
SPIE Remote Sensing Toulouse
Milestone Date: 27/09/17
ID: 28
Preliminary Design Review
Start: 24/05/16 ID: 6
Finish: 01/07/16 Dur: 30 days
Rec:
Intermediate Meeting
Milestone Date: 04/07/16
ID: 7
Engineering
Start: 24/03/15 ID: 29
Finish: 17/04/18 Dur: 805 days
Comp: 0%
Preliminary Design
Start: 24/03/15 ID: 30
Finish: 23/05/16 Dur: 305 days
Comp: 0%
Mission Design
Start: 24/03/15 ID: 31
Finish: 29/06/15 Dur: 70 days
Comp: 0%
State of the art
Start: 24/03/15 ID: 32
Finish: 11/05/15 Dur: 35 days
Comp: 0%
Analyse mission requirements
Start: 24/03/15 ID: 33
Finish: 20/04/15 Dur: 20 days

4. Estimate Activity Resource

4.1. Resource Identification

Three different types of resources have been identified:

- Worker: person that works for the project. In the case of collaboration with stakeholders, this would also be considered as a worker.
- Cost: something that is paid to get something in return. Outsourcing of some activities to a stakeholder is considered to be a cost.
- Material: Expenditures required for the project. The main ones in the ECCO project are the costs associated with the software licenses and the three different sensors.

The list of resources for the project is presented below.

Table 8. List of resources

Resource ID	Description of the resource	Type of resource
PM.M	Project Manager	Worker
PM.S	Project Management Secretary	Worker
PM.EXT	E-TIS Euroconsultores outsourcing	Cost
AS.M	Administration Services Manager	Worker
AS.S	Administration Services Secretary	Worker
HR.W	Human Resources worker	Worker
F.W1	Financial Worker 1	Worker
F.W2	Financial Worker 2	Worker
C.M	Communication Manager	Worker
C.EXT	BCCI Communication Outsourcing	Cost
E.MD.M	Mech. Dept. Manager	Worker
E.MD.S	Mech. Dept. Secretary	Worker
E.MDD.M	Mission Design Dept. Manager	Worker
E.PD.M	Payloads Dept. Manager	Worker
E.MDD.S	Mission Design and Payloads Depts. Secretary	Worker
E.P	Propulsion Dept. Manager	Worker
E.ED.M	Electronics Dept. Manager	Worker
E.CD.M	Communications Dept. Manager	Worker
E.CD.S	Communications and Electronics Dept. Secretary	Worker
SWE1	Software engineer 1	Worker
SWE2	Software engineer 2	Worker
SWE3	Software engineer 3	Worker

Resource ID	Description of the resource	Type of resource
SWE4	Software engineer 4	Worker
TE1	Telecommunications engineer 1	Worker
TE2	Telecommunications engineer 2	Worker
TE3	Telecommunications engineer 3	Worker
TE4	Telecommunications engineer 4	Worker
EE1	Electronics engineer 1	Worker
EE2	Electronics engineer 2	Worker
SE1	Space engineer 1	Worker
SE2	Space engineer 2	Worker
SE3	Space engineer 3	Worker
SE4	Space engineer 4	Worker
SE5	Space engineer 5	Worker
SE6	Space engineer 6	Worker
MD.EXT 1	Ball Aerospace Collaboration	Cost
MD.EXT 2	Stuttgart University Collaboration	Worker
MD.EXT 3	Orbital ATK Collaboration	Cost
MDD.EXT 1	Cranfield University Collaboration	Worker
MDD.EXT 2	SENER Collaboration	Cost
UPC	Polytechnic University of Catalonia Collaboration	Worker
UPV	Polytechnic University of Valencia Collaboration	Worker
CD.EXT 1	Southampton University Collaboration	Worker
PD.EXT 1	Silvanet Collaboration	Worker
PD.EXT 2	Surrey Satellites Collaboration	Worker
PD.EXT 3	Amptek Collaboration	Worker
SOFT.1	ANSYS Workbench Software	Material
SOFT.2	Keysight ADS Software	Material
SOFT.3	LTSpice Software	Material
SOFT.4	Matlab R2015b	Material
SOFT.5	Visual Studio	Material
SOFT.6	Microsoft Project	Material
SOFT.7	STK Software	Material
SOFT.8	Catia Software	Material
LAB. COM	Communication laboratory	Cost
LAB. ELE	Electronics laboratory - UPV Collaboration	Cost
LAB. INT	Integration laboratory – ATT Collaboration	Cost
EO	Event organization	Cost
USDOC	Stuttgart University Collaboration Doct.	Cost

4.2. Activity Resource Requirement

Table 9. List of resource requirements

WBS ID	Resource ID	Quantity	Assumptions
PM	PM.M, PM.S, PM.EXT, SOFT.6	1, 1, 1, 1	The project management will be in part outsourced to E-TIS Euroconsultores
AS	AS.M, AS.S	1, 1	Administrative services include the Human Resources and Financial parts of the project
AS.1	HR.W	1	
AS.2	HR.W	1	
AS.3	F.W1, F.W2	1, 1	
AS.4	F.W1, F.W2	1, 1	
PN	AS.M, AS.S, HR.W	1, 1, 1	There PN tasks are developed by the workers of the AS Department
C	C.M, C.EXT	1, -	The dissemination of the project will be mostly done by BCCI Communications
PD.M	E.MDD.M, E.MDD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
PD.M.SA.1	SE1;SE2	1, 1	In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts and in collaboration with Cranfield University
PD.M.SA.2	SE1;SE2	1, 1	
PD.M.1	SE1;SOFT.7;SE2	1, 1, 1, 2	
PD.M.2	SE1;SE3;SOFT.7	1, 1, 1, 2	
PD.M.3	SE2;SE4;SOFT.7;MDD.EXT 1	1, 1, 3, 2	
PD.C	E.CD.M, E.CD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
PD.C.SA.1	TE1;SE1	1, 1	These tasks will be done in collaboration with Orbital ATK
PD.C.SA.2	TE1;SE1	1, 1	
PD.C.SA.3	TE1;SE1	1, 1	
PD.C.SA.4	MD.EXT 3;TE1;SE1	1, 1, 3	
PD.C.HW.1	SE1;TE1	1, 1	These task will be done in collaboration with University of Southampton
PD.C.HW.2	SE1;TE1;CD.EXT 1	1, 1, 3	
PD.C.HW.3	TE2;SE2	1, 1	
PD.C.HW.4	TE2;SE2	1, 1	
PD.C.SW.1	SWE1;SE1;TE1;SOFT.5	1, 1, 1, 3	Very interdisciplinary team for the preliminary design of the communication software using Visual Studio software
PD.C.SW.2	SWE1;SE1;TE1;SOFT.5	1, 1, 1, 3	
PD.N	E.MDD.M, E.MDD.S	1, 1	The manager and secretary are

WBS ID	Resource ID	Quantity	Assumptions
			working in all of the aspects of this group of tasks
PD.N.SA.1	SE1;TE1	1, 1	The Spatial engineer assists the Telecommunication engineer and software engineer in technical things about the space working conditions and the specific requirements that must be accomplished
PD.N.SA.2	TE2;SE2	1, 1	
PD.N.SA.3	SE1;TE1	1, 1	
PD.N.HW.1	SE3;TE3	1, 1	
PD.N.SW.1	SWE1;SE3;TE3	1, 1, 1, 3	
PD.P	E.P;E.MD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
PD.P.SA.1	SE4	1	These tasks will be done in collaboration with Orbital ATK
PD.P.SA.2	MD.EXT 3;SE5	3, 1	
PD.P.SA.3	MD.EXT 3;SE4	3, 1	
PD.P.SA.4	MD.EXT 3;SE5	3, 1	
PD.P.HW.1	SE2;SE4	1, 1	These tasks will be done in collaboration with Orbital ATK
PD.P.HW.2	SE4	1	
PD.P.HW.3	SE5;MD.EXT 3	3, 1	
PD.P.HW.4	SE5	1	
PD.P.SW.1	SWE1;SE4	1, 1, 2	The Spatial engineer assist the Software engineer
PD.P.SW.2	SWE2;SE2	1, 1, 2	
PD.ME	E.MD.M, E.MD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
PD.ME.SA.1	SE1	1	These tasks will be done in collaboration with the University of Stuttgart
PD.ME.SA.2	SE1	1	
PD.ME.SA.3	MD.EXT 2;SE1	1, 3	
PD.ME.SA.4	SE3	1	
PD.ME.1	SOFT.8;SE1;SE2	1, 1, 1	A lot of software will be used in this part by spatial engineers
PD.ME.ST.1	SOFT.1;SOFT.8;SE1	1, 1, 1	
PD.ME.ST.2	SOFT.1;SOFT.8;SE2	1, 1, 1	
PD.ME.T.1	USDOC	3	These tasks will be done in collaboration with Stuttgart University
PD.ME.T.2	USDOC	3	
PD.E	E.CD.S;E.ED.M	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
PD.E.SA.1	EE1	1, 1	The electronics engineers that will develop these tasks have many experience already in space
PD.E.SA.2	EE1	1	
PD.E.HW.1	EE1;EE2	1, 1	

WBS ID	Resource ID	Quantity	Assumptions
PD.E.HW.2	EE1;EE2	1, 1	related projects
PD.E.HW.3	EE1;EE2	1, 1	
PD.E.HW.4	EE1	1, 1	
PD.E.HW.5	EE1	1, 1	
FD.C	E.CD.M, E.CD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
FD.C.HW.1	CD.EXT 1;TE1;SE3;TE2	1, 1, 3	These tasks will be done in collaboration with Southampton University and Orbital ATK
FD.C.HW.2	TE2;SE4;TE1	1, 1	
FD.C.HW.3	MD.EXT 3;TE3;SE5	1, 1, 3	
FD.C.SW.1	TE1;CD.EXT 1;SE1	1, 1, 1, 3	These tasks will be done in collaboration with Southampton University
FD.C.SW.2	SOFT.5;SWE2;TE2;SE2	1, 1, 1, 3	
FD.C.SW.3	SWE1;SOFT.5;TE2;SE3	1, 1, 3, 3	
FD.C.SW.4	SOFT.5;TE3;SE2;SWE3	1, 1, 1, 3	
FD.N	E.MDD.M, E.MDD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
FD.N.HW.1	TE4;SE6	1, 1	The Spatial engineer assists the Telecommunication engineer
FD.N.HW.2	TE4;SE6	1, 1	
FD.N.SW.1	TE4;SE6;MDD.EXT 2;SWE1	1, 1, 3, 3	These tasks will be done in collaboration with SENER
FD.N.SW.2	TE4;SE6;SWE4	1, 1, 1, 3	
FD.N.SW.3	TE4;SE6;SWE1;SWE3	1, 1, 1, 3	
FD.P	E.P;E.MD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
FD.P.HW.1	SE1	1	These tasks will be done in collaboration with Orbital ATK
FD.P.HW.2	MD.EXT 3;SE3	1, 3	
FD.P.HW.3	SE1	1	
FD.P.SW.1	SWE1;SE1	1, 1, 3	
FD.P.SW.2	SWE2;SE1	1, 1, 3	
FD.ME	E.MD.M, E.MD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
FD.ME.MD.1	MD.EXT1;SE3	1, 1, 3	These tasks will be done in collaboration with Stuttgart University, Ball Aerospace and UPV
FD.ME.MD.2	SOFT.1;SOFT.8;UPV;SE3	3, 2	
FD.ME.MD.3	SOFT.1;SOFT.8;SE3;MD.EXT 2	1, 3	
FD.ME.MD.4	SOFT.8;SE4;SE2	1, 1, 1, 3	
FD.ME.ID.1	MD.EXT1;SE3	1, 1	These tasks will be done in collaboration with Stuttgart
FD.ME.ID.2	SOFT.1;SOFT.8;UPV;SE3	1, 2	

WBS ID	Resource ID	Quantity	Assumptions
FD.ME.ID.3	SOFT.1;SOFT.8;SE3;MD.EXT 2	3	University and UPV
FD.ME.ID.4	SOFT.8;SE4;SE2	2, 3	
FD.E	E.ED.M, E.CD.S	1, 1	The manager and secretary are working in all of the aspects of this group of tasks
FD.E.HW.1	EE1;EE2	1, 1	For these tasks it is required to have already the sensors developed by Amptek, Silvanet and Surrey Satellites
FD.E.HW.2	EE1;EE2	1, 1	
FD.E.HW.3	EE1;EE2	3, 3, 3	
T.C	E.CD.M; E.CD.S	1	These tasks will be developed in a subcontracted Communications laboratory
T.C.1	LAB.COM;SOFT.2;TE1;SE4	-, 2	
T.C.2	LAB.COM;SOFT.2;TE1;SE4	-, 2	
T.C.3	LAB.COM;SE2	1	
T.N	E.MDD.S;E.MDD.M	1	The mission design manager is the responsible for this testing
T.N.1	LAB.INT;SOFT.7;SOFT.5;SE6	-, 1, 1	
T.P	E.P;E.MD.S	1	The propulsion manager is the responsible for this testing
T.P.1	SOFT.1;SE1	1, 2	
T.ME	E.MD.M;E.MD.S	1	The mechanical manager is the responsible for this testing
T.ME.1	SOFT.1;SE1	1, 2	
T.E	E.CD.S;E.ED.M	1	These tasks will be developed in the electronics laboratory of UPV
T.E.1	LAB.ELE;EE1;SE5	1, -	
T.A	E.CD.M;E.CD.S	1	The communication manager is the responsible for the testing
T.A.1	LAB.COM;TE1	-, 1, 1, 1	These tasks will be developed in a subcontracted Communications laboratory
T.A.2	SOFT.4;UPC;SWE1;TE1	3, 1, 2, 1, 1, 1	UPC is the responsible for the testing of this task

Comments: since the project is developed in the framework of an existing company, some basic resources such as desks, computers and basic software are assumed to be already available. Also, the engineers of the company can be working in other projects during the duration of the ECCO project, so they may not be working in the project for a period of time.

4.3. Resource Breakdown Structure

In the figure below, the resource breakdown diagram structure is presented.

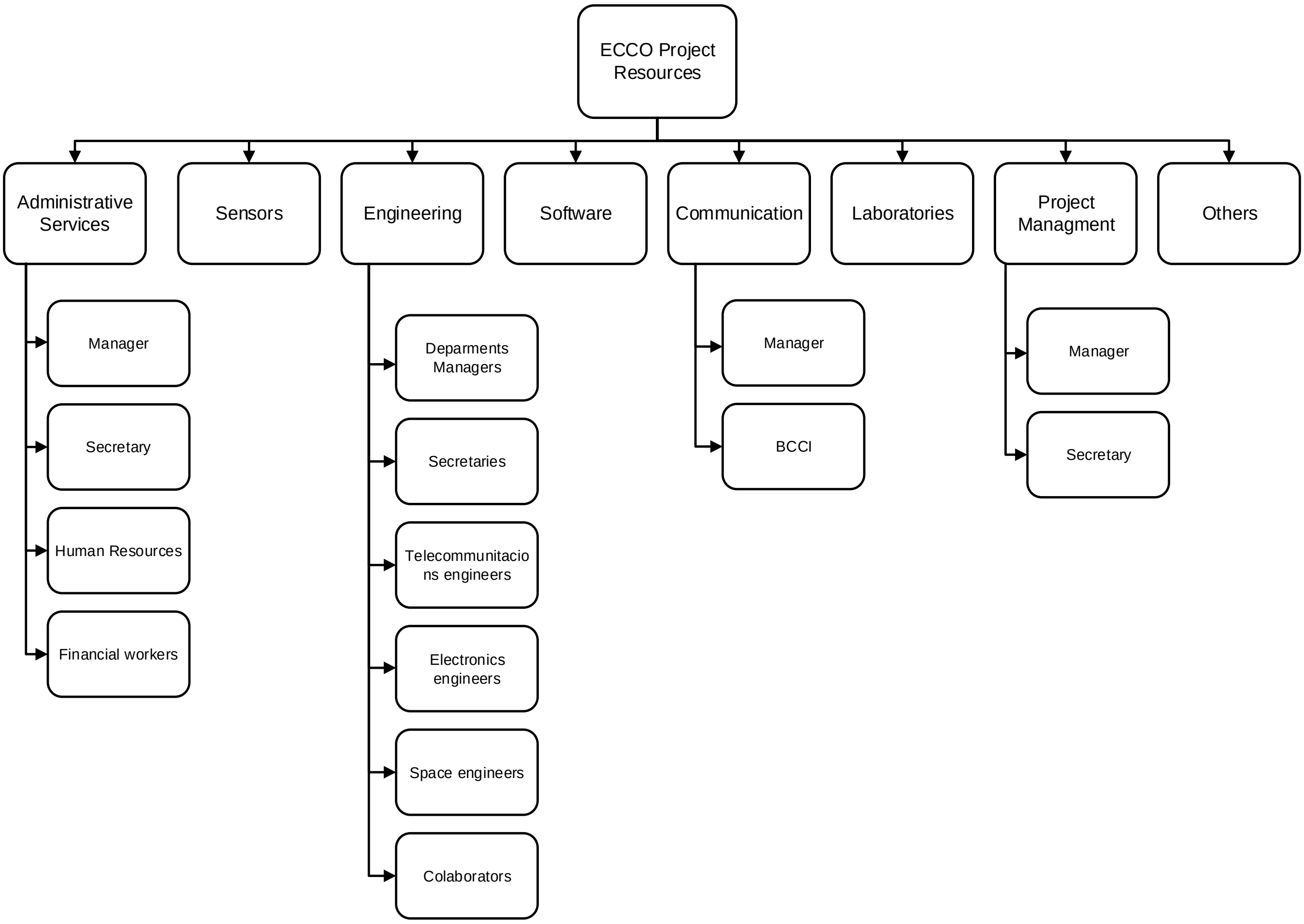


Figure 3. Resource breakdown structure

5. Estimate Activity Duration

For the estimation of the activity duration, the three point estimates method has been followed. Three different estimations are done for each task and then with the weighting equation the expected duration time is obtained.

In the table below the estimate activity duration for the ECCO project is presented.

Table 10. List of three point estimates

Three point estimates					
WBS ID	**Optimistic duration**	**Most likely duration**	**Pessimistic duration**	**Weighting equation**	**Expected duration estimate**
PM	**Project Management**				
PM.1	20	30	40	(o+4m+p)/6	30
PM.2	950	1000	1494	(o+4m+p)/6	1074
PM.3	20	30	40	(o+4m+p)/6	30
AS	**Administrative Services**				
AS.1	7	10	43	(o+4m+p)/6	15
AS.2	950	1000	1584	(o+4m+p)/6	1089
AS.3	20	30	40	(o+4m+p)/6	30
AS.4	950	1000	1494	(o+4m+p)/6	1074
PN	**Partnership and Network**				
PN.1	950	1000	1494	(o+4m+p)/6	1074
PN.2	950	1000	1494	(o+4m+p)/6	1074
C	**Dissemination**				
C.1	950	1000	1494	(o+4m+p)/6	1074
C.2	950	1000	1494	(o+4m+p)/6	1074
C.3	680	720	1240	(o+4m+p)/6	800
C.4	680	720	1240	(o+4m+p)/6	800
C.5	680	720	1240	(o+4m+p)/6	800
PD	**Preliminary Design**				
PD.M	**Mission Design**				
PD.M.SA.1	10	15	50	(o+4m+p)/6	20
PD.M.SA.2	10	15	20	(o+4m+p)/6	15
PD.M.1	10	15	20	(o+4m+p)/6	15
PD.M.2	25	30	35	(o+4m+p)/6	30
PD.M.3	15	20	25	(o+4m+p)/6	20
PD.C	**Communication**				

Three point estimates					
WBS ID	**Optimistic duration**	**Most likely duration**	**Pessimistic duration**	**Weighting equation**	**Expected duration estimate**
PD.C.SA.1	10	15	20	(o+4m+p)/6	15
PD.C.SA.2	15	20	25	(o+4m+p)/6	20
PD.C.SA.3	10	15	50	(o+4m+p)/6	20
PD.C.SA.4	10	15	20	(o+4m+p)/6	15
PD.C.HW.1	10	15	20	(o+4m+p)/6	15
PD.C.HW.2	20	25	60	(o+4m+p)/6	30
PD.C.HW.3	10	15	20	(o+4m+p)/6	15
PD.C.HW.4	20	30	40	(o+4m+p)/6	30
PD.C.SW.1	30	40	50	(o+4m+p)/6	40
PD.C.SW.2	20	30	40	(o+4m+p)/6	30
PD.N	**Navigation**				
PD.N.SA.1	10	15	20	(o+4m+p)/6	15
PD.N.SA.2	15	20	25	(o+4m+p)/6	20
PD.N.SA.3	10	15	20	(o+4m+p)/6	15
PD.N.HW.1	15	20	25	(o+4m+p)/6	20
PD.N.SW.1	25	35	75	(o+4m+p)/6	40
PD.P	**Propulsion**				
PD.P.SA.1	10	15	20	(o+4m+p)/6	15
PD.P.SA.2	15	20	25	(o+4m+p)/6	20
PD.P.SA.3	15	20	25	(o+4m+p)/6	20
PD.P.SA.4	15	20	25	(o+4m+p)/6	20
PD.P.HW.1	10	15	20	(o+4m+p)/6	15
PD.P.HW.2	30	35	70	(o+4m+p)/6	40
PD.P.HW.3	30	40	50	(o+4m+p)/6	40
PD.P.HW.4	30	40	50	(o+4m+p)/6	40
PD.P.SW.1	25	30	95	(o+4m+p)/6	40
PD.P.SW.2	30	40	50	(o+4m+p)/6	40
PD.ME	**Mechanical**				
PD.ME.SA.1	25	38	63	(o+4m+p)/6	40
PD.ME.SA.2	15	20	205	(o+4m+p)/6	50
PD.ME.SA.3	15	20	205	(o+4m+p)/6	50
PD.ME.SA.4	15	20	205	(o+4m+p)/6	50
PD.ME.1	25	30	95	(o+4m+p)/6	40
PD.ME.ST.1	35	40	105	(o+4m+p)/6	50
PD.ME.ST.2	35	40	105	(o+4m+p)/6	50
PD.ME.T.1	35	40	45	(o+4m+p)/6	40

Three point estimates					
WBS ID	**Optimistic duration**	**Most likely duration**	**Pessimistic duration**	**Weighting equation**	**Expected duration estimate**
PD.ME.T.2	35	40	45	(o+4m+p)/6	40
PD.E	**Electronics**				
PD.E.SA.1	7	10	13	(o+4m+p)/6	10
PD.E.SA.2	7	10	13	(o+4m+p)/6	10
PD.E.HW.1	7	10	73	(o+4m+p)/6	20
PD.E.HW.2	40	50	60	(o+4m+p)/6	50
PD.E.HW.3	40	50	60	(o+4m+p)/6	50
PD.E.HW.4	7	10	13	(o+4m+p)/6	10
PD.E.HW.5	7	10	13	(o+4m+p)/6	10
FD	**Final Design**				
FD.C	**Communication Detailed Design**				
FD.C.HW.1	100	120	140	(o+4m+p)/6	120
FD.C.HW.2	100	120	140	(o+4m+p)/6	120
FD.C.HW.3	80	90	100	(o+4m+p)/6	90
FD.C.SW.1	80	90	280	(o+4m+p)/6	120
FD.C.SW.2	80	90	100	(o+4m+p)/6	90
FD.C.SW.3	50	60	70	(o+4m+p)/6	60
FD.C.SW.4	80	90	160	(o+4m+p)/6	100
FD.N	**Navigation Detailed Design**				
FD.N.HW.1	50	60	130	(o+4m+p)/6	70
FD.N.HW.2	25	30	95	(o+4m+p)/6	40
FD.N.SW.1	50	60	70	(o+4m+p)/6	60
FD.N.SW.2	50	60	70	(o+4m+p)/6	60
FD.N.SW.3	60	80	100	(o+4m+p)/6	80
FD.P	**Propulsion Detailed Design**				
FD.P.HW.1	50	60	190	(o+4m+p)/6	80
FD.P.HW.2	50	60	190	(o+4m+p)/6	80
FD.P.HW.3	50	60	70	(o+4m+p)/6	60
FD.P.SW.1	60	80	-20	(o+4m+p)/6	60
FD.P.SW.2	60	80	-20	(o+4m+p)/6	60
FD.ME	**Mechanical Detailed Design**				
FD.ME.MD.1	15	20	205	(o+4m+p)/6	50
FD.ME.MD.2	80	90	160	(o+4m+p)/6	100
FD.ME.MD.3	50	60	70	(o+4m+p)/6	60
FD.ME.MD.4	80	90	100	(o+4m+p)/6	90
FD.ME.ID.1	15	20	145	(o+4m+p)/6	40

Three point estimates					
WBS ID	**Optimistic duration**	**Most likely duration**	**Pessimistic duration**	**Weighting equation**	**Expected duration estimate**
FD.ME.ID.2	80	90	160	(o+4m+p)/6	100
FD.ME.ID.3	50	60	70	(o+4m+p)/6	60
FD.ME.ID.4	80	90	100	(o+4m+p)/6	90
FD.E	**Electronics Detailed Design**				
FD.E.HW.1	50	60	70	(o+4m+p)/6	60
FD.E.HW.2	50	60	70	(o+4m+p)/6	60
FD.E.HW.3	80	90	322	(o+4m+p)/6	127
T	**Test and Validations**				
T.C	**Communications**				
T.C.1	90	100	230	(o+4m+p)/6	120
T.C.2	90	100	230	(o+4m+p)/6	120
T.C.3	70	80	90	(o+4m+p)/6	80
T.N	**Navigation**				
T.N.1	80	90	40	(o+4m+p)/6	80
T.P	**Propulsion**				
T.P.1	70	80	-90	(o+4m+p)/6	50
T.ME	**Mechanical**				
T.ME.1	70	80	90	(o+4m+p)/6	80
T.E	**Electronics**				
T.E.1	80	90	40	(o+4m+p)/6	80
T.A	**Data acquisition**				
T.A.1	30	40	50	(o+4m+p)/6	40
T.A.2	50	60	70	(o+4m+p)/6	60

6. Project Schedule

The project schedule of the ECCO project contains the start and finish dates of the different tasks and a summary of the whole project. For the ECCO project, a Gantt chart has been developed. Since there are many tasks, the diagram is complex and big. In the next page the Gantt chart can be found.

