Project Plan

Design Synthesis Exercise

Group 15 — Manned Martian Aircraft

May 4, 2023

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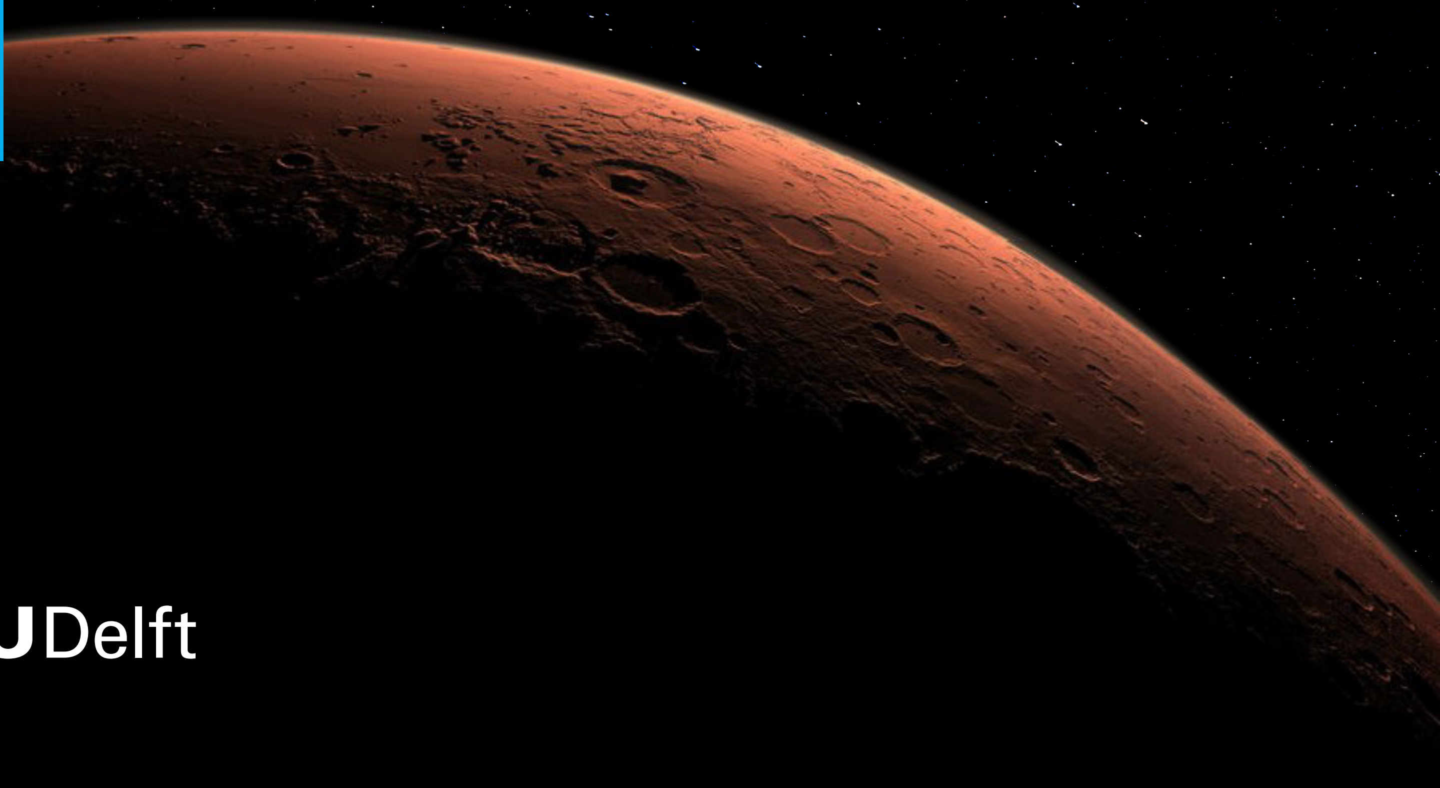
Delft University of Technology



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1.0	28-04-2023	All	First draft
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Thesis committee: Dr. A. Sciacchitano, TU Delft, tutor
Dr. S. J. Paardekooper, TU Delft, coach
Dr. ir. J. A. Pascoe, TU Delft, coach

Cover image credit: Pam van Schie (accessed April 2023)

TU Delft

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Introduction and System Context & Description

By Joachim Bron and Pedro Santos

At the end of their studies, BSc students at the faculty of Aerospace Engineering of the TU Delft need to complete the Design Synthesis Exercise (DSE), a 10 week long project in which groups of 10 students generate a conceptual design based on a specific mission, given by a user or client. In this edition of the DSE, group 15 is tasked with the development of a manned martian aircraft capable of transporting two people over a range of 1000 km at a speed of 400 km/h. Throughout the duration of the DSE, the team and its main milestones will be monitored by the principal tutor, Dr. A. Sciacchitano, and its coaches, Dr. Ir. J.A. Pascoe and Dr. S. Paardekooper.

With the goal of becoming a multi-planetary species, humans will be arriving on Mars in the coming decades. Once there, and after installation of basic life support systems, humans will need to explore the surface of the Martian planet for various reasons. These include, but are not limited to, the execution of scientific experiments to characterize Mars' surface, geology and soil. Currently, no feasible solution exists for human transportation on Mars over vast ranges and in a fast manner. Current methods for human exploration on Mars close to the surface are limited. Unmanned aerial vehicles have been developed, such as NASA's Ingenuity helicopter, but these are not able to transport humans and thus inherently limited in their capabilities. Land rovers could be used to transport humans, but these are usually slow and limited in their available power, since many of them rely on sunlight as a power source. Even if these were to improve drastically in the future such that their speed and available power are not a problem anymore, these ground vehicles are still inherently limited in the terrains they can explore.

The reasons above justify the development of a manned martian aircraft for the exploration of Mars. The conditions on Mars, however, render the design of such an aircraft difficult. Although Mars has a gravitational acceleration approximately 2.5 times less than that of the Earth (gravitational acceleration on Mars $g_{mars} \approx 3.71\,\mathrm{m\,s^{-2}}$ vs on Earth $g_{earth} \approx 9.81\,\mathrm{m\,s^{-2}}$) [1], its air density is approximately 60 times less than on the Earth (air density on Mars $\rho_{mars} \approx 0.020\,\mathrm{kg\,m^{-3}}$ vs on Earth $\rho_{earth} \approx 1.225\,\mathrm{kg\,m^{-3}}$)[1], rendering flight difficult as there is an effective reduction in the capability to generate lift of approximately 25 times. This means the design of an aerial vehicle will be vastly different than one designed for the Earth due to these vastly different conditions, as it will need to operate at much lower Reynolds numbers than on Earth and probably use much larger lifting surfaces. Furthermore, Mars' atmosphere is composed mostly (95.1%) of CO2 [1], making the use of traditional air-breathing jet engines difficult, if not impossible.

Since this is a complex project, the design process needs to be properly planned. The purpose of this report is to give an overview of the planning of the project. First, the mission need statement and the project objective statement were created based on the given user requirements, and are given in Chapter 2. Then, the management aspect of the project was considered and is detailed in Chapter 3. Risks with respect to project organization are assessed in Chapter 4, where the most significant risks are identified and appropriate mitigation solutions are implemented. Additionally, the main structure of the technical approach to the design process is presented with the help of project logic diagrams in Chapter 5 where a workflow diagram, work breakdown structure and Gantt chart are presented. The project rules are set up in Chapter 6 in order to prevent some of the risks and to ensure a healthy and efficient interaction between team members. Finally, sustainability is a core value of this project, and its economical, environmental, and ethical aspects are discussed in more detail in Chapter 7. In conclusion, this plan provides confidence that the project will run as intended, ensuring it is completed on time and that smooth operations prevail between team members.

[1] URL: https://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html [cited 28-04-2023]

2 User Requirements

By Joachim Bron, Timo de Kemp

The project is defined through a mission statement and project objective, as well as the given top-level requirements. The mission statement (MS) and the project objective statement (POS) are:

> *MS: Transport two astronauts with payload quickly over a long range on Mars.*
>
> *POS: Design, using 10 people in 10 weeks, an aerial vehicle that is capable of transporting two astronauts for at least* 1000 km *on Mars.*

From the project objective, it is possible to extract two main requirements. It is meant to transport two astronauts, which is a requirement on the human transportation capability, and the range of the aircraft should be at least 1000 km, which gives a requirement on the range. Descriptions of the other main (given) user requirements are stated below, along with explanations of how and why each of the requirements influence the design.

2.1. Performance

By Patrick Kostelac, Thomas van de Pavoordt

The performance requirements deal with the range and the cruise speed of the aircraft. As was mentioned in the project objective, the aircraft range should be at least 1000 km. The range will mostly be influenced by the lift-to-drag ratio and the end-to-begin mass ratio. The second performance requirement is that the cruise speed should be at least 400 km/h. The speed is mostly influenced by the drag and the thrust of the aircraft.

2.2. Safety and reliability

By Patrick Kostelac, Thomas van de Pavoordt

The safety and reliability requirements ensure that the aircraft can operate in the specified condition. The aircraft is required to operate in Mars's atmosphere, which is very thin (air density $\rho_{mars} = 0.02\,\mathrm{kg/m^3}$). This is a big challenge as all the aerodynamic forces are going to be approximately 60 times smaller than on Earth, which needs to be compensated for. Additionally, the aircraft needs to be capable of taking off and landing on Mars soil. Since there are no established runways that could be used for take-off and landing, the design will have to be adapted to these constraining circumstances.

2.3. Sustainability

By Patrick Kostelac, Thomas van de Pavoordt

The sustainability requirements are imposed to ensure that the aircraft can operate on Mars for a long period of time without the need for external supplies. In order to do so, the aircraft propulsion and electrical systems should employ resources that are available on Mars. Mars's atmosphere is mostly made out of CO_2, meaning that normal combustion engines used on Earth will not work and that alternatives need to be found.

2.4. Engineering budgets

By Patrick Kostelac, Thomas van de Pavoordt

The engineering budgets deal with the mass budget of the aircraft and a maximum operating Mach number. The maximum operating Mach number influences the airfoil used as it is necessary for the airfoil critical Mach number to be below the given maximum operating number. The mass budget can be separated into the payload budget of the aircraft itself and the payload budget of the launch vehicle which will deliver the aircraft to Mars. The launch vehicle has a set budget which limits the Maximum Take-Off Mass (MTOM) of the aircraft to 3000 kg. The maximum mass of the aircraft will affect the size of the aircraft which limits the lifting surface area. The aircraft payload budget sets the minimum payload requirement to 100 kg payload and two astronauts. The aircraft payload budget adds additional mass to the aircraft meaning that a larger lifting surface is required.

2.5. Cost

By Patrick Kostelac, Thomas van de Pavoordt

There is no top-level system requirement on cost. However, development cost and manufacturing cost will be monitored throughout the project to provide a high-level estimation of the total cost for the final design, and an effort will be made to minimize these.

2.6. Other

By Patrick Kostelac, Thomas van de Pavoordt

The final user requirement concerns the modularity of the design. This requirement is the result of the limited space on board the rocket and satellite which will bring the aircraft to Mars. It should be designed such that all of it can be transported to Mars and that it can be assembled there.

2.7. User Requirement List

By Thomas van de Pavoordt, Joachim Bron

Each of these requirements will have an impact on the design. The user requirements explained above are listed below in the following list:

- **REQ-USER-PERF-01:** The system shall have a range of at least 1000 km.
- **REQ-USER-PERF-02:** The system shall have a cruise speed of at least 400 km/h.
- **REQ-USER-SARE-01:** The system shall be able to perform all its functions in the Mars atmosphere.
- **REQ-USER-SARE-02:** The system shall be able to take-off and land on Mars soil.
- **REQ-USER-SUST-01:** The system shall be able to use in-situ resources to function.
- **REQ-USER-ENGB-01:** The system shall have a MTOM of less than 3000 kg.
- **REQ-USER-ENGB-02:** The system shall be able to transport 2 astronauts having a maximum mass of 250 kg.
- **REQ-USER-ENGB-03:** The system shall be able to carry a payload of at least 100 kg.
- **REQ-USER-OTHR-01:** The system shall be able to be assembled on Mars.

