Interreg Sudoe

NANO STAR

European Regional Development Fund

Research and innovation

Preliminary Mission Design contents template

Contents template

NANOSTAR consortium

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This template should serve as a guide for writing the preliminary design document of the phase 1 challenge competition. Although it is recommended to follow the proposed division into sections and subsections (with the corresponding contents), it is not compulsory to follow this document format (other formats are also accepted), and each team is free to add new sections to the document.

The maximum allowed length of the document, excluding title pages and appendices, is 50 pages. Longer documents shall not be evaluated by the commission. All deliverables shall be presented in English.

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EXECUTIVE ABSTRACT

A brief a summary of the mission, its main goals, the work carried out, the methodology used, and the solution found.

INTRODUCTION

Brief section, describing the object and scope of the report, and enumerating its different parts (including appendices). Here you can also add a brief description of the team composition and roles.

APPLICABLE AND REFERENCE DOCUMENTS

List of all references used or mentioned in the main text, and may include a list of the acronyms used in the report. A change record table, like the one reported below, should be added in this section.

TABLE 1: Example of a change log record table

Edition/Revision	Date	Description of the change
V0.0	DD/MM/YYYY	Initial version of the document
V0.1	DD/MM/YYYY	Added section X and updated description of subsystem Y
V1.0	-	
V1.1	-	
V2.0	-	
V3.0	-	

MISSION OVERVIEW, REQUIREMENTS FLOWDOWN AND TESTS

The mission, its goals, any preliminary design ideas and a rough way to test them. If you have data on similar studies, background information, etc., this is a good place to tell about it as well.

After that, the general objective of this section is to describe the mission and the solution you have found, from a systems engineering point of view. It should describe the different mission phases, the payload, the system segments, and the subsystems that compose your system.

The list of derived subsystem requirements (V-cycle framework) or user stories (Agile framework) to fulfill the mission requirements, a test plan[1] (V-cycle) or acceptance tests (Agile), as well as any design diagrams or project management document (PBS[4], WBS[5], OBS[6], RBS[7], Gantt charts, UML2[8], SysML[9], Product Backlogs, Story Map, conformity matrix) should be referenced here, although it can be provided as an appendix at the end of the report.

[1] Test plan: in V-cycle framework, according to IVVQCA[2] and traceability principles, in predesign phase, for each requirement, this is a basic list of test cases (test name + brief description + acceptance criteria) along with their IADT[3] matrix. Further in the process, other important parameters will be added for each test case (e.g. complete description, means, duration, prerequisites, resources, etc. needed to run each test case or complete test suites or test campaigns).

[2] IVVQCA = Integration, Verification, Validation, Qualification, Certification, Acceptance: all the phases from the left side of the V-cycle

[3] IADT = Inspection, Analysis, Demonstration, Test: 4 different ways to meet a criterion

[4] PBS = Product Breakdown Structure: a chart that shows how a system is split into products

[5] WBS = Work Breakdown Structure: a chart that shows how a system is split into work packages

[6] OBS = Organization Breakdown Structure: an organizational chart

[7] RBS = Resource Breakdown Structure or Risk Breakdown Structure: two different meanings for two different charts that shows either risks or resources

[8] UML2 = Unified Modeling Language 2: a graphical language to describe and model a system

[9] SysML = Systems Modeling Language, a subset of UML2 specific to systems engineering

SUBSYSTEMS ANALYSIS AND DESIGN

Description of each subsystem and any other relevant part of the mission. Assumptions, computations, design choices and results should all be documented. The justified trade-off analysis for each subsystem is also included here, referencing the other sections (and their trade-offs) when necessary.

MISSION ANALYSIS

This section should analyze the orbit followed by the nanosatellite and provide at least one trajectory analysis with a **Delta-V budget**.

PAYLOAD

Based on the high level requirements, this section should take up given geometry, power and thermal constraints along with any dimensioning and trade-offs with other systems (C&DH, CS, ADCS, etc.) considering the mission analysis.

SYSTEMS OPERATIONS MODES

This section should describe the different system operations modes, associated to the different mission phases.

SPACE PROPULSION SUBSYSTEM (SPS)

This section should include the thruster selection and trade-off, and provide the **propellant mass budget.**

ATTITUDE, DETERMINATION AND CONTROL SUBSYSTEM (ADCS)

This section should present the trade-off and selection of the ADCS components and their sizing to control the nanosatellite attitude, for each mission operations mode, throughout the mission duration.

COMMAND AND DATA HANDLING (C&DH)

Should you wish to detail the C&DH further, this section should describe the onboard computer main functions and characteristics according to the payload, subsystems and the chosen distribution of the calculus. Else the C&DH subsystem could be just included in the Communication System section below.

COMMUNICATIONS SUBSYSTEM (CS) AND GROUND SEGMENT (GS)

This section should describe both the ground segment and the onboard communications subsystem of the nanosatellite. The components selection and the **telecommunications link budgets** should be presented here.

ELECTRIC POWER SUBSYSTEM (EPS)

This section should describe the selected components of the electric power subsystem, their sizing and the total **energy and power budget**.

MECHANICAL DESIGN AND STRUCTURE

This section should describe the mechanical structure (e.g. chassis), its foreseen mechanisms (e.g. the deployment of the solar array, orbital deployment system interface) and satellite configurations, as well as provide an overall view of the whole nanosatellite and its global properties (a 3D view from IDM-VIEW, all the subsystems components, the computation of the nanosatellite center of mass location, etc…). The overall **Mass budget** should be presented here.

THERMAL CONTROL SUBSYSTEM (TCS)

The thermal control subsystem should be presented here, with a preliminary thermal analysis showing that thermal requirements are satisfied.

LAUNCHER

This section should describe the launcher and possibly the launchpad location choice based on the mission analysis. All impacts of the launcher type on the design analysis should be addressed in the relevant sections (e.g. vibrations, oscillatory resonance, etc.).

OTHER?

If your nanosatellite has other subsystems or parts that need to be described, you can do so in additional subsections like this one (e.g. extra payloads, radiation protection, etc.).

RISK ANALYSIS AND MITIGATION

This section should describe the identified mission risks, based on an evaluation of their likelihood and criticality. Here you should specify your risk acceptance criteria and suggest some mitigation strategies for the most critical risks.

CONCLUSIONS

The chosen design solution is summarized in this section, highlighting any important aspect or critical issue that has been identified during the study. Guidelines for future work may be included here as well.

APPENDICES

Appendices can be used to attach additional materials that your Team may find relevant to understand the report. In particular, the list of all subsystem requirements or product backlog with user stories (that permit to meet the mission-level requirements), other tables created during the project (e.g. change logs of the subsystem requirements, tables of conformity), or the description of the tools developed by the team, can be included here.