Id	Nombre de tarea	Nombres de los recursos	Comienzo	Fin
0	**ECCO**		**lun 23/03/15**	**mié 18/04/18**
1	Kick-Off meeting	[illegible]	lun 23/03/15	lun 23/03/15
2	**Project Management**	[illegible]	[illegible]	[illegible]
3	Project Management Plan		[illegible]	[illegible]
4	Project Management Plan Deliverable		[illegible]	[illegible]
5	Monitoring of project evolution		[illegible]	[illegible]
6	Preliminary Design Review		[illegible]	[illegible]
7	Intermediate Meeting	[illegible]	[illegible]	[illegible]
8	**Administrative Services**	[illegible]	[illegible]	[illegible]
9	Human resources initial plan	[illegible]	[illegible]	[illegible]
10	Monitoring of human resources evolution	[illegible]	[illegible]	[illegible]
11	Financial plan	[illegible]	[illegible]	[illegible]
12	Monitoring of financial evolution	[illegible]	[illegible]	[illegible]
13	**Partnership and network**	[illegible]	[illegible]	[illegible]
14	Coordination and cooperative control		[illegible]	[illegible]
15	Stakeholders contact control		[illegible]	[illegible]
16	**Dissemination**	[illegible]	[illegible]	[illegible]
17	Publishing and meetings		[illegible]	[illegible]
18	Press communications		[illegible]	[illegible]
19	Conferences		[illegible]	[illegible]
20	Public relations, outreach and education		[illegible]	[illegible]
21	Media, social media and web		[illegible]	[illegible]
22	ICECO Day 1	[illegible]	[illegible]	[illegible]
23	ICECO Day 2	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]
25	The Japan International Aerospace Exhibition	[illegible]	[illegible]	[illegible]
26	Airshow China	[illegible]	[illegible]	[illegible]
27	International Paris Air Show at Bourget	[illegible]	[illegible]	[illegible]
28	SPIE Remote Sensing Toulouse	[illegible]	[illegible]	[illegible]
29	**Engineering**		[illegible]	[illegible]
30	**Preliminary Design**		[illegible]	[illegible]
31	**Mission Design**	**Mission Design Dept. Manager;M**	**mar 24/03/15**	**lun 29/06/15**
32	**State of the art**		**mar 24/03/15**	**lun 11/05/15**
33	Analyse mission requirements	Space engineer 1[50%];Space engineer 2[50%]	mar 24/03/15	lun 20/04/15
34	Research and analyse corrent earth orbit observations	Space engineer 1[50%];Space engineer 2[50%]	mar 21/04/15	lun 11/05/15
35	Select optimum orbital paràmetres	Space engineer 1;STK Software[1];Space engineer 2	mar 12/05/15	lun 01/06/15
36	Specify technological requirements	Space engineer 1;Space engineer 3;STK Software[1]	mar 02/06/15	lun 29/06/15
37	Specify incremental Deployment requirements	Space engineer 2;Space engineer 4;STK	mar 02/06/15	lun 29/06/15
38	Report of results and conclusions		lun 29/06/15	lun 29/06/15
39	**Communication**	**Communications and Electronics**	**mar 30/06/15**	**lun 21/12/15**
40	**State of the art**		**mar 30/06/15**	**lun 31/08/15**
41	Analyse work environament	Telecommunications engineer 1[50%];Space engineer 1[50%]	mar 30/06/15	lun 20/07/15
42	Analyse modules communication requirements	Telecommunications engineer 1[50%];Space engineer 1[50%]	mar 21/07/15	lun 10/08/15
43	Analyse ground – Space Communications requirements	Telecommunications engineer 1[50%];Space engineer 1[50%]	mar 21/07/15	lun 10/08/15
44	Analyse power transmission requirements	Orbital ATK Collaboration[4.500,00 €];Telecommunications engineer	mar 11/08/15	lun 31/08/15
45	**Hardware**		**mar 01/09/15**	**lun 12/10/15**
46	Select modules communication System	Space engineer 1;Telecommunications engineer	mar 01/09/15	lun 14/09/15
47	Modules communicatin System	Space engineer 1;Telecommunications engineer	mar 15/09/15	lun 12/10/15
48	Select ground – space communication system	Telecommunications engineer 2;Space engineer 2	mar 01/09/15	lun 14/09/15
49	Ground – space communication system	Telecommunications engineer 2;Space engineer 2	mar 15/09/15	lun 12/10/15
50	**Software**		**mar 13/10/15**	**lun 21/12/15**
51	Communication control software	Software engineer 1[50%];Space engineer	mar 13/10/15	lun 23/11/15
52	Simulation program	Software engineer 1[50%];Space engineer	mar 24/11/15	lun 21/12/15
53	Report of results and conclusions		lun 21/12/15	lun 21/12/15
54	**Navigation**	**Mission Design and Payloads De**	**mar 30/06/15**	**vie 13/11/15**
55	**State of the art**		**mar 30/06/15**	**lun 31/08/15**
56	Analyse work environment	Space engineer 1[50%];Telecommunications	mar 30/06/15	lun 20/07/15
57	Analyse navigation requirements	Telecommunications engineer 2[50%];Space engineer 2[50%]	mar 21/07/15	lun 10/08/15
58	Analyse attitude propulsion requirements	Space engineer 1[50%];Telecommunications	mar 11/08/15	lun 31/08/15
59	**Hardware**		**lun 14/09/15**	**vie 02/10/15**
60	Attitude control requirements	Space engineer 3;Telecommunications engineer	lun 14/09/15	vie 02/10/15
61	**Software**		**lun 05/10/15**	**vie 13/11/15**
62	Navigation and attitude control software	Software engineer 1[50%];Space engineer	lun 05/10/15	vie 13/11/15
63	Report of results and conclusions		vie 13/11/15	vie 13/11/15
64	**Propulsion**	**Propulsion Dept. Manager;Mech**	**mar 01/09/15**	**lun 14/03/16**
65	**State of the art**		**mar 01/09/15**	**lun 26/10/15**
66	Analyse available propulsion Systems	Space engineer 4	mar 01/09/15	lun 21/09/15
67	Analyse power unit requirements	Orbital ATK Collaboration[6.000,00 €];Space	mar 01/09/15	lun 28/09/15
68	Analyse power unit transmission requirements	Orbital ATK Collaboration[6.000,00 €];Space engineer 4	mar 29/09/15	lun 26/10/15
69	Analyse power unit receivers requirements	Orbital ATK Collaboration[6.000,00 €];Space	mar 29/09/15	lun 26/10/15
70	**Hardware**		**mar 10/11/15**	**lun 01/02/16**
71	Select a suitable propulsion System and its peripherals	Space engineer 2[50%];Space engineer 4[50%]	mar 10/11/15	lun 30/11/15
72	Propulsion Systems	Space engineer 4	mar 01/12/15	lun 11/01/16
73	Power unit System	Space engineer 5;Orbital ATK Col	mar 10/11/15	lun 21/12/15
74	Power storage System	Space engineer 5	mar 22/12/15	lun 01/02/16
75	**Software**		**mar 02/02/16**	**lun 14/03/16**
76	Power control software	Software engineer 1;Space engin	mar 02/02/16	lun 14/03/16
77	Propulsion control software	Software engineer 2;Space engineer 2	mar 02/02/16	lun 14/03/16
78	Report of results and conclusions		lun 14/03/16	lun 14/03/16
79	**Mechanical**	**Mechanical Dept. Manager;Mec**	**mar 02/02/16**	**lun 23/05/16**
80	**State of the art**		**mar 02/02/16**	**lun 14/03/16**
81	Analyse work environment	Space engineer 1[50%]	mar 02/02/16	lun 22/02/16
82	Analyse estructural effects on Earth observation satelites	Space engineer 1[50%]	mar 23/02/16	lun 14/03/16
83	Analyse thermal effects on Earth observation satellites	Stuttgart University Collaboration;Space engineer 1[50%]	mar 23/02/16	lun 14/03/16
84	Analyse radiation effects on Earth observation satellites	Space engineer 3[50%]	mar 23/02/16	lun 14/03/16
85	Integration of sub-systems	Catia Software[1];Space engineer	mar 15/03/16	lun 25/04/16
86	**Structural Design**		**mar 26/04/16**	**lun 23/05/16**
87	Structural design of insfrastructure modules	ANSYS Workbench Software[1];Catia	mar 26/04/16	lun 23/05/16
88	Structural design of payload modules	ANSYS Workbench Software[1];Catia	mar 26/04/16	lun 23/05/16
89	**Thermal Design**		**mar 26/04/16**	**lun 23/05/16**
90	Payload insulation	Stuttgart University Collaboratio	mar 26/04/16	lun 23/05/16
91	Infrastructure insulation	Stuttgart University Collaboratio	mar 26/04/16	lun 23/05/16
92	Report of results and conclusions		lun 23/05/16	lun 23/05/16
93	**Electronics**	**Communications and Electronics**	**lun 27/07/15**	**lun 21/12/15**
94	**State of the art**		**lun 27/07/15**	**vie 21/08/15**
95	Analyse work environament	Electronics engineer 1	lun 27/07/15	vie 07/08/15
96	Analyse electronic requirements	Electronics engineer 1	lun 10/08/15	vie 21/08/15
97	**Hardware**		**lun 24/08/15**	**lun 21/12/15**
98	Select suitable electronic components	Electronics engineer 1[50%];Electronics engineer	mar 13/10/15	lun 09/11/15
99	Payload modules electronic Systems	Electronics engineer 1[50%];Electronics engineer	mar 10/11/15	lun 21/12/15
100	Infrastructures electronic systems	Electronics engineer 1[50%];Electronics engineer	mar 10/11/15	lun 21/12/15
101	Determine the sensors requirements	Electronics engineer 1	lun 24/08/15	vie 11/09/15
102	Contact and specify sensors from developers	Electronics engineer 1	lun 14/09/15	vie 09/10/15
103	Report of results and conclusions		lun 21/12/15	lun 21/12/15
104	Preliminary Design Report		lun 23/05/16	lun 23/05/16
105	**Final Design**		**mar 26/04/16**	**mié 06/09/17**
106	**Communication Detailed Design**	**Communications and Electronics Dept.**	**mar 26/04/16**	**jue 03/11/16**
107	**Hardware**		**mar 26/04/16**	**vie 15/07/16**
108	Modules communication system	Southampton University Collaboration;Telecommunicatio	mar 26/04/16	vie 15/07/16
109	Ground-space communication System	Telecommunications engineer 2[50%];Space engineer	mar 26/04/16	vie 15/07/16
110	Power transmission system	Orbital ATK Collaboration[12.000,00	mar 26/04/16	vie 17/06/16
111	**Software**		**lun 15/08/16**	**jue 03/11/16**
112	Protocol Communications	Telecommunications engineer 1;Southampton University	lun 15/08/16	jue 20/10/16
113	Information control management software	Visual Studio[1];Software engineer 2;Telecommunications	lun 15/08/16	jue 03/11/16
114	Power transmission control System	Software engineer 1;Visual Studio[1];Telecommunications	lun 15/08/16	jue 20/10/16
115	Communication Simulator program	Visual Studio[1];Telecommunications	lun 15/08/16	jue 03/11/16
116	Report of results and conclusions		jue 03/11/16	jue 03/11/16
117	**Navigation Detailed Design**	**Mission Design and Payloads De**	**mar 26/04/16**	**mié 25/01/17**
118	**Hardware Design**		**mar 26/04/16**	**vie 12/08/16**
119	Attitude sensors	Telecommunications engineer 4[	mar 26/04/16	vie 17/06/16
120	Attitude control Systems	Telecommunications engineer 4[	lun 20/06/16	vie 12/08/16
121	**Software Design**		**lun 15/08/16**	**mié 25/01/17**
122	Constellation navigation control software	Telecommunications engineer 4[50%];Space engineer	lun 15/08/16	vie 07/10/16
123	Module attitude control software	Telecommunications engineer 4[50%];Space engineer	lun 15/08/16	jue 03/11/16
124	Navigation and attitude Simulator software	Telecommunications engineer 4[50%];Space engineer	vie 04/11/16	mié 25/01/17
125	Report of results and conclusions		mié 25/01/17	mié 25/01/17
126	**Propulsion Detailed Design**	**Propulsion Dept. Manager;Mech**	**vie 04/11/16**	**mié 17/05/17**
127	**Hardware Design**		**vie 04/11/16**	**mié 22/03/17**
128	Propulsion systems	**Space engineer 1**	vie 04/11/16	mié 25/01/17
129	Power unit system	Orbital ATK Collaboration[9.000,(	vie 04/11/16	mié 25/01/17
130	Power storage system	Space engineer 1	jue 26/01/17	mié 22/03/17
131	**Software**		**jue 23/03/17**	**mié 17/05/17**
132	Power control software	Software engineer 1;Space engin	jue 23/03/17	mié 17/05/17
133	Propulsion control software	Software engineer 2;Space engineer 1[50%]	jue 23/03/17	mié 17/05/17
134	Report of results and conclusions		mié 17/05/17	mié 17/05/17
135	**Mechanical Detailed Design**	**Mechanical Dept. Manager;Mec**	**jue 23/03/17**	**mié 06/09/17**
136	**Module Design**		**jue 23/03/17**	**mié 06/09/17**
137	Material selection	**Ball Aerospace Collaboration;Space engineer**	jue 23/03/17	mié 19/04/17
138	Module structure	ANSYS Workbench Software[1];C	jue 20/04/17	mié 12/07/17
139	Thermal insulation	ANSYS Workbench Software[1];Catia	jue 13/07/17	mié 06/09/17
140	Sub-systems Integration	Catia Software[1];Space engineer	jue 20/04/17	mié 12/07/17
141	**Infrastructure Design**		**jue 23/03/17**	**mié 06/09/17**
142	Material selection	**Ball Aerospace Collaboration;Space engineer**	jue 23/03/17	mié 19/04/17
143	Module structure	ANSYS Workbench Software[1];C	jue 20/04/17	mié 12/07/17
144	Thermal insulation	ANSYS Workbench Software[1];Catia	jue 13/07/17	mié 06/09/17
145	Sub-systems Integration	Catia Software[1];Space engineer	jue 20/04/17	mié 12/07/17
146	Report of results and conclusions		mié 06/09/17	mié 06/09/17
147	**Electronic Detailed Design**	**Communications and Electronics**	**lun 18/07/16**	**mié 22/02/17**
148	**Hardware Design**		**lun 18/07/16**	**mié 22/02/17**
149	Payload modules electronic Systems	Electronics engineer 1[50%];Electronics engineer	vie 04/11/16	mié 22/02/17
150	Infrastructures electronic systems	Electronics engineer 1[50%];Electronics engineer	vie 04/11/16	mié 22/02/17
151	Selection and integration of sensors	Electronics engineer 1[50%];Electronics engineer	lun 18/07/16	jue 03/11/16
152	Report of results and conclusions		mié 22/02/17	mié 22/02/17
153	**Test and Validations**		**lun 05/12/16**	**mar 17/04/18**
154	**Communication**	**Communications Dept. Manager**	**lun 05/12/16**	**vie 24/03/17**
155	Test and validation for communication satellite-satellite	Communication laboratory[14.545,45 €];Keysight ADS	lun 05/12/16	vie 24/03/17
156	Test and validation for communication ground-satellite	Communication laboratory[14.545,45 €];Keysight ADS	lun 05/12/16	vie 24/03/17
157	Test and validation for power transmission	Communication laboratory[10.909,10 €];Space	lun 05/12/16	vie 24/02/17
158	Report of results and conclusions		vie 24/03/17	vie 24/03/17
159	**Navigation**	**Mission Design and Payloads De**	**jue 26/01/17**	**mié 19/04/17**
160	Test and validation of the navigation, attitude and control system using computer simulated programs	Integration laboratory - ATT Collaboration[30.000,00 €];STK Software[1];Visual Studio[1];Space engineer 6	jue 26/01/17	mié 19/04/17
161	Report of results and conclusions		mié 19/04/17	mié 19/04/17
162	**Propulsion**	**Propulsion Dept. Manager;Mech**	**jue 18/05/17**	**mié 09/08/17**
163	Test and validation of the propulsion system using computer simulated programs	ANSYS Workbench Software[1];Space engineer 1	jue 18/05/17	mié 09/08/17
164	Report of results and conclusions		mié 09/08/17	mié 09/08/17
165	**Mechanical**	**Mechanical Dept. Manager;Mec**	**jue 07/09/17**	**mar 28/11/17**
166	Test and validation using computer simulation programs	ANSYS Workbench Software[1];Space engineer 1	jue 07/09/17	mar 28/11/17
167	Report of results and conclusions		mar 28/11/17	mar 28/11/17
168	**Electronics**	**Communications and Electronics**	**jue 23/02/17**	**mié 17/05/17**
169	Test and validation using computer simulation programs	Electronics laboratory - UPV Collaboration[12.000,00 €];Electronics engineer 1;Space	jue 23/02/17	mié 17/05/17
170	Report of results and conclusions		mié 17/05/17	mié 17/05/17
171	**Data acquisition**	**Communications Dept. Manager**	**mié 29/11/17**	**mar 17/04/18**
172	Validation of signal quality	Communication laboratory;Telec	mié 29/11/17	mar 23/01/18
173	Test and validation for 3D mapping and new acquisition modes developed	Matlab R2015b[1];Politechnical University of Catalonia Collaboration;Software engineer 1;Telecommunications engineer	mié 24/01/18	mar 17/04/18
174	Report of results and conclusions about possible benefits related to climate change		mar 17/04/18	mar 17/04/18
175	Final report		mar 17/04/18	mar 17/04/18
176	Final meeting	Dissemination Manager;Commur	mié 18/04/18	mié 18/04/18

7. Activity Attributes

In the *ANNEX I* there is a table for each activity, where a summary of all the important attributes of the task can be found.

The following table is an example of the information tables that can be found in the *ANNEX I.*

<table>
<tr><td colspan="3">ID:</td><td colspan="4">Activity:</td></tr>
<tr><td colspan="7">Description of Work:</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td colspan="2">Relationship</td><td>Lag</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Number and Type of Resources Required:</td><td colspan="3">Skill Requirements:</td><td colspan="2">Other Required Resources:</td></tr>
<tr><td colspan="7">Type of Effort:</td></tr>
<tr><td colspan="7">Location of Performance:</td></tr>
<tr><td colspan="7">Constraints:</td></tr>
<tr><td colspan="7">Assumptions:</td></tr>
</table>

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ETSEIAT

Departament de Projectes d'Enginyeria

EARTH CLIMATE CHANGE OBSERVATION

ECCO

Cost and Procurement Management

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1. Cost estimating

1.1. Level of accuracy

Due to the high numbers that are going to be used to estimate costs of each task, it is interesting to define how values will be rounded.

In this case is selected to round all values to tens.

1.2. Cost estimation worksheet

In the table below, the estimation costs for each task are exposed. A three point estimate methodology has been used.

Table 1. List of three point estimates

Three Point Estimates					
WBS ID	**Optimistic cost (m.u.)**	**Most Likely Cost (m.u.)**	**Pessimistic Cost (m.u.)**	**Weighting Equation**	**Expected Cost Estimate (€)**
START	3,500 €	3,730 €	3,960 €	(o+4m+p)/4	3,730 €
PM	**Project Management**				**439,210 €**
PM.1	0 €	12,030 €	24,050 €	(o+4m+p)/5	12,030 €
PM.2	0 €	415,150 €	830,300 €	(o+4m+p)/6	415,150 €
PM.3	0 €	12,030 €	24,050 €	(o+4m+p)/6	12,030 €
AS	**Administrative Services**				**383,760 €**
AS.1	1,200 €	2,700 €	4,200 €	(o+4m+p)/6	2,700 €
AS.2	80,000 €	189,180 €	298,360 €	(o+4m+p)/6	189,180 €
AS.3	2,200 €	5,400 €	8,600 €	(o+4m+p)/6	5,400 €
AS.4	80,000 €	186,480 €	292,960 €	(o+4m+p)/6	186,480 €
PN	**Partnership and Network**				**290,080 €**
PN.1	0 €	145,040 €	290,080 €	(o+4m+p)/6	145,040 €
PN.2	0 €	145,040 €	290,080 €	(o+4m+p)/6	145,040 €
C	**Communications**				**315,210 €**
C.1	0 €	64,360 €	128,710 €	(o+4m+p)/6	64,360 €
C.2	0 €	64,360 €	128,710 €	(o+4m+p)/6	64,360 €
C.3	0 €	49,700 €	99,390 €	(o+4m+p)/6	49,700 €
C.4	0 €	49,700 €	99,390 €	(o+4m+p)/6	49,700 €
C.5	0 €	49,700 €	99,390 €	(o+4m+p)/6	49,700 €
REP.C.1	15,200 €	16,560 €	17,910 €	(o+4m+p)/6	16,560 €
REP.C.2	17,500 €	20,830 €	24,150 €	(o+4m+p)/6	20,830 €

Three Point Estimates					
WBS ID	**Optimistic cost (m.u.)**	**Most Likely Cost (m.u.)**	**Pessimistic Cost (m.u.)**	**Weighting Equation**	**Expected Cost Estimate (€)**
PD	**Preliminary Design**				**743,590 €**
PD.M	**Mission Design**				**68,350 €**
PD.M.SA.1	8,500 €	14,340 €	20,180 €	(o+4m+p)/6	14,340 €
PD.M.SA.2	6,450 €	10,760 €	15,060 €	(o+4m+p)/6	10,760 €
PD.M.1	6,300 €	10,760 €	15,210 €	(o+4m+p)/6	10,760 €
PD.M.2	13,200 €	21,510 €	29,810 €	(o+4m+p)/6	21,510 €
PD.M.3	5,100 €	10,980 €	16,860 €	(o+4m+p)/6	10,980 €
PD.C	**Communication**				**165,570 €**
PD.C.SA.1	3,000 €	7,510 €	12,010 €	(o+4m+p)/6	7,510 €
PD.C.SA.2	4,200 €	10,010 €	15,810 €	(o+4m+p)/6	10,010 €
PD.C.SA.3	4,100 €	10,010 €	15,910 €	(o+4m+p)/6	10,010 €
PD.C.SA.4	5,840 €	10,390 €	14,930 €	(o+4m+p)/6	10,390 €
PD.C.HW.1	6,500 €	10,870 €	15,230 €	(o+4m+p)/6	10,870 €
PD.C.HW.2	14,670 €	23,410 €	32,140 €	(o+4m+p)/6	23,410 €
PD.C.HW.3	4,900 €	10,870 €	16,830 €	(o+4m+p)/6	10,870 €
PD.C.HW.4	11,500 €	21,730 €	31,950 €	(o+4m+p)/6	21,730 €
PD.C.SW.1	19,450 €	32,550 €	45,650 €	(o+4m+p)/6	32,550 €
PD.C.SW.2	16,710 €	28,220 €	39,740 €	(o+4m+p)/6	28,220 €
PD.N	**Navigation**				**84,000 €**
PD.N.SA.1	3,000 €	8,400 €	13,800 €	(o+4m+p)/6	8,400 €
PD.N.SA.2	4,200 €	11,200 €	18,200 €	(o+4m+p)/6	11,200 €
PD.N.SA.3	3,000 €	8,400 €	13,800 €	(o+4m+p)/6	8,400 €
PD.N.HW.1	8,560 €	15,680 €	22,800 €	(o+4m+p)/6	15,680 €
PD.N.SW.1	24,670 €	40,320 €	55,970 €	(o+4m+p)/6	40,320 €
PD.P	**Propulsion**				**157,000 €**
PD.P.SA.1	3,100 €	6,580 €	10,060 €	(o+4m+p)/6	6,580 €
PD.P.SA.2	8,000 €	12,610 €	17,220 €	(o+4m+p)/6	12,610 €
PD.P.SA.3	6,200 €	10,690 €	15,180 €	(o+4m+p)/6	10,690 €
PD.P.SA.4	5,950 €	10,690 €	15,430 €	(o+4m+p)/6	10,690 €
PD.P.HW.1	6,150 €	9,940 €	13,730 €	(o+4m+p)/6	9,940 €
PD.P.HW.2	8,500 €	17,540 €	26,570 €	(o+4m+p)/6	17,540 €
PD.P.HW.3	15,670 €	25,220 €	34,760 €	(o+4m+p)/6	25,220 €
PD.P.HW.4	8,500 €	17,540 €	26,570 €	(o+4m+p)/6	17,540 €
PD.P.SW.1	17,000 €	26,270 €	35,540 €	(o+4m+p)/6	26,270 €
PD.P.SW.2	17,500 €	26,500 €	35,490 €	(o+4m+p)/6	26,500 €

Three Point Estimates					
WBS ID	**Optimistic cost (m.u.)**	**Most Likely Cost (m.u.)**	**Pessimistic Cost (m.u.)**	**Weighting Equation**	**Expected Cost Estimate (€)**
PD.ME	**Mechanical**				**128,080 €**
PD.ME.SA.1	4,100 €	10,390 €	16,670 €	(o+4m+p)/6	10,390 €
PD.ME.SA.2	5,000 €	12,980 €	20,960 €	(o+4m+p)/6	12,980 €
PD.ME.SA.3	6,700 €	14,440 €	22,170 €	(o+4m+p)/6	14,440 €
PD.ME.SA.4	5,150 €	12,980 €	20,810 €	(o+4m+p)/6	12,980 €
PD.ME.1	17,100 €	23,830 €	30,550 €	(o+4m+p)/6	23,830 €
PD.ME.ST.2	10,950 €	18,580 €	26,210 €	(o+4m+p)/6	18,580 €
PD.ME.ST.1	10,500 €	18,580 €	26,660 €	(o+4m+p)/6	18,580 €
PD.ME.T.1	2,150 €	8,150 €	14,140 €	(o+4m+p)/6	8,150 €
PD.ME.T.2	2,150 €	8,150 €	14,140 €	(o+4m+p)/6	8,150 €
PD.E	**Electronics**				**140,590 €**
PD.E.SA.1	2,000 €	8,230 €	14,450 €	(o+4m+p)/6	8,230 €
PD.E.SA.2	2,000 €	8,230 €	14,450 €	(o+4m+p)/6	8,230 €
PD.E.HW.1	8,140 €	20,930 €	33,720 €	(o+4m+p)/6	20,930 €
PD.E.HW.2	10,970 €	41,130 €	71,280 €	(o+4m+p)/6	41,130 €
PD.E.HW.3	10,970 €	41,130 €	71,280 €	(o+4m+p)/6	41,130 €
PD.E.HW.4	4,150 €	10,470 €	16,780 €	(o+4m+p)/6	10,470 €
PD.E.HW.5	4,150 €	10,470 €	16,780 €	(o+4m+p)/6	10,470 €
FD	**Final Design**				**1,154,110 €**
FD.C	**Communication Detailed Design**				**277,680 €**
FD.C.HW.1	33,560 €	46,540 €	59,520 €	(o+4m+p)/6	46,540 €
FD.C.HW.2	20,560 €	30,410 €	40,260 €	(o+4m+p)/6	30,410 €
FD.C.HW.3	21,530 €	29,840 €	38,140 €	(o+4m+p)/6	29,840 €
FD.C.SW.1	37,480 €	44,490 €	51,500 €	(o+4m+p)/6	44,490 €
FD.C.SW.2	22,560 €	34,190 €	45,810 €	(o+4m+p)/6	34,190 €
FD.C.SW.3	10,350 €	16,330 €	22,300 €	(o+4m+p)/6	16,330 €
FD.C.SW.4	58,250 €	75,880 €	93,520 €	(o+4m+p)/6	75,880 €
FD.N	**Navigation Detailed Design**				**260,820 €**
FD.N.HW.1	19,450 €	41,370 €	63,290 €	(o+4m+p)/6	41,370 €
FD.N.HW.2	14,240 €	27,420 €	40,590 €	(o+4m+p)/6	27,420 €
FD.N.SW.1	36,570 €	60,010 €	83,440 €	(o+4m+p)/6	60,010 €
FD.N.SW.2	38,690 €	56,580 €	74,470 €	(o+4m+p)/6	56,580 €
FD.N.SW.3	48,320 €	75,440 €	102,560 €	(o+4m+p)/6	75,440 €
FD.P	**Propulsion Detailed Design**				**197,880 €**
FD.P.HW.1	16,000 €	43,620 €	71,230 €	(o+4m+p)/6	43,620 €
FD.P.HW.2	29,780 €	56,100 €	82,410 €	(o+4m+p)/6	56,100 €
FD.P.HW.3	11,470 €	32,720 €	53,960 €	(o+4m+p)/6	32,720 €

Three Point Estimates					
WBS ID	**Optimistic cost (m.u.)**	**Most Likely Cost (m.u.)**	**Pessimistic Cost (m.u.)**	**Weighting Equation**	**Expected Cost Estimate (€)**
FD.P.SW.1	25,350 €	32,720 €	40,080 €	(o+4m+p)/6	32,720 €
FD.P.SW.2	3,000 €	32,720 €	65,430 €	(o+4m+p)/6	32,720 €
FD.M	**Mechanical Detailed Design**				**213,960 €**
FD.ME.MD.1	18,460 €	28,820 €	39,170 €	(o+4m+p)/6	28,820 €
FD.ME.MD.2	5,150 €	18,430 €	31,710 €	(o+4m+p)/6	18,430 €
FD.ME.MD.3	11,380 €	20,020 €	28,660 €	(o+4m+p)/6	20,020 €
FD.ME.MD.4	26,470 €	46,110 €	65,740 €	(o+4m+p)/6	46,110 €
FD.ME.ID.1	15,430 €	23,060 €	30,680 €	(o+4m+p)/6	23,060 €
FD.ME.ID.2	14,780 €	28,190 €	41,590 €	(o+4m+p)/6	28,190 €
FD.ME.ID.3	3,140 €	11,060 €	18,980 €	(o+4m+p)/6	11,060 €
FD.ME.ID.4	26,470 €	38,270 €	50,060 €	(o+4m+p)/6	38,270 €
FD.E	**Electronic Detailed Design**				**203,770 €**
FD.E.HW.1	24,520 €	59,780 €	95,040 €	(o+4m+p)/6	59,780 €
FD.E.HW.2	23,420 €	59,780 €	96,140 €	(o+4m+p)/6	59,780 €
FD.E.HW.3	25,470 €	84,210 €	142,950 €	(o+4m+p)/6	84,210 €
T	**Test and Validations**				**308,910 €**
T.C	**Communications**				**95,620 €**
T.C.1	23,670 €	34,150 €	44,620 €	(o+4m+p)/6	34,150 €
T.C.2	23,670 €	34,150 €	44,620 €	(o+4m+p)/6	34,150 €
T.C.3	16,780 €	27,320 €	37,850 €	(o+4m+p)/6	27,320 €
T.N	**Navigation**				**30,360 €**
T.N.1	13,670 €	30,360 €	47,050 €	(o+4m+p)/6	30,360 €
T.P	**Propulsion**				**24,000 €**
T.P.1	10,960 €	24,000 €	37,040 €	(o+4m+p)/6	24,000 €
T.ME	**Mechanical**				**38,400 €**
T.ME.1	15,360 €	38,400 €	61,440 €	(o+4m+p)/6	38,400 €
T.E	**Electronics**				**56,400 €**
T.E.1	31,640 €	56,400 €	81,160 €	(o+4m+p)/6	56,400 €
T.A	**Data Acquisition**				**52,400 €**
T.A.1	9,230 €	20,240 €	31,250 €	(o+4m+p)/6	20,240 €
T.A.2	15,630 €	32,160 €	48,690 €	(o+4m+p)/6	32,160 €
FINISH	10,230 €	11,730 €	13,230 €	(o+4m+p)/6	11,730 €

1.3. Activity cost estimation

For the activity cost estimation the model grant agreement for the Horizon 2020 projects has been followed. There are 4 different types of cost:

- Cost from direct personnel
- Cost of subcontracting
- Other direct costs
- Indirect costs

They can be ordered in two categories, direct and indirect costs. The direct costs include the personnel costs, travel costs, equipment for the project, cost of subcontracting, and other types of direct costs. The indirect costs include telephone bills, cost of renting, heating …

For simplicity, in H2020 the European Commission decided that for the indirect costs a flat rate of 25% of the direct costs would be applied. Therefore, the direct cost has been obtained and then the indirect cost comes from taking the 25% to that value. Finally, the total cost of the activity is the sum of both quantities.