3
Organizational Breakdown Structure

To organize work within the team, each member is given a core responsibility on both managerial and technical aspects. This spread of responsibility is meant to ensure commitment to the project and involvement during the entirety of the DSE. The organization can be separated between managerial roles, described and attributed in Section 3.1, and technical roles, described and attributed in Section 3.2. Finally, the interaction between roles can be visualized by an Organogram in Figure 3.1.

3.1. Managerial Roles

By team

Within the team, the managerial or organizational roles are for general overviews of different non-technical aspects of the project. The roles were determined by looking at the project needs and goals, as well as the number of team members. The roles were assigned by performing an individual SWOT analysis which can be seen in Table A.1

Table 3.1: *Overview of the organizational role division*

Organisational Role	**Person**	**Description**
IT and File Manager	Dominik	Responsible for ensuring the proper setup and use of tools used by the team. This involves the organization of the tools, the setup of the tools, and the management of the outputs. These outputs are to be classified and filed as determined by the IT and File Manager.
Team Leader	Sebastian	Responsible for keeping an overview of the group from the team atmosphere point of view. The individual is responsible for resolving internal conflicts, and ensuring team well-being and motivation. The individual shall also lead internal and external meetings.
Budget Manager	Freek	Responsible for maintaining an overview of the various budgets of the project. This includes the use of the printing card, and although the role is not inherently technical, it also involves keeping an overview of the mass and power budgets, and any other budgets used during the project.
Deliverable Compliance Manager	Joachim	Responsible for ensuring the deliverables are compliant with their specific requirements. This encompasses page limits, styling, and other criteria given by the project guide.
Secretary	Javier	Responsible for taking minutes during meetings and maintaining a written summary of all internal meeting discussions.
Systems Engineering Manager	Pedro	Responsible for maintaining the project within the lines of the technical requirements. This role also encompasses keeping an overview of the requirements and the proper use of systems engineering tools within the team. Differs from the chief engineer as it does not deal with interfaces of the subsystems and does not keep a deep overview of the subsystem designs.
External Affairs Manager	Adrian	Responsible for the communication with external parties, such as the TAs, tutors, coaches, and any external parties involved.
Graphics Design Manager	Patrick	Responsible for compliance and consistency regarding the visual elements of all deliverables. The individual shall ensure all graphics are of the same style and of high quality.
Project Manager	Timo	Responsible for keeping the project on schedule and keeping an overview of the project. Shall keep an overview of the progress of all members on their respective tasks.
Sustainability Manager	Thomas	Ensures that all aspects of the group's work and the development of the product are performed in a sustainable manner (e.g. using sustainable materials, being ethically sustainable, operational sustainability, etc.).

3.2. Technical Roles

By team

In contrast to the managerial roles, the technical roles are linked to a single design aspect of the project. Each technical role is responsible for a specific part of the technical design and is the person of reference for any work done on that part. It is important to note that these roles are mainly for the distribution of responsibility. If it is found throughout the project that a reallocation of human resources (i.e. that an engineer of one subsystem needs to help the design aspect of another subsystem) is more efficient than the initial distribution, this reallocation will be adopted. The technical roles, the person and backup person assigned, and a short description of the role, are provided in Table 3.2.

Table 3.2: *Overview of the technical roles of the team, the person assigned to the role, and the description of what the role entails.*

Technical Role	Person	Deputy	Description
Chief / Integration engineer	Joachim	Pedro	Responsible for keeping an overview of the whole technical design, its subsystems and their compatibility (including interfaces). Provide technical help and advice to individual subsystems, and resolve technical conflicts between subsystems. This role differs from the systems engineering manager as it does not focus on making sure systems engineering tools are properly used.
Aerodynamics engineer - Lift Devices	Adrian	Timo	Responsible for the design's lift production surfaces aerodynamics. Takes care of lift devices and airfoil selection and other tasks based on requirements for control and stability.
Aerodynamics engineer - Main Body	Sebastian	Joachim	Responsible for the aerodynamics of the design's main body.
Propulsion Engineer	Pedro	Freek	Responsible for the design's propulsion subsystem. Ensure sufficient power thrust is generated to fulfill the requirements.
Stability and Controllability Engineer	Patrick	Thomas	Responsible for the design's stability and controllability. Ensure the safe operation of the vehicle.
Power and Hydraulics Engineer	Freek	Sebastian	Responsible for the design's power, electrical systems and hydraulics.
Structures Engineer	Javier	Patrick	Responsible for the design's structural components and structural integrity, as well as assembly on Mars.
Materials Engineer	Timo	Javier	Responsible for the selection of suitable materials for the design's different components.
Ground Operations Engineer	Thomas	Dominik	Responsible for the ground operations of the design, which entails but is not limited to maintenance, refueling, boarding, take-off and landing.
Flight Performance Engineer	Dominik	Adrian	Responsible for the design's flight performance aspect, which includes climb speed, range, endurance, flight profile, etc.

3.3. Organogram

By Joachim Bron, Timo de Kemp, Javier Alonso García

The organizational and technical roles provided in Table 3.1 and Table 3.2 are summarized in an organogram, giving a global overview of all of the roles of the team, with the addition of a hierarchical responsibility structure. This organogram is shown in Figure 3.1.

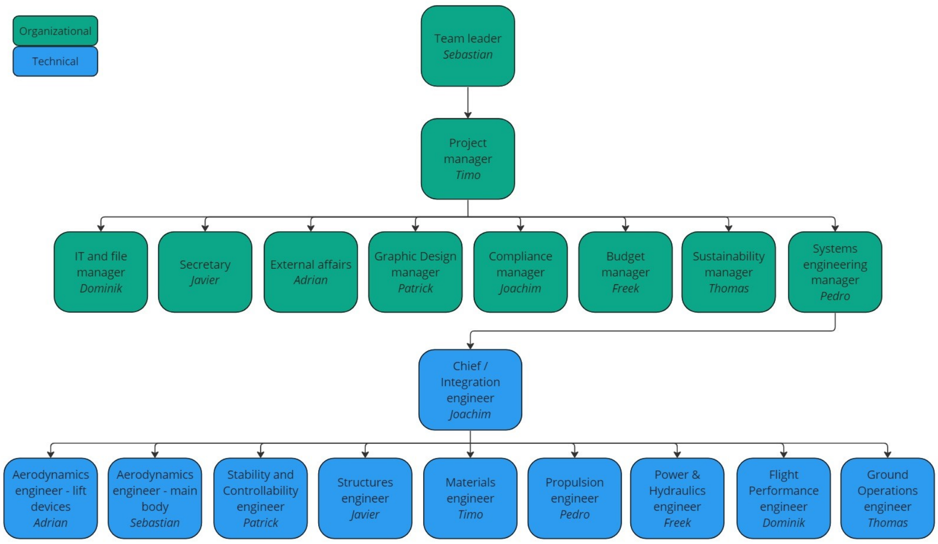


Figure 3.1: *Project organogram*

4 Organizational Risk Assessment

By Sebastian Harris, Thomas van de Pavoordt

The Risk Management Process is iterative by nature and can be defined by 5 main activities: Risk Planning, Identification, Assessment, Analysis, and Handling. Risk Planning entails all decisions taken ahead of the risks in order to determine how risks will be managed. Next, potential risks must be identified and their root causes determined; this process is accomplished in Section 4.1. Once the risks are identified, they must be characterized and quantified in order to determine which risks must be assessed in the Risk Assessment Phase, found in Section 4.2. Next, the alternatives to handle the most important risks must be analyzed in order to determine which are most effective. Finally, the Risk Handling Phase implements these risk solutions and monitors the effects of the chosen handling process, the results of this process are visible in Section 4.3.

4.1. Risk Identification

By Sebastian Harris, Thomas van de Pavoordt, Joachim Bron

In order to ensure the proper completion of the project, risks that could harm the project were identified. Each project risk was assigned an ID, and its consequence on the project was determined. Each risk was also assigned a probability of occurence score and an impact score, which ranges between 1 (low probability, negligible impact) and 5 (high probability, catastrophic impact). These risks are shown in Table 4.1.

Table 4.1: *Potential Risks to encounter*

ID	Risk	Consequence	Probability (1-5)	Impact (1-5)
R01A	Transit Disruption	Group member is delayed	3	3
R01B	Unexpected Absence	Group member not present	3	4
R01C	Expected Absence	Group member not present	5	3
R01D	Unreachable Tutor/Mentor	Unable to receive feedback	2	3
R02A	Member hungover	Member is not productive	2	2
R02B	Member Injured	Member is underproductive	2	2
R02C	Member Unwilling to Work	Member is not productive	1	2
R02D	Member Quits Program	Member no longer productive	1	4
R02E	Members in conflict	Members unwilling to collaborate	1	3
R03A	Power outage	No WiFi, no charging	2	5
R03B	Unavailable Workspaces	No dedicated work area	2	4
R04A	Overleaf is unavailable	No access to reporting tools	1	4
R04B	MS Project is unavailable	No access to Gantt Chart	1	3
R04C	File corruption	No access to saved files	1	4
R05A	Flooding	Occupied dealing with the flooding	1	5
R05B	Wind Storm	Road-blocking Debris	2	3
R06A	Lack of Communication	Unaccounted Delays	3	4
R06B	Overassignment of a Member	Delays	3	3
R06C	Underestimating Workload	Unaccounted Delays	4	4
R06D	Overestimating Workload	Underestimation of possible tasks	3	3
R06E	Unexpected Changes	Work must be redone	2	4

4.2. Risk Assessment

By Sebastian Harris, Thomas van de Pavoordt

Once the risks are listed in Table 4.1, each risk identifier can be placed in a matrix. This matrix organizes the identifiers based on the risk probability and impact value that was assigned previously. The matrix is color-coded to facilitate understanding while also having a numbered axis indicating the magnitude of impact or probability. This matrix can be found in Table 4.2:

Table 4.2: *Risk Matrix*

		Probability				
		Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Impact	Catastrophic (5)	R05A	R03A			
	Critical (4)	R02D, R04A, R04C	R03B, R06E	R01B, R06A	R06C	
	Moderate (3)	R02E, R04B	R01D, R05B	R01A, R06B, R06D		R01C
	Marginal (2)	R02C	R02A, R02B			
	Negligible (1)					

From the above table, the main risks to take into account for the project are R06C and R01C, followed by R01B, R06A and R03A. The Risks present in the white zone (R01A, R03B, R05A, R06B, R06D, R06E) are still to be considered, although their total risk is lower than those mentioned above. Finally, low probability and low impact risks will still be handled in order to minimize total project risk further.

4.3. Risk Analysis & Handling

By Sebastian Harris, Thomas van de Pavoordt

The next step in the Risk Management Plan is to analyze the risks from Table 4.2 and determine the optimal way of reducing the risk for each element. Risk Handling will then lay out and summarize how each risk will be mitigated. Table 4.3 shows, for each risk, the probability and impact mitigation plan and how this will affect the probability and impact scale.