The reserve has a different percentage depending on the confidence level of the activity. The applied values are:

- For Non-critical activities: 5%
- For Semi-critical activities: 15%
- For Critical activities: 21%

These percentages has been selected to ensure that, in case of some failures, there are enough cash to solve it and continue with the expected schedule, or at least, with the minimum delay.

The critical activities are the ones found in the critical path. The semi-critical activities are close to the critical path, but without much time for delays. Finally, the rest of the activities are non-critical.

Being aware that the outsourcing of the sensors was the most critical activity, a contingency plan for this tasks has been planned. In order to reduce the risk and criticality of these tasks, the outsourcing of the sensors will start as soon as possible, so there is enough time in case of delays.

In the following table there is the list of the activity cost estimation.

Table 2. List of activity cost estimation

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
START	C.M;E.CD.M;E.ED.M; E.MDD.M;E.PD.M;PM.S;PM.M;EO	2,990 €	750 €	420 €	3,730 €	4,150 €	460 €	VHC
PM	**Project Management**							
PM.1	SOFT.6;PM.S;PM.M;PM.EXT	9,620 €	2,410 €	1,360 €	12,030 €	13,380 €	24,050 €	MC
PM.2	SOFT.6;PM.S;PM.M;PM.EXT	332,120 €	83,030 €	46,690 €	415,150 €	461,840 €	830,300 €	MC
PM.3	SOFT.6;PM.S;PM.M;PM.EXT	9,620 €	2,410 €	1,360 €	12,030 €	13,380 €	24,050 €	MC
AS	**Administrative Services**							
AS.1	AS.M;AS.S; HR.W	2,160 €	540 €	310 €	2,700 €	3,010 €	3,000 €	VHC
AS.2	AS.M;AS.S; HR.W	151,350 €	37,840 €	21,280 €	189,180 €	210,460 €	218,360 €	VHC
AS.3	AS.M;AS.S; F.W1	4,320 €	1,080 €	610 €	5,400 €	6,010 €	6,400 €	MC
AS.4	AS.M;AS.S; F.W1	149,190 €	37,300 €	20,970 €	186,480 €	207,450 €	212,960 €	HC
PN	**Partnership and network**							
PN.1	AS.M;AS.S;HR.W	116,040 €	29,010 €	16,310 €	145,040 €	161,350 €	290,080 €	VHC
PN.2	AS.M;AS.S;HR.W	116,040 €	29,010 €	16,310 €	145,040 €	161,350 €	290,080 €	VHC
C	**Communications**							
C.1	C.EXT;C.M	51,490 €	12,880 €	7,240 €	64,360 €	71,600 €	128,710 €	VHC
C.2	C.EXT;C.M	51,490 €	12,880 €	7,240 €	64,360 €	71,600 €	128,710 €	VHC
C.3	C.EXT;C.M	39,760 €	9,940 €	5,590 €	49,700 €	55,290 €	99,390 €	VHC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
C.4	C.EXT;C.M	39,760 €	9,940 €	5,590 €	49,700 €	55,290 €	99,390 €	VHC
C.5	C.EXT;C.M	39,760 €	9,940 €	5,590 €	49,700 €	55,290 €	99,390 €	VHC
REP.C.1	C.EXT;C.M; E.CD.M;E.ED.M;E.MDD.M;E.PD.M;PM.S;PM.M;EO	13,250 €	3,320 €	1,870 €	16,560 €	18,420 €	2,710 €	VHC
REP.C.2	C.EXT;C.M; PD.EXT 3;MD.EXT1;E.CD.M;MDD.EXT 1;E.ED.M;EO	16,660 €	4,170 €	2,350 €	20,830 €	23,170 €	6,650 €	VHC
PD	**Preliminary Design**							
PD.M	**Mission Design**							
PD.M.SA.1	E.MDD.S;E.MDD.M; SE1;SE2	11,470 €	2,870 €	1,620 €	14,340 €	15,950 €	11,680 €	HC
PD.M.SA.2	E.MDD.S;E.MDD.M; SE1;SE2	8,610 €	2,160 €	1,210 €	10,760 €	11,970 €	8,610 €	HC
PD.M.1	E.MDD.S;E.MDD.M; SE1;SE3;SOFT.7;SE4	8,610 €	2,160 €	1,210 €	10,760 €	11,970 €	8,910 €	HC
PD.M.2	E.MDD.S;E.MDD.M; SE2;SE1;SOFT.7;SE3	17,210 €	4,310 €	2,420 €	21,510 €	23,930 €	16,610 €	HC
PD.M.3	E.MDD.S;E.MDD.M; MDD.EXT 1;SOFT.7;SE4;SE1	8,790 €	2,200 €	1,240 €	10,980 €	12,220 €	11,760 €	HC
PD.C	**Communications**							
PD.C.SA.1	E.CD.S;E.CD.M; TE1;TE2	6,010 €	1,510 €	850 €	7,510 €	8,350 €	9,010 €	HC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
PD.C.SA.2	E.CD.S;E.CD.M; TE1;TE3	8,010 €	2,010 €	1,130 €	10,010 €	11,130 €	11,610 €	HC
PD.C.SA.3	E.CD.S;E.CD.M; SE2;SE3	8,010 €	2,010 €	1,130 €	10,010 €	11,130 €	11,810 €	HC
PD.C.SA.4	E.CD.S;E.CD.M; MD.EXT 3;TE1;SE2	8,310 €	2,080 €	1,170 €	10,390 €	11,550 €	9,090 €	HC
PD.C.HW.1	E.CD.S;E.CD.M; SE1;TE2	8,690 €	2,180 €	1,680 €	10,870 €	12,540 €	8,730 €	HC
PD.C.HW.2	E.CD.S;E.CD.M; SE1;TE2;CD.EXT 2	18,730 €	4,690 €	3,600 €	23,410 €	27,010 €	17,470 €	HC
PD.C.HW.3	E.CD.S;E.CD.M; SE2;TE3	8,690 €	2,180 €	1,680 €	10,870 €	12,540 €	11,930 €	HC
PD.C.HW.4	E.CD.S;E.CD.M; SE2;TE3	17,380 €	4,350 €	3,350 €	21,730 €	25,070 €	20,450 €	HC
PD.C.SW.1	E.CD.S;E.CD.M; SE1;SOFT.5;SE3;TE2	26,040 €	6,510 €	3,670 €	32,550 €	36,210 €	26,200 €	HC
PD.C.SW.2	E.CD.S;E.CD.M; SE1;TE1;SOFT.5;SE2	22,580 €	5,650 €	3,180 €	28,220 €	31,400 €	23,030 €	HC
PD.N	**Navigation**							
PD.N.SA.1	E.MDD.S;E.MDD.M; SE1;TE3	6,720 €	1,680 €	950 €	8,400 €	9,350 €	10,800 €	HC
PD.N.SA.2	E.MDD.S;E.MDD.M; SE1;TE2	8,960 €	2,240 €	1,260 €	11,200 €	12,460 €	14,000 €	HC
PD.N.SA.3	E.MDD.S;E.MDD.M; SE1;TE2	6,720 €	1,680 €	950 €	8,400 €	9,350 €	10,800 €	HC
PD.N.HW.1	E.MDD.S;E.MDD.M;	12,550 €	3,140 €	1,770 €	15,680 €	17,450 €	14,240 €	HC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
	TE1;SE3							
PD.N.SW.1	E.MDD.S;E.MDD.M; SE1;SE2;TE1	32,260 €	8,070 €	4,540 €	40,320 €	44,860 €	31,300 €	HC
PD.P	**Propulsion**							
PD.P.SA.1	E.P;E.MD.S; SE3	5,270 €	1,320 €	740 €	6,580 €	7,320 €	6,960 €	HC
PD.P.SA.2	E.P;E.MD.S; MD.EXT 3;SE4	10,090 €	2,530 €	1,420 €	12,610 €	14,030 €	9,220 €	HC
PD.P.SA.3	E.P;E.MD.S; MD.EXT 3;SE3	8,550 €	2,140 €	1,210 €	10,690 €	11,890 €	8,980 €	HC
PD.P.SA.4	E.P;E.MD.S; MD.EXT 3;SE4	8,550 €	2,140 €	1,210 €	10,690 €	11,890 €	9,480 €	HC
PD.P.HW.1	E.P;E.MD.S; SE2;SE3	7,950 €	1,990 €	1,120 €	9,940 €	11,060 €	7,580 €	HC
PD.P.HW.2	E.P;E.MD.S; SE2	14,030 €	3,510 €	1,980 €	17,540 €	19,510 €	18,070 €	HC
PD.P.HW.3	E.P;E.MD.S; MD.EXT 3;SE4	20,180 €	5,050 €	5,190 €	25,220 €	30,410 €	19,090 €	HC
PD.P.HW.4	E.P;E.MD.S; SE4	14,030 €	3,510 €	3,610 €	17,540 €	21,150 €	18,070 €	HC
PD.P.SW.1	E.P;E.MD.S; SE1;SE2	21,020 €	5,260 €	2,960 €	26,270 €	29,230 €	18,540 €	HC
PD.P.SW.2	E.P;E.MD.S; SE2;SE4	21,200 €	5,300 €	2,980 €	26,500 €	29,480 €	17,990 €	HC
PD.ME	**Mechanical**							
PD.ME.SA.1	E.MD.M;E.MD.S ; SE3	8,310 €	2,080 €	1,170 €	10,390 €	11,550 €	12,570 €	HC
PD.ME.SA.2	E.MD.M;E.MD.S ; TE1	10,390 €	2,600 €	1,460 €	12,980 €	14,440 €	15,960 €	HC
PD.ME.SA.3	E.MD.M;E.MD.S ; TE2;MD.EXT 2	11,550 €	2,890 €	1,630 €	14,440 €	16,060 €	15,470 €	HC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
PD.ME.SA.4	E.MD.M;E.MD.S ; SE2	10,390 €	2,600 €	1,460 €	12,980 €	14,440 €	15,660 €	HC
PD.ME.1	E.MD.M;E.MD.S ; SOFT.8;SE1;SE3	19,060 €	4,770 €	2,680 €	23,830 €	26,500 €	13,450 €	HC
PD.ME.ST.2	E.MD.M;E.MD.S ; SOFT.1;SOFT.8;SE3	14,870 €	3,720 €	2,090 €	18,580 €	20,670 €	15,260 €	HC
PD.ME.ST.1	E.MD.M;E.MD.S ; SOFT.1;SOFT.8;SE4	14,870 €	3,720 €	2,090 €	18,580 €	20,670 €	16,160 €	HC
PD.ME.T.1	E.MD.M;E.MD.S ; MD.EXT 2	6,520 €	1,630 €	920 €	8,150 €	9,060 €	11,990 €	HC
PD.ME.T.2	E.MD.M;E.MD.S ; MD.EXT 2	6,520 €	1,630 €	920 €	8,150 €	9,060 €	11,990 €	HC
PD.E	**Electronics**							
PD.E.SA.1	E.CD.S;E.ED.M; EE1;EE2	6,580 €	1,650 €	930 €	8,230 €	9,150 €	12,450 €	HC
PD.E.SA.2	E.CD.S;E.ED.M; EE1	6,580 €	1,650 €	930 €	8,230 €	9,150 €	12,450 €	HC
PD.E.HW.1	E.CD.S;E.ED.M; EE1;EE2	16,750 €	4,190 €	2,360 €	20,930 €	23,290 €	25,580 €	HC
PD.E.HW.2	E.CD.S;E.ED.M; EE1;EE2	32,900 €	8,230 €	4,630 €	41,130 €	45,750 €	60,310 €	HC
PD.E.HW.3	E.CD.S;E.ED.M; EE1;EE2	32,900 €	8,230 €	4,630 €	41,130 €	45,750 €	60,310 €	HC
PD.E.HW.4	E.CD.S;E.ED.M; EE1;EE2	8,380 €	2,100 €	1,180 €	10,470 €	11,650 €	12,630 €	HC
PD.E.HW.5	E.CD.S;E.ED.M; EE1;EE2	8,380 €	2,100 €	1,180 €	10,470 €	11,650 €	12,630 €	HC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
FD	**Final Design**							
FD.C	**Communication Detailed Design**							
FD.C.HW.1	E.CD.S;E.CD.M; CD.EXT 2;SE3;TE2	37,230 €	9,310 €	5,240 €	46,540 €	51,770 €	25,960 €	MC
FD.C.HW.2	E.CD.S;E.CD.M; SE3;TE3	24,330 €	6,090 €	3,420 €	30,410 €	33,830 €	19,700 €	MC
FD.C.HW.3	E.CD.S;E.CD.M; MD.EXT 3;SE2;TE3	23,870 €	5,970 €	3,360 €	29,840 €	33,190 €	16,610 €	MC
FD.C.SW.1	E.CD.S;E.CD.M; SE3;SE5;TE3;SOFT.5	35,590 €	8,900 €	5,010 €	44,490 €	49,490 €	14,020 €	MC
FD.C.SW.2	E.CD.S;E.CD.M; SE2;SE5;TE1;SOFT.5	27,350 €	6,840 €	3,850 €	34,190 €	38,030 €	23,250 €	MC
FD.C.SW.3	E.CD.S;E.CD.M; MD.EXT 3;SE3;SE2;SOFT.5	13,060 €	3,270 €	1,840 €	16,330 €	18,170 €	11,950 €	MC
FD.C.SW.4	E.CD.S;E.CD.M; SE1;SE1;TE1;SOFT.5	60,710 €	15,180 €	8,540 €	75,880 €	84,420 €	35,270 €	MC
FD.N	**Navigation Detailed Design**							
FD.N.HW.1	E.MDD.S;E.MDD.M; SE4;TE2	33,100 €	8,280 €	8,510 €	41,370 €	49,880 €	43,840 €	MC
FD.N.HW.2	E.MDD.S;E.MDD.M; SE1;TE3	21,940 €	5,490 €	5,640 €	27,420 €	33,060 €	26,350 €	MC
FD.N.SW.1	E.MDD.S;E.MDD.M; MDD.EXT 2;SE3;SE1	48,010 €	12,010 €	6,750 €	60,010 €	66,750 €	46,870 €	MC
FD.N.SW.2	E.MDD.S;E.MDD.M; SE1;SE2;TE1	45,270 €	11,320 €	6,370 €	56,580 €	62,950 €	35,780 €	MC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
FD.N.SW.3	E.MDD.S;E.MDD.M; SE1;SE2;TE1	60,350 €	15,090 €	15,520 €	75,440 €	90,960 €	54,240 €	MC
FD.P	**Propulsion Detailed Design**							
FD.P.HW.1	E.P;E.MD.S; SE1	34,900 €	8,730 €	4,910 €	43,620 €	48,520 €	55,230 €	MC
FD.P.HW.2	E.P;E.MD.S; MD.EXT 3;SE2	44,880 €	11,220 €	11,540 €	56,100 €	67,640 €	52,630 €	MC
FD.P.HW.3	E.P;E.MD.S; SE1	26,170 €	6,550 €	3,680 €	32,720 €	36,390 €	42,490 €	MC
FD.P.SW.1	E.P;E.MD.S; SE1;SE2	26,170 €	6,550 €	3,680 €	32,720 €	36,390 €	14,730 €	MC
FD.P.SW.2	E.P;E.MD.S; SE1;SE2	26,170 €	6,550 €	3,680 €	32,720 €	36,390 €	65,430 €	MC
FD.ME	**Mechanical Detailed Design**							
FD.ME.MD.1	E.MD.M;E.MD.S; MD.EXT1;SE3;SE4	23,060 €	5,770 €	3,250 €	28,820 €	32,060 €	20,710 €	MC
FD.ME.MD.2	E.MD.M;E.MD.S; SOFT.1;UPV	14,750 €	3,690 €	2,080 €	18,430 €	20,510 €	26,560 €	MC
FD.ME.MD.3	E.MD.M;E.MD.S; SE3;MD.EXT 2	16,020 €	4,010 €	2,260 €	20,020 €	22,270 €	17,280 €	MC
FD.ME.MD.4	E.MD.M;E.MD.S; SOFT.8;SE3;SE4;SE5	36,890 €	9,230 €	5,190 €	46,110 €	51,290 €	39,270 €	MC
FD.ME.ID.1	E.MD.M;E.MD.S; MD.EXT1;SE2;SE5	18,450 €	4,620 €	2,600 €	23,060 €	25,650 €	15,250 €	MC
FD.ME.ID.2	E.MD.M;E.MD.S; SOFT.1;SE1	22,550 €	5,640 €	3,170 €	28,190 €	31,360 €	26,810 €	MC
FD.ME.ID.3	E.MD.M;E.MD.S; MD.EXT 2	8,850 €	2,220 €	1,250 €	11,060 €	12,310 €	15,840 €	MC
FD.ME.ID.4	E.MD.M;E.MD.S;	30,620 €	7,660 €	4,310 €	38,270 €	42,570 €	23,590 €	MC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
	SOFT.8;SE2;SE3							
FD.E	**Electronic Detailed Design**							
FD.E.HW.1	E.CD.S;E.ED.M; EE1;EE2	47,830 €	11,960 €	6,730 €	59,780 €	66,500 €	70,520 €	MC
FD.E.HW.2	E.CD.S;E.ED.M; EE1;EE2	47,830 €	11,960 €	6,730 €	59,780 €	66,500 €	72,720 €	MC
FD.E.HW.3	E.CD.S;E.ED.M; PD.EXT 3;SOFT.3;PD.EXT 1	67,370 €	16,850 €	9,470 €	84,210 €	93,680 €	117,480 €	MC
T	**Test and Validations**							
T.C	**Communication**							
T.C.1	E.CD.M; LAB.COM;SOFT.2	27,320 €	6,830 €	3,840 €	34,150 €	37,990 €	20,950 €	MC
T.C.2	E.CD.M; LAB.COM;SOFT.2	27,320 €	6,830 €	3,840 €	34,150 €	37,990 €	20,950 €	MC
T.C.3	E.CD.M; LAB.COM	21,860 €	5,470 €	3,080 €	27,320 €	30,390 €	21,070 €	MC
T.N	**Navigation**							
T.N.1	E.MDD.M; LAB.INT;SOFT.7;SOFT.5	24,290 €	6,080 €	3,420 €	30,360 €	33,780 €	33,380 €	MC
T.P	**Propulsion**							
T.P.1	E.P; SE3	19,200 €	4,800 €	2,700 €	24,000 €	26,700 €	26,080 €	MC
T.M	**Mechanical**							
T.ME.1	E.MD.M; SOFT.1;SE1	30,720 €	7,680 €	4,320 €	38,400 €	42,720 €	46,080 €	MC

WBS ID	Resources	Direct Costs	Indirect Costs	Reserve	Estimate	Estimate with Reserve	Range	Confidence Level *
T.E	**Electronics**							
T.E.1	E.ED.M; EE1;LAB.ELE	45,120 €	11,280 €	6,350 €	56,400 €	62,750 €	49,520 €	MC
T.A	**Data acquisition**							
T.A.1	E.CD.M; LAB.COM	16,200 €	4,050 €	2,280 €	20,240 €	22,520 €	22,020 €	MC
T.A.2	E.CD.M; SOFT.4;UPC;SE1	25,730 €	6,440 €	3,620 €	32,160 €	35,780 €	33,060 €	MC
FINISH	C.M;E.CD.M;E.ED.M; E.MDD.M;E.PD.M;PM. S;PM.M;EO	9,390 €	2,350 €	1,320 €	11,730 €	13,050 €	3,000 €	VHC

* MC: Medium Confidence – HC: High Confidence – VHC: Very High Confidence

In the following table the cost of each resource is presented.

Table 3. Assumptions for the resources

Resource ID	Resource name	Assumptions
AS.M	Administration Services Manager	Std. Rate 36€/h, worker
AS.S	Administration Services Secretary	Std. Rate 24€/h, worker
C.EXT	BCCI Communication Outsourcing	Cost, 200k€
C.M	Communication Manager	Std. Rate 36€/h, worker
CD.EXT 2	Southampton University Collaboration	Std. Rate 48€/h, 3 workers
E.CD.M	Communications Dept. Manager	Std. Rate 42€/h, worker
E.CD.S	Communications and Electronics Dept. Secretary	Std. Rate 24€/h, worker
E.ED.M	Electronics Dept. Manager	Std. Rate 42€/h, worker
E.MD.M	Mechanical Dept. Manager	Std. Rate 42€/h, worker
E.MD.S	Mechanical and Propulsion Dept. Secretary	Std. Rate 24€/h, worker
E.MDD.M	Mission Design Dept. Manager	Std. Rate 42€/h, worker
E.MDD.S	Mission Design and Payloads Depts. Secretary	Std. Rate 24€/h, worker
E.P	Propulsion Dept. Manager	Std. Rate 42€/h, worker
E.PD.M	Payloads Dept. Manager	Std. Rate 42€/h, worker
EE1	Electronics engineer 1	Std. Rate 36€/h, worker
EE2	Electronics engineer 2	Std. Rate 36€/h, worker
EO	Event organization	Cost, 48k€
F.W1	Financial Worker 1	Std. Rate 28€/h, worker
F.W2	Financial Worker 2	Std. Rate 28€/h, worker
HR.W	Human Resources worker	Std. Rate 36€/h, worker
LAB.COM	Communication laboratory	Laboratory testing, 40k€
LAB.ELE	Electronics laboratory - UPV Collaboration	Laboratory testing, 12k€
LAB.INT	Integration laboratory - ATT Collaboration	Laboratory testing, 30k€
MD.EXT 2	Stuttgart University Collaboration	Std. Rate 48€/h, 3 workers
MD.EXT 3	Orbital ATK Collaboration	Cost, 52.5k€
MD.EXT1	Ball Aerospace Collaboration	Cost, 6k€
MDD.EXT 1	Cranfield University Collaboration	Std. Rate 48€/h, 3 workers
MDD.EXT 2	SENER Collaboration	Cost, 20k€
PD.EXT 1	Silvanet Collaboration	Collaboration free of charge
PD.EXT 2	Surrey Satellites Collaboration	Collaboration free of charge
PD.EXT 3	Amptek Collaboration	Cost, 6k€
PM.EXT	E-TIS Eurocons outsourcing	Cost, 160k€
PM.M	Project Manager	Std. Rate 50€/h, worker

Resource ID	Resource name	Assumptions
PM.S	Project Management Secretary	Std. Rate 24€/h, worker
SE1	Software engineer 1	Std. Rate 36€/h, worker
SE2	Software engineer 2	Std. Rate 36€/h, worker
SE3	Software engineer 3	Std. Rate 36€/h, worker
SE4	Software engineer 4	Std. Rate 36€/h, worker
SOFT.1	ANSYS Workbench Software	The license is share in the company. 5000€ / yr
SOFT.2	Keysight ADS Software	The license is shared with other projects of the company. 1000€ / yr
SOFT.3	LTSpice Software	The license is shared with other projects of the company. 1000€ / yr
SOFT.4	Matlab R2015b	The license is shared with other projects of the company. 2000€ / yr
SOFT.5	Visual Studio	The license is shared with other projects of the company. 1000€ / yr
SOFT.6	Microsoft Project	The license is shared with other projects of the company. 3000€ / yr
SOFT.7	STK Software	The license is shared with other projects of the company. 5000€ / yr
SOFT.8	Catia Software	The license is shared with other projects of the company. 4000€ / yr
SpE1	Space engineer 1	Std. Rate 36€/h, worker
SpE2	Space engineer 2	Std. Rate 36€/h, worker
SpE3	Space engineer 3	Std. Rate 36€/h, worker
SpE4	Space engineer 4	Std. Rate 36€/h, worker
SpE5	Space engineer 5	Std. Rate 36€/h, worker
SpE6	Space engineer 6	Std. Rate 36€/h, worker
TE1	Telecommunications engineer 1	Std. Rate 36€/h, worker
TE2	Telecommunications engineer 2	Std. Rate 36€/h, worker
TE3	Telecommunications engineer 3	Std. Rate 36€/h, worker
TE3	Telecommunications engineer 4	Std. Rate 36€/h, worker
UPC	Politechnical University of Catalonia Collaboration	Std. Rate 48€/h, 3 workers
UPV	Politechnical University of Valencia Collaboration	Std. Rate 48€/h, 3 workers
USDOC	Stuttgart University Collaboration Doct.	Cost, 5k€

2. Cumulative costs

2.1. Cumulative cost curve

The cost baseline presented in the figure shows the evolution of the overall cost of the project per month.

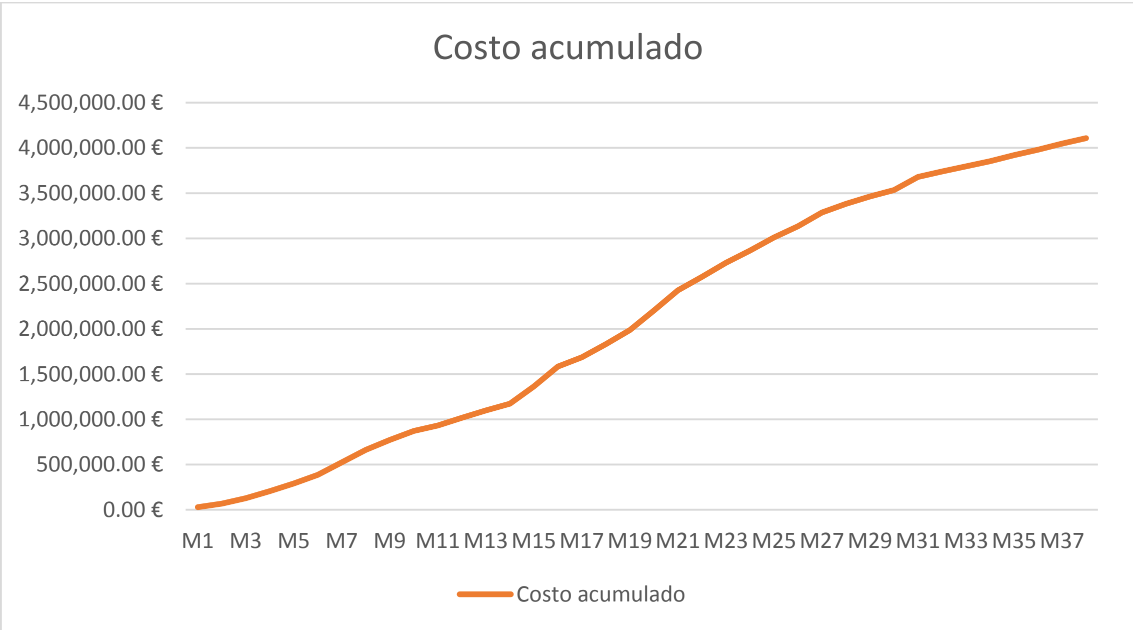

Figure 1. Cost baseline of the project

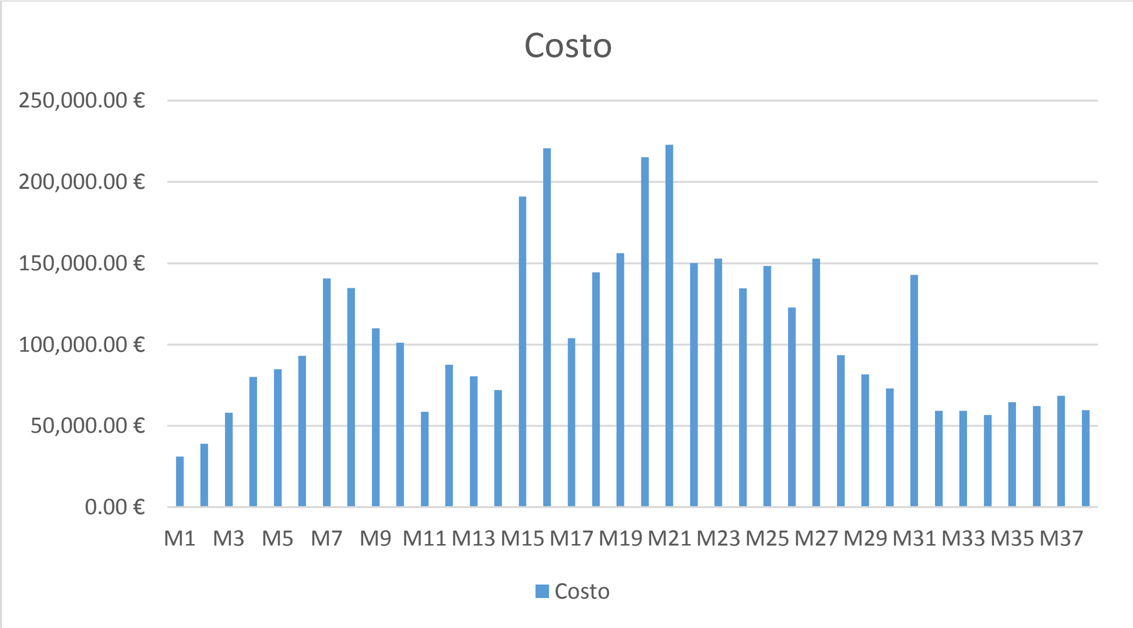

Figure 2. Distribution of costs per month

There are two zones in the graph. From M0 to M17, there is a peak value in cost corresponding to the preliminary design. At M17 the preliminary design is almost finished and the final design is started, which is the zone in the right. At the beginning of the detailed design there is a lot of the cost and then it decreases until the end of the project.