Table 4.3: *Risk Mitigation Options for each Risk*

ID	Probability Mitigation	Impact Mitigation	New Probability (1-5)	New Impact (1-5)
R01A	Not Feasible	Increase Travel Time Margin	3	2 (-1)
R01B	Increase Communication Channels	Use back-up technical roles	2 (-1)	2 (-2)
R01C	Promote planning outside of hours	Use back-up technical roles and plan ahead in Gantt Chart	3 (-2)	2 (-1)
R01D	Increase Communication Channels	Regularly Present Critical Questions	1 (-1)	1 (-2)
R02A	Develop Responsibility within Group through an agreement to work extra if inefficient	Use back-up technical roles	1 (-1)	1 (-1)
R02B	Not Feasible	Use back-up technical roles	2	1 (-1)
R02C	Regularly Check-up on Group Motivation	Use back-up technical roles	1	1 (-1)
R02D	Regularly Check-up on Group Motivation	Use back-up technical roles	1	3 (-1)
R02E	Create Team Leader Role	Practice Conflict Resolution	1	1 (-2)
R03A	Not Feasible	Charge Batteries Overnight, Use Mobile Data if Necessary	2	2 (-3)
R03B	Book Library Project Room as back-up	Relocate to other buildings	1 (-1)	2 (-2)
R04A	Not Feasible	Temporarily use alternative Software	1	2 (-2)
R04B	Not Feasible	Maintain Back-up of Gantt Chart	1	1 (-2)
R04C	Follow Proper Saving Procedures and Use Cloud Storage	Regularly Save Files	1	2 (-2)
R05A	Not Feasible	Prepare Remote Work	1	1 (-4)
R05B	Not Feasible	Prepare Remote Work	2	1 (-2)
R06A	Promote Open Communication within Team	Prepare buffers in Gantt Chart	2 (-1)	2 (-2)
R06B	Proper Use of Gantt Chart	Prepare buffers in Gantt Chart	1 (-2)	2 (-1)
R06C	Prepare Detailed Work Breakdown Structure	Prepare buffers in Gantt Chart	2 (-2)	2 (-2)
R06D	Prepare Detailed Work Breakdown Structure	Prepare buffers in Gantt Chart	1 (-2)	1 (-2)
R06E	Regularly Update Gantt Chart	Prepare buffers in Gantt Chart	1 (-1)	2 (-2)

Table 4.4 shows the updated Risk Matrix, where it is now visible that all risks are within a safe margin:

Table 4.4: *Updated Risk Matrix*

		Probability				
		Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Impact	Catastrophic (5)					
	Critical (4)					
	Moderate (3)	R02D				
	Marginal (2)	R03B, R04A, R04C, R06B, R06E	R01B, R03A, R06A, R06C	R01A, R01C		
	Negligable (1)	R02A, R04B, R01D, R02C, R02E, R05A, R06D	R02B, R05B			

4.4. SWOT Analysis

By Sebastian Harris

A Strength, Weakness, Opportunity, and Threat Diagram, or SWOT Diagram, provides an overview of the various aspects of a team. To produce such a diagram, the team was asked to self-identify their own strengths, weaknesses, opportunities, and threats in a separate table, which can be found in Appendix A. This was combined with the Strengths, Weaknesses, Opportunities, and Threats of the project itself. All results were combined into Table 4.5

Table 4.5: *SWOT Analysis from a Team Standpoint*

Strengths	**Weaknesses**
The team is strongly devoted to the project	Team is inexperienced with MS Project
Team has strong common knowledge	Risk of internal conflicts
Team has experience in projects in groups of 10	Team doesn't know each other, must build trust
Team members don't follow other courses	Team is unaccustomed to long work hours
	Scope of the project is unconventional with respect to course content
Opportunities	**Threats**
Access to knowledgeable and dedicated coaches	Strong dependency on external modes of transport
Access to paid software: MS Project, MS Teams	Potentially underconstrained project
Potential Access to external insight through professional networks	Short time frame
Access to research articles and books through licenses provided by the university	Variety of Team Cultural Origins can lead to friction

5
Project Logic

By Patrick Kostelac, Adrian Beňo

The Project Logic Diagram provides an overview of the planning process of the project. This will serve to produce a linked set of steps to follow in order to finish the project. The first step is to break down the project into phases, as done in Section 5.1. Next, the main Milestones of the project are listed in Section 5.2. Given the milestones and main phases, the core tasks necessary to achieve each step of the process is present in Section 5.3. Finally, the detailed tasks necessary to achieve each milestone are detailed in Section 5.4 with the resulting Gantt Chart being added in Section 5.5.

5.1. Phasing

By Patrick Kostelac, Adrian Beňo

In order to efficiently organize the relevant tasks throughout the project, the project will be divided into four phases.

- **Project planning phase:** The team plans all activities necessary for the successful completion of the DSE. This includes the determination of all tasks, assignment of members responsible to carry out the tasks, and time estimate on the duration of all the work, as distributed among the team members.
- **Baseline phase:** The team produces user requirement analysis, including its verification and validation, from which sub-requirements are derived and driving and killer requirements are identified. The team then brainstorms and exhaustively explores all the design options using the design options tree. A number of designs are selected for further research during the Mid-term phase.
- **Mid-term phase:** This phase is dedicated to the development of the concepts selected in the Baseline phase. Here concept adherence towards the requirements is evaluated by further research and more detailed design development. Finally, a trade-off is performed to select one concept which will be studied in detail in the final phase.
- **Final phase:** This phase deals with the in-depth development of the selected concept from the Midterm Review. This phase is specially dedicated to the aircraft subsystem design and the integration of those subsystems into a complete aircraft. This includes the evaluation of flight performance, materials, control systems, etc. This phase leads toward the final report.

5.2. Deadlines

By Patrick Kostelac, Adrian Beňo

The team has several deadlines during the DSE. These deadlines represent major events withing the project, such as reviews and rehearsals. All of the deadlines relevant to the project can be seen in Table 5.1 and in the Gantt chart Section 5.5.

Table 5.1: *Deadlines for the project*

Deadline	Due Date	Deadline	Due Date
Draft project plan	[28/04/2023]	Interim Grading	[02/06/2023]
Final project plan	[04/05/2023]	Jury Summary	[14/06/2023]
Personal appendix	[28/04/2023, 23/05/2023, 21/06/2023]	Draft final report and poster	[21/06/2023]
Status tutor meeting	[every Tuesday]	Final report peer review	[23/06/2023]
Draft baseline report	[04/05/2023]	Final Review	[26-27/06/2023]
Baseline review	[08/05/2023]	Final report and poster	[27/06/2023]
Draft midterm report	[23/05/2023]	Symposium Rehearsal	[28/06/2023]
Peer review midterm	[24/05/2023]	Symposium	[28/06/2023]
Midterm review	[(26-30)/05/2023]		

5.3. Work Flow Diagrams

By team

A detailed WFD for each of the phases from Section 5.1 was created. WFDs of the project planning phase, baseline report phase, mid-term report phase and final report phase are provided in Figure 5.1, Figure 5.2, Figure 5.3 and Figure 5.4, respectively. The diagrams are connected by their respective inputs and outputs. The output of the Figure 5.1 is used as the input for Figure 5.2 and so on. In the WFD the top bar has the identifier of the process, in the lower left corner the initials of the group members doing the tasks (see cover page to see which group member corresponds to which initials). If a dash is present the people of its sub tasks are doing this overarching task, to be found in the work breakdown structure. The lower right corner shows the total time (in hours) that will be allocated to the completion of the task.

5.4. Work Breakdown Structure

By team

The work breakdown structure (WBS) is a hierarchical decomposition of the work to be executed by the project team. It breaks down the tasks from the WFD into smaller sub-tasks. The number of hours required to complete the task and the person completing the task are mentioned for every task. The WBSs for the project planning phase and the baseline report contain the most detailed hour distribution, while the Midterm and the Final report WBSs do not yet contain the tasks divided into the smallest possible sub-tasks. They do contain the task division in detail necessary for project planning, but sub-tasks specific to the design concept are yet to be determined because the design concept will only be known after the mid-term report. After mid-term report, the WBSs will be updated accordingly. WBSs of the project planning phase, baseline report phase, mid-term report phase and the final report phase are provided in Figure 5.5, Figure 5.6, Figure 5.7 and Figure 5.8, respectively.

5.5. Schedule

By Dominik Stiller, Timo de Kemp, Freek Braspenning, Javier Alonso, Pedro Santos

The Gantt chart is the third representation of our task distribution. It combines the logical dependencies of the Work Flow Diagram (WFD) with the detailed breakdown of the Work Breakdown Structure (WBS) while adding hourly scheduling of each task. The Gantt Chart aims to distribute the work evenly while considering the expertise of each individual and assigning tasks accordingly. Two versions are shown below: one with only the high-level work packages shown in the WFD, one showing all tasks of the WBS.

MS Project was used to facilitate the scheduling. While other tools were considered, MS Project offered the most comprehensive set of features and allowed the export of a compact Gantt chart. There was no live collaboration option in the version that was used, but splitting up the project into sub-projects enabled simultaneous editing of different phases.

The project's phases correspond to the four report deliverables. Each one was scheduled by one person who worked on the WFD for that phase using a mix of manual and automatic scheduling. The schedule ensures all deadlines are met. The schedule does not account for slack as this is implemented into the work packages.