2.2. Budget at completion

The budget of the project has been set to 3.6 M€. This amount is distributed to the different working groups of the project and to be used in the aforementioned costs. The expected amount for each package can be seen in the following table.

Table 4. Amount for each work package

Department	Amount
Project Management	596.440,00 €
Administrative Services	399.280,00 €
Partnership and Network	297.600,00 €
Communications	776.600,00 €
Engineering	2.016.492,00 €
Others	22.224,00 €
Total	**4.108.636,00 €**

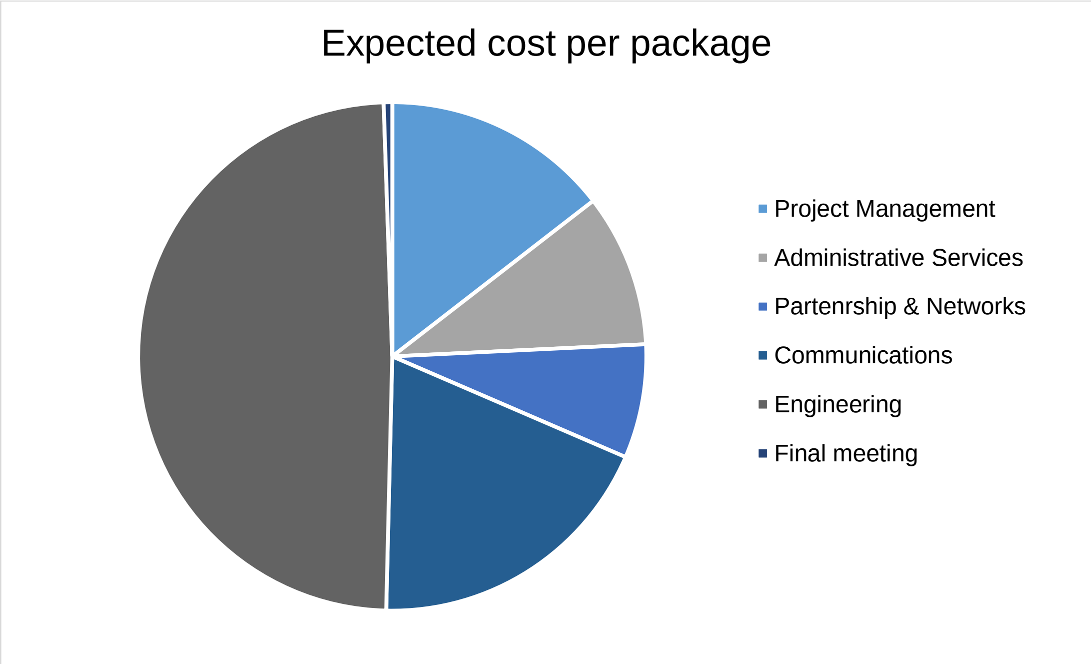

Figure 3. Sector diagram of the distribution of the amount per work package

Due to its large implication in the project, the engineering department has been separated into different expertise sub-departments.

Table 5. Amount for each sub-department

Department	**Amount**
Mission Design	69.952,00 €
Communication	572.100,00 €
Navigation	363.488,00 €
Propulsion	367.200,00 €
Mechanical	260.040,00 €
Electronics	286.752,00 €
Others	96.960,00 €
TOTAL	**2.016.492,00 €**

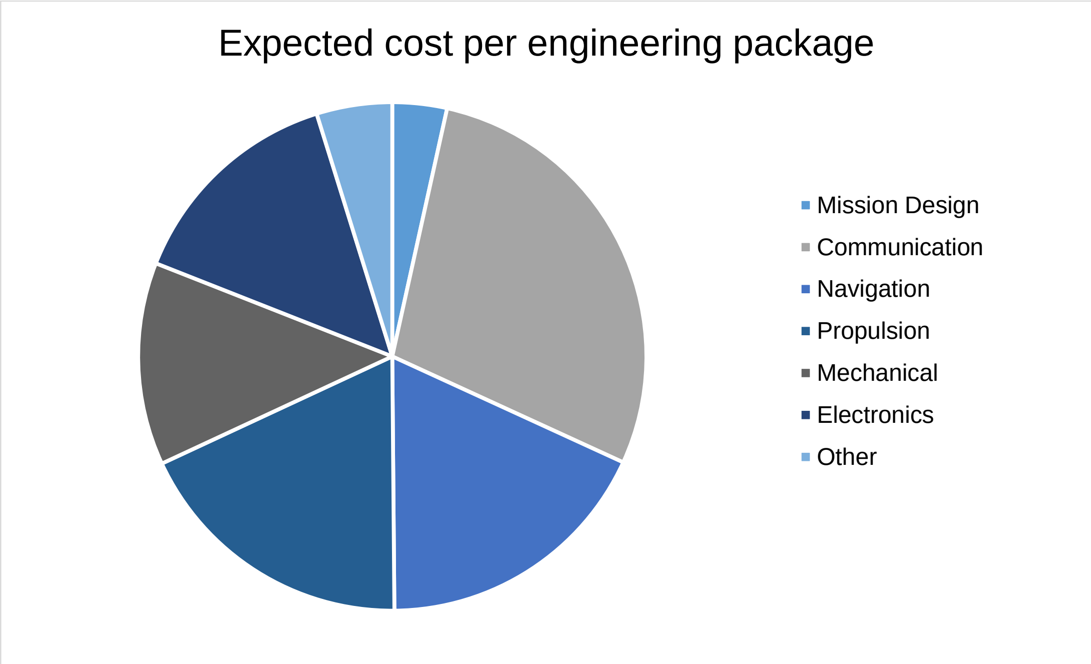

Figure 4. Sector diagram of the distribution of amount in the engineering department

3. Plan procurement management

3.1. Make or Buy decisions

Table 6. List of procurement items

WBS ID	Work Package Name	Reason for BUY	Cost Estimate	Type of Contract	Possible Risks	List of Suppliers	Special Considerations or Constraints
PD.E.HW.5	Contact and specify sensors from developers	Requires high tech and specialized workers, been not affordable to produce three sensors.	84.210 €	Fixed Lump Contract (maximum price of 93.680 € including VAT)	1. Inadequate specifications of the sensor. 2. Malfunction of an internal subsystem. 3. Difficulties to integrate sensor into the module.	1. e2V 2. SIC 3. HeadWall 4. Amptek 5. Silvanet (UPM) 6. Surrey Satellite Tech.	The schedule must be accomplished without exception.
C	Dissemination	Specialized marketing companies could offer best prices and more efficiency.	776.600 €	Fixed Lump Contract (maximum price of 776.600 € including VAT)	1. Copyright violation. 2. Inadequate communication. 3. No transmission of the ECCO ideas.	1. BCCI 2. newsfile 3. Research Media	Due the objective of ECCO project, the EU criteria referred to sustainability must be accomplished.
T.E	Electronics tests and validations	Collaboration with UPV university leads us to reduce costs and use specialized laboratories.	56.400 €	Fixed Lump Contract (maximum price of 62.750 € including VAT)	1. Invalid tests. 2. Nonqualified students.	1. UPV 2. Angelatoni Test Tech.(ATT) 3. ETSETB UPC	Collaboration contract.

3.2. Statement of work

The statement of work (SOW) for each procurement is included in the following annexes:

- SOW Image Sensor: *Annex II*
- SOW Electronics laboratory and testing: *Annex III*
- SOW Dissemination Service: *Annex IV*

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

Quality and Risk Management

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1. Quality Management Plan

1.1. Quality Assurance Approach

The ECCO Project does not simply conform to improving product and service quality, instead it is deploying extensive activities to perform the world's top quality management in order to provide the highest level of satisfaction in all aspects to our customers and stakeholders. To achieve this, the quality department deploys various quality improvement activities, with attention also given to improving quality management.

The quality assurance will be applied to products during the pre-production in order to know whether what will be made meets specifications and requirements, and during manufacturing production runs by validating samples meet specified quality controls. Quality assurance is also applied to software to verify that features and functionality meet objectives, and that code is relatively bug free prior to shipping or releasing new software products and versions.

In order to assure quality, some procedures will be performed:

- Audit charter updates by phase.

  (Once per project phase)

- Audit plan content and updates, project priorities, and task estimation.

  (Once per project phase)

- Audit the following project activities:
  - Quality (weekly)
  - Communications (weekly)
  - Project progress (weekly)

- Audit stage checkpoints.

  (Once per project phase)

- Audit project reviews by phase.

  (Once per project phase)

Other techniques and tools that will be used in the quality assurance approach of the ECCO project are:

- Project checklists: This involves development of a list of all critical steps involved in the manufacturing process. As each step is completed, a line manager or shift manager should check off that step on the checklist. This diligent technique prevents neglect or avoidance of important procedures throughout production.
- Process reviews: The production processes and assurance standards against industry benchmarks and best practices will be regularly reviewed. This helps the project ensure that the standards align with current process and do not lag with other companies.

Moreover, and regarding the technical parts of the project related to the development of software, controls and verifications will be done periodically in order to guarantee the quality assurance.

All methods and tools will demonstrate conformity with the internal quality assurance detailed in the ECCO document "ECCO Procurement Quality Requirements" (ECCO_D_22MFG4).

General Quality Standards (ISO/EN) that must be followed and accomplished are, depending on the task:

- 9100- Quality System for Aerospace Manufacturers
- 9101-Checksheet for 9100
- 9110-Quality System for Aerospace Repair Stations
- 9111-Checksheet for 9110
- 9120-Quality System for Distributors
- 9121-Checksheet for 9120

1.2. Quality Control and Improvement Approach

ECCO project will assure that the final products fulfil the quality requirements by the Quality Control Approach.

The procedures, processes, methods and tools used in performing the quality control activities depend in which area it is being done.

Data validation:

The validation of the laboratory data is essential to assure the quality control. The following procedures will be followed:

- Proper chain-of-custody and sample handling procedures followed.
- Parametric holding times met.
- Samples prepared and analysed according to specified methods.
- Instrumentation calibrated according the specified methods.
- Calculations performed correctly and verified.
- Transcription of final data correct.

The data sheet of each laboratory test will collect all the procedures below in order to assure they have been done correctly and the data obtained is reliable. Specifically, it will collect the information below using a checklist scheme.

Software:

In order to assure the software quality control, all the standards that must be followed will be written in the documentation standards. The next documents will be elaborated:

- Coding standards: description of all the coding standards.
- Comment standards: description of all the comment standards.

It is important to assure an optimum development of the software the standards to be perfectly stablished.

During all the software development, some procedures will be done regularly in order to ensure the quality and detect possible errors:

- Check that assumptions and criteria for the selection of data and the different factors related to data are documented.
- Check for transcription errors in data input and reference.

- Check the integrity of database files.
- Check for consistency in data.
- Check that the movement of inventory data among processing steps is correct.
- Check for uncertainties in data, database files etc.
- Undertake review of internal documentation.
- Check methodological and data changes resulting in recalculations.
- Undertake completeness checks.
- Compare Results to previous Results.

Once an error is detected, the person who discovered the error is responsible for reporting it to the Task Manager. Then, the software engineers try to solve the problem and when this is already solved, all the changes and patches made are written down in a document that collects all the code modifications with the date and description of each one.

Also verification and validation procedures will be done along all the project in order to answer two main questions:

Verification: "Are we building the product right?" The software should conform to its specification.

Validation: "Are we building the right product?" The software should do what the user really requires.

The set of techniques and tools for process improvement that will be used is the Six Sigma. It seeks to improve the quality output of process identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. Thus, set of quality management methods that will be used are mainly empirical and statistical. The project methodology chosen is the DMAIC.

The DMAIC project methodology has five phases:

- Define the system, the voice of the customer and their requirements, and the project goals, specifically.
- Measure key aspects of the current process and collect relevant data; calculate the 'as-is' Process Capability.
- Analyse the data to investigate and verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation.

- Improve or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- Control the future state process to ensure that any deviations from the target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process.

1.3. Quality Roles and Responsibilities

The following table identifies the quality-related responsibilities of the project team and lists specific roles and quality responsibilities.

Table 1. List of quality roles and responsibilities

Role:	Responsibilities:
Project Manager	• Responsible for management, review and approval of planning, strategy and testing execution and tools. • Provide formal sign-off on all deliverables • Review of results and defects to determine/assess impact to overall project plan and implementation schedule. • Works with the all the other managers to establish timetables and agree on a Quality Assurance plan. • Assure that practice of quality control measures is documented, communicated and adequate to ensure agreed quality levels for the ECCO project. • Oversees determination of need, selection, implementation and maintenance of quality control measures and tools. • Facilitates weekly quality assurance meetings and maintains the meeting agenda. • Assure training plan addresses all project skill levels. • Assure project management gap resolution.
Administration Services Manager	• Coordinate communication about the status of quality assurance efforts to stakeholders. • Work with the Project Manager, Engineering Managers and Stakeholders to assist with the writing of use cases and test cases.

Role:	**Responsibilities:**
Engineering Managers	• Responsible for the design and test planning and coordination for their module. • Assure their work package is complete, trackable and on-schedule. • Provide formal sign-off on all deliverables of their module. • Primary point of communication for engineers and technicians. • Have a better understanding of the business/functional requirements for their unit. • Provide guidance and assistance on the engineering team. • Provide feedback on the design and test processes to the project manager. • Technical leadership for the project, including design and test approach. • Selectively review test and simulation results and reconciliation for completeness and accuracy. • Verifying the quality of the requirements, including requirement definition, design, and testability. • Staying current on latest design and test approaches and tools, and transferring this knowledge to the team.
Engineers	• Understand and follow design and test processes and responsibilities. • Report the work developed. • Record any new defects uncovered during their labour. • Provide comments on any defects that are discovered.

Role:	Responsibilities:
Laboratory Cooperation	• Provide training and assistance to engineers to ensure they are following agreed design and test reporting processes. • Work with the Engineering Managers to ensure that test design cases and scenarios are assigned and being tested. • Provide status reports to the module manager. • Identify and assess defects uncovered in testing. • Assist in the validation of use cases and test cases. • Create and maintain testing environments. • Migrate objects to appropriate test environments. • Allocate technical resources to address defects/issues during testing phases.

2. Risk Management Plan

2.1. Definitions of Probability

To evaluate the potential risks of the project, a definition of the probability used is necessary to quantify it correctly. A scale of 1% - 100% is used to set the probability of a risk to occur during the project. The maximum (100%) means that the risk is unavoidable, and the minimum (1%) that is very difficult to occur

Table 2. List of definitions of probability

Probability	Description	Probability Score
Very High	It is a fact and unavoidable	(81 – 100) %
High	High probability to happen	(61 – 80) %
Medium	Half probability to happen or not	(41 – 60) %
Low	Low probability to happen	(21 – 40) %
Very Low	Too difficult to happen	(1 – 20) %

2.2. Definitions of impacts by objective

To specify the effect of a risk into the overall project, a scale from 1 to 5 is set to quantify the impact. 5 means the highest impact on the project, and 1 the lowest. In the tables below, a quantification of the risks is explained, evaluating the scope and quality, schedule and costs impacts individually.

Table 3. List of scope/quality impacts

Scope/Quality Impact	Description	Scope Impact Score
Very High	Risks that produce several impact on the project and its results, been unable to achieve the desired objectives	5
High	Risks that produce important impact on the project and its results, reducing the quality of the desired objectives under the acceptance criteria	4
Medium	Risks that produce a moderate impact on the project and its results, reducing the quality of the desired objectives but still above the acceptance criteria	3
Low	Risks that produce a low impact on the project and its results, reducing the quality of the desired objectives but well enough.	2
Very Low	Risks that produce an insignificant impact on the project and its results	1

Table 4. List of schedule impacts

Schedule Impacts	Description	Schedule Impact Score
Very High	Risks that produce several impact on the project schedule, delaying the schedule more than 3 months	5
High	Risks that produce important impact on the project schedule, delaying the schedule by 2 - 3 months	4
Medium	Risks that produce a moderate impact on the project schedule, delaying the schedule by 1 - 2 months	3
Low	Risks that produce a reduced impact on the project schedule, delaying the schedule less than 1 month	2
Very Low	Risks that produce an insignificant impact on the project schedule with no delays	1

Table 5. List of cost impacts

Cost Impacts	Description	Cost Impact Score
Very High	Risks that produce several impact on the project cost, incrementing the final cost of the project greater than 20%.	5
High	Risks that produce important impact on the project cost, incrementing the final cost of the project between 16% and 20%.	4
Medium	Risks that produce a moderate impact on the project cost, incrementing the final cost of the project between 11% and 15%.	3
Low	Risks that produce a reduced impact on the project cost, incrementing the final cost of the project between 6% and 10%	2
Very Low	Risks that produce an insignificant impact on the project cost lower than 5%.	1

2.3. Probability and Impact Matrix

In the probability and impact matrix, the final evaluation of the risk is done. For each combination of probability and impact an evaluation from extreme to minimum is set. Impact for each risk is evaluated using the system exposed in the risk rating section, taking into account the scope and quality impact, schedule impact and costs impact.

Risks that are evaluated as extreme risks are critical and some counter measures must be applied to prevent it, or if is not possible, to reduce its impact. The risks that are evaluated as minimum are negligible and will not be taking into account during the risk management.

Impact / Probability	1	2	3	4	5
Very High	Low Risk	Moderate Risk	High Risk	Extreme Risk	Extreme Risk
High	Minimum Risk	Moderate Risk	High Risk	Extreme Risk	Extreme Risk
Medium	Minimum Risk	Low Risk	Moderate Risk	High Risk	High Risk
Low	Minimum Risk	Low Risk	Low Risk	Moderate Risk	High Risk
Very Low	Minimum Risk	Minimum Risk	Low Risk	Moderate Risk	High Risk

Figure 1. Probability and impact matrix

Only risks that have a probability higher or equal to medium and presents a probability higher or equal to 3 will have a contingency plan (including budget contingency and time for the schedule).

2.4. Risk Rating

In order to identify the position of the probability impact matrix, risk rating should be defined to calculate the overall impact of the risk taking into account the individual impact that has been defined in the table above.

$$Impact = 5 \cdot \left(\chi_{scope} \cdot \frac{I_{scope}}{5} + \chi_{schedule} \cdot \frac{I_{schedule}}{5} + \chi_{costs} \frac{I_{costs}}{5}\right)$$

Where the variables $(\chi_{scope}, \chi_{schedule}, \chi_{costs})$ defined are the weight of each impact in parts per unit. The sum of the variables of the same risk should be equal to 1.

In this kind of project the schedule and the scope and quality are the most important factors in order to accomplish the initial scope and the desired objectives. So, the following criteria is stablished in order to compute the overall impact of each risk.

$$\chi_{scope} = 0.35\,, \chi_{schedule} = 0.35\,, \chi_{costs} = 0.30$$

2.5. Risk Identification and assessment

Table 6. List of risk identification and assessment

Risk ID	Risk Statement	Probability	Impact			Score	Response
			Scope/Quality	Schedule	Cost		
R.1	Software bug detected during the test and validation phase	Very High	5	5	3	4.4	Mitigation: check software during its development to detect programming errors
R.2	Malfunction of the sensors selected during its integration	Low	5	4	3	4.05	Mitigation: stablish close contact with sensors' outsourced company and be aware of any changes in the integration requirements
R.3	Simulation software not accomplish the expectations of INDRA (customer)	Very High	4	5	5	4.65	Mitigation: create a very close contact with INDRA in order to know its requirements
R.4	Dissemination of the project is not successful and not achieved the desired objectives	Medium	2	1	1	1.35	Transfer: dissemination will be transferred to an expert company
R.5	Lack of innovation on the developed systems and software	Low	5	1	2	2.7	Avoidance: all changes of design are allowed to improve innovation

Risk ID	Risk Statement	Probability	Impact			Score	Response
			Scope/Quality	Schedule	Cost		
R.6	Lack of communication between work-packages and project manager	Medium	3	4	3	3.35	Avoidance: periodical meeting with the different work-packages responsible
R.7	Economic risk due to changes in commodity prices	Medium	2	1	4	2.25	Acceptance: control the cost evolution of the project along time.
R.8	New systems and procedures used during the development that could create operational issues	Low	2	3	2	2.35	Mitigation: well prepared definition of the procedure to follow
R.9	Human Resources issues due to illness, personnel reduction among others	Medium	3	5	1	3.1	Acceptance: personnel control and anticipation in unexpected personnel reduction
R.10	Insufficient laboratory's facilities in order to carry out the desired tests and validations	Medium	4	3	3	3.35	Transfer: Laboratories will be outsourced, so risk is transferred to third parties

Table 7. List of revised risk identification and assessment

Risk ID	Revised Probability	Revised Impact			Revised Score	Owner	Actions
		Scope/Quality	Schedule	Cost			
R.1	High	3	3	2	2.7	Manager of each department	Focus on the resolution of the bug and increase the human resources if it is needed to accomplish the schedule and scope
R.2	Minimum	3	2	1	2.05	Electronics department manager	Develop and matching network to allow the integration and if it is not feasible contact with the company to redesign it
R.3	Medium	4	5	4	4.35	Navigation and communication department manager	Modify the software to accomplish the requirements
R.4	Minimum	2	1	1	1.35	Communication manager	Recall the desired objectives given to the expert company
R.5	Minimum	5	1	2	2.7	Project Manager	Take the necessary measured to achieve to desired level of innovation including redesign and propose alternatives

Risk ID	Revised Probability	Revised Impact			Revised Score	Owner	Actions
		Scope/Quality	Schedule	Cost			
R.6	Minimum	3	4	3	3.35	Project Manager	Stablish more effective collective meetings and individual tracking of each work-package
R.7	Medium	2	1	2	1.65	Administrative service manager	Use the contingency budget to afford the new unexpected outcomes
R.8	Minimum	1	2	2	1.65	Project Manager	identify and change possible issues on the procedures and clear it to all work-packages workers
R.9	Medium	3	3	1	2.4	Administrative services manager	Be aware of possible human resources reduction and contract if it is needed
R.10	Minimum	4	3	3	3.35	Project Manager	Search for a certified and qualified laboratory to carry out all tests and validations

2.6. Risk Data Sheet

Table 8. Risk R.1 data sheet

<table>
<tr><td>Risk ID:
R.1</td><td colspan="5">Risk Description:
Detect a bug into the software developed in the tests and validation phases.</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This kind of risk would be caused by a programing error created during its development, and maybe by other programing factors that are not taking into account.</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td>Response</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td rowspan="2">4.4</td><td rowspan="2">Mitigation: check software during its development to detect programming errors.</td></tr>
<tr><td>Very High</td><td>5</td><td>5</td><td>3</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">High</td><td rowspan="3">3</td><td rowspan="3">3</td><td rowspan="3">2</td><td rowspan="3">2.7</td><td>Manager of each department.</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Focus on the resolution of the bug and increase the human resources if it is needed to accomplish the schedule and scope.</td></tr>
<tr><td colspan="6">Secondary Risk:
The continued checking during the development may affect the workers and reduce its efficiency.</td></tr>
<tr><td colspan="6">Residual Risk
Human factor is unavoidable, so this risk cannot be avoided. However, applying the response indicated this risk can be mitigated.</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
If this error is detected, a meeting with the managers of each department and the project manager should be done. After this, the response indicated in the cell above should be applied.</td><td colspan="2">Contingency Funds:
14,180 €</td></tr>
<tr><td colspan="2">Contingency Time:
7 months</td></tr>
</table>

Table 9. Risk R.2 data sheet

<table>
<tr><td>Risk ID:
R.2</td><td colspan="5">Risk Description:
Malfunction of the sensors selected during its integration into the ECCO systems developed in the project.</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This kind of risk would be caused by an unexpected software bug or to a hardware trouble (maybe dirt, bad manipulation…).</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td>Response</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td rowspan="2">4.05</td><td rowspan="2">Mitigation: stablish close contact with sensors' outsourced company and be aware of any changes in the integration requirements.</td></tr>
<tr><td>Low</td><td>5</td><td>4</td><td>3</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Minimum</td><td rowspan="3">3</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">2.05</td><td>Electronics department manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Develop and matching network to allow the integration and if it is not feasible contact with the company to redesign it.</td></tr>
<tr><td colspan="6">Secondary Risk:
Possible failure of the company in charge of the sensor development.</td></tr>
<tr><td colspan="6">Residual Risk
Problems related to integration, but with the response selected it is reduced to minimum.</td></tr>
<tr><td colspan="5" rowspan="2">Contingency Plan:
No needed</td><td>Contingency Funds:
No needed</td></tr>
<tr><td>Contingency Time:
No needed</td></tr>
</table>

Table 10. Risk R.3 data sheet

<table>
<tr><td>Risk ID:
R.3</td><td colspan="5">Risk Description:
The simulation software developed not accomplish the expectations of the INDRA company.</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
The main cause in this risk is the lack of communication between the team in charge of its development and the INDRA company</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td>Response</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td rowspan="2">4.65</td><td rowspan="2">Mitigation: create a very close contact with INDRA in order to know its requirements</td></tr>
<tr><td>Very High</td><td>4</td><td>5</td><td>5</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Medium</td><td rowspan="3">4</td><td rowspan="3">5</td><td rowspan="3">4</td><td rowspan="3">4.35</td><td>Navigation and communication department manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Modify the software to accomplish the requirements</td></tr>
<tr><td colspan="6">Secondary Risk:
The redesign and development of the software could increase time and costs, and INDRA would not want to pay for it.</td></tr>
<tr><td colspan="6">Residual Risk
The risk of not accomplish the desired objectives due to time, costs and knowledge is still possible and must be taken into account.</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
If this error is detected, a meeting with the managers of each department and the project manager should be done. After this, the response indicated in the cell below should be applied.</td><td colspan="2">Contingency Funds:
24,060 €</td></tr>
<tr><td colspan="2">Contingency Time:
1.5 months</td></tr>
</table>

Table 11. Risk R.4 data sheet

<table>
<tr><td>Risk ID:
R.4</td><td colspan="5">Risk Description:
Dissemination of the project is not successful and not achieved the desired objectives</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This kind of risk would appear if no new technologies are used to disseminate the projects idea, and if no international meetings with the indicated persons are done.</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td>Response</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td rowspan="2">1.35</td><td rowspan="2">Transfer: dissemination will be transferred to an expert company.</td></tr>
<tr><td>Medium</td><td>2</td><td>1</td><td>1</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Minimum</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">1</td><td rowspan="3">1.35</td><td>Communication manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Recall the desired objectives given to the expert company</td></tr>
<tr><td colspan="6">Secondary Risk:
Secondary risk appears due to outsourcing the dissemination. Maybe the desired objectives are not accomplished and should be reminded to the outsourced company.</td></tr>
<tr><td colspan="6">Residual Risk
Residual risk is reduced to minimum by transfer to an expert company.</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
No needed</td><td colspan="2">Contingency Funds:
No needed</td></tr>
<tr><td colspan="2">Contingency Time:
No needed</td></tr>
</table>

Table 12. Risk R.5 data sheet

<table>
<tr><td>Risk ID:
R.5</td><td colspan="5">Risk Description:
Lack of innovation on the developed systems and software</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
Lack of innovation could be produced due to the long time required to finalize the project, increasing the possibilities to work with technology that at the end becomes obsolete.</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td>Response</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td rowspan="2">2.7</td><td rowspan="2">Avoidance: all changes of design are allowed to improve innovation.</td></tr>
<tr><td>Low</td><td>5</td><td>1</td><td>2</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Minimum</td><td rowspan="3">5</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">2.7</td><td>Project Manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Take the necessary measured to achieve to desired level of innovation including redesign and propose alternatives</td></tr>
<tr><td colspan="6">Secondary Risk:
The continued checking and modifications on the original design could create confusion into the project.</td></tr>
<tr><td colspan="6">Residual Risk
No residual risk related to lack of innovation.</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
No needed</td><td colspan="2">Contingency Funds:
No needed</td></tr>
<tr><td colspan="2">Contingency Time:
No needed</td></tr>
</table>

Table 13. Risk R.6 data sheet

Risk ID: R.6	**Risk Description:** Lack of communication between work-packages and project manager				
Status: Closed	**Risk Cause:** This risk can be caused because of bad intern communication between team-workers due to lack of interest or personal situations				
Probability	**Impact**			**Score**	**Responses**
	Scope/Quality	Schedule	Cost		
Medium	3	4	3	3.35	Avoidance: periodical meeting with the different work-packages responsible
Revised Probability	**Revised Impact**			**Revised Score**	**Owner**
	Scope/Quality	Schedule	Cost		
Minimum	3	4	3	**3.35**	Project Manager **Actions** Stablish more effective collective meetings and individual tracking of each work-package
Secondary Risk: The implementation of new techniques in order to get a more efficient result in communication can cause an increase in time.					
Residual Risk The risk of a bad communication and an increase in time due to this situation is minimum taking into account the corrections to be done so there will produce minimum problems requiring no contingency in the project					
Contingency Plan: **No needed**				**Contingency Funds:** **No needed** **Contingency Time:** **No needed**	

Table 14. Risk R.7 data sheet

<table>
<tr><td>Risk ID:
R.7</td><td colspan="5">Risk Description:
Economic risk due to changes in commodity prices</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This kind of risk can appear if material prices exponentially increase due to any crisis or lack of the materials or the technology applied at that moment</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td rowspan="2">Score</td><td rowspan="2">Responses</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td>Medium</td><td>2</td><td>1</td><td>4</td><td>2.25</td><td>Acceptance: control the cost evolution of the project along time.</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Medium</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">1.65</td><td>Administrative service manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Use the contingency budget to afford the new unexpected outcomes</td></tr>
<tr><td colspan="6">Secondary Risk:
The secondary risk appears due to the possibility of a redesign in the project due to problems with the initial budget of this project</td></tr>
<tr><td colspan="6">Residual Risk
The risk of any change in the commodity prices is still important so it will be taken into account a contingency in order to reduce the impact on the project's budget</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
If this problem is detected, the administrative and services manager should decide what kind of measured should be taken. After this, the project response indicated in the cell below should be applied</td><td colspan="2">Contingency Funds:
20,970 €</td></tr>
<tr><td colspan="2">Contingency Time:
1 month</td></tr>
</table>

Table 15. Risk R.8 data sheet

<table>
<tr><td>Risk ID:
R.8</td><td colspan="5">Risk Description:
New systems and procedures used during the development that could create operational issues</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This risk can be caused by the acknowledgement of operators due to fast technology improvement and the need of constant learning</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td rowspan="2">Responses</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td></td></tr>
<tr><td>Low</td><td>2</td><td>3</td><td>2</td><td>2.35</td><td>Mitigation: well prepared definition of the procedure to follow</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Minimum</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">2</td><td rowspan="3">1.65</td><td>Project Manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Identify and change possible issues on the procedures and clear it to all work-packages workers</td></tr>
<tr><td colspan="6">Secondary Risk:
Secondary risk appears due to new technology that can cause problems in time and scope as operators should be able to learn new procedures in short times</td></tr>
<tr><td colspan="6">Residual Risk
Residual risk is reduced to minimum as it is mitigated with well prepared and defined procedures</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
No needed</td><td colspan="2">Contingency Funds:
No needed</td></tr>
<tr><td colspan="2">Contingency Time:
No needed</td></tr>
</table>

Table 16. Risk R.9 data sheet

<table>
<tr><td>Risk ID:
R.9</td><td colspan="5">Risk Description:
Human Resources issues due to illness, personnel reduction among others</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This kind of risk can be caused in any situation and any project, so it is a well-known risk, due to any health problem among other possibilities</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td rowspan="2">Responses</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td></td></tr>
<tr><td>Medium</td><td>3</td><td>5</td><td>1</td><td>3.1</td><td>Acceptance: personnel control and anticipation in unexpected personnel reduction</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Medium</td><td rowspan="3">3</td><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3">2.4</td><td>Administrative services manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Be aware of possible human resources reduction and contract if it is needed</td></tr>
<tr><td colspan="6">Secondary Risk:
The secondary risk can cause a time increase that will delay the project, therefore, it is applied some solutions in order to reduce this time problems</td></tr>
<tr><td colspan="6">Residual Risk
The risk of not solving the problem with an efficient solution can cause a problem in scope and time that will be taken into account with a contingency</td></tr>
<tr><td colspan="5" rowspan="2">Contingency Plan:
If this problem is detected the administrative services manager should start a plan to reduce the impact caused by human resources issues. After this, the response indicated in the cell below should be applied.</td><td>Contingency Funds:
21,590 €</td></tr>
<tr><td>Contingency Time:
15 days</td></tr>
</table>

Table 17. Risk R.10 data sheet

<table>
<tr><td>Risk ID:
R.10</td><td colspan="5">Risk Description:
Insufficient laboratory's facilities in order to carry out the desired tests and validations</td></tr>
<tr><td>Status:
Closed</td><td colspan="5">Risk Cause:
This risk can be caused by a poor qualified laboratory in charge of carrying out the tests and validations needed on the project or a misunderstood in the scope of the project</td></tr>
<tr><td rowspan="2">Probability</td><td colspan="3">Impact</td><td>Score</td><td rowspan="2">Responses</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td><td></td></tr>
<tr><td>Medium</td><td>4</td><td>3</td><td>3</td><td>3.35</td><td>Transfer: Laboratories will be outsourced, so risk is transferred to third parties</td></tr>
<tr><td rowspan="2">Revised Probability</td><td colspan="3">Revised Impact</td><td rowspan="2">Revised Score</td><td rowspan="2">Owner</td></tr>
<tr><td>Scope/Quality</td><td>Schedule</td><td>Cost</td></tr>
<tr><td rowspan="3">Minimum</td><td rowspan="3">4</td><td rowspan="3">3</td><td rowspan="3">3</td><td rowspan="3">3.35</td><td>Project Manager</td></tr>
<tr><td>Actions</td></tr>
<tr><td>Search for a certified and qualified laboratory to carry out all tests and validations</td></tr>
<tr><td colspan="6">Secondary Risk:
The secondary risks increases the problems in scope which will be solved transferring the laboratories to third parties</td></tr>
<tr><td colspan="6">Residual Risk
The residual risk is minimum so there will be no need to execute any contingency plan</td></tr>
<tr><td colspan="4" rowspan="2">Contingency Plan:
No needed</td><td colspan="2">Contingency Funds:
No needed</td></tr>
<tr><td colspan="2">Contingency Time:
No needed</td></tr>
</table>

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BARCELONATECH
Departament de Projectes d'Enginyeria

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

Communications Management

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1. Communication Management Plan

The purpose of the Communications Management Plan is to define the communication requirements for the project and how information will be distributed to the stakeholders and to the general public, but more importantly disseminated to staff at all levels. The Communications Management Plan defines the following:

- What information will be communicated.
- How the information will be communicated.
- When information will be distributed.
- Who is responsible for communicating project information.
- Communication requirements for all project stakeholders.
- How any sensitive or confidential information is communicated and who must authorize the release of the communication.
- How changes in communication or the communication process are managed.
- The flow of project communications.
- Any constraints, internal or external, which affect communications from the Project Management Team.
- Any standard templates, formats, or documents the project must use for communicating.

In the context of Horizon 2020 proposal, this Communications Management Plan sets the communications framework for this project. It will serve as a guide for communications throughout the life of the project and will be updated as communication needs change. It also includes a communications matrix which maps the communication requirements of this project. A directory for the ECCO team is included to provide contact information for all involved in the project and their areas of responsibility which will be made available to all stakeholders.

The intended audience of the ECCO Communication Management Plan is the project manager, project team, ECCO Staff, and any other stakeholders whose support is needed to carry out the project.

1.1. Communications management approach

The Project Manager will take a proactive role in ensuring effective communications on this project. The communications requirements are documented in the Communications Matrix presented in this document. The Communications Matrix will be used as the guide for what information to communicate, who is to do the communicating, when to communicate it and to whom to communicate.

As with most project plans, updates or changes may be required as the project progresses or changes are approved. Changes or updates may be required due to changes in personnel, scope, budget, or other reasons. Additionally, updates may be required as the project matures and additional requirements are needed. The project manager is responsible for managing all proposed and approved changes to the communications management plan. Once the change is approved, the project manager will update the plan and supporting documentation and will distribute the updates to the interested parts. This methodology ensures that all project stakeholders remain aware and informed of any changes to communications management.

1.2. Communications management constraints

All projects are subject to limitations and constraints as they must be within scope and adhere to budget, scheduling, and resource requirements. Project planning and documentation are no exception to this rule. There may also be legislative, regulatory, technology or departmental policy requirements which must be followed as part of communications management. While communications management is arguably one of the most important aspects of project management, it must be done in an effective manner and within the constraints of the allocated time and resources.

Communication activities are performed by the project management team as appropriate and all members of the team are kept informed of communication. Communication activities will occur in accordance with the frequencies detailed in the Communication Matrix in order to ensure the project adheres to schedule constraints.

Standardised formats and templates will be used for all communications to ensure a consistent approach and to create awareness with all stakeholders that this communication is important.

The ECCO organizational policy also states that only a team manager or higher level employee may authorize the distribution of confidential information. The project manager is responsible for ensuring that approval is requested and obtained prior to the distribution of any confidential information regarding this project.

1.3. Stakeholder communication requirements

As this project consists of a broad range of stakeholders, all of whom may have differing interests and influence on the project, the Project management team in the first instance, has sought feedback to determine the communication requirements of stakeholders in order to more effectively communicate information. This feedback will be maintained by the project manager in the project's Stakeholder Register. Standard project communications will occur in accordance with the Communication Matrix; however, depending on the identified stakeholder communication requirements, individual communication is acceptable and within the constraints outlined for this project.

In addition to identifying communication preferences, stakeholder communication requirements must identify the project's communication channels and ensure that stakeholders have access to these channels. If project information is communicated via secure means or through internal company resources, all stakeholders, internal and external, must have the necessary access to receive project communications.

Once all stakeholders have been identified and communication requirements are established, the project team will maintain this information in the project's Stakeholder Register and use this, along with the project communication matrix as the basis for all communications.

1.4. Participants roles and responsibilities

Project Communications are the ECCO Project primary tool for promoting cooperation, participation, coordination and an understanding of acceptance between all stakeholders. ECCO Project has eight primary stakeholder groups and has specific communications goals for each.

Steering Committee

The ECCO steering committee will provide strategic direction, and resolve conflicts or expedite a process that is not resolved at a lower level. The committee is responsible for providing and maintaining the necessary resources needed for the successful completion of the ECCO project. Also the committee will provide leadership, support, and assist in implementing departmental policies as required to support the ECCO Project.

Project Manager

The ECCO project manager is responsible for communicating status for scope, schedule, and cost, as well as monitoring, controlling, and communicating the risks.

The ECCO project manager has the responsibility to ensure that all information related to the ECCO project is consistent, correct, accurate, and timely.

The ECCO project manager will review and approve all information being provided to the various stakeholders. The project manager will ensure continued user involvement and requirements remain relatively stable throughout the ECCO project.

Project Management

The ECCO Project Management team is composed of the Project Manager and all of the different department managers, including the technical and non-technical departments.

The roles and responsibilities of the ECCO Project Management are:

- Provide leadership and direction.
- Review progress, risks, and issues and recommend resolution.
- Make recommendations to the project sponsor.
- Assure ECCO implementation by educating district and program staff, provide means for training, and support implementation efforts.

Technical Project Team

The ECCO technical project team is composed of the ECCO staff working directly in the project.

It will be responsible for the successful development, documentation, data conversion, implementation, and ongoing operational support of the ECCO Project. The technical team will also be responsible for developing, providing, and conducting training to the state for the ECCO project. The ECCO technical team will deliver a system that meets all the functional requirements of the contract. The ECCO technical team shall deliver the system per the schedule that will be described in the state approved ECCO Project Management Plan. The ECCO technical project lead will oversee the other technical personnel working on the solution, including any contractors and sub-contractors. The ECCO technical project lead is responsible to report any issues impacting the project, provide recommendations to resolve issues, and assist the project manager in successful implementation of the ECCO project.

The ECCO technical project lead will report directly to the ECCO project manager and provide all project information to them. The ECCO technical project lead will be responsible for collecting and gathering all ECCO related information from the subcontractors under their current contract.

Project Team

The ECCO Project Team is composed of the technical project team and the close collaborators of the ECCO Project. Their roles and responsibilities are to develop the solution and progress in the project without losing the scope, schedule and budget constraints.

The ECCO project team will report directly to the ECCO project manager and provide all project information to them. The ECCO project team will be responsible for collecting and gathering all ECCO related information from the subcontractors under their current contract.

Outsourcing companies

This group is formed by the external collaborators to the ECCO Project. The communication will be almost unidirectional, from the collaborator to the correspondent department. Within a Statement of Work the ECCO Project states the amount of work to do and the collaborators must fulfil the requirements.

Roles and responsibilities within this group are:

- Inform and secure commitment from this group to support and participate in ECCO Project.
- Support this group so they may fully utilize the functions of the ECCO Project in their key business processes.
- To participate in the ECCO Project with the appropriate resources, program management, and policies to support their participation.

- Develop communications messages, materials and activities that respond to the needs of the ECCO Project.
- Evaluate the Project Communications plan by measuring customer satisfaction.

External costumers

The companies that belong to this group are the ones that will buy some part of the results of the project.

Roles and responsibilities within this group are:

- Inform the companies about the benefits which ECCO Project will provide to them.
- Secure timely companies participation in the definition of common business functions that will be integrated into ECCO Project design and development.
- Participate in the communications feedback loop, by providing comments back to the messenger based on the message received.

External agents

This group includes the dissemination targets. Dissemination activities are described later in this document.

All of the described groups are summarized in the following figure.

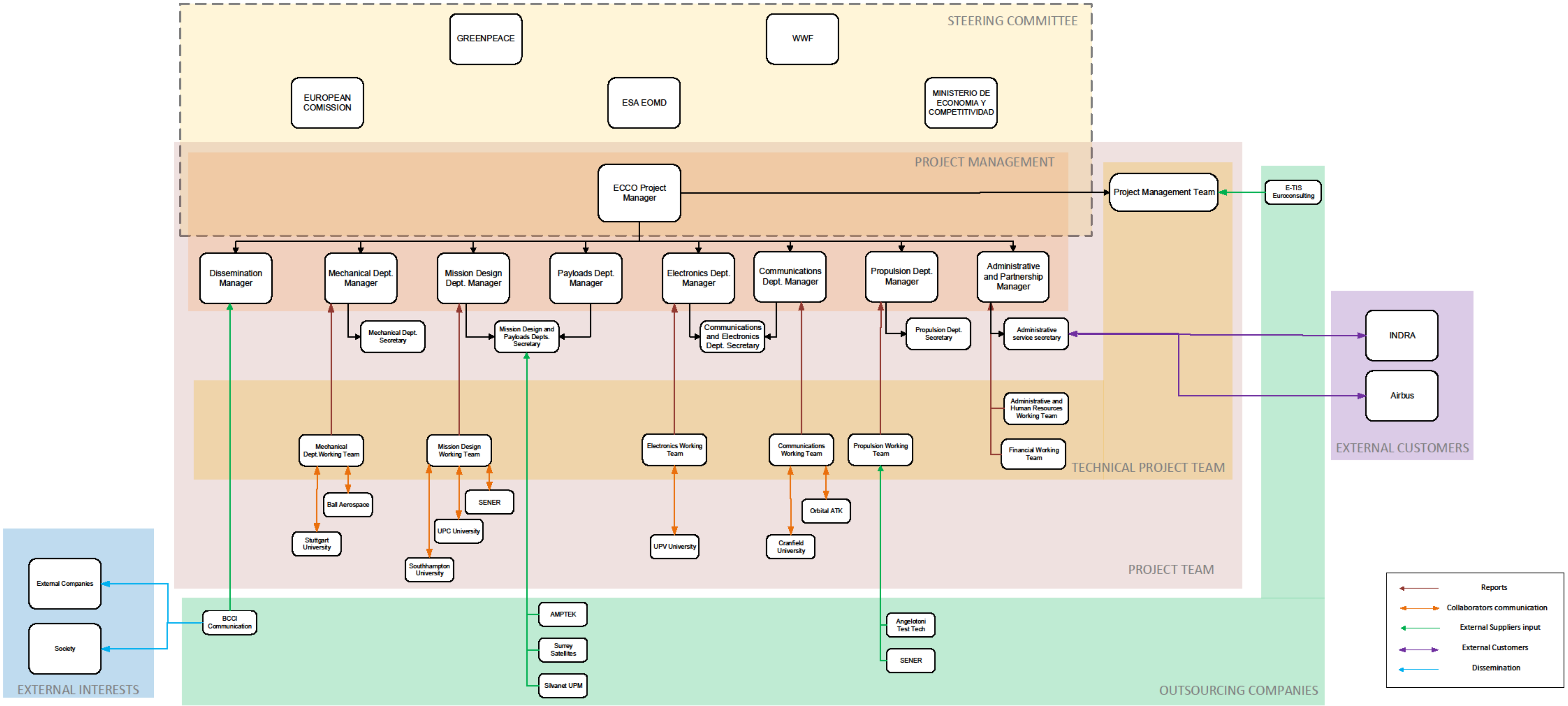

Figure 1. Participant roles and responsibilities diagram

1.5. Project management team directory

The following table presents contact information for all persons identified in this communications management plan, which belong to the ECCO Project organization. The email addresses and phone numbers in this table will be used to communicate with these people.

Table 1. Project team directory

Role	Name	Department	Email	Phone
ECCO Project Manager	Ona Martos Fortunato	ECCO Project	ona.martos@ecco.cat	+34 933874002
Department Manager	Edgar Teixidó Martínez	Dissemination Dept.	edgar.teixido@ecco.cat	+34 933874015
Department Manager	María Casas del Bosque	Mechanical Dept.	maria.casas@ecco.cat	+34 933874029
Department Manager	Jordi Cunill Warsaw	Mission Design Dept.	jordi.cunill@ecco.cat	+34 933874004
Department Manager	Elena Fantino Argentón	Payloads Dept.	elena.fantino@ecco.cat	+34 933874095
Department Manager	David González Diaz	Electronics Dept.	david.gonzalez@ecco.cat	+34 933874073
Department Manager	Ignacio Gil Garrido	Communications Dept.	ignacio.gil@ecco.cat	+34 933874044
Department Manager	Marc Maymó Llorens	Propusion Dept.	marc.maymo@ecco.cat	+34 933874031
Department Manager	Laura Pascual Gabaldón	Administrative and partnership	laura.pascual@ecco.cat	+34 933874010
Stakeholders	See Stakeholder Register	See Stakeholder Register	See Stakeholder Register	See Stakeholder Register

1.6. Communication process, methods and technologies

Often the methods and technologies used to communicate are just as important a consideration as the information being communicated. The different technological capabilities of the stakeholders must be taken into consideration when planning the communication technologies. Some may have access to video teleconferencing and others only have telephone and email capabilities. In order to be effective, project information must be communicated to everyone involved by some method using available technology.

The ECCO Project maintains a SharePoint platform called *ECComm* which all projects use to provide updates, archive various reports, and conduct project communications. This platform enables senior management, as well as stakeholders with compatible technology, to access project data and communications at any point in time. SharePoint also provides the ability for stakeholders and project team members to collaborate on project work and communication.

For stakeholders who do not have the ability to access *ECComm SharePoint*, a web site will also be established for the project. Access to the website will be controlled with a username and password. Any stakeholders identified who are not able to access *ECComm SharePoint* will be issued a unique username and password in order to access the web site. The project manager is responsible for ensuring all project communications and documentation are copied to the web site and that the content mirrors what is contained on the *ECComm SharePoint* platform.

All project communication and documentation, in addition to being maintained on the *ECComm SharePoint* platform and project website, will be archived on the internal ECCO Project shared drive which resides in the Project Management Team program directory. Organizational naming conventions for files and folder will be applied to all archived work.

The Project Management Team will determine, the communication methods and technologies based on several factors to include: stakeholder communication requirements, available technologies (internal and external), and organisational policies and standards. Three types of communication processes are identified and explained below:

Informal communications

Informal communications serve to supplement and enhance formal communications. A number of methods of informal communication can be considered. Some examples include e-mails, phone calls or informal meetings. Due to the varied types and ad-hoc nature of informal communications, they are not discussed in this plan.

Formal communications

The ECCO Project will engage in various types of formal communication. The general types and their purpose are described below.

- **Status Meetings**

There are five basic types of status meetings for the ECCO Project:

1. Status meetings internal to the ECCO technical project team to discuss assignments, activities, and to share information.

2. Status meetings and reports between the ECCO project management team, and the project team.

3. Project management team meetings with the project stakeholders, and project manager to review progress, risks and issues.

4. Status meetings and reports between the ECCO project manager and the steering committee.

5. Status meetings and reports to stakeholders, such as external customers and outsourcing companies.

- **Status Reports**

A variety of status reports will be produced during the project. The status reports will be produced on regular intervals to provide stakeholders project information on the status and progress of the ECCO project. At a minimum the reports will contain:

- Project status on major activities
- Project schedule
- Budget and cost tracking
- Status of issues and risks
- Health status
- Status of action items, if applicable.
- Future or planned activities

The intent of the status reports is to inform stakeholders of the project's progress and keep them actively involved in the project. The information provided will contain enough detail to allow stakeholders to make informed decisions and maintain oversight of the project.

- **External Communications, Dissemination**

Apart from the internal communication activities, the philosophy of the company is to care about the importance of having a good dissemination plan, with the objective of keeping informed not only stakeholders but also all the general public.

To achieve this aim ECCO outsources some external communication tasks to an external specialized firm.

In order to perform this dissemination, the following tasks will be developed:

- **Social Networking**

Dissemination campaign must be compatible with the current media, taking profit of new technology and reach European inhabitants. The dissemination of media, social media and a website will offer a friendly approach to the project through many channels of communication. All the non-confidential information about the development of the project and the new discoveries will be published in the webpage and social networks with an update three times a week.

- ***ECCO Day* International congress**

Two international congresses will be organized to attract possible stakeholders and keep the interest of the current ones. The ECCO stakeholders and some potential new stakeholders will be invited to attend and/or participate in the two international congresses where some conferences will be given. The first ECCO Day will be done in the 61st week of the project and the second ECCO Day will be done at the end of the project, around the 115th week.

- **Specialized journals and magazines**

In order to keep informed the interested public, ECCO will also publish articles periodically in some of the specialized journals. In the following table is mentioned the magazines in which participation is foreseen:

Table 2. List of specialized journals and magazines

Journal	Frequency	Format	Description
Space Science & Engineering International Journal	1 per year	Online magazine (Only for subscribers) Paper magazine	This journal produces 4 issues per year about original and multidisciplinary research papers in all areas of space activities. (Into the covered topics they specify earth observation from space and data processing).
CEAS Space Journal	1 per year	Online version Paper Version	The CEAS Space Journal has been created by the Space Branch of the Council of European Aerospace Societies to provide an appropriate platform for excellent scientific publications submitted by scientists and engineers.
Space Science Reviews	1 per year	Online Version Paper Version	As an international key journal on scientific space research, its purpose is to provide a comprehensive synthesis of the various branches of space research. Space Science Reviews continues to boast a very strong Impact Factor, and is found in the 1st quartile of all Astronomy and Astrophysics journals by Thomson Scientific.

Aerospacio	2 per year	Online magazine Paper magazine	Spanish magazine where important aerospace discoveries are published.
Progress in Aerospace Sciences	1 per year	Online Version Paper Version	An international review journal designed to be of broad interest and use to all those concerned with research in aerospace sciences and their applications in research establishments, industry and universities.
Aerospace Science and Technology	1 per year	Online Version Paper Version	This journal publishes original papers, review articles and short communications related to all fields of aerospace research, fundamental and applied potential applications. (Into the covered topics they specify earth observation and aerospace communications, among others).
Advances in Space Research	2 per year	Online OPEN journal	The Official Journal of the Committee on Space Research (COSPAR), a Scientific Committee of the International Council for Science (ICSU).

- **Trade Fairs**

Participation in trade fairs of the sector is a very important part of the dissemination of the project. There are specialized fairs where ECCO can present the project to the public. In the following list are the trade fairs in which ECCO will participate:

ILA Berlin Air Show. ILA Berlin Air Show is not only the oldest fair in the industry but it is also considered to be the leading international aerospace trade show. Many exhibitors, among others, from the areas of commercial aviation, aerospace, defense and security, equipment, engines and materials present their new products and innovations. The fair is an industry meeting place and also a crowd puller. For example, the "International Suppliers Center ISC" offers to the international suppliers in the industry an excellent platform to present themselves in front of an international trade audience. In addition, visitors can expect an excellent conference program. The "ILA Career Center" is the ideal platform for human resources and recruiting. Here employers and future employees can meet in a relaxed environment.

Date: 31.05.2016 -05.06.2016

Location: Berlin

Contact and information: www.ila-berlin.de/ila2014/home/index.cfm

The Japan International Aerospace Exhibition in Tokyo. It is an international exhibition of aviation and space technology. Here the newest technologies, products, services and developments in the industry are presented and information is exchanged in order to contribute to the development of the aerospace industry with appropriate activities. Both the professional and the just plain interested visitors get an overview on aviation and space technology at the several stalls of the exhibitors.

Date: 12.10.2016 -15.10.2016

Location: Tokyo

Contact and information: www.japanaerospace.jp/eng/Index

Airshow China. China International Aviation & Aerospace Exhibition (namely Airshow China) is the only international aerospace trade show in China that is endorsed by the Chinese central government. It features the display of real-size products, trade talks, technological exchange and flying display. Since 1996, the show has been successfully held in Zhuhai in every even-number year for 10 sessions.

Date: 01.11.2016 -06.11.2016

Location: Zhuhai, China

Contact and information: www.airshow.com.cn/en/

International Paris Air Show Le Bourget. This fair is an international aviation and aerospace exhibition, which is organized every two years by the SIAE, a subsidiary of GIFAS, the French Aerospace Industries Association. It is one of the oldest and largest air shows in the world. Here the newest technologies of the aerospace industry and related equipment, such as aircraft engines, satellite navigation technology, aircraft cabins and seats and weapons systems will be presented. Over the years this show has become one of the most important international platforms in the industry. The first days of the fair are reserved exclusively for trade visitors, at the weekend the event will open its doors for the general public. About 150 aircrafts are presented. Many of them show their skills during the daily flying demonstrations in the afternoon which gives exhibitors the opportunity to demonstrate their technical expertise to the public. The exhibition is accompanied by a B2B meeting program where the exchange of knowledge and experiences in combination with the search for solutions in the aerospace sector is in the foreground.

Date: 20.06.2017 -20.06.2017

Location: Paris

Contact and information: http://www.siae.fr/EN

SPIE Remote Sensing Toulouse. This fair is Europe's largest international forum for remote sensing. The event offers comprehensive coverage of remote sensing including next-generation satellites, SAR image analysis, LADAR technologies and more. The conference covers the latest enabling technologies and applications for sensor technologies, sensing of the environment, and signal and image processing. Remote Sensing is co-located with Security and Defense.

Date: 24.09.2017 -27.09.2017

Location: Paris

Contact and information: www.spie.org

- **Other dissemination activities**

Since some part of the dissemination will be outsourced, it is expected to have modifications in this Dissemination plan. More activities that are eligible to be included in the dissemination plan are, for example, school lessons, science festivals, informative meetings, organizing sport events, leaflets, press releases and others, depending on the target group.

1.7. Guidelines for meetings

Formal meetings will adhere to the following best practice guidelines.

Meeting Agenda

Meeting Agenda will be distributed 5 business days in advance of the meeting. The Agenda should identify the presenter for each topic along with a time limit for that topic. The first item in the agenda should be a review of action items from the previous meeting.

Meeting Minutes

Meeting minutes will be distributed within 2 business days following the meeting. Meeting minutes will include the status of all items from the agenda along with new action items and the Parking Lot list.

Action Items

Action Items are recorded in both the meeting agenda and minutes. Action items will include both the action item along with the owner of the action item. Meetings will start with a review of the status of all action items from previous meetings and end with a review of all new action items resulting from the meeting. The review of the new action items will include identifying the owner for each action item.

Note Taker

The Note Taker is responsible for documenting the status of all meeting items, maintaining a Parking Lot item list and taking notes of anything else of importance during the meeting.

1.8. Communication Standards

In order to achieve consistent and effective communications, standardisation of documentation is a proven way to simplify the complexities of project management communications. The Project Management Office has developed standard templates or formats for the various communication tools used throughout the project. Standard templates and formats of font will be applied specific types of communication (i.e. emails, status reports, e-zines, bulletins etc.). By using standardisation, it can help to achieve consistent and effective communications. Formal project communications are detailed in the project's communication matrix and include:

Kick-off Meeting – project team will utilize ECCO Project standard templates for meeting agenda and meeting minutes. Additionally, any slides presented will use the ECCO Project standard slideshow template.

Project Team Meetings – project team will utilize ECCO Project standard templates for meeting agenda and meeting minutes. Additionally, any slides presented will use the ECCO Project standard slideshow template.

Technical Design Meetings – project team will utilize ECCO Project standard templates for meeting agenda and meeting minutes. Additionally, any slides presented will use the ECCO Project standard slideshow template.

Monthly Project Status Meetings – project team will utilize ECCO Project standard templates for meeting agenda and meeting minutes. Additionally, any slides presented will use the ECCO Project standard slideshow template.

Project Status Reports – project team will utilize ECCO Project standard templates for meeting agenda and meeting minutes. Additionally the standard project status report document, available on the share drive, will be used to provide project status.

Informal project communications should be professional and effective but there is no standard template or format that must be used.

1.9. Communication Escalation Process

Efficient and timely communication is the key to successful project completion. As such, it is imperative that any disputes, conflicts, or discrepancies regarding project communications are resolved in a way that is conducive to maintaining the project schedule, ensuring the correct communications are distributed, and preventing any ongoing difficulties. In order to ensure projects stay on schedule and issues are resolved, the ECCO Project will use its standard escalation model to provide a framework for escalating communication issues.