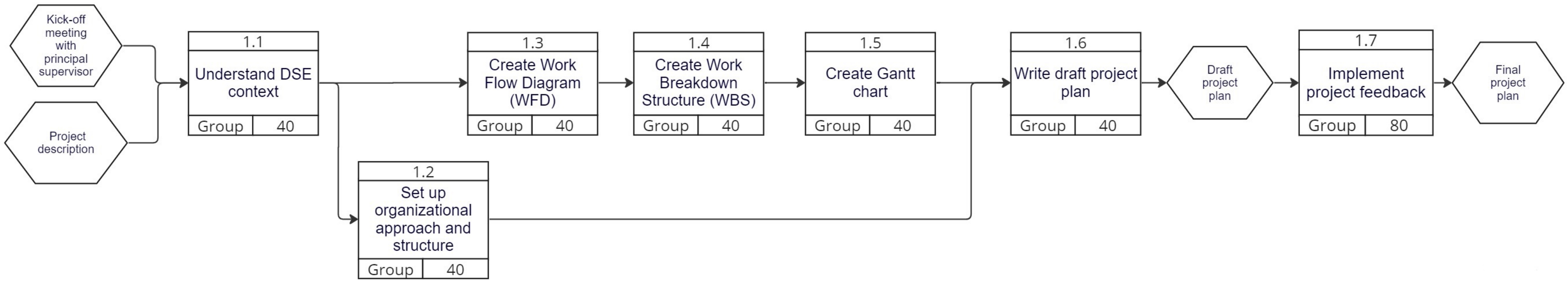


Figure 5.1: *WFD Project Plan*

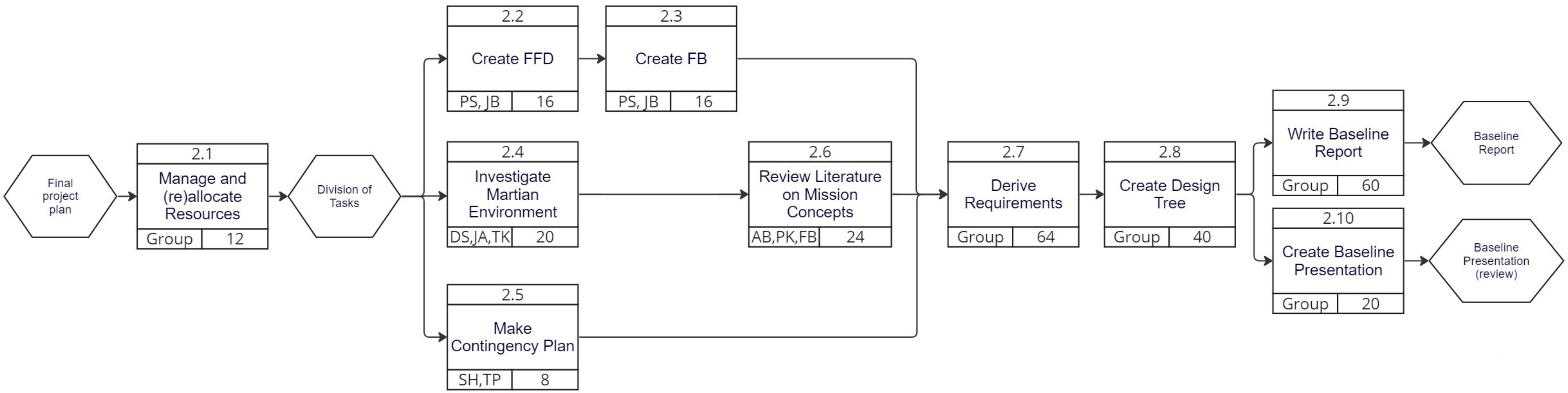


Figure 5.2: *WFD Baseline Report*

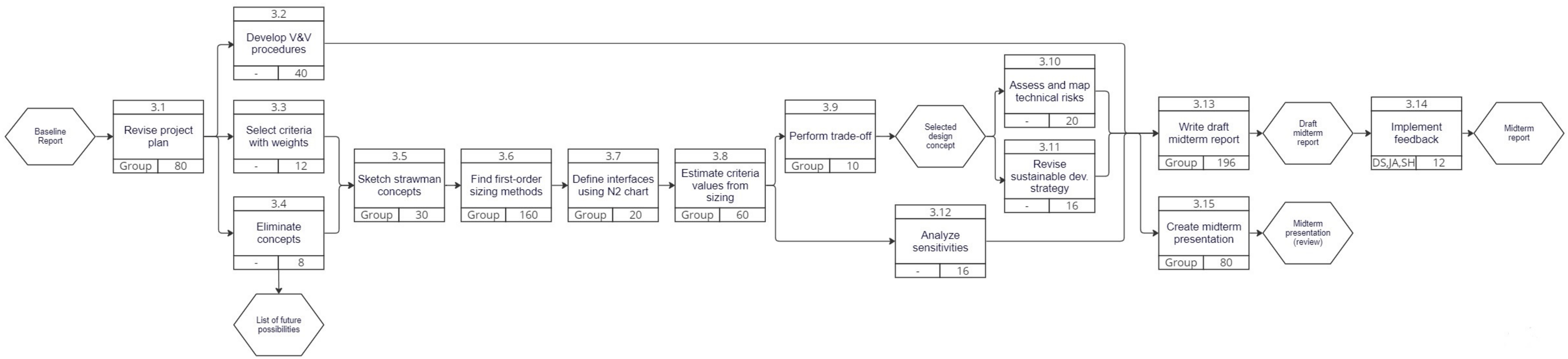


Figure 5.3: *WFD Midterm Report*

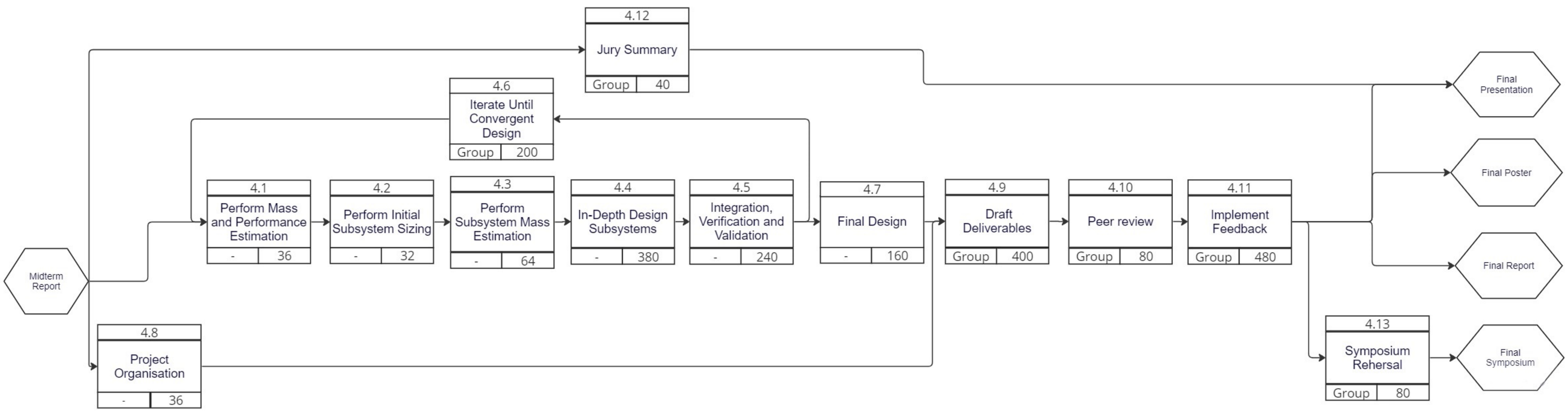


Figure 5.4: *WFD Final Report*

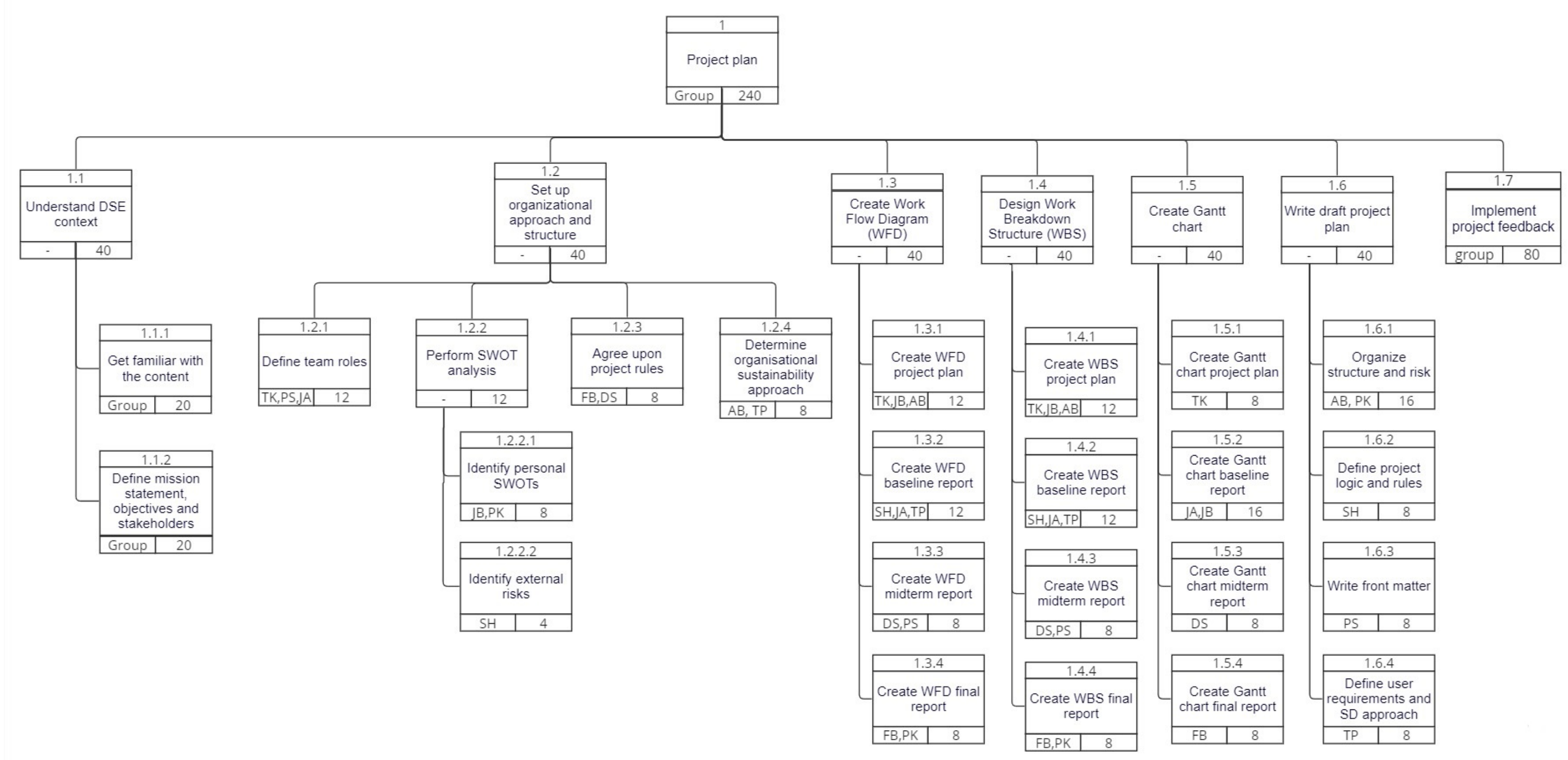


Figure 5.5: *WBS Project Plan*

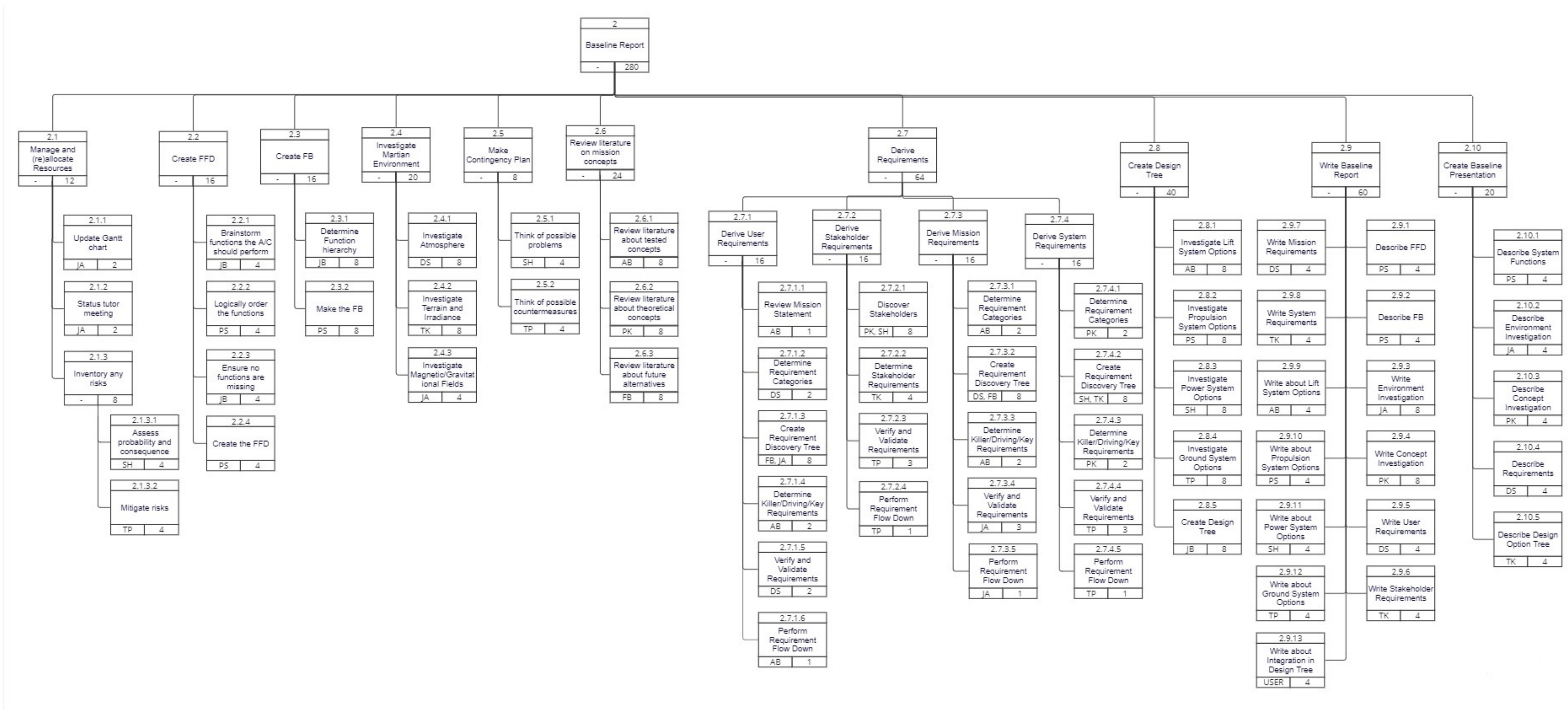


Figure 5.6: *WBS Baseline Report*

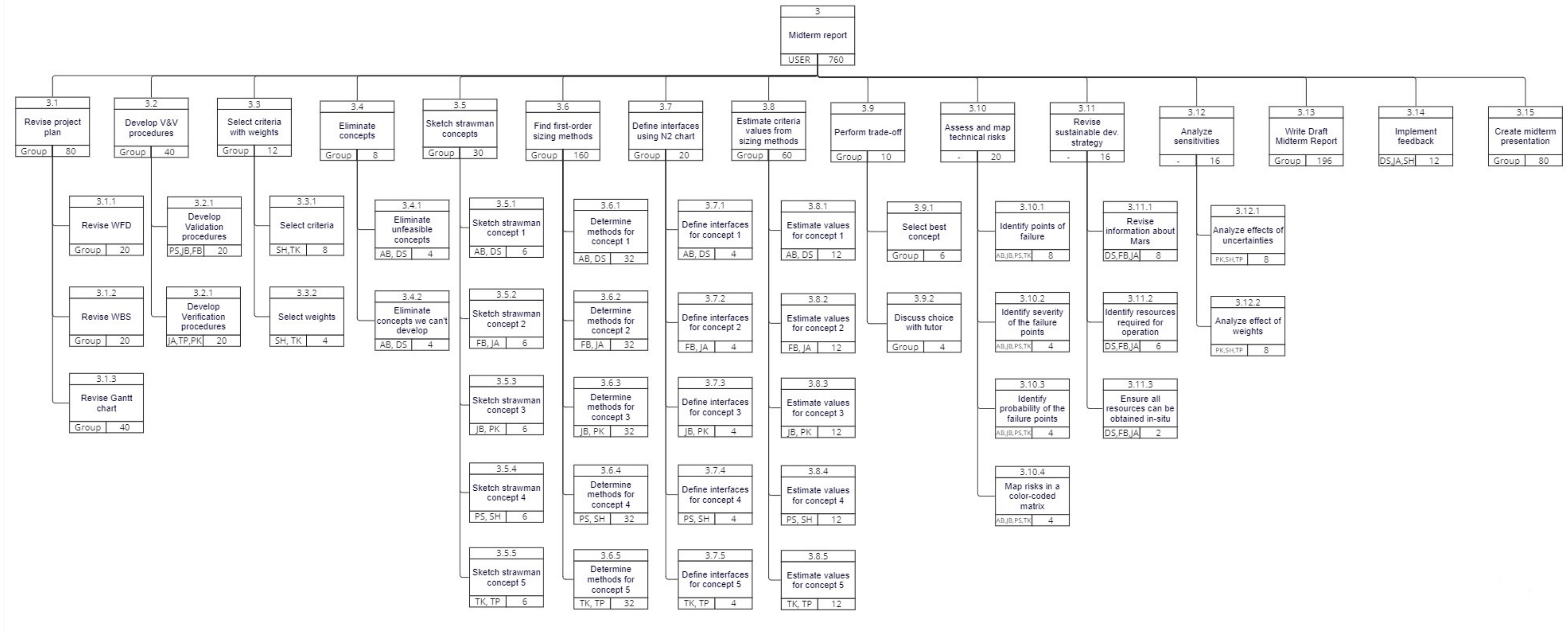


Figure 5.7: *WBS Midterm Report*

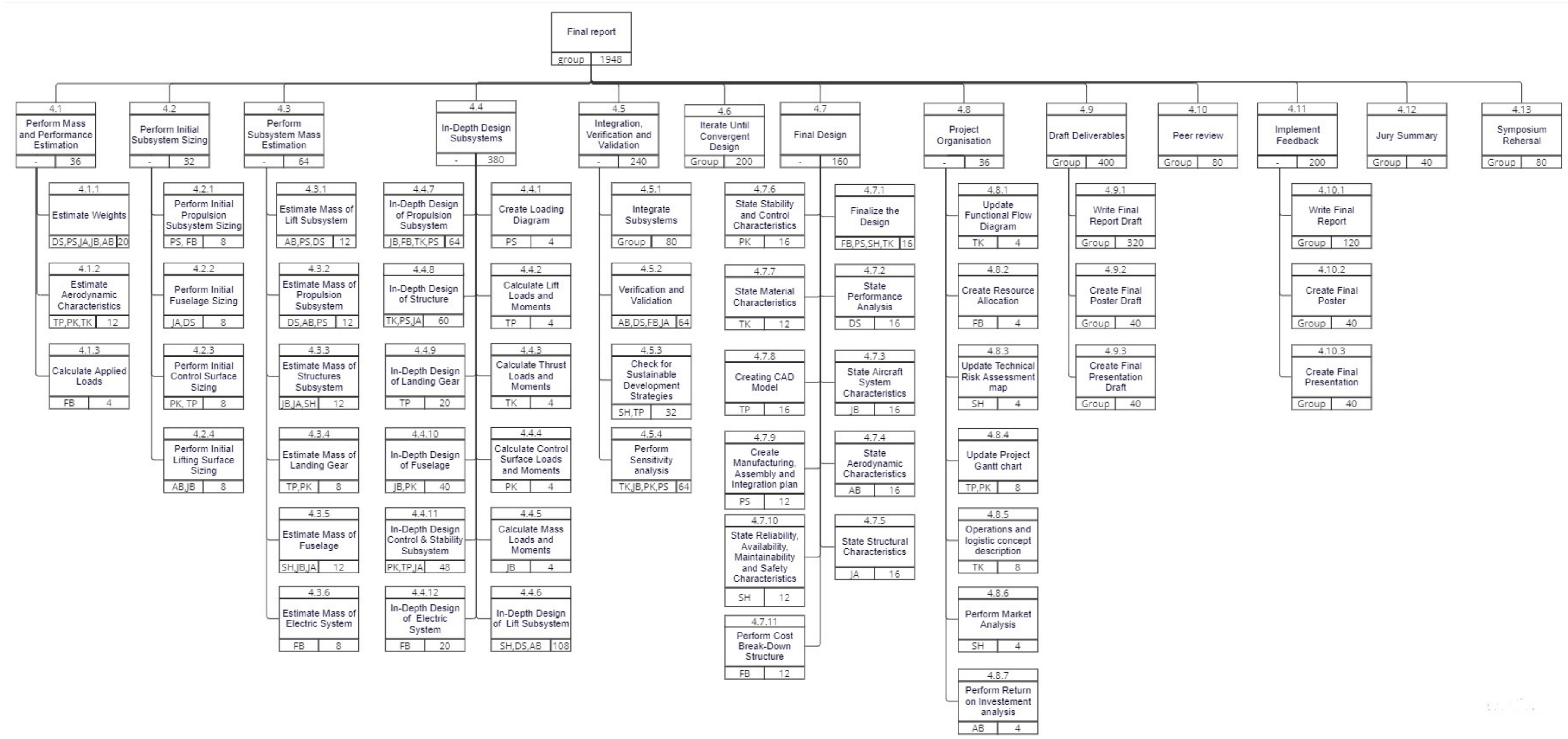
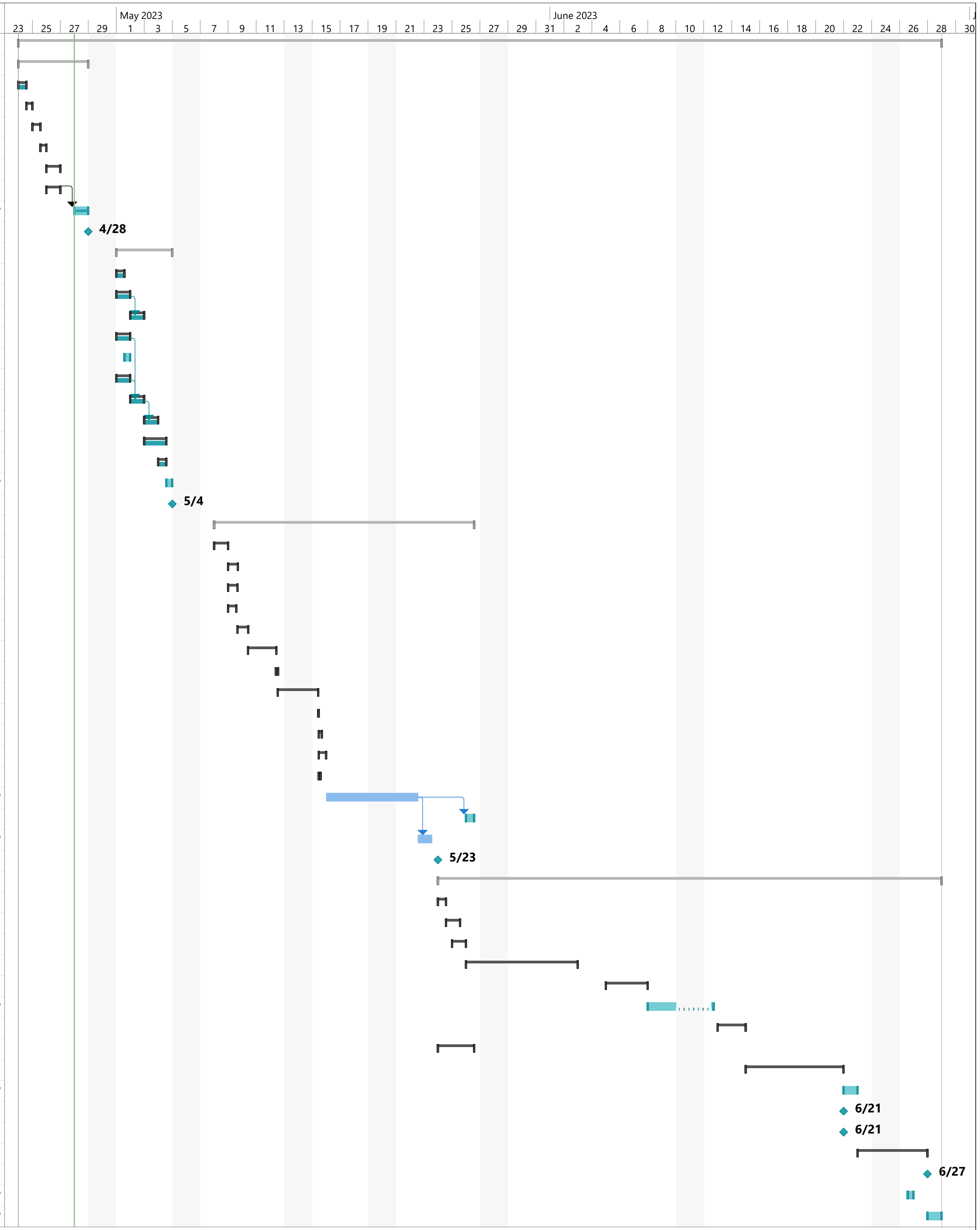