The table below defines the priority levels, decision authorities, and timeframes for resolution.

Table 3. Priority levels for the escalation process

Priority	Definition	Decision Authority	Timeframe for Resolution
Priority 1	Major impact to project or business operations. If not resolved quickly there will be a significant adverse impact to revenue and/or schedule.	Steering committee	Within 4 hours
Priority 2	Medium impact to project or business operations which may result in some adverse impact to revenue and/or schedule.	Project Manager	Within one business day
Priority 3	Slight impact which may cause some minor scheduling difficulties with the project but no impact to business operations or revenue.	Department manager	Within two business days
Priority 4	Insignificant impact to project but there may be a better solution.	Team Manager	Work continues and any recommendations are submitted via the project change control process

2. Communication management plan matrix

The following table identifies the communications requirements for this project.

Table 4. Communication management plan matrix

Communication Type	Objective of Communication	Medium	Frequency	Audience	Owner	Deliverable	Format
Kickoff Meeting	Introduce the project team and the project. Review project objectives and management approach.	• Face to Face	Once, at the beginning of the project.	• Steering committee • Project Team • Stakeholders	Project Manager	• Agenda • Meeting Minutes	• Soft copy archived on project *ECComm SharePoint* site and project web site
Project Team Meetings	Review status of the project with the team.	• Face to Face • Conference Call	Weekly	• Project Team	Project Manager	• Agenda • Meeting Minutes • Project schedule	• Soft copy archived on project *ECComm SharePoint* site and project web site
Technical Design Meetings	Discuss and develop technical design solutions for the project.	• Face to Face	As Needed	• Project Technical Staff	Technical Lead	• Agenda • Meeting Minutes	• Soft copy archived on project *ECComm SharePoint* site and project web site
Monthly Project Status Meetings	Report on the status of the project to management.	• Face to Face • Conference Call	Monthly	• Project management team	Project Manager	• Slide updates • Project schedule	• Soft copy archived on project *ECComm SharePoint* site and project web site

Project Status Reports	Report the status of the project including activities, progress, costs and issues.	• Email	Monthly	• Project Team • Stakeholders • Project management team	Project Manager	• Project Status Report • Project schedule	• Soft copy archived on project *ECComm SharePoint* site and project web site
Steering committee meetings	Provide strategic direction, and resolve conflicts or expedite a process that is not resolved at a lower level.	• Face to face • Conference Call	After each milestone	• Steering committee • Project Manager	Project Manager	• Agenda • Meeting Minutes	• Soft copy archived on project *ECComm SharePoint* site and project web site
ECCO Day	Dissemination of the project	• Face to face • Conference	Twice, at 61st and 115th weeks	• Open to everyone	Project Manager	See Dissemination plan	See Dissemination plan
Dissemination activities	Reach external agents with news of the project	See Dissemination plan	See Disseminati on plan	• External companies • General public	Project Manager	See Dissemination plan	See Dissemination plan

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EARTH CLIMATE CHANGE OBSERVATION

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ANNEX I

Activity Attributes

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List of Tables

Table 1. Activity PM.1 attributes

ID: PM.1		**Activity:** Project Management Plan			
Description of Work: A document that defines a more detailed and technical vision of the project, specifying resources, their distribution in time to accomplish the project objectives, a detailed version of the project Charter, control and monitoring actions and level of implementation among others.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
START	-	-	REP.PM;PM.2;C	FF;FS;FS	-
Number and Type of Resources Required: PM.S PM.M PM.EXT		**Skill Requirements:** Average Expert Expert		**Other Required Resources:** SOFT.6	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and E-TIS Euroconsulting outsourcing					
Constraints: Project Management Report					
Assumptions: The project management will be in part outsourced to E-TIS Euroconsultores					

Table 2. Activity PM.2 attributes

<table>
<tr><td colspan="3">ID: PM.2</td><td colspan="3">Activity: Monitoring of project evolution</td></tr>
<tr><td colspan="6">Description of Work:
Check and update the state of the project, be aware of any change in budget or deadline ensuring a satisfactory end of it.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM.1</td><td>FS</td><td>-</td><td>PN</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
PM.S
PM.M
PM.EXT</td><td colspan="2">Skill Requirements:

Average
Expert
Expert</td><td colspan="2">Other Required Resources:
SOFT.6</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and E-TIS Euroconsulting outsourcing</td></tr>
<tr><td colspan="6">Constraints:
Project Management Report</td></tr>
<tr><td colspan="6">Assumptions:
The project management will be in part outsourced to E-TIS Euroconsultores</td></tr>
</table>

Table 3. Activity PM.3 attributes

<table>
<tr><td colspan="3">ID: PM.3</td><td colspan="3">Activity: Preliminary design review</td></tr>
<tr><td colspan="6">Description of work:
Check the preliminary design document and ensure the expectations, scope and objectives are achieved.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>REP.PD</td><td>FS</td><td>-</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
PM.S
PM.M
PM.EXT</td><td colspan="2">Skill Requirements:

Average
Expert
Expert</td><td colspan="2">Other Required Resources:
SOFT.6</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and E-TIS Euroconsulting outsourcing</td></tr>
<tr><td colspan="6">Constraints:
Project Management Report</td></tr>
<tr><td colspan="6">Assumptions:
The project management will be in part outsourced to E-TIS Euroconsultores</td></tr>
</table>

Table 4. Activity AS.1 attributes

ID: AS.1			**Activity:** Human resources plan		
Description of Work: Estimated plan of the human resources management department so as to evaluate the number and characteristics of the required employees and persons in charge.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
START	-	-	AS.2	FS	-
Number and Type of Resources Required: AS.M AS.S HR.W		**Skill Requirements:** Expert Average Average		**Other Required Resources:** -	
Type of Effort: Fixed amount of time					
Location of Performance: In the company					
Constraints: -					
Assumptions: Administrative services include the Human Resources and Financial parts of the project.					

Table 5. Activity AS.2 attributes

ID: AS.2		**Activity:** Monitoring of human resources evolution			
Description of Work: Check and update the state of human resources, be aware of any change needed resources ensuring a satisfactory end of the project.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
AS.1	FS	-	FINISH	-	-
Number and Type of Resources Required: AS.M, AS.S, HR.W		**Skill Requirements:** Expert, Average, Average		**Other Required Resources:** -	
Type of Effort: Fixed amount of time					
Location of Performance: In the company					
Constraints: -					
Assumptions: Administrative services include the Human Resources and Financial parts of the project					

Table 6. Activity AS.3 attributes

<table>
<tr><td colspan="3">ID: AS.3</td><td colspan="3">Activity: Financial plan</td></tr>
<tr><td colspan="6">Description of Work:
Evaluate the cost required by each of the departments in order to carry on the project.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>START</td><td>-</td><td>-</td><td>AS.4</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
AS.M
AS.S
F.W1
F.W2</td><td colspan="2">Skill Requirements:

Expert
Average
Average
Average</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of time</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
-</td></tr>
<tr><td colspan="6">Assumptions:
Administrative services include the Human Resources and Financial parts of the project</td></tr>
</table>

Table 7. Activity AS.4 attributes

ID: AS.4			**Activity:** Monitoring of financial evolution		
Description of Work: Evaluate the cost required by each of the departments in order to carry on the project.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
AS.3	FS	-	FINISH	-	-
Number and Type of Resources Required: AS.M AS.S F.W1 F.W2		**Skill Requirements:** Expert Average Average Average		**Other Required Resources:** -	
Type of Effort: Fixed amount of time					
Location of Performance: In the company					
Constraints: -					
Assumptions: Administrative services include the Human Resources and Financial parts of the project					

Table 8. Activity PN.1 attributes

ID: PN.1		**Activity:** Coordination and cooperation control			
Description of Work: Coordinate and check the evolution of the project, and maintain the common scope between all the project partners					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
REP.PM.1	FS	-	FINISH	-	-
Number and Type of Resources Required: AS.M AS.S HR.W		**Skill Requirements:** Expert Average Average		**Other Required Resources:** -	
Type of Effort: Fixed amount of time					
Location of Performance: In the company					
Constraints: ECCO International Congress (REP.C.2).					
Assumptions: There PN tasks are developed by the workers of the AS Department.					

Table 9. Activity PN.2 attributes

ID: PN.2		**Activity:** Stakeholders contact control			
Description of Work: Check and update the interests of the stakeholders and the company during the development of the project.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
REP.PM.1	FS	-	FINISH	-	-
Number and Type of Resources Required: AS.M AS.S HR.W		**Skill Requirements:** Expert Average Average		**Other Required Resources:** -	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company and also where the stakeholders develop their activities.					
Constraints: ECCO International Congress (REP.C.2).					
Assumptions: There PN tasks are developed by the workers of the AS Department.					

Table 10. Activity C.1 attributes

<table>
<tr><td colspan="3">ID: C.1</td><td colspan="3">Activity: Publishing and meetings</td></tr>
<tr><td colspan="6">Description of Work:
Make possible the interaction with the media, science and technologic field so as to let know the new advances.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM.1</td><td>FS</td><td>-</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
C.EXT
C.M</td><td colspan="2">Skill Requirements:

Expert
Expert</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where BCCI Communication Outsourcing develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
ECCO International Congress (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The dissemination of the project will be mostly done by BCCI Communications</td></tr>
</table>

Table 11. Activity C.2 attributes

<table>
<tr><td colspan="3">ID: C.2</td><td colspan="3">Activity: Press communications</td></tr>
<tr><td colspan="6">Description of Work:
Start the contact with the written press in order to state the past, the current and the future fractionated satellite technology advances.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PM.1</td><td>FS</td><td>-</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
C.EXT
C.M</td><td colspan="2">Skill Requirements:

Expert
Expert</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where BCCI Communication Outsourcing develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
ECCO International Congress (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The dissemination of the project will be mostly done by BCCI Communications</td></tr>
</table>

Table 12. Activity C.3 attributes

<table>
<tr><td colspan="2">ID: C.3</td><td colspan="4">Activity: Conferences</td></tr>
<tr><td colspan="6">Description of Work:
Planning and development of future conferences to attract possible stakeholders and keep the interest of the current ones.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM.1; START</td><td>FS;SS</td><td>-;267</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
C.EXT
C.M</td><td colspan="2">Skill Requirements:

Expert
Expert</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where BCCI Communication Outsourcing develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
ECCO International Congress (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The dissemination of the project will be mostly done by BCCI Communications</td></tr>
</table>

Table 13. Activity C.4 attributes

<table>
<tr><td colspan="3">ID: C.4</td><td colspan="3">Activity: Public relations outreach and enquiries</td></tr>
<tr><td colspan="6">Description of Work:
Interact with general population so as to introduce the topic, its new technology and the benefits of providing useful data as to live in a better world.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM.1; START</td><td>FS;SS</td><td>-;267</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
C.EXT
C.M</td><td colspan="2">Skill Requirements:

Expert
Expert</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where BCCI Communication Outsourcing develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
ECCO International Congress (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The dissemination of the project will be mostly done by BCCI Communications</td></tr>
</table>

Table 14. Activity C.5 attributes

<table>
<tr><td colspan="2">ID: C.5</td><td colspan="4">Activity: Media, social media and web</td></tr>
<tr><td colspan="6">Description of Work:
Approach the whole project in a friendly way through many different channels of communication.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM.1; START</td><td>FS;SS</td><td>-;267</td><td>FINISH</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
C.EXT
C.M</td><td colspan="2">Skill Requirements:

Expert
Expert</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where BCCI Communication Outsourcing develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
ECCO International Congress (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The dissemination of the project will be mostly done by BCCI Communications</td></tr>
</table>

Table 15. Activity PD.M.SA.1 attributes

<table>
<tr><td colspan="2">ID: PD.M.SA.1</td><td colspan="4">Activity: Analyse mission requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search exhaustively information about the mission of this project in order to stablish a solid base to run the project.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>START</td><td>SS</td><td>-</td><td>PD.M.SA.2;PD.M.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MDD.S
E.MDD.M
SE1
SE2</td><td colspan="2">Skill Requirements:

Average
Expert
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.M.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts.</td></tr>
</table>

Table 16. Activity PD.M.SA.2 attributes

<table>
<tr><td colspan="2">ID: PD.M.SA.2</td><td colspan="4">Activity: Research and analyse current Earth orbit observations</td></tr>
<tr><td colspan="6">Description of Work:
Make a careful analysis of the today orbit observations market to place this project in the sector.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.M.SA.1</td><td>FS</td><td>-</td><td>PD.M.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MDD.S
E.MDD.M
SE1
SE2</td><td colspan="2">Skill Requirements:

Average
Expert
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.M.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts.</td></tr>
</table>

Table 17. Activity PD.M.1 attributes

ID: PD.M.1		**Activity:** Select optimum orbital parameters			
Description of Work: Selection of the optimum orbital parameters to track Earth information and specify operative data, for instance, height or type of orbit in order to start states of the arts of each department.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.M.SA	FS	-	PD.M.2;PD.M.3;PD.M.1	FS	-
Number and Type of Resources Required: E.MDD.S E.MDD.M SE1 SE3 SE4		**Skill Requirements:** Average Expert Senior Senior Senior		**Other Required Resources:** SOFT.7	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.M.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts.					

Table 18. Activity PD.M.2 attributes

ID: PD.M.2			**Activity:** Specify technological requirements		
Description of Work: Listing specific technological requirements of the mission in order to accomplish stablished scope.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.M.1	SS	-	REP.M.1;PD.M.1	FF;FS	-
Number and Type of Resources Required: E.MDD.S E.MDD.M SE1 SE2 SE3			**Skill Requirements:** Average Expert Senior Senior Senior		**Other Required Resources:** SOFT.7
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.M.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts.					

Table 19. Activity PD.M.3 attributes

ID: PD.M.3			**Activity:** Specify incremental deployment requirements		
Description of Work: Determine and specify the requirements of incremental deployment system.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.M.1	SS	-	REP.M.1;PD.M.1	FF;FS	-
Number and Type of Resources Required:		**Skill Requirements:**		**Other Required Resources:**	
E.MDD.S		Average		SOFT.7	
E.MDD.M		Expert			
SE1		Senior			
SE4		Senior			
MDD.EXT		Senior			
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.M.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. In the PD.M only Space Engineers work due to their broad knowledge in mission design concepts.					

Table 20. Activity PD.C.SA.1 attributes

<table>
<tr><td colspan="2">ID: PD.C.SA.1</td><td colspan="4">Activity: Analyse work environment</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in communication systems.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.M</td><td>FS</td><td>-</td><td>PD.C.SA.2
PD.C.SA.3
PD.C.HW;PD.P</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
TE.1
TE.2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 21. Activity PD.C.SA.2 attributes

<table>
<tr><td colspan="3">ID: PD.C.SA.2</td><td colspan="3">Activity: Analyse modules communication requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search for information to have a clear idea about the specific requirements for the communication between the modules.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.C.SA.1</td><td>FS</td><td>-</td><td>PD.C.SA.4
PD.C.HW;PD.P</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
TE1
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 22. Activity PD.C.SA.3 attributes

ID: PD.C.SA.3	**Activity:** Analyse ground – space communications requirements				
Description of Work: Search for information to have a clear idea about the specific requirements for the communication between the ground station and the space station.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.C.SA.1	FS	-	PD.C.SA.4 PD.C.HW;PD.P	FS	-
Number and Type of Resources Required: E.CD.M E.CD.S SE.2 SE.3		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 23. Activity PD.C.SA. 4 attributes

ID: PD.C.SA.4	**Activity:** Analyse power transmission requirements				
Description of Work: Search for information that will provide a clear idea about the requirements of the power transmission in the conditions of this project					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.C.SA.2;PD.C.SA.3	FS	-	PD.C.HW;PD.P	FS	-
Number and Type of Resources Required: E.CD.M E.CD.S TE1 SE2 MD.EXT 3		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company and also where Orbital ATK develops its activities.					
Constraints: Report of results and conclusions (REP.C.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.					

Table 24. Activity PD.C.HW.1 attributes

<table>
<tr><td colspan="2">ID: PD.C.HW.1</td><td colspan="4">Activity: Select modules of the communication system</td></tr>
<tr><td colspan="6">Description of Work:
After an exhaustive research and assessment a selection of the communication has to be done, including frequency, bandwidth taking in account noise and possible undesired effects due to external factors.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.C.SA</td><td>FS</td><td>-</td><td>PD.C.HW.2
PD.C.SW
PD.E.HW;PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
SE1
TE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 25. Activity PD.C.HW.2 attributes

ID: PD.C.HW.2			**Activity:** Modules communication system		
Description of Work: Preliminary design of communication hardware, including mixers, filters and amplifiers between modules has to be done. The design must fulfil all the specifications that have been indicated in related tasks.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.C.HW.1;PD.C.SA	FS	-	PD.C.SW PD.E.HW;PD.ME	FS	-
Number and Type of Resources Required: E.CD.M E.CD.S SE1 TE2 CD.EXT 2			**Skill Requirements:** Expert Average Senior Senior Junior	**Other Required Resources:** -	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. These task will be done in collaboration with University of Stuttgart					

Table 26. Activity PD.C.HW.3 attributes

ID: PD.C.HW.3		**Activity:** Select ground – space communication system			
Description of Work: After an exhaustive research and assessment a selection of the communication has to be done, including frequency, bandwidth taking in account noise and possible undesired effects due to external factors.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.C.SA	FS	-	PD.C.HW.4	FS	-
Number and Type of Resources Required: E.CD.M E.CD.S SE2 TE3		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.1).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 27. Activity PD.C.HW.4 attributes

<table>
<tr><td colspan="3">ID: PD.C.HW.4</td><td colspan="3">Activity: Ground – space communication system</td></tr>
<tr><td colspan="6">Description of Work:
Preliminary design of communication hardware, including mixers, filters and amplifiers between satellite and ground station has to be done. The design must fulfil all the specifications that have been indicated in related tasks.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.C.HW.3;PD.C.SA</td><td>FS</td><td>-</td><td>PD.C.SW
PD.E.HW;PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
SE2
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 28. Activity PD.C.SW.1 attributes

ID: PD.C.SW.1		**Activity:** Communication control software			
Description of Work: Development of the software that controls and enables transmission data through hardware designed.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.C.HW	FS	-	PD.C.SW.2;REP.C.1	FS;FF	-
Number and Type of Resources Required: E.CD.M E.CD.S SE1 IE3 TE2		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** SOFT.5	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.1).					
Assumptions: Very interdisciplinary team for the preliminary design of the communication software.					

Table 29. Activity PD.C.SW.20 attributes

<table>
<tr><td colspan="3">ID: PD.C.SW.2</td><td colspan="3">Activity: Simulation program</td></tr>
<tr><td colspan="6">Description of Work:
For making sure the correct performance of the communication system it will be developed a computational simulation to check communication software developed.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.C.SW.1;PD.C.HW</td><td>FS</td><td>-</td><td>REP.C.1</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
IE1
TE1
SE2</td><td colspan="2">Skill Requirements:
Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.1).</td></tr>
<tr><td colspan="6">Assumptions:
Very interdisciplinary team for the preliminary design of the communication software.</td></tr>
</table>

Table 30. Activity PD.N.SA.1 attributes

<table>
<tr><td colspan="3">ID: PD.N.SA.1</td><td colspan="3">Activity: Analyse work environment</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in navigation systems.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.M</td><td>FS</td><td>-</td><td>PD.N.SA.2;PD.N.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MDD.M
E.MDD.S
SE1
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.N.1)</td></tr>
<tr><td colspan="6">Assumptions:
The Spatial engineer assists the Telecommunication engineer in technical things about the space working conditions and the specific requirements that must be accomplished.</td></tr>
</table>

Table 31. Activity PD.N.SA.2 attributes

ID: PD.N.SA.2			**Activity:** Analyse navigation requirements		
Description of Work: Search, summarise and asses specific information about the particular needs of this project in the navigation system.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.N.SA.1;PD.M	FS	-	PD.N.SA.3;PD.N.HW	FS	-
Number and Type of Resources Required: E.MDD.M E.MDD.S SE1 TE2		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.1)					
Assumptions: The Spatial engineer assists the Telecommunication engineer in technical things about the space working conditions and the specific requirements that must be accomplished.					

Table 32. Activity PD.N.SA.3 attributes

<table>
<tr><td colspan="3">ID: PD.N.SA.3</td><td colspan="3">Activity: Analyse attitude propulsion requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search for information to have a clear idea about the specific requirements for the attitude propulsion requirements.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.N.SA.2</td><td>FS</td><td>-</td><td>PD.N.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MDD.M
E.MDD.S
SE1
TE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.N.1)</td></tr>
<tr><td colspan="6">Assumptions:
The Spatial engineer assists the Telecommunication engineer in technical things about the space working conditions and the specific requirements that must be accomplished.</td></tr>
</table>

Table 33. Activity PD.N.HW.1 attributes

<table>
<tr><td colspan="3">ID: PD.N.HW.1</td><td colspan="3">Activity: Attitude control requirements</td></tr>
<tr><td colspan="6">Description of Work:
Study the attitude control of a module and determine the requirements in trust that includes position of rockets, thrust and an estimation of fuel consumption during its operative life.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.N.SA;PD.E.HW.4</td><td>FS</td><td>-</td><td>PD.P.HW.2
PD.N.SW
PD.E.HW;PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="3">Number and Type of Resources Required:
E.MDD.M
E.MDD.S
TE1
SE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td>Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.N.1)</td></tr>
<tr><td colspan="6">Assumptions:
The Spatial engineer assists the Telecommunication engineer in technical things about the space working conditions and the specific requirements that must be accomplished.</td></tr>
</table>

Table 34. Activity PD.N.SW.1 attributes

ID: PD.N.SW.1		**Activity:** Navigation and attitude control software			
Description of Work: Development of the attitude and navigation equations, and create a preliminary software to compute real trajectories and determine the reactions needed to change the orbit or attitude to the desired one.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.N.HW	FS	-	REP.N.1	FF	-
Number and Type of Resources Required: E.MDD.M E.MDD.S IE1 IE2 TE1		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** SOFT.5	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.1)					
Assumptions: The Spatial engineer assists the Telecommunication engineer in technical things about the space working conditions and the specific requirements that must be accomplished.					

Table 35. Activity PD.P.SA.1 attributes

<table>
<tr><td colspan="3">ID: PD.P.SA.1</td><td colspan="3">Activity: Analyse available propulsion systems</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in the propulsion systems.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.C.SA;PD.E.SA</td><td>FS</td><td>-</td><td>PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
SE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 36. Activity PD.P.SA.2 attributes

<table>
<tr><td colspan="3">ID: PD.P.SA.2</td><td colspan="3">Activity: Analyse power unit requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search for information to have a clear idea about the specific requirements for the power unit.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.C.SA;PD.E.SA</td><td>FS</td><td>-</td><td>PD.P.SA.3
PD.P.SA.4;PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
MD.EXT3
SE4</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where Orbital ATK develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 37. Activity PD.P.SA.3 attributes

<table>
<tr><td colspan="3">ID: PD.P.SA.3</td><td colspan="3">Activity: Analyse power unit transmission requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in the power unit transmission requirements.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.P.SA.2</td><td>FS</td><td>-</td><td>PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
MD.EXT3
SE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where Orbital ATK develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 38. Activity PD.P.SA.4 attributes

ID: PD.P.SA.4		**Activity:** Analyse power unit receivers requirements			
Description of Work: Search for information to have a clear idea about the specific requirements for the power unit receivers.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.P.SA.2	FS	-	PD.P.HW	FS	-
Number and Type of Resources Required: E.PD.M E.MD.S MD.EXT3 SE4		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also where Orbital ATK develop its activities.					
Constraints: Report of results and conclusions (REP.P.1)					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.					

Table 39. Activity PD.P.HW.1 attributes

<table>
<tr><td colspan="2">ID: PD.P.HW.1</td><td colspan="4">Activity: Select a suitable propulsion system and its peripherals</td></tr>
<tr><td colspan="6">Description of Work:
After an exhaustive research and assessment it will be provided a selection of the most suitable modules for the propulsion system and its peripherals.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.P.SA;PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.P.HW.2
PD.P.SW;PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
SE2
SE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 40. Activity PD.P.HW.2 attributes

<table>
<tr><td colspan="3">ID: PD.P.HW.2</td><td colspan="3">Activity: Propulsion systems</td></tr>
<tr><td colspan="6">Description of Work:
A preliminary design of rockets that fulfil all the requirements has to be done.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.P.HW.1;PD.N.HW.1;
PD.P.SA;PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.P.SW
PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
SE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 41. Activity PD.P.HW.3 attributes

<table>
<tr><td colspan="3">ID: PD.P.HW.3</td><td colspan="3">Activity: Power unit system</td></tr>
<tr><td colspan="6">Description of Work:
It will be given a global approach to the power unit system.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.P.SA;PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.P.HW.4
PD.P.SW
PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
MD.EXT3
SE4</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where Orbital ATK develop its activities.</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 42. Activity PD.P.HW.4 attributes

<table>
<tr><td colspan="3">ID: PD.P.HW.4</td><td colspan="3">Activity: Power storage system</td></tr>
<tr><td colspan="6">Description of Work:
It will be given a global approach to the power storage requirements and physical systems needed.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.P.HW.3; PD.P.SA;PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.P.SW;PD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
SE4</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 43. Activity PD.P.SW.1 attributes

<table>
<tr><td colspan="3">ID: PD.P.SW.1</td><td colspan="3">Activity: Power control software</td></tr>
<tr><td colspan="6">Description of Work:
Preliminary design of the software that control the power generation, charge/discharge of storage systems and transmission to other modules.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.P.HW</td><td>FS</td><td>-</td><td>REP.P.1</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PD.M
E.MD.S
IE1
SE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 44. Activity PD.P.SW.2 attributes

ID: PD.P.SW.2			**Activity:** Propulsion control software		
Description of Work: Preliminary design of the software that control and check status of integrated propulsion systems.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.P.HW	FS	-	REP.P.1	FF	-
Number and Type of Resources Required: E.PD.M E.MD.S IE2 SE4		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** SOFT.5	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.P.1)					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 45. Activity PD.ME.SA.1 attributes

<table>
<tr><td colspan="2">ID: PD.ME.SA.1</td><td colspan="4">Activity: Analyse work environment</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in mechanics.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.M</td><td>FS</td><td>-</td><td>PD.ME.SA.2
PD.ME.SA.3
PD.ME.SA.4
PD.ME.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
IE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1)</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with the University of Stuttgart</td></tr>
</table>

Table 46. Activity PD.ME.SA.2 attributes

ID: PD.ME.SA.2		**Activity:** Analyse structural effects on Earth observation satellites			
Description of Work: Search, summarise and asses specific information about the particular structural effects of this project on Earth observation satellites.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.ME.SA.1;PD.M	FS	-	PD.ME.1	FS	-
Number and Type of Resources Required: E.MD.M E.MD.S IE1		**Skill Requirements:** Expert Average Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.ME.1)					
Assumptions: These tasks will be done in collaboration with the University of Stuttgart.					