Figure 5.8: *WBS Final Report*

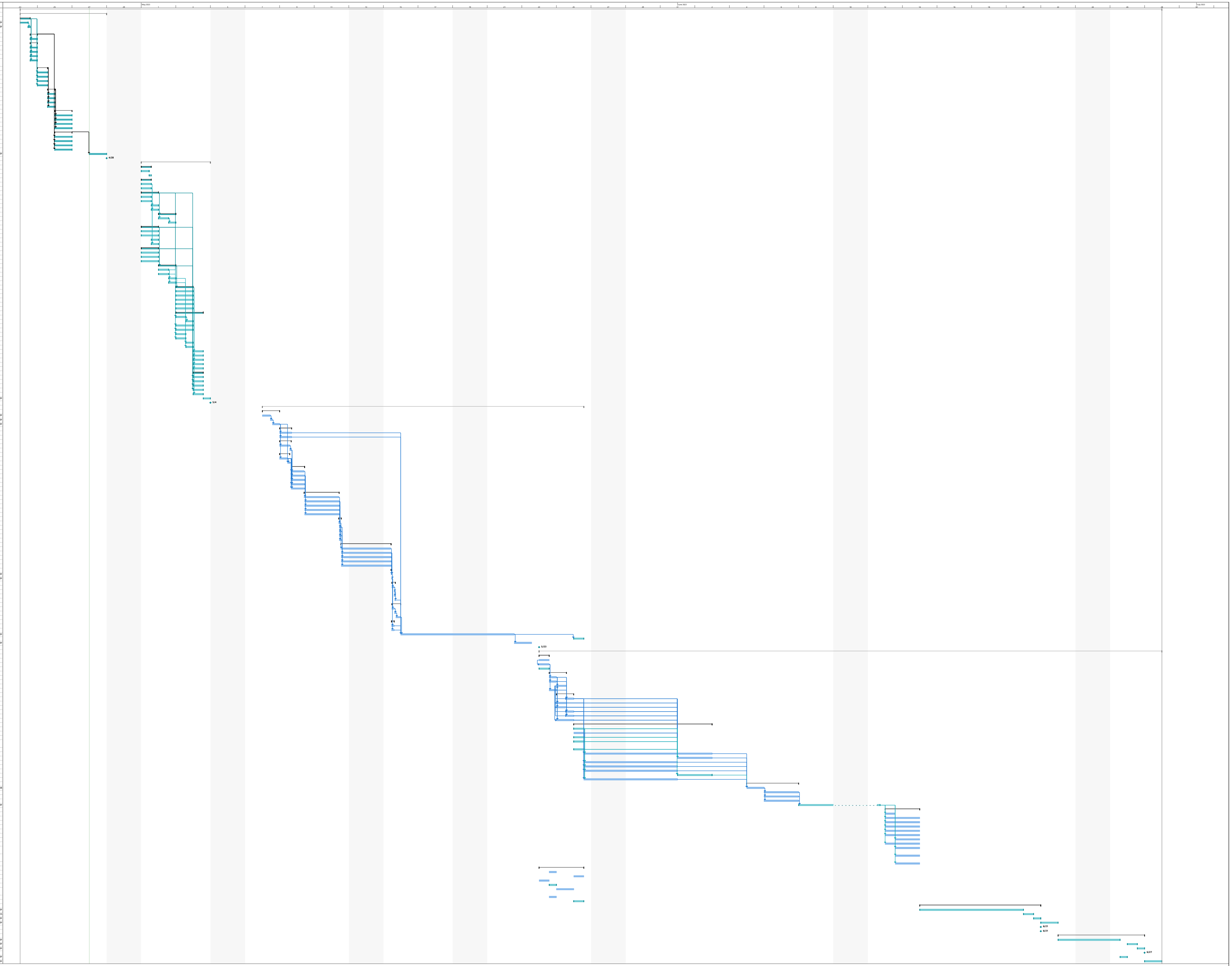
ID	WBS	Task Name	Work	Duration	Start	Finish	Resource Initials
0		**DSE**	**3,348 hrs**	**344 hrs**	**Mon 4/24/23 9:00 AM**	**Wed 6/28/23 6:00 PM**	
1	**1**	**Project plan**	**320 hrs**	**32 hrs**	**Mon 4/24/23 9:00 AM**	**Fri 4/28/23 6:00 PM**	
1	**1.1**	**Understand DSE context**	**40 hrs**	**4 hrs**	**Mon 4/24/23 9:00 AM**	**Mon 4/24/23 2:00 PM**	
4	**1.2**	**Set-up orginisational approach and struc**	**40 hrs**	**4 hrs**	**Mon 4/24/23 2:00 PM**	**Mon 4/24/23 6:00 PM**	
11	**1.3**	**Create WFD**	**40 hrs**	**4 hrs**	**Tue 4/25/23 9:00 AM**	**Tue 4/25/23 2:00 PM**	
16	**1.4**	**Create WBS**	**40 hrs**	**4 hrs**	**Tue 4/25/23 2:00 PM**	**Tue 4/25/23 6:00 PM**	
21	**1.5**	**Create Gantt chart**	**40 hrs**	**8 hrs**	**Wed 4/26/23 9:00 AM**	**Wed 4/26/23 6:00 PM**	
26	**1.6**	**Write draft project plan**	**40 hrs**	**8 hrs**	**Wed 4/26/23 9:00 AM**	**Wed 4/26/23 6:00 PM**	
31	1.7	Implement feedback	80 hrs	8 hrs	Fri 4/28/23 9:00 AM	Fri 4/28/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
32		Project plan (draft)	0 hrs	0 hrs	Fri 4/28/23 6:00 PM	Fri 4/28/23 6:00 PM	
2		**Baseline report**	**320 hrs**	**32 hrs**	**Mon 5/1/23 9:00 AM**	**Thu 5/4/23 6:00 PM**	
1	**2.1**	**Manage and (re)allocate resources**	**12 hrs**	**4 hrs**	**Mon 5/1/23 9:00 AM**	**Mon 5/1/23 2:00 PM**	
7	**2.2**	**Create FFD**	**16 hrs**	**8 hrs**	**Mon 5/1/23 9:00 AM**	**Mon 5/1/23 6:00 PM**	
12	**2.3**	**Create FB**	**16 hrs**	**8 hrs**	**Tue 5/2/23 9:00 AM**	**Tue 5/2/23 6:00 PM**	
15	**2.4**	**Investigate Martian Environment**	**20 hrs**	**8 hrs**	**Mon 5/1/23 9:00 AM**	**Mon 5/1/23 6:00 PM**	
19	2.5	Make contingency plan	8 hrs	4 hrs	Mon 5/1/23 2:00 PM	Mon 5/1/23 6:00 PM	SH,TP
20	**2.6**	**Review literature on mission concepts**	**24 hrs**	**8 hrs**	**Mon 5/1/23 9:00 AM**	**Mon 5/1/23 6:00 PM**	
24	**2.7**	**Derive requirements**	**64 hrs**	**8 hrs**	**Tue 5/2/23 9:00 AM**	**Tue 5/2/23 6:00 PM**	
29	**2.8**	**Create design tree**	**40 hrs**	**8 hrs**	**Wed 5/3/23 9:00 AM**	**Wed 5/3/23 6:00 PM**	
35	**2.9**	**Write baseline report**	**60 hrs**	**12 hrs**	**Wed 5/3/23 9:00 AM**	**Thu 5/4/23 2:00 PM**	
49	**2.10**	**Create baseline presentation**	**20 hrs**	**4 hrs**	**Thu 5/4/23 9:00 AM**	**Thu 5/4/23 2:00 PM**	
55	2.11	Safety margin	40 hrs	4 hrs	Thu 5/4/23 2:00 PM	Thu 5/4/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
56		Baseline report (draft)	0 hrs	0 hrs	Thu 5/4/23 6:00 PM	Thu 5/4/23 6:00 PM	
3		**Midterm report**	**760 hrs**	**100 hrs**	**Mon 5/8/23 9:00 AM**	**Fri 5/26/23 2:00 PM**	
1	**3.1**	**Revise project plan**	**80 hrs**	**8 hrs**	**Mon 5/8/23 9:00 AM**	**Mon 5/8/23 6:00 PM**	
5	**3.2**	**Develop V&V procedures**	**40 hrs**	**6.67 hrs**	**Tue 5/9/23 9:00 AM**	**Tue 5/9/23 4:40 PM**	
8	**3.3**	**Select criteria with weights**	**12 hrs**	**6 hrs**	**Tue 5/9/23 9:00 AM**	**Tue 5/9/23 4:00 PM**	
11	**3.4**	**Eliminate concepts**	**8 hrs**	**4 hrs**	**Tue 5/9/23 9:00 AM**	**Tue 5/9/23 2:00 PM**	
14	**3.5**	**Sketch strawman concepts**	**30 hrs**	**3.67 hrs**	**Tue 5/9/23 4:00 PM**	**Wed 5/10/23 10:40 AM**	
20	**3.6**	**Find first-order sizing methods**	**160 hrs**	**16.67 hr:**	**Wed 5/10/23 10:00 AM**	**Fri 5/12/23 10:40 AM**	
26	**3.7**	**Define interfaces using N2 chart**	**20 hrs**	**2.67 hrs**	**Fri 5/12/23 10:00 AM**	**Fri 5/12/23 1:40 PM**	
32	**3.8**	**Estimate criteria values from sizing meth**	**60 hrs**	**6.67 hrs**	**Fri 5/12/23 1:00 PM**	**Mon 5/15/23 10:40 AM**	
38	**3.9**	**Perform tradeoff**	**10 hrs**	**1 hr**	**Mon 5/15/23 10:40 AM**	**Mon 5/15/23 11:40 AM**	
41	**3.10**	**Assess and map technical risks**	**20 hrs**	**4 hrs**	**Mon 5/15/23 11:40 AM**	**Mon 5/15/23 4:40 PM**	
46	**3.11**	**Revise sustainable development strategy**	**16 hrs**	**5.33 hrs**	**Mon 5/15/23 11:40 AM**	**Mon 5/15/23 6:00 PM**	
50	**3.12**	**Analyze sensitivities**	**16 hrs**	**2.67 hrs**	**Mon 5/15/23 11:16 AM**	**Mon 5/15/23 2:56 PM**	
53	3.13	Write draft midterm report	196 hrs	19.6 hrs	Tue 5/16/23 9:00 AM	Mon 5/22/23 1:36 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
54	3.14	Implement feedback	12 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	DS,JA,SH
55	3.15	Create midterm presentation	80 hrs	8 hrs	Mon 5/22/23 1:36 PM	Tue 5/23/23 1:36 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
56		Midterm report (draft)	0 hrs	0 hrs	Tue 5/23/23 6:00 PM	Tue 5/23/23 6:00 PM	
4		**Final report**	**1,948 hrs**	**200 hrs**	**Wed 5/24/23 9:00 AM**	**Wed 6/28/23 6:00 PM**	
1	**4.1**	**Perform Mass and Performance Estimati**	**36 hrs**	**4 hrs**	**Wed 5/24/23 9:00 AM**	**Wed 5/24/23 2:00 PM**	
5	**4.2**	**Perform Initial Subsystem Sizing**	**32 hrs**	**8 hrs**	**Wed 5/24/23 2:00 PM**	**Thu 5/25/23 2:00 PM**	
10	**4.3**	**Perform Subsystem Mass Estimation**	**64 hrs**	**8 hrs**	**Thu 5/25/23 9:00 AM**	**Thu 5/25/23 6:00 PM**	
17	**4.4**	**In-Depth Design Subsystems**	**380 hrs**	**40 hrs**	**Fri 5/26/23 9:00 AM**	**Fri 6/2/23 6:00 PM**	
30	**4.5**	**Integration, Verification and Validation**	**240 hrs**	**24 hrs**	**Mon 6/5/23 9:00 AM**	**Wed 6/7/23 6:00 PM**	
35	4.6	Iterate Until Convergent Design	200 hrs	20 hrs	Thu 6/8/23 9:00 AM	Mon 6/12/23 5:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
36	**4.7**	**Final Design**	**160 hrs**	**16 hrs**	**Tue 6/13/23 9:00 AM**	**Wed 6/14/23 6:00 PM**	
48	**4.8**	**Project Organisation**	**36 hrs**	**20 hrs**	**Wed 5/24/23 9:00 AM**	**Fri 5/26/23 2:00 PM**	
56	**4.9**	**Draft Deliverables**	**400 hrs**	**40 hrs**	**Thu 6/15/23 9:00 AM**	**Wed 6/21/23 6:00 PM**	
60	4.10	Peer Review	80 hrs	8 hrs	Thu 6/22/23 9:00 AM	Thu 6/22/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
61		Final Report (Draft)	0 hrs	0 hrs	Wed 6/21/23 6:00 PM	Wed 6/21/23 6:00 PM	
62		Poster	0 hrs	0 hrs	Wed 6/21/23 6:00 PM	Wed 6/21/23 6:00 PM	
63	**4.11**	**Implement Feedback**	**200 hrs**	**24 hrs**	**Fri 6/23/23 9:00 AM**	**Tue 6/27/23 6:00 PM**	
67		Final Report	0 hrs	0 hrs	Tue 6/27/23 6:00 PM	Tue 6/27/23 6:00 PM	
68	4.12	Jury Summary	40 hrs	4 hrs	Mon 6/26/23 2:00 PM	Mon 6/26/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
69	4.13	Symposium Rehearsal	80 hrs	8 hrs	Wed 6/28/23 9:00 AM	Wed 6/28/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP



Project: DSE
Date: Fri 4/28/23 5:28 PM

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Manual Progress
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Progress	

ID	WBS	Task Name	Work	Duration	Start	Finish	Resource Initials
0		DSE	3,348 hrs	344 hrs	Mon 4/24/23 9:00 AM	Wed 6/28/23 6:00 PM	
1	1	Project plan	320 hrs	32 hrs	Mon 4/24/23 9:00 AM	Fri 4/28/23 6:00 PM	
1	1.1	Understand DSE context	40 hrs	4 hrs	Mon 4/24/23 9:00 AM	Mon 4/24/23 2:00 PM	
2	1.1.1	Get familiar with the content	20 hrs	2 hrs	Mon 4/24/23 9:00 AM	Mon 4/24/23 11:00 AM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
3	1.1.2	Define mission statement, objectives and stakeholders	20 hrs	2 hrs	Mon 4/24/23 11:00 AM	Mon 4/24/23 2:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
4	1.2	Set-up orginisational approach and struc	40 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	
5	1.2.1	Define team roles	12 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	JA,PS,TK
6	1.2.2	Perform SWOT analysis	12 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	
7	1.2.2.1	Identify Personal SWOTs	8 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	JB,PK
8	1.2.2.2	Identify external risks	4 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	SH
9	1.2.3	Agree upon project rules	8 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	DS,FB
10	1.2.4	Determine organisational sustainability approach	8 hrs	4 hrs	Mon 4/24/23 2:00 PM	Mon 4/24/23 6:00 PM	AB,TP
11	1.3	Create WFD	40 hrs	4 hrs	Tue 4/25/23 9:00 AM	Tue 4/25/23 2:00 PM	
12	1.3.1	Create WFD project plan	12 hrs	4 hrs	Tue 4/25/23 9:00 AM	Tue 4/25/23 2:00 PM	AB,JB,TK
13	1.3.2	Create WFD baseline report	12 hrs	4 hrs	Tue 4/25/23 9:00 AM	Tue 4/25/23 2:00 PM	JA,SH,TP
14	1.3.3	Create WFD midterm review	8 hrs	4 hrs	Tue 4/25/23 9:00 AM	Tue 4/25/23 2:00 PM	DS,PS
15	1.3.4	Create WFD final report	8 hrs	4 hrs	Tue 4/25/23 9:00 AM	Tue 4/25/23 2:00 PM	FB,PK
16	1.4	Create WBS	40 hrs	4 hrs	Tue 4/25/23 2:00 PM	Tue 4/25/23 6:00 PM	
17	1.4.1	Create WBS project plan	12 hrs	4 hrs	Tue 4/25/23 2:00 PM	Tue 4/25/23 6:00 PM	AB,JB,TK
18	1.4.2	Create WBS baseline report	12 hrs	4 hrs	Tue 4/25/23 2:00 PM	Tue 4/25/23 6:00 PM	JA,SH,TP
19	1.4.3	Create WBS midterm review	8 hrs	4 hrs	Tue 4/25/23 2:00 PM	Tue 4/25/23 6:00 PM	DS,PS
20	1.4.4	Create WBS final report	8 hrs	4 hrs	Tue 4/25/23 2:00 PM	Tue 4/25/23 6:00 PM	FB,PK
21	1.5	Create Gantt chart	40 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	
22	1.5.1	Create Gantt chart project plan	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	TK
23	1.5.2	Create Gantt chart baseline report	16 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	JA,JB
24	1.5.3	Create Gantt chart midterm review	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	DS
25	1.5.4	Create Gantt chart final report	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	FB
26	1.6	Write draft project plan	40 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	
27	1.6.1	Organize structure and risk	16 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	AB,PK
28	1.6.2	Define project logic and rules	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	SH
29	1.6.3	Write front matter	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	PS
30	1.6.4	Define user requirements and SD appro	8 hrs	8 hrs	Wed 4/26/23 9:00 AM	Wed 4/26/23 6:00 PM	TP
31	1.7	Implement feedback	80 hrs	8 hrs	Fri 4/28/23 9:00 AM	Fri 4/28/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
32		Project plan (draft)	0 hrs	0 hrs	Fri 4/28/23 6:00 PM	Fri 4/28/23 6:00 PM	
2		Baseline report	320 hrs	32 hrs	Mon 5/1/23 9:00 AM	Thu 5/4/23 6:00 PM	
1	2.1	Manage and (re)allocate resources	12 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	
2	2.1.1	Update Gantt chart	2 hrs	2 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 11:00 AM	JA
3	2.1.2	Tutor status meeting	2 hrs	2 hrs	Mon 5/1/23 11:00 AM	Mon 5/1/23 2:00 PM	JA
4	2.1.3	Inventory any risks	8 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	
5	2.1.3.1	Asses probability and consequences	4 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	SH
6	2.1.3.2	Mitigate risks	4 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	TP
7	2.2	Create FFD	16 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	
8	2.2.1	Brainstorm functions the A/C should pe	4 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	JB
9	2.2.2	Logically order the functions	4 hrs	4 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 2:00 PM	PS
10	2.2.3	Ensure no functions are missing	4 hrs	4 hrs	Mon 5/1/23 2:00 PM	Mon 5/1/23 6:00 PM	JB
11	2.2.4	Creater the FFD	4 hrs	4 hrs	Mon 5/1/23 2:00 PM	Mon 5/1/23 6:00 PM	PS
12	2.3	Create FB	16 hrs	8 hrs	Tue 5/2/23 9:00 AM	Tue 5/2/23 6:00 PM	
13	2.3.2	Establish hierarchy	8 hrs	4 hrs	Tue 5/2/23 9:00 AM	Tue 5/2/23 2:00 PM	JB,PS
14	2.3.3	Create the FB	8 hrs	4 hrs	Tue 5/2/23 2:00 PM	Tue 5/2/23 6:00 PM	PS,JB
15	2.4	Investigate Martian Environment	20 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	
16	2.4.1	Investigate atmosphere	8 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	DS
17	2.4.2	Investigate terrain and irradiance	8 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	TK
18	2.4.3	Investigate magnetism and gravity field	4 hrs	4 hrs	Mon 5/1/23 2:00 PM	Mon 5/1/23 6:00 PM	JA
19	2.5	Make contingency plan	8 hrs	4 hrs	Mon 5/1/23 2:00 PM	Mon 5/1/23 6:00 PM	SH,TP
20	2.6	Review literature on mission concepts	24 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	
21	2.6.1	Investigate tested concepts	8 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	AB
22	2.6.2	Investigate theoretical concepts	8 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	PK
23	2.6.3	Investigate possible future alternatives	8 hrs	8 hrs	Mon 5/1/23 9:00 AM	Mon 5/1/23 6:00 PM	FB
24	2.7	Derive requirements	64 hrs	8 hrs	Tue 5/2/23 9:00 AM	Tue 5/2/23 6:00 PM	
25	2.7.2	Derive user requirements	16 hrs	4 hrs	Tue 5/2/23 9:00 AM	Tue 5/2/23 2:00 PM	AB,DS,FB,JA
26	2.7.3	Derive stakeholder requirements	16 hrs	4 hrs	Tue 5/2/23 9:00 AM	Tue 5/2/23 2:00 PM	PK,SH,TK,TP
27	2.7.4	Derive mission requirements	16 hrs	4 hrs	Tue 5/2/23 2:00 PM	Tue 5/2/23 6:00 PM	AB,DS,FB,JA
28	2.7.5	Derive system requirements	16 hrs	4 hrs	Tue 5/2/23 2:00 PM	Tue 5/2/23 6:00 PM	PK,SH,TK,TP
29	2.8	Create design tree	40 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	
30	2.8.1	Investigate lift system options	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	AB
31	2.8.2	Investigate propulsion system options	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	FB
32	2.8.3	Investigate power system options	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	SH
33	2.8.4	Investigate ground system options	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	TP
34	2.8.5	Create design tree	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	JB
35	2.9	Write baseline report	60 hrs	12 hrs	Wed 5/3/23 9:00 AM	Thu 5/4/23 2:00 PM	
36	2.9.1	Describe FFD	4 hrs	4 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 2:00 PM	PS
37	2.9.2	Describe FB	4 hrs	4 hrs	Wed 5/3/23 2:00 PM	Wed 5/3/23 6:00 PM	PS
38	2.9.3	Write environment investigation	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	JA
39	2.9.4	Write concept investigation	8 hrs	8 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 6:00 PM	PK
40	2.9.5	Write user requirements	4 hrs	4 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 2:00 PM	DS
41	2.9.6	Write stakeholder requirements	4 hrs	4 hrs	Wed 5/3/23 9:00 AM	Wed 5/3/23 2:00 PM	TK
42	2.9.7	Write mission requirements	4 hrs	4 hrs	Wed 5/3/23 2:00 PM	Wed 5/3/23 6:00 PM	DS
43	2.9.8	Write system requirements	4 hrs	4 hrs	Wed 5/3/23 2:00 PM	Wed 5/3/23 6:00 PM	TK
44	2.9.9	Describe lift system options	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	AB
45	2.9.10	Describe propulsion system options	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	FB
46	2.9.11	Describe power system options	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	SH
47	2.9.12	Describe ground system options	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	TP
48	2.9.13	Describe system integrations	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	JB
49	2.10	Create baseline presentation	20 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	
50	2.10.1	Describe system functions	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	PS
51	2.10.2	Describe environment	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	JA
52	2.10.3	Describe concept investigation	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	PK
53	2.10.4	Describe requirements	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	DS
54	2.10.5	Describe design tree	4 hrs	4 hrs	Thu 5/4/23 9:00 AM	Thu 5/4/23 2:00 PM	TK
55	2.11	Safety margin	40 hrs	4 hrs	Thu 5/4/23 2:00 PM	Thu 5/4/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
56		Baseline report (draft)	0 hrs	0 hrs	Thu 5/4/23 6:00 PM	Thu 5/4/23 6:00 PM	
3		Midterm report	760 hrs	100 hrs	Mon 5/8/23 9:00 AM	Fri 5/26/23 2:00 PM	
1	3.1	Revise project plan	80 hrs	8 hrs	Mon 5/8/23 9:00 AM	Mon 5/8/23 6:00 PM	