Table 47. Activity PD.ME.SA.3 attributes

<table>
<tr><td colspan="3">ID: PD.ME.SA.3</td><td colspan="3">Activity: Analyse thermal effects on Earth observation satellites</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the thermal effects of this project on the Earth observation satellites.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.SA.1;PD.M</td><td>FS</td><td>-</td><td>PD.ME.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
IE2
MD.EXT.2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Junior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Stuttgart University</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1)</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with the University of Stuttgart.</td></tr>
</table>

Table 48. Activity PD.ME.SA.4 attributes

<table>
<tr><td colspan="2">ID: PD.ME.SA.4</td><td colspan="4">Activity: Analyse radiation effects on Earth observation satellites</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the radiation effects of this project on Earth observation satellites.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.SA.1;PD.M</td><td>FS</td><td>-</td><td>PD.ME.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
IE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1)</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with the University of Stuttgart.</td></tr>
</table>

Table 60. Activity PD.ME.1 attributes

<table>
<tr><td colspan="3">ID: PD.ME.1</td><td colspan="3">Activity: Integration of sub-systems</td></tr>
<tr><td colspan="6">Description of Work:
Integration of all sub-systems in one so as to be able to do a general mechanical verification and start the preliminary design of structure, isolation and wire connexions.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.SA
PD.M</td><td>FS</td><td>-</td><td>PD.ME.ST
PD.ME.T
FD
PD.ME.1</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
SE1
SE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.1
SOFT.8</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1)</td></tr>
<tr><td colspan="6">Assumptions:
-</td></tr>
</table>

Table 49. Activity PD.ME.ST.1 attributes

ID: PD.ME.ST.1			**Activity:** Structural design of payload modules		
Description of Work: The payload modules need a structural support that will be design taking into account the requirements of this project.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.ME.1	FS	-	REP.ME.1	FF	-
Number and Type of Resources Required: E.MD.M E.MD.S SE3		**Skill Requirements:** Expert Average Senior		**Other Required Resources:** SOFT.1 SOFT.8	
Type of Effort: Fixed amount of work					
Location of Performance: The company dependences					
Constraints: Report of results and conclusions (REP.ME.1).					
Assumptions: -					

Table 50. Activity PD.ME.ST.2 attributes

ID: PD.ME.ST.2			**Activity:** Structural design of infrastructure modules		
Description of Work: The infrastructure modules need a structural support that will be design taking into account the requirements of this project.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.ME.1	FS	-	REP.ME.1	FF	-
Number and Type of Resources Required: E.MD.M E.MD.S SE3		**Skill Requirements:** Expert Average Senior		**Other Required Resources:** SOFT.1 SOFT.8	
Type of Effort: Fixed amount of work					
Location of Performance: The company dependences					
Constraints: Report of results and conclusions (REP.ME.1).					
Assumptions: -					

Table 51. Activity PD.ME.T.1 attributes

<table>
<tr><td colspan="2">ID: PD.ME.T.1</td><td colspan="4">Activity: Payload insulation</td></tr>
<tr><td colspan="6">Description of Work:
The insulation of the payload is a very important task in order to protect the information that can be received.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.1</td><td>FS</td><td>-</td><td>REP.ME.1</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
MD.EXT 2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Stuttgart University</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with Stuttgart University.</td></tr>
</table>

Table 52. Activity PD.ME.T.2 attributes

<table>
<tr><td colspan="2">ID: PD.ME.T.2</td><td colspan="4">Activity: Infrastructure insulation</td></tr>
<tr><td colspan="6">Description of Work:
The insulation of the infrastructure is a very important task in order to protect the information that can be transmitted.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.1</td><td>FS</td><td>-</td><td>REP.ME.1</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
MD.EXT 2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Stuttgart University</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.1).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with Stuttgart University.</td></tr>
</table>

Table 53. Activity PD.E.SA.1 attributes

<table>
<tr><td colspan="2">ID: PD. E.SA.1</td><td colspan="4">Activity: Analyse work environment</td></tr>
<tr><td colspan="6">Description of Work:
Search, summarise and asses specific information about the particular needs of this project in electronic systems.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PM</td><td>SS</td><td>-</td><td>PD.E.SA.2</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 54. Activity PD.E.SA.2 attributes

<table>
<tr><td colspan="3">ID: PD.E.SA.2</td><td colspan="3">Activity: Analyse electronic requirements</td></tr>
<tr><td colspan="6">Description of Work:
Search for information to have a clear idea about the specific requirements for the electronic system.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.E.SA.1</td><td>FS</td><td>-</td><td>PD.E.SA.2</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 55. Activity PD.E.HW.1 attributes

<table>
<tr><td colspan="2">ID: PD.E.HW.1</td><td colspan="4">Activity: Select suitable electronic components</td></tr>
<tr><td colspan="6">Description of Work:
The electronic components must be in accordance to the requirements of the projects claimed above, that includes the estimation of compute power, memory and buss bandwidth among others.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.C.HW
PD.N.HW</td><td>FS</td><td>-</td><td>PD.E.HW.2
PD.E.HW.3;PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 56. Activity PD.E.HW.2 attributes

<table>
<tr><td colspan="3">ID: PD.E.HW.2</td><td colspan="3">Activity: Payload modules electronic systems</td></tr>
<tr><td colspan="6">Description of Work:
Specify the electronic system integrated in each payload module, including its performance and specifications.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.E.HW.2
PD.E.HW.3;PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 57. Activity PD.E.HW.3 attributes

<table>
<tr><td colspan="2">ID: PD.E.HW.3</td><td colspan="4">Activity: Infrastructure electronic system</td></tr>
<tr><td colspan="6">Description of Work:
Specify the electronic system integrated in each infrastructure module, including its performance and specifications.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.E.HW.1</td><td>FS</td><td>-</td><td>PD.E.HW.2
PD.E.HW.3;PD.P.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 58. Activity PD.E.HW.4 attributes

<table>
<tr><td colspan="3">ID: PD.E.HW.4</td><td colspan="3">Activity: Determine the sensors requirements</td></tr>
<tr><td colspan="6">Description of Work:
Determine the information to be tracked and specify the requirements desired taking in account stakeholders.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.E.SA</td><td>FS</td><td>-</td><td>PD.E.HW.5;PD.N.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 59. Activity PD.E.HW.5 attributes

<table>
<tr><td colspan="3">ID: PD.E.HW.5</td><td colspan="3">Activity: Start the contact with developers of sensors</td></tr>
<tr><td colspan="6">Description of Work:
The sensors that have been chosen to be integrated in the modules must be provided through a particular entity.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.E.HW.4</td><td>FS</td><td>-</td><td>PD.E.HW.5;PD.N.HW</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.1).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. The electronics engineers that will develop these tasks have many experience already in space related projects</td></tr>
</table>

Table 60. Activity FD.C.HW.1 attributes

<table>
<tr><td colspan="3">ID: FD.C.HW.1</td><td colspan="3">Activity: Modules communication system</td></tr>
<tr><td colspan="6">Description of Work:
The final communication system between the modules must be well defined and implemented.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.1</td><td>FS</td><td>-</td><td>FD.S.SW</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
SE4
TE2
CD.EXT 2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Junior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Southampton University</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These task will be done in collaboration with Southampton University</td></tr>
</table>

Table 61. Activity FD.C.HW.2 attributes

<table>
<tr><td colspan="3">ID: FD.C.HW.2</td><td colspan="3">Activity: Ground – space communication system</td></tr>
<tr><td colspan="6">Description of Work:
The final communication system between the Ground-Space stations must be well defined and implemented.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.1</td><td>FS</td><td>-</td><td>FD.C.SW</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
SE3
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 62. Activity FD.C.HW.3 attributes

<table>
<tr><td colspan="3">ID: FD.C.HW.3</td><td colspan="3">Activity: Power transmission system</td></tr>
<tr><td colspan="6">Description of Work:
The final power transmission between modules must be well defined and implemented</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>PD.ME.1</td><td>FS</td><td>-</td><td>FD.C.SW</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
SE3
TE3
MD.EXT.3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Junior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also where Orbital ATK develops its activities.</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.
These task will be done in collaboration with Orbital ATK</td></tr>
</table>

Table 63. Activity FD.C.SW.1 attributes

<table>
<tr><td colspan="3">ID: FD.C.SW.1</td><td colspan="3">Activity: Protocol communications</td></tr>
<tr><td colspan="6">Description of Work:
It must be developed a protocol in communications to be followed in a regular case or an emergency case.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.C.HW</td><td>FS</td><td>-</td><td>FD.C.SW.2</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
IE3
SE5
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
-</td></tr>
</table>

Table 64. Activity FD.C.SW.2 attributes

<table>
<tr><td colspan="3">ID: FD.C.SW.2</td><td colspan="3">Activity: Information control management software</td></tr>
<tr><td colspan="6">Description of Work:
A final control management software will be responsible of integrating the whole information that is received by the different modules.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.C.SW.1</td><td>FS</td><td>-</td><td>FD.C.SW.4
FD.E.HW.1;FD.E.HW.2</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
IE3
SE5
TE3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
-</td></tr>
</table>

Table 65. Activity FD.C.SW.3 attributes

<table>
<tr><td colspan="3">ID: FD.C.SW.3</td><td colspan="3">Activity: Power transmission control system</td></tr>
<tr><td colspan="6">Description of Work:
Final stage in the design of the power transmission control system of the communication module.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.C.HW</td><td>FS</td><td>-</td><td>FD.C.SW.4
FD.E.HW.1;FD.E.HW.2</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
IE3
SE5
TE1
MD.EXT.3</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Orbital ATK dependences.</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with Orbital ATK.</td></tr>
</table>

Table 66. Activity FD.C.SW.4 attributes

<table>
<tr><td colspan="3">ID: FD.C.SW.4</td><td colspan="3">Activity: Communication simulator program</td></tr>
<tr><td colspan="6">Description of Work:
Final design of the communication simulator software developed to simulate the communication between modules and module – ground.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.C.SW.2
FD.C.SW.3</td><td>FS</td><td>-</td><td>FD.C.SW.4
FD.E.HW.1;FD.E.HW.2</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
E.CD.S
IE3
SE5
TE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 67. Activity FD.N.HW.1 attributes

ID: FD.N.HW.1		**Activity:** Attitude sensors			
Description of Work: Final stage in the design of the attitude sensors of the navigation system.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.ME.1	FS	-	FD.N.HW.2	FS	-
Number and Type of Resources Required: E.MDD.M E.MDD.S SE4 TE2		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.2).					
Assumptions: -					

Table 68. Activity FD.N.HW.2 attributes

ID: FD.N.HW.2		**Activity:** Attitude control system			
Description of Work: Final stage in the design of the attitude control system.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.N.HW.1	FS	-	FD.N.HW.2	FS	-
Number and Type of Resources Required: E.MDD.M E.MDD.S SE4 TE2		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.2).					
Assumptions: -					

Table 69. Activity FD.N.SW.1 attributes

ID: FD.N.SW.1			**Activity:** Constellation navigation control software		
Description of Work: The final control software responsible of navigation must be designed.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.N.HW	FS	-	FD.N.SW.3 FD.E.HW.1 FD.E.HW.2	FS	-
Number and Type of Resources Required: E.MDD.M E.MDD.S IE3 SE1 MDD.EXT2		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** SOFT.5	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also where SENER develop its activities.					
Constraints: Report of results and conclusions (REP.N.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with SENER.					

Table 70. Activity FD.N.SW.2 attributes

<table>
<tr><td colspan="3">ID: FD.N.SW.2</td><td colspan="3">Activity: Module attitude control software</td></tr>
<tr><td colspan="6">Description of Work:
The final control software responsible of module attitude must be designed.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.N.HW</td><td>FS</td><td>-</td><td>FD.N.SW.3;FD.E.HW.1
FD.E.HW.2;FD.P</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MDD.M
E.MDD.S
IE1
IE2
TE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.N.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 71. Activity FD.N.SW.3 attributes

ID: FD.N.SW.3			**Activity:** Navigation and attitude simulator software		
Description of Work: An operative software must be designed and checked to simulate the behaviour of the constellation in its work environment, using the navigation and attitude control software.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.N.SW.1 FD.N.SW.2	FS	-	FD.N.SW.3 FD.E.HW.1 FD.E.HW.2;FD.P	FS	-
Number and Type of Resources Required: E.MDD.M E.MDD.S IE1 IE2 TE1		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** SOFT.5	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 72. Activity FD.P.HW.1 attributes

<table>
<tr><td colspan="2">ID: FD.P.HW.1</td><td colspan="4">Activity: Propulsion systems</td></tr>
<tr><td colspan="6">Description of Work:
The design of the propulsion system reaches its final stage. It is fully defined and implemented.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.N.SW.2</td><td>FS</td><td>-</td><td>FD.P.SW;FD.ME</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PRD.M
E.MD.S
SE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 73. Activity FD.P.HW.2 attributes

ID: FD.P.HW.2		**Activity:** Power unit system			
Description of Work: The design of the power unit system reaches its final stage. It is fully defined and implemented.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.N.SW.2	FS	-	FD.P.HW.3	FS	-
Number and Type of Resources Required: E.PRD.M E.MD.S SE1 MD.EXT.3		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also where Orbital ATK develops its activities.					
Constraints: Report of results and conclusions (REP.P.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. These tasks will be done in collaboration with Orbital ATK.					

Table 74. Activity FD.P.HW.3 attributes

ID: FD.P.HW.3			**Activity:** Power storage system		
Description of Work: The design of the power storage system reaches its final stage. It is fully defined and implemented.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.P.HW.2	FS	-	FD.P.HW.3	FS	-
Number and Type of Resources Required: E.PRD.M E.MD.S SE2		**Skill Requirements:** Expert Average Senior		**Other Required Resources:** -	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.P.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 75. Activity FD.P.SW.1 attributes

<table>
<tr><td colspan="2">ID: FD.P.SW.1</td><td colspan="4">Activity: Power control software</td></tr>
<tr><td colspan="6">Description of Work:
The final control software will be responsible of integrating the power system.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.P.HW</td><td>FS</td><td>-</td><td>REP.P.2</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PRD.M
E.MD.S
SE2
IE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 76. Activity FD.P.SW.2 attributes

<table>
<tr><td colspan="3">ID: FD.P.SW.2</td><td colspan="3">Activity: Propulsion control software</td></tr>
<tr><td colspan="6">Description of Work:
The final control software will be responsible of integrating the propulsion system.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.P.HW</td><td>FS</td><td>-</td><td>REP.P.2</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PRD.M
E.MD.S
SE2
IE1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
SOFT.5</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 77. Activity FD.ME.MD.1 attributes

<table>
<tr><td colspan="2">ID: FD.ME.MD.1</td><td colspan="4">Activity: Materials selection</td></tr>
<tr><td colspan="6">Description of Work:
Materials selection taking in account temperature, radiation, structural resistance during the launch and other kind of mission and space adverse conditions.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.P.HW</td><td>FS</td><td>-</td><td>FD.ME.MD.2</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
SE3
SE4
MD.EXT1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.2).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration Stuttgart University, with Ball Aerospace and UPV</td></tr>
</table>

Table 78. Activity FD.ME.MD.2 attributes

ID: FD.ME.MD.2		**Activity:** Module structure			
Description of Work: The module structure, that has to be big enough to enclosure all the sub-systems defined, and to protect them from space debris.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.ME.MD.1	FS	-	FD.ME.MD.3 FD.ME.MD.4	SS	-
Number and Type of Resources Required: E.MD.M E.MD.S UPV		**Skill Requirements:** Expert Average Junior		**Other Required Resources:** SOFT.1	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also in Polytechnic University of Valencia.					
Constraints: Report of results and conclusions (REP.ME.2).					
Assumptions: These tasks will be done in collaboration UPV.					

Table 79. Activity FD.ME.MD.3 attributes

<table>
<tr><td colspan="3">ID: FD.ME.MD.3</td><td colspan="3">Activity: Thermal insulation</td></tr>
<tr><td colspan="6">Description of Work:
Thermal insulation to protect sub-systems from the adverse conditions outside the module. Temperature levels inside the module must reach specific temperature to ensure the correct functionality of all electronic devices.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.ME.MD.2</td><td>FS</td><td>-</td><td>FD.ME.MD.3
FD.ME.MD.4</td><td>SS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
SE3
MD.EXT2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.2).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration Stuttgart University, with Ball Aerospace.</td></tr>
</table>

Table 80. Activity FD.ME.MD.4 attributes

ID: FD.ME.MD.4			**Activity:** Sub-system integration		
Description of Work: Final integration of the Sub-systems into one.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.ME.MD.3	FS	-	FD.ME.MD.3 FD.ME.MD.4	SS	-
Number and Type of Resources Required: E.MD.M E.MD.S SE3 SE4 SE5		**Skill Requirements:** Expert Average Senior Senior Senior		**Other Required Resources:** SOFT.8	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.ME.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 81. Activity FD.ME.ID.1 attributes

<table>
<tr><td colspan="2">ID: FD.ME.ID.1</td><td colspan="4">Activity: Material selection</td></tr>
<tr><td colspan="6">Description of Work:
Materials selection taking in account temperature, radiation, structural resistance during the launch and other kind of mission and space adverse conditions.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.P.HW</td><td>FS</td><td>-</td><td>FD.ME.ID.2</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
SE2
SE5
MD.EXT1</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior
Junior</td><td colspan="2">Other Required Resources:</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Stuttgart</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.2).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be done in collaboration with Stuttgart University.</td></tr>
</table>

Table 82. Activity FD.ME.ID.2 attributes

ID: FD.ME.ID.2			**Activity:** Module structure		
Description of Work: The module structure, that has to be big enough to enclosure all the sub-systems defined, and to protect them from space debris.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.ME.MD.1	FS	-	FD.ME.ID.3;FD.ME.ID.4	FS	-
Number and Type of Resources Required: E.MD.M E.MD.S SE1			**Skill Requirements:** Expert Average Senior	**Other Required Resources:** SOFT.1	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.ME.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 83. Activity FD.ME.ID.3 attributes

<table>
<tr><td colspan="3">ID: FD.ME.ID.3</td><td colspan="3">Activity: Thermal insulation</td></tr>
<tr><td colspan="6">Description of Work:
Thermal insulation to protect sub-systems from the adverse conditions outside the module. Temperature levels inside the module must reach specific temperature to ensure the correct functionality of all electronic devices.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.ME.MD.2</td><td>FS</td><td>-</td><td>FD.ME.ID.3;FD.ME.ID.4</td><td>FS</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.MD.M
E.MD.S
MD.EXT2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company and also in Stuttgart</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.ME.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks. These task will be done in collaboration with Stuttgart University.</td></tr>
</table>

Table 84. Activity FD.ME.ID.4 attributes

ID: FD.ME.ID.4		**Activity:** Sub-system integration			
Description of Work: Final integration of the sub-systems into one.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.ME.MD.3	FS	-	FD.ME.ID.3;FD.ME.ID.4	FS	-
Number and Type of Resources Required: E.MD.M E.MD.S SE2 SE3		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** SOFT.8	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also in Stuttgart					
Constraints: Report of results and conclusions (REP.ME.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks.					

Table 85. Activity FD.E.HW.1 attributes

<table>
<tr><td colspan="3">ID: FD.E.HW.1</td><td colspan="3">Activity: Payload modules electronic systems</td></tr>
<tr><td colspan="6">Description of Work:
Final design of the payload modules. They must be fully defined and implemented.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.C ; FD.N</td><td>FS</td><td>-</td><td>REP.E.2</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 86. Activity FD.E.HW.2 attributes

<table>
<tr><td colspan="2">ID: FD.E.HW.2</td><td colspan="4">Activity: Infrastructure electronic systems</td></tr>
<tr><td colspan="6">Description of Work:
Final stage in the design of the infrastructures of the electronic systems. They are fully defined and implemented.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>FD.C ; FD.N</td><td>FS</td><td>-</td><td>REP.E.2</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
E.CD.S
EE1
EE2</td><td colspan="2">Skill Requirements:

Expert
Average
Senior
Senior</td><td colspan="2">Other Required Resources:
-</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.2).</td></tr>
<tr><td colspan="6">Assumptions:
The manager and secretary are working in all of the aspects of this group of tasks.</td></tr>
</table>

Table 87. Activity FD.E.HW.3 attributes

ID: FD.E.HW.3		**Activity:** Selection of final sensors and their providers			
Description of Work: The sensors that will be installed are finally chosen between all the possible providers.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
PD.ME.1	FS	-	REP.E.2	FF	-
Number and Type of Resources Required: E.ED.M E.CD.S PD.EXT.1 PD.EXT.3		**Skill Requirements:** Expert Average Senior Senior		**Other Required Resources:** SOFT.3	
Type of Effort: Fixed amount of work					
Location of Performance: In the company and also where our collaborators develop their activities.					
Constraints: Report of results and conclusions (REP.E.2).					
Assumptions: The manager and secretary are working in all of the aspects of this group of tasks. For these tasks it is required to have already the sensors developed by Amptek, Silvanet and Surrey Satellites.					

Table 88. Activity T.C.1 attributes

<table>
<tr><td colspan="2">ID: T.C.1</td><td colspan="4">Activity: Test and validation for communication satellite-satellite</td></tr>
<tr><td colspan="6">Description of Work:
The final communication system between satellite-satellite is tested and validated.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.C</td><td>FS</td><td>-</td><td>REP.C.3</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M</td><td colspan="2">Skill Requirements:
Expert</td><td colspan="2">Other Required Resources:
LAB.COM
SOFT.2</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of work</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.C.3).</td></tr>
<tr><td colspan="6">Assumptions:
These task will be developed in a subcontracted Communications laboratory.</td></tr>
</table>

Table 89. Activity T.C.2 attributes

ID: T.C.2	**Activity:** Test and validation for communication ground-satellite				
Description of Work: The final communication system between ground-satellite is tested and validated.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.C	FS	-	REP.C.3	FF	-
Number and Type of Resources Required: E.CD.M		**Skill Requirements:** Expert		**Other Required Resources:** LAB.COM SOFT.2	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.3).					
Assumptions: These task will be developed in a subcontracted Communications laboratory.					

Table 90. Activity T.C.3 attributes

ID: T.C.3			**Activity:** Test and validation for power transmission		
Description of Work: The power transmission system is tested and validated.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.C	FS	-	REP.C.3	FF	-
Number and Type of Resources Required: E.CD.M		**Skill Requirements:** Expert		**Other Required Resources:** LAB.COM	
Type of Effort: Fixed amount of work					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.C.3).					
Assumptions: These task will be developed in a subcontracted Communications laboratory.					

Table 91. Activity T.N.1 attributes

ID: T.N.1		**Activity:** Test and validation of the navigation, attitude and control systems using computer simulated programs			
Description of Work: The navigation, attitude and control systems are tested and validated using simulation software assisted by computer.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.N	FS	-	REP.N.3	FF	-
Number and Type of Resources Required: E.MDD.M		**Skill Requirements:** Expert		**Other Required Resources:** LAB.INT SOFT.5 SOFT.7	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.N.3).					
Assumptions: The mission design manager is the responsible for this testing.					

Table 92. Activity T.P.1 attributes

<table>
<tr><td colspan="2">ID: T.P.1</td><td colspan="4">Activity: Test and validation of the propulsion system using computer simulated programs</td></tr>
<tr><td colspan="6">Description of Work:
The propulsion system is tested and validated using simulation software assisted by computer.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.P</td><td>FS</td><td>-</td><td>REP.P.3</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.PRD.M</td><td colspan="2">Skill Requirements:

Expert</td><td colspan="2">Other Required Resources:
SE5
SOFT.1</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort.</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.P.3).</td></tr>
<tr><td colspan="6">Assumptions:
The propulsion manager is the responsible for this testing.</td></tr>
</table>

Table 93. Activity T.ME.1 attributes

ID: T.ME.1			**Activity:** Test and validation of the mechanical system using computer simulation programs		
Description of Work: The mechanical system is tested and validated using simulation software assisted by computer.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
FD.ME	FS	-	REP.ME.3	FF	-
Number and Type of Resources Required: E.MD.M		**Skill Requirements:** Expert		**Other Required Resources:** SE1 SOFT.1	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions (REP.ME.3).					
Assumptions: The mechanical manager is the responsible for this testing					

Table 94. Activity T.E.1 attributes

<table>
<tr><td colspan="2">ID: T.E.1</td><td colspan="4">Activity: Test and validation of the electronics system using computer simulation programs</td></tr>
<tr><td colspan="6">Description of Work:
The electronics system is tested and validated using simulation software assisted by computer.</td></tr>
<tr><th>Predecessors</th><th>Relationship</th><th>Lag</th><th>Successor</th><th>Relationship</th><th>Lag</th></tr>
<tr><td>FD.E</td><td>FS</td><td>-</td><td>REP.E.3</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.ED.M
EE1</td><td colspan="2">Skill Requirements:

Expert
Senior</td><td colspan="2">Other Required Resources:
LAB.ELE</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions (REP.E.3).</td></tr>
<tr><td colspan="6">Assumptions:
These tasks will be developed in the electronics laboratory of UPV.</td></tr>
</table>

Table 95. Activity T.A.1 attributes

ID: T.A.1			**Activity:** Validation for the quality of the signal received		
Description of Work: The quality of the final signal received is tested and validated.					
Predecessors	**Relationship**	**Lag**	**Successor**	**Relationship**	**Lag**
T.C; T.N; T.P; T.ME; T.E	FS	-	REP.A	FF	-
Number and Type of Resources Required: E.CD.M		**Skill Requirements:** Expert		**Other Required Resources:** LAB.COMB S1.T S2.C S3.GD	
Type of Effort: Fixed amount of effort					
Location of Performance: In the company					
Constraints: Report of results and conclusions about possible benefits related to climate change (REP.M.1).					
Assumptions: The communication manager is the responsible for the testing. These tasks will be developed in a subcontracted Communications laboratory.					

Table 96. Activity T.A.2 attributes

<table>
<tr><td colspan="2">ID: T.A.2</td><td colspan="4">Activity: Test and validation for the 3D mapping and the other new acquisition modes developed</td></tr>
<tr><td colspan="6">Description of Work:
The 3D mapping and other new acquisition modes developed are tested and validated.</td></tr>
<tr><td>Predecessors</td><td>Relationship</td><td>Lag</td><td>Successor</td><td>Relationship</td><td>Lag</td></tr>
<tr><td>T.A.1</td><td>FS</td><td>-</td><td>REP.A</td><td>FF</td><td>-</td></tr>
<tr><td colspan="2">Number and Type of Resources Required:
E.CD.M
UPC
IE1</td><td colspan="2">Skill Requirements:

Expert
Junior
Senior</td><td colspan="2">Other Required Resources:
SOFT.4
S1.T
S2.C
S3.GD</td></tr>
<tr><td colspan="6">Type of Effort:
Fixed amount of effort</td></tr>
<tr><td colspan="6">Location of Performance:
In the company</td></tr>
<tr><td colspan="6">Constraints:
Report of results and conclusions about possible benefits related to climate change (REP.M.1).</td></tr>
<tr><td colspan="6">Assumptions:
The communication manager is the responsible for the testing. UPC is the responsible for the testing of this task.</td></tr>
</table>

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BARCELONATECH
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EARTH CLIMATE CHANGE OBSERVATION

ECCO

ANNEX II

Image sensor SOW

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Tutor: Pierre Huguenet

Group 02 – 220310 PM – P22015 28 – 05 – 2015

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1. Background

A new revolutionary design of a constellation of fractionated satellites is proposed to help the European Community to raise awareness of global warming. While combining the best characteristics of the classical satellites, this new technology allows an unprecedented maintainability, scalability, flexibility and responsiveness among others that customers will appreciate.

In ECCO satellite, sensors are distributed into different modules (payload modules) that could be standardized, in terms of mass and power requirements, being able to launch small commercial modules with new necessities and replace them in the future. Moreover, the existence of different payload modules leads to acquire multiple data from the same point of view, increasing precision of data and creating three-dimensional data maps, or from different points of view due to the independent attitude control system in each module. In this case, three sensors would provide information of the surface, a three-dimensional mapping of greenhouse and pollution gases and three-dimensional mapping of temperature. All this data, acquired simultaneously would lead to an improvement of precision of data and knowledge about the human activities effects on the Earth.

2. Scope

This Statement of Work defines the effort required for the design, development, fabrication and integration of the image sensor into the ECCO satellite. The image sensor shall provide high-resolution images of the Earth in different bands of the electromagnetic spectrum, being able to elaborate detailed maps of surface temperature, emissivity and elevation. In order to ensure its functionality, the sensor shall be designed to track data during periods of sun and shadow. Moreover, the sensor must resist the launching forces and be able to operate in the space.

The designed sensor must be fully compatible with the ECCO satellite (Payload Module), meaning that physical integration of sensor into the satellite could be done with few hours and ECCO software recognizes the sensor and can use all functions developed.

In the following lines, brief list of aspects that shall be done are exposed:

1. Pre-design of the sensor to meet all the requirements specified.
2. Develop the sensor and its integration into the ECCO system, including the interface that connects both systems.
3. Determine the performance of the sensor by testing and define the requirements related to interferences and other issues to guarantee its functionality.
4. Development of documents, including its final design, support plans/need and user's manual.

3. Requirements and constraints

The requirements and constraints that the Sensor needs to fulfill once built are:

- General constraints

1. Maximum size of 20x20x20 cm
2. Maximum mass of 1500 g
3. Operating temperature range of -30ºC to 70ºC

- Power and supply constraints

4. Maximum average in one day power consumption of 2000 mW
5. Maximum peak power consumption of 2500 mW
6. Supply voltage 2.0 V nominal. Max supply voltage of 2.1V and minimum 1.9V

- Imaging performance constraints

7. Pixel size of 2.2µm x 2.2µm
8. Color filter array of RGB Bayer pattern
9. Maximum data rate of 96 Mp/s at 96 MHz
10. Full resolution programmable up to 14 fps
11. 720P resolution programmable up to 60 fps
12. Responsivity of 1.4V/lux-s (550 nm)

- System signals constraints

13. Maximum allowable SNR of 38.1 dB at full resolution and 44dB at 720P
14. Pixel dynamic range of 70.1 dB at full resolution and 76 dB at 720P
15. Output gain of 10e-/LSB

4. Project planning

4.1. Meetings and reviews

This proposal does include the kick off meeting, 2 intermediate meetings and a final review meeting at the ECCO office at Barcelona. The rest of meetings will be held by teleconference or videoconference.

The Contractor shall provide meeting agendas to the ECCO team and shall prepare minutes of the formal meetings.

4.2. Work description structure

The coordinator must submit the deliverables through an electronic exchange system that is given. All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

The work is divided in four main parts, as presented in the scope:

1. Pre-design of the sensor
2. Develop and integration of the sensor
3. Determine performance of the sensor
4. Development of the technical sheet of the sensor

Different deliverables will be presented:

- Technical reports
    - Intermediate report: It includes an explanation of work carried out, an overview of progress, and a publishable summary.
    - Final report: It is a publishable summary of the entire task (describing the overview of the results and their exploitation and dissemination, the conclusions on the action and its socio-economic impact).

The work will be presented in four deliverables:

- D1: Kick off meeting and Action plan
- D2: Intermediate report 1: Presenting the results of the Activity 1
- D3: Intermediate report 2: Presenting the results of the Activity 2
- D4: Final report: Presenting the results of all of the Activities

4.3. Schedule

The following milestones will be taken into account following the previous work description and deliverables required:

Table 1.Schedule of the image sensor SOW

Deliverable number	Deliverable	Due dates
1	Kick off meeting and Action plan	T0
2	Intermediate report 1: Presenting the results of the activity 1	T0 + 2 months
3	Intermediate report 2: Presenting the results of the activity 2	T0 + 4 months
4	Final Report: Presenting the results of all the activities	T0 + 10 months

5. Insurance contract

Except in relation to death or personal injury the amount of the Contractor's liability under this Contract for claims recoverable under the Contractor's Professional Indemnity, Third Party, Contractor's All Risk insurance policies shall be up to € 52,000 per claim and in the aggregate.

For all other claims or actions under the Contract the Contractor's maximum cumulative liability shall not exceed 50% of the total value of the contract.

The Contractor shall not be liable under or in connection with this Contract whether in contract or in tort, for breach of statutory duty or otherwise for any loss of profit, loss of production, loss of contracts or for any indirect or consequential loss or damage whatsoever that may be suffered.

The Contractor shall exercise all reasonable skill, care and diligence in the performance of his obligations under the Contract. In case of defects, deficiencies, errors and omissions the Contractor's exclusive liability in respect of any damages caused by said defects, deficiencies, errors and omissions shall be to correct and/or to re-perform any unsatisfactory services.

6. System safety and health hazard

System safety shall conduct analyses as required to identify and quantify hazards in hardware, software and human interfaces. The program shall involve system safety in the design process to assure safety in design, manufacture, handling, testing, usage, maintenance and integration. Hazards, including environmental and hazardous materials, shall be eliminated or controlled to an acceptable level of risk.

6.1. Environmental and Hazardous Material

The Contractor shall meet all applicable international, federal, state and local environmental regulations. The Contractor shall tailor its environmental and hazardous material management program to accommodate the requirements of this program. This program shall integrate the management of environmental safety and health impacts and pollution prevention initiatives into the systems engineering process. Specifically, this includes identification of environmental, safety and health impacts associated with material and process decisions with emphasis on hazardous materials required and hazardous waste generated during the maintenance, operation, and disposal of the sensor system. The Contractor shall address not just impacts to the program, but the reduction and elimination of hazardous material where possible in the sensor system life cycle. This shall be accomplished DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives.

6.2. Reliability, Maintainability and Built in Test

The Contractor shall establish and maintain an active and effective Reliability and Maintainability (R&M) program during all the phases. The R&M program shall ensure achievement of the Imagery Sensor Performance Specification. This program shall include analyses and test tasks for the sensor system. Different type of procedures shall be proposed by the supplier, as are ATP and environmental qualification test procedures. Also a schedule with estimated start and completion points for the R&M analysys and tests must be included.

6.3. Failure Reporting, Analysis and Corrective Action System

A report regarding all the failures occurred throughout integration, manufacture, handling, checkout, and testing for the sensor shall be initiated by the contractor. All failures occurring during testing shall be collected and analyzed. . These data shall be used for design improvements and pattern failure identification. Failure analysis shall be of sufficient depth to permit the identification of failure causes and the corrective actions. Criticality of failures shall be prioritized IAW their individual impact on the operational performance of the equipment. Failure analysis reports shall be closed out within 30 days of failure occurrence or rationale shall be provided for any extensions.

6.4. System Reliability Predictions

The effects of complexity on the probability of mission success can be evaluated by performing a reliability prediction analysis. Results from the analysis may determine a need for redundant systems, back-up systems, subsystems, assemblies, or component parts. A reliability prediction can also assist in evaluating the significance of reported failures. Ultimately, the results obtained by performing a reliability prediction analysis can be useful when conducting further analyses such as a FMECA (Failure Modes, Effects and Criticality Analysis), RBD (Reliability Block Diagram) or a Fault Tree analysis. The reliability predictions are used to evaluate the probabilities of failure events described in these alternate failure analysis models.

6.5. System Maintainability Predictions

The prediction of the expected number of hours that a system or device will be in an inoperative or “down” while it is undergoing maintenance is of vital importance because of the adverse effect that excessive downtime has on mission success. A technique must be utilized to predict its maintainability as early as possible during the design phase. This prediction should be updated continuously as the design progresses. The contractor shall provide maintainability predictions in accordance to MIL-HDBK-472.

6.6. Maintainability and BIT Demonstration

The contractor shall conduct Maintainability and Built-In Test (BIT) Demonstrations to verify Mean Time Before Failure (MTBF) and BIT performance. BIT and MTBF reporting and analysis shall be initiated by the contractor. These data shall be used for design improvements.

6.7. Reliability Critical Items

The Contractor shall identify and make recommendations for control of those items which require "special attention" because of complexity, life limit, limited shelf life, application of advanced state of the art techniques and the impact of potential failure on safety, readiness, mission success, or the demand for maintenance/logistics support. This information will be made available through the Integrated Product and Process Development (IPPD).

6.8. Part Level Stress Analysis

The contractor shall propose parts derating criteria which must consider past component history, environmental stresses and component criticality. The analysis of the parts stress shall be performed to verify compliance with agreed-to derating criteria under the following conditions: Nominal unit and module power dissipation, steady state worse case piece part stress, and steady state worst case aircraft environments. This information shall be included in the system reliability prediction.

6.9. Failure Modes, And Effects And Criticality Analysis (FMECA)

The Contractor shall perform a functional Failure Modes Effects, Criticality Analysis-Task Analysis (FMECA) on the Imagery Sensor to support the Logistics Management Information (LMI) and maintain the results of the FMECA. It requires the identification of the following basic information:

- Item(s)
- Function(s)
- Failure(s)
- Effect(s) of Failure
- Cause(s) of Failure
- Current Control(s)
- Recommended Action(s)

Plus other relevant details upon mutual agreement, the Contractor shall document all failure modes down to the Weapons Replaceable Assembly (WRA) level and a severity classification category for each indentured level. For those WRAs identified as "I" level candidates, the Contractor shall document all failure modes down to the SRA level and a severity classification category for each indentured level. Where practical, the Contractor shall maximize use of the sensor system internal BIT analysis.

6.10. Electromagnetic Environmental Effects

Each system shall be electromagnetically compatible among all subsystems and equipment within the system and with environments caused by emitters and other electromagnetic sources external to the system to ensure safe and proper operation and performance. This standard identifies baseline design requirements and verification to address E3 issues. Requirements and verification approaches may be tailored based on engineering justification derived from the system's operational requirements and engineering analysis. Design techniques used to protect equipment against EMI effects shall be verifiable, maintainable, and effective over the rated lifecycle of the system. Design margins shall be established based on system criticality, hardware tolerances, and uncertainties involved in verification of system- level design requirements. Verification shall address all life cycle aspects of the system, including (as applicable) normal in-service operation, checkout, storage, transportation, handling, packaging, loading, unloading, launch, and the normal operating procedures associated with each aspect. The Data Item Description (DID) called out in the standard provide a means for establishing an overall integrated E3 design and verification approach to identify areas of concern early in the program, mitigate risk, and document test results. The Contractor shall plan, conduct, and support E3 (Electromagnetic Environmental Effects) testing in accordance with the requirements defined.

7. Quality assurance

The quality assurance takes into account internal company quality factors, as well as, International and European quality standards. The internal quality assurance will take into account the general quality requirements detailed in the ECCO document "ECCO Procurement Quality Requirements" (ECCO_D_22MFG4). In addition to this, it has been generated the template of the important documents to hand in. Documentation developed as the result of this task will be retained by the quality responsible for a minimum of 5 years.

General Quality Standards (ISO/EN) that must be followed and accomplished are:

- 9100- Quality System for Aerospace Manufacturers
- 9101-Checksheet for 9100
- 9110-Quality System for Aerospace Repair Stations
- 9111-Checksheet for 9110
- 9120-Quality System for Distributors
- 9121-Checksheet for 9120

8. Economical proposal

The contract established with the selected bidder will be a Fixed Lump Contract with a maximum price of 31.230 € (including VAT).

The rates and prices specified by the bidder must include the following expenses:

- Any necessary licenses or resources to fully satisfy the scope of the contract
- Any travel expenses for travel between the Contractor's place of business and the ECCO facilities
- Any travel and living expenses for the relocation of resources to satisfy the terms of any resulting contract

The activities included in the bid are listed in the previous sections of the statement of work.

According to the milestones established in section 4.3, the pricing schedule will be the following:

Table 1: Payment schedule of the image sensor SOW

Deliverable number	Due dates	Payment
1	T0	30 %
2	T0 + 2 months	10 %
3	T0 + 4 months	10 %
4	T0 + 10 months	50 %

9. Supply support

The bidder must comply with all the same standards specified for the ECCO project, listed in section 7, and the European Commission. If the contractor does not comply with any certification or it is determined that any certification made by the contractor is untrue, ECCO has the right to terminate the contract for default.

10. Facilities

The Contractor shall identify facilities both ashore and afloat required to support the sensor development, training, movement, and maintenance, and peculiar support equipment. The Contractor shall identify specific technical requirements upon which facilities modifications shall be predicated. The Contractor may participate in any site survey activity. Results shall be documented according to the ECCO project procedures (ECCO_D_22MFG4).

11. Manpower and personnel

The Contractor shall provide prove that the desired quality will be achieved, guaranteeing the capability and expertise needed for the tasks. The Contractor shall perform the appropriate studies to ensure that all manpower and personnel requirements are met.

The analysis shall identify the different sensor specifications in order to be to be used in the constellation of fractionated satellites, as well as the manpower and skill level requirements for each task performed.

12. Procurement metrics

The evaluation methodology to choose the supplier for each work package will consist in the following punctuation system:

Principal module:

- Participation in previous similar projects. Punctuation given taking into account the similarity and the amount of projects. (0-30 points)
- Proposed budget for the project (0-20)
- Guaranty the manpower and skill level required for each task. (0-20)
- Identification of the facilities required to support the activity. (0-15)

Secondary module:

- Being an ECCO collaborator. (0-5 points)
- Being an environmentally friendly company. (0-5 points)
- Others (0-5)

A company will not be considered in the selection process of suppliers without the minimum score of 50 points in the principal module.

The company with more punctuation will be the selected one.

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

ANNEX III

Electronics laboratory and testing SOW

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Tutor: Pierre Huguenet

Group 02 – 220310 PM – P22015 28 – 05 – 2015

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1. Background

A new revolutionary design of a constellation of fractionated satellites is proposed to help the European Community to raise awareness of global warming. While combining the best characteristics of the classical satellites, this new technology allows an unprecedented maintainability, scalability, flexibility and responsiveness among others that customers will appreciate.

In ECCO satellite, sensors are distributed into different modules (payload modules) that could be standardized, in terms of mass and power requirements, being able to launch small commercial modules with new necessities and replace them in the future. Moreover, the existence of different payload modules leads to acquire multiple data from the same point of view, increasing precision of data and creating three-dimensional data maps, or from different points of view due to the independent attitude control system in each module. In this case, three sensors would provide information of the surface, a three-dimensional mapping of greenhouse and pollution gases and three-dimensional mapping of temperature. All this data, acquired simultaneously would lead to an improvement of precision of data and knowledge about the human activities effects on the Earth.

2. Scope

This Statement of Work defines the effort required to evaluate and test the reliability and performance of the selected system. In this case, the evaluation and testability of the systems must be carried in cooperation with the UPV University, offering the opportunity to the students to develop its personal career doing bachelor's and/or master projects to develop the electronic systems of the ECCO satellite and supported by the university offering its laboratories to realise all tests needed.

The testability and the results obtained should be enough to validate the system and accomplish the European conditions and expectations. All of them are exposed in the list below.

The specific list of tasks to be performed to all of the developed electronic components are:

1. Conducting visual investigations
2. Taking voltage measurements
3. Test for correct wiring polarity
4. Test for improper neutral-ground bonds
5. Take ground impedance measurements
6. Measure neutral impedance
7. Take electrical noise measurements
8. Perform a harmonic analysis of the voltage waveform
9. Measure electrostatic discharge
10. Capture voltage disturbances

3. Requirements and constraints

The requirements and constraints for the Electronics laboratory and testing are:

1. Project offers are two bachelor's projects, two master's projects and a place for an intern worker.
2. UPV would support ECCO by ensuring that two qualified workers specialized in laboratory experiments are in the laboratory to support the students during their projects.
3. All the electronic components measurements should be performed in a white room of category ISO 7 (regarding to ISO 14644-1).

4. Project planning

4.1. Meetings and reviews

This collaboration contract does include the kick off meeting and some intermediate meetings. Some of the meetings will be held by teleconference or videoconference.

UPV shall provide meeting agendas to the ECCO network and partnership department and shall prepare minutes of the formal meetings.

4.2. Work description structure

The coordinator must submit the deliverables through an electronic exchange system that is given. All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

The laboratory will be for the use of ECCO testing only during 4 days a week.

Different deliverables will be presented:

Technical reports from UPV laboratory:

- Kick off meeting and action plan report: It includes the minutes of the formal kick off meeting and the action plan.
- Intermediate reports: It includes an explanation of work carried out, an overview of progress, and a publishable summary.
- Final report: It is a publishable summary of the entire obtained results.

There isn't a fixed amount of work to deliver for each deliverable. The workload will depend on the availability of the laboratory and of the electronic components to be tested.

4.3. Schedule

The following milestones will be taken into account following the previous work description and deliverables required from the UPV laboratory:

An intermediate report will be delivered at the end of any fortnight.

Table 1: Schedule for the UPV deliverables

Deliverable number	Deliverable	Due dates
1	Kick off meeting and action plan	T0
2a	First intermediate report	T0 + 15 days
2b	Second intermediate report	T0 + 1 month
2c	Third intermediate report	T0 + 1'5 months
2d	Fourth intermediate report	T0 + 2 months
3	Final report of results	T0 + 2,5 months

5. Insurance contract

Except in relation to death or personal injury the amount of the Contractor's liability under this Contract for claims recoverable under the Contractor's Professional Indemnity, Third Party, Contractor's All Risk insurance policies shall be up to € 40,000 per claim and in the aggregate.

For all other claims or actions under the Contract the Contractor's maximum cumulative liability shall not exceed 50% of the total value of the contract.

The Contractor shall not be liable under or in connection with this Contract whether in contract or in tort, for breach of statutory duty or otherwise for any loss of profit, loss of production, loss of contracts or for any indirect or consequential loss or damage whatsoever that may be suffered.

The Contractor shall exercise all reasonable skill, care and diligence in the performance of his obligations under the Contract. In case of defects, deficiencies, errors and omissions the Contractor's exclusive liability in respect of any damages caused by said defects, deficiencies, errors and omissions shall be to correct and/or to re-perform any unsatisfactory services.

6. System safety and health hazard

System safety shall be accomplished regarding the criteria stablished. The Contractor shall conduct analyses as required to identify and quantify hazards. The program shall involve system safety in the design process to assure safety in design, manufacture, handling, testing, usage, maintenance and integration. Hazards, including environmental and hazardous materials, shall be eliminated or controlled to an acceptable level of risk.

6.1. Environmental And Hazardous Material

The Contractor shall meet all applicable international, federal, state and local environmental regulations. The Contractor shall tailor its environmental and hazardous material management program to accommodate the requirements of this program. This program shall integrate the management of environmental safety and health impacts and pollution prevention initiatives into the systems engineering process. Specifically, this includes identification of environmental, safety and health impacts associated with material and process decisions with emphasis on hazardous materials required and hazardous waste generated during the maintenance, operation, and disposal of the sensor system. The Contractor shall address not just impacts to the program, but the reduction and elimination of hazardous material where possible in the sensor system life cycle. This shall be accomplished DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives.

6.2. Reliability, Maintainability And Built In Test

The Contractor shall establish and maintain an active and effective Reliability and Maintainability (R&M) program during all the tests done in the laboratories. The R&M program shall ensure achievement of the test goals. This program shall include several laboratory techniques in order to get results about the behaviour and the quality of some satellite parts. Different type of procedures shall be proposed by the supplier, as are ATP and environmental qualification test procedures. Also a schedule with estimated start and completion points for the R&M analysis and tests must be included.

6.3. Failure Reporting, Analysis And Corrective Action System

A report regarding all the failures occurred throughout the laboratory tests shall be initiated by the contractor. All failures occurring during testing shall be collected and analysed. . These data shall be used for design improvements and pattern failure identification. Failure analysis shall be of sufficient depth to permit the identification of failure causes and the corrective actions. Failure analysis reports shall be closed out within 30 days of failure occurrence or rationale shall be provided for any extensions.

6.4. Reliability Critical Items

The Contractor shall identify and make recommendations for control of those items which require "special attention" because of complexity, life limit, limited shelf life, application of advanced state of the art techniques and the impact of potential failure on safety, readiness, mission success, or the demand for maintenance/logistics support. This information will be made available through the Integrated Product and Process Development (IPPD).

6.5. Part Level Stress Analysis

The contractor shall propose some tests capable of determining which parts have the most critical stresses. All the analysis of the part stress shall be performed to verify compliance with agreed-to derating criteria under the following conditions: strength of the material, elastic modulus of the material, conductivity of the material…

This information shall be included in the system reliability prediction.

6.6. Failure Modes, And Effects And Criticality Analysis (FMECA)

The Contractor shall perform a functional Failure Modes Effects, Criticality Analysis-Task Analysis (FMECA) on the satellites parts to support the Logistics Management Information (LMI) and maintain the results of the FMECA. It requires the identification of the following basic information:

- Item(s)
- Function(s)
- Failure(s)
- Effect(s) of Failure
- Cause(s) of Failure
- Current Control(s)
- Recommended Action(s)

7. Quality assurance

The quality assurance takes into account internal company quality factors, as well as, International and European quality standards. The internal quality assurance will take into account the general quality requirements detailed in the ECCO document "ECCO Procurement Quality Requirements" (ECCO_D_22MFG4). In addition to this, it has been generated the template of the important documents to hand in. Documentation developed as the result of this task will be retained by the quality responsible for a minimum of 5 years, after which it may be discarded at the direction of the IO. It must be ensured the correct development of the scope of the work at each stage carried on by the laboratory responsible and coordinators.

General Quality Standards (ISO/EN) that must be followed and accomplished are:

- 9100- Quality System for Aerospace Manufacturers
- 9101-Checksheet for 9100
- 9120-Quality System for Distributors
- 9121-Checksheet for 9120

8. Economical proposal

The contract established with the selected bidder will be a Fixed Lump Contract with a maximum price of 12000 € (including VAT).

The rates and prices specified by the bidder must include the following expenses:

- Any necessary licenses or resources to fully satisfy the scope of the contract
- Any travel expenses for travel between the Contractor's place of business and the ECCO facilities
- Any travel and living expenses for the relocation of resources to satisfy the terms of any resulting contract

The activities included in the bid are listed in the previous sections of the statement of work.

According to the milestones established in section 4.3, the pricing schedule will be the following:

Table 2: Payment schedule for the UPV

Deliverable number	Due dates	Payment
1	T0	30 %
2a	T0 + 15 days	10 %
2b	T0 + 1 month	10 %
2c	T0 + 1'5 months	10 %
2d	T0 + 2 months	10 %
3	T0 + 2,5 months	30 %

Since it is a collaboration contract, some benefits for the university can be proposed.

9. Supply support

The bidder must comply with all the same standards specified for the ECCO project, listed in section 7, and the European Commission. If the contractor does not comply with any certification or it is determined that any certification made by the contractor is untrue, ECCO has the right to terminate the contract for default.

10. Facilities

The Contractor shall identify facilities both ashore and afloat required to support testing, training, movement, and maintenance of the electronic prototypes and simulations and peculiar support equipment. The Contractor shall identify specific technical requirements upon which facilities modifications shall be predicated. The Contractor may participate in any site survey activity.

11. Manpower and personnel

The Contractor shall provide prove that the desired quality will be achieved, guaranteeing the capability and expertise needed for the tasks. The Contractor shall perform the appropriate studies to ensure that all manpower and personnel requirements are met.

The analysis shall identify the different tests to be carried with the electronic systems, as well as the manpower and skill level requirements for each task performed.

12. Procurement metrics

The evaluation methodology to choose the supplier for each work package will consist in the following punctuation system:

Principal module:

- Participation in previous similar projects. Punctuation given taking into account the similarity and the amount of projects. (0-30 points)
- Proposed budget for the project (0-20)
- Guaranty the manpower and skill level required for each task. (0-20)
- Identification of the facilities required to support the activity. (0-15)

Secondary module:

- Being an ECCO collaborator. (0-5 points)
- Being an environmentally friendly company. (0-5 points)
- Others (0-5)

A company will not be considered in the selection process of suppliers without the minimum score of 50 points in the principal module.

The company with more punctuation will be the selected one.

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EARTH CLIMATE CHANGE OBSERVATION

ECCO

ANNEX IV

Dissemination SOW

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Eric Godayol Capdevila

Valentin Valhondo Pascual

Tutor: Pierre Huguenet

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In ECCO satellite, sensors are distributed into different modules (payload modules) that could be standardized, in terms of mass and power requirements, being able to launch small commercial modules with new necessities and replace them in the future. Moreover, the existence of different payload modules leads to acquire multiple data from the same point of view, increasing precision of data and creating three-dimensional data maps, or from different points of view due to the independent attitude control system in each module. In this case, three sensors would provide information of the surface, a three-dimensional mapping of greenhouse and pollution gases and three-dimensional mapping of temperature. All this data, acquired simultaneously would lead to an improvement of precision of data and knowledge about the human activities effects on the Earth.

2. Scope

This Statement of Work defines the effort required to disseminate the ECCO project through web, media, conferences and other systems. The company would provide an interaction to science and technologic fields to explain the future of satellites and transmit the progress of the ECCO project and the advantages that could offer to the European inhabitants. This could be supported by international press communications and meetings. Therefore, dissemination in different languages through media would be appreciate, including a webpage for the project with current updates and news related to the project phase would be interesting too.

Dissemination campaign must be compatible with the current media, taking profit of new technology and reach European inhabitants.

In the following lines, brief list of aspects that shall be done are exposed:

1. Publishing and meetings: Make possible the interaction with the media, science and technologic field so as to let know the new advances.
2. International Press communications: Start the contact with the written press in order to state the past, the current and the future fractionated satellite technology advances.
3. Conferences organization: Planning and development of future conferences to attract possible stakeholders and keep the interest of the current ones.
4. Public relations outreach and enquiries: Interact with general population so as to introduce the topic, its new technology and the benefits of providing useful data as to live in a better world.
5. Media, social media and web: Approach the whole project in a friendly way through many different channels of communication.
6. Event organization of two ECCO international congresses.

3. Requirements and constraints

The requirements of the communication are:

- Be compatible with all web browsers
- Compatibility with the H2020 standards.
- ECCO logo must be in all documents to avoid copyright violations.
- Be translated to French, German, English and Spanish.
- All conferences must be done in English.

4. Project planning

4.1. Meetings and reviews

This proposal does include the kick off meeting, periodical intermediate meetings and a final review meeting at the ECCO office at Barcelona. Some meetings will be held by teleconference or videoconference.

The Contractor shall provide meeting agendas to the ECCO communication manager and shall prepare minutes of the formal meetings.

4.2. Work description structure

The coordinator must submit the deliverables through an electronic exchange system that is given. All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

The work is divided in the following main parts:

1. Publishing and meetings: Make possible the interaction with the media, science and technologic field so as to let know the new advances.
2. International Press communications: Start the contact with the written press in order to state the past, the current and the future fractionated satellite technology advances.
3. Conferences organization: Planning and development of future conferences to attract possible stakeholders and keep the interest of the current ones.
4. Public relations outreach and enquiries: Interact with general population so as to introduce the topic, its new technology and the benefits of providing useful data as to live in a better world.
5. Media, social media and web: Approach the whole project in a friendly way through many different channels of communication.
6. Event organization of two ECCO international congresses.

Different deliverables will be presented:

- Initial action plan with some alternative marketing options for general dissemination.
- Definitive dissemination action plan.
- Trimestral report of dissemination results.
- Action plan for each congress organization.

- Results report after each congress.

The work will be presented in three deliverables:

- D1a: Kick off meeting and Initial Action plan
- D1b: Definitive dissemination action plan
- D2: Trimestral report of dissemination results.
- D3: Action plan for the first ECCO international congress
- D4: Results of the first ECCO international congress
- D5: Action plan for the second ECCO international congress
- D6: Results of the second ECCO international congress

4.3. Schedule

The following milestones will be taken into account following the previous work description and deliverables required.

Table 1.Schedule of the image sensor SOW

Deliverable number	Deliverable	Due Dates
1a	Kick off meeting and Initial Action plan	T0
1b	Definitive dissemination action plan	T0 +1 month
2	Trimestral report of dissemination results	Each trimester from T0 to the end of the project
3	Action plan for the first ECCO international congress	1 month before the congress
4	Results of the first ECCO international congress	2 weeks after the congress
5	Action plan for the second ECCO international congress	1 month before the congress
6	Results of the second ECCO international congress	2 weeks after the congress

5. Insurance contract

Unless otherwise stated, all the material published within the website, the press or any type of media is copyright of ECCO Project. No part may be reproduced, in whole or in part, without the specific written permission of ECCO Project first hand and obtained.

Except in relation to death or personal injury the amount of the Contractor's liability under this Contract for claims recoverable under the Contractor's Professional Indemnity, Third Party, Contractor's All Risk insurance policies shall be up to € 10,000 per claim and in the aggregate.

The Contractor shall exercise all reasonable skill, care and diligence in the performance of his obligations under the Contract. In case of defects, deficiencies, errors and omissions the Contractor's exclusive liability in respect of any damages caused by said defects, deficiencies, errors and omissions shall be to correct and/or to re-perform any unsatisfactory services.

6. System safety and health hazard

Safety shall be accomplished regarding the criteria stablished. All the information upload to the Internet has to be encoded using the protocols stabilised in order to avoid hacking. All the data has to be saved in a minimum of 3 different servers in order to have a redundant system able to avoid system drops.

All the press processing has to be done regarding the EU criteria referred to the sustainable using of paper and chemical inks. The Contractor shall meet all applicable international, federal, state and local environmental regulations. These chemicals have to be non-toxic as well as biodegradable.

All the defective exemplars have to be recycled and not rejected.

7. Quality assurance

The quality assurance takes into account internal company quality factors. The internal quality assurance will take into account the general quality requirements detailed in the ECCO document "ECCO Procurement Quality Requirements" (ECCO_D_22MFG4). In addition to this, it has been generated the template of the important documents to hand in. Documentation developed as the result of this task will be retained by the quality responsible for a minimum of 5 years, after which it may be discarded at the direction of the IO. It must be ensured that conferences and meetings catch up its scope at the project.

8. Economical proposal

The contract established with the selected bidder will be a Fixed Lump Contract with a maximum price of 350.660 € (including VAT).

The rates and prices specified by the bidder must include the following expenses:

- Any necessary licenses or resources to fully satisfy the scope of the contract
- Any travel expenses for travel between the Contractor's place of business and the ECCO facilities
- Any travel and living expenses for the relocation of resources to satisfy the terms of any resulting contract

The activities included in the bid are listed in the previous sections of the statement of work.

According to the milestones established in section 4.3, the pricing schedule will be the following:

Table 1: Payment schedule of the image sensor SOW

Deliverable number	Due Dates	Payment
1a	T0	30 %
1b	T0 +1 month	10 %
2	Each trimester from T0 to the end of the project	-
3	1 month before the congress	10 %
4	2 weeks after the congress	10%
5	1 month before the congress	20 %
6	2 weeks after the congress	20 %

9. Supply support

The bidder must comply with all the same standards specified for the ECCO project, listed in section 7, and the European Commission. If the contractor does not comply with any certification or it is determined that any certification made by the contractor is untrue, ECCO has the right to terminate the contract for default.

10. Facilities

The Contractor shall identify facilities both ashore and afloat required to support the publishing, press communications, conferences organization, public outreach and enquires, and media approaching for the appropriate dissemination of the ECCO project. The Contractor shall identify specific technical requirements upon which facilities modifications shall be predicated. The Contractor may participate in any site survey activity. Results shall be documented according to the ECCO project procedures (ECCO_D_22MFG4).

11. Manpower and personnel

The Contractor shall provide prove that the desired quality will be achieved, guaranteeing the capability and expertise needed for the tasks. The Contractor shall perform the appropriate studies to ensure that all manpower and personnel requirements are met.

The analysis shall identify the different activities to be carried during the length of the project, as well as the manpower and skill level requirements for each task performed.

12. Procurement metrics

The evaluation methodology to choose the supplier for each work package will consist in the following punctuation system:

Principal module:

- Participation in previous similar projects. Punctuation given taking into account the similarity and the amount of projects. (0-30 points)
- Proposed budget for the project (0-20)
- Guaranty the manpower and skill level required for each task. (0-20)
- Identification of the facilities required to support the activity. (0-15)

Secondary module:

- Being an ECCO collaborator. (0-5 points)
- Being an environmentally friendly company. (0-5 points)
- Others (0-5)

A company will not be considered in the selection process of suppliers without the minimum score of 50 points in the principal module.

The company with more punctuation will be the selected one.