2	3.1.1	Revise WFD	20 hrs	2 hrs	Mon 5/8/23 9:00 AM	Mon 5/8/23 11:00 AM	FB,PK,TK,SH,AB,DS,JA,JB,PS,TP
3	3.1.2	Revise WBS	20 hrs	2 hrs	Mon 5/8/23 11:00 AM	Mon 5/8/23 2:00 PM	FB,PK,TK,SH,AB,DS,JA,JB,PS,TP
4	3.1.3	Revise Gantt chart	40 hrs	4 hrs	Mon 5/8/23 2:00 PM	Mon 5/8/23 6:00 PM	FB,PK,TK,SH,AB,DS,JA,JB,PS,TP
5	3.2	Develop V&V procedures	40 hrs	6.67 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 4:40 PM	
6	3.2.1	Develop validation procedures	20 hrs	6.67 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 4:40 PM	PS,JB,FB
7	3.2.2	Develop verification procedures	20 hrs	6.67 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 4:40 PM	JA,TP,PK
8	3.3	Select criteria with weights	12 hrs	6 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 4:00 PM	
9	3.3.1	Select criteria	8 hrs	4 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 2:00 PM	SH,TK
10	3.3.2	Select weights	4 hrs	2 hrs	Tue 5/9/23 2:00 PM	Tue 5/9/23 4:00 PM	TK,SH
11	3.4	Eliminate concepts	8 hrs	4 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 2:00 PM	
12	3.4.1	Eliminate unfeasible concepts	4 hrs	2 hrs	Tue 5/9/23 9:00 AM	Tue 5/9/23 11:00 AM	AB,DS
13	3.4.2	Eliminate concept we can't develop	4 hrs	2 hrs	Tue 5/9/23 11:00 AM	Tue 5/9/23 2:00 PM	AB,DS
14	3.5	Sketch strawman concepts	30 hrs	3.67 hrs	Tue 5/9/23 4:00 PM	Wed 5/10/23 10:40 AM	
15	3.5.1	Sketch strawman concept 1	6 hrs	3 hrs	Tue 5/9/23 4:00 PM	Wed 5/10/23 10:00 AM	AB,DS
16	3.5.2	Sketch strawman concept 2	6 hrs	3 hrs	Tue 5/9/23 4:40 PM	Wed 5/10/23 10:40 AM	FB,JA
17	3.5.3	Sketch strawman concept 3	6 hrs	3 hrs	Tue 5/9/23 4:40 PM	Wed 5/10/23 10:40 AM	JB,PK
18	3.5.4	Sketch strawman concept 4	6 hrs	3.67 hrs	Tue 5/9/23 4:00 PM	Wed 5/10/23 10:40 AM	PS,SH
19	3.5.5	Sketch strawman concept 5	6 hrs	3.67 hrs	Tue 5/9/23 4:00 PM	Wed 5/10/23 10:40 AM	TK,TP
20	3.6	Find first-order sizing methods	160 hrs	16.67 hrs	Wed 5/10/23 10:00 AM	Fri 5/12/23 10:40 AM	
21	3.6.1	Determine methods for concept 1	32 hrs	16 hrs	Wed 5/10/23 10:00 AM	Fri 5/12/23 10:00 AM	AB,DS
22	3.6.2	Determine methods for concept 2	32 hrs	16 hrs	Wed 5/10/23 10:40 AM	Fri 5/12/23 10:40 AM	FB,JA
23	3.6.3	Determine methods for concept 3	32 hrs	16 hrs	Wed 5/10/23 10:40 AM	Fri 5/12/23 10:40 AM	JB,PK
24	3.6.4	Determine methods for concept 4	32 hrs	16 hrs	Wed 5/10/23 10:40 AM	Fri 5/12/23 10:40 AM	PS,SH
25	3.6.5	Determine methods for concept 5	32 hrs	16 hrs	Wed 5/10/23 10:40 AM	Fri 5/12/23 10:40 AM	TK,TP
26	3.7	Define interfaces using N2 chart	20 hrs	2.67 hrs	Fri 5/12/23 10:00 AM	Fri 5/12/23 1:40 PM	
27	3.7.1	Define interfaces for concept 1	4 hrs	2 hrs	Fri 5/12/23 10:00 AM	Fri 5/12/23 12:00 PM	AB,DS
28	3.7.2	Define interfaces for concept 2	4 hrs	2 hrs	Fri 5/12/23 10:40 AM	Fri 5/12/23 1:40 PM	FB,JA
29	3.7.3	Define interfaces for concept 3	4 hrs	2 hrs	Fri 5/12/23 10:40 AM	Fri 5/12/23 1:40 PM	JB,PK
30	3.7.4	Define interfaces for concept 4	4 hrs	2 hrs	Fri 5/12/23 10:40 AM	Fri 5/12/23 1:40 PM	PS,SH
31	3.7.5	Define interfaces for concept 5	4 hrs	2 hrs	Fri 5/12/23 10:40 AM	Fri 5/12/23 1:40 PM	TK,TP
32	3.8	Estimate criteria values from sizing meth	60 hrs	6.67 hrs	Fri 5/12/23 1:00 PM	Mon 5/15/23 10:40 AM	
33	3.8.1	Estimate values for concept 1	12 hrs	6 hrs	Fri 5/12/23 1:00 PM	Mon 5/15/23 10:00 AM	AB,DS
34	3.8.2	Estimate values for concept 2	12 hrs	6 hrs	Fri 5/12/23 1:40 PM	Mon 5/15/23 10:40 AM	FB,JA
35	3.8.3	Estimate values for concept 3	12 hrs	6 hrs	Fri 5/12/23 1:40 PM	Mon 5/15/23 10:40 AM	JB,PK
36	3.8.4	Estimate values for concept 4	12 hrs	6 hrs	Fri 5/12/23 1:40 PM	Mon 5/15/23 10:40 AM	PS,SH
37	3.8.5	Estimate values for concept 5	12 hrs	6 hrs	Fri 5/12/23 1:40 PM	Mon 5/15/23 10:40 AM	TK,TP
38	3.9	Perform tradeoff	10 hrs	1 hr	Mon 5/15/23 10:40 AM	Mon 5/15/23 11:40 AM	
39	3.9.1	Select best concept	6 hrs	0.6 hrs	Mon 5/15/23 10:40 AM	Mon 5/15/23 11:16 AM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
40	3.9.2	Discuss choice with tutor	4 hrs	0.4 hrs	Mon 5/15/23 11:16 AM	Mon 5/15/23 11:40 AM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
41	3.10	Assess and map technical risks	20 hrs	4 hrs	Mon 5/15/23 11:40 AM	Mon 5/15/23 4:40 PM	
42	3.10.1	Identify points of failure	8 hrs	2 hrs	Mon 5/15/23 11:40 AM	Mon 5/15/23 2:40 PM	AB,JB,PS,TK
43	3.10.2	Identify severity of failure points	4 hrs	1 hr	Mon 5/15/23 2:40 PM	Mon 5/15/23 3:40 PM	AB,JB,PS,TK
44	3.10.3	Identify probability of failure points	4 hrs	1 hr	Mon 5/15/23 2:40 PM	Mon 5/15/23 3:40 PM	AB,JB,PS,TK
45	3.10.4	Map risks in a color-coded matrix	4 hrs	1 hr	Mon 5/15/23 3:40 PM	Mon 5/15/23 4:40 PM	AB,JB,PS,TK
46	3.11	Revise sustainable development strategy	16 hrs	5.33 hrs	Mon 5/15/23 11:40 AM	Mon 5/15/23 6:00 PM	
47	3.11.1	Revise information about Mars	8 hrs	2.67 hrs	Mon 5/15/23 11:40 AM	Mon 5/15/23 3:20 PM	DS,FB,JA
48	3.11.2	Identify resources required for operatio	6 hrs	2 hrs	Mon 5/15/23 3:20 PM	Mon 5/15/23 5:20 PM	DS,FB,JA
49	3.11.3	Ensure all resources can be obtained in	2 hrs	0.67 hrs	Mon 5/15/23 5:20 PM	Mon 5/15/23 6:00 PM	DS,FB,JA
50	3.12	Analyze sensitivities	16 hrs	2.67 hrs	Mon 5/15/23 11:16 AM	Mon 5/15/23 2:56 PM	
51	3.12.1	Analyze effects of uncertainties	8 hrs	2.67 hrs	Mon 5/15/23 11:16 AM	Mon 5/15/23 2:56 PM	PK,SH,TP
52	3.12.2	Analyze effects of weights	8 hrs	2.67 hrs	Mon 5/15/23 11:16 AM	Mon 5/15/23 2:56 PM	PK,SH,TP
53	3.13	Write draft midterm report	196 hrs	19.6 hrs	Tue 5/16/23 9:00 AM	Mon 5/22/23 1:36 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
54	3.14	Implement feedback	12 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	DS,JA,SH
55	3.15	Create midterm presentation	80 hrs	8 hrs	Mon 5/22/23 1:36 PM	Tue 5/23/23 1:36 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
56		Midterm report (draft)	0 hrs	0 hrs	Tue 5/23/23 6:00 PM	Tue 5/23/23 6:00 PM	
4		Final report	1,948 hrs	200 hrs	Wed 5/24/23 9:00 AM	Wed 6/28/23 6:00 PM	
1	4.1	Perform Mass and Performance Estimati	36 hrs	4 hrs	Wed 5/24/23 9:00 AM	Wed 5/24/23 2:00 PM	
2	4.1.1	Estimate Weights	20 hrs	4 hrs	Wed 5/24/23 9:00 AM	Wed 5/24/23 2:00 PM	DS,PS,JA,JB,AB
3	4.1.2	Estimate Aerodynamic Characteristics	12 hrs	4 hrs	Wed 5/24/23 9:00 AM	Wed 5/24/23 2:00 PM	TP,PK,TK
4	4.1.3	Calculate Applied Loads	4 hrs	4 hrs	Wed 5/24/23 9:00 AM	Wed 5/24/23 2:00 PM	FB
5	4.2	Perform Initial Subsystem Sizing	32 hrs	8 hrs	Wed 5/24/23 2:00 PM	Thu 5/25/23 2:00 PM	
6	4.2.1	Perform Inital Propulsion Susbsystem S	8 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	PS,FB
7	4.2.2	Perform Initial Fuselage Sizing	8 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	JA,DS
8	4.2.3	Perform Initial Control Surface Sizing	8 hrs	4 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 2:00 PM	PK,TP
9	4.2.4	Perform Initial Lifting Surface Sizing	8 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	AB,JB
10	4.3	Perform Subsystem Mass Estimation	64 hrs	8 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 6:00 PM	
11	4.3.1	Estimate Mass of Lift Subsystem	12 hrs	4 hrs	Thu 5/25/23 2:00 PM	Thu 5/25/23 6:00 PM	AB,PS,DS
12	4.3.2	Estimate Mass of Propulsion Subsystem	12 hrs	4 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 2:00 PM	DS,AB,PS
13	4.3.3	Estimate Mass of Structures Subsystem	12 hrs	4 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 2:00 PM	JB,JA,SH
14	4.3.4	Estimate Mass of Landing Gear	8 hrs	4 hrs	Thu 5/25/23 2:00 PM	Thu 5/25/23 6:00 PM	TP,PK
15	4.3.5	Estimate Mass of Fuselage	12 hrs	4 hrs	Thu 5/25/23 2:00 PM	Thu 5/25/23 6:00 PM	SH,JB,JA
16	4.3.6	Estimate Mass of Electric System	8 hrs	8 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 6:00 PM	FB
17	4.4	In-Depth Design Subsystems	380 hrs	40 hrs	Fri 5/26/23 9:00 AM	Fri 6/2/23 6:00 PM	
18	4.4.1	Create Loading Diagram	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	PS
19	4.4.2	Calculate Lift Loads and Moments	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	TP
20	4.4.3	Calculate Thrust Loads and Moments	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	TK
21	4.4.4	Calculate Control Surface Loads and Moments	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	PK
22	4.4.5	Calculate Mass Loads and Moments	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	JB
23	4.4.6	In-Depth Design of Lift Subsystem	108 hrs	36 hrs	Fri 5/26/23 2:00 PM	Fri 6/2/23 6:00 PM	SH,DS,AB
24	4.4.7	In-Depth Design of Propulsion Subsyste	64 hrs	16 hrs	Thu 6/1/23 9:00 AM	Fri 6/2/23 6:00 PM	JB,FB,TK,PS
25	4.4.8	In-Depth Design of Structure	60 hrs	20 hrs	Fri 5/26/23 2:00 PM	Wed 5/31/23 6:00 PM	TK,PS,JA
26	4.4.9	In-Depth Design of Landing Gear	20 hrs	20 hrs	Fri 5/26/23 2:00 PM	Wed 5/31/23 6:00 PM	TP
27	4.4.10	In-Depth Design of Fuselage	40 hrs	20 hrs	Fri 5/26/23 2:00 PM	Wed 5/31/23 6:00 PM	JB,PK
28	4.4.11	In-Depth Design Control & Stability Sub	48 hrs	16 hrs	Thu 6/1/23 9:00 AM	Fri 6/2/23 6:00 PM	PK,TP,JA
29	4.4.12	In-Depth Design of Electric System	20 hrs	20 hrs	Fri 5/26/23 2:00 PM	Wed 5/31/23 6:00 PM	FB
30	4.5	Integration, Verification and Validation	240 hrs	24 hrs	Mon 6/5/23 9:00 AM	Wed 6/7/23 6:00 PM	
31	4.5.1	Integrate Subsystems	80 hrs	8 hrs	Mon 6/5/23 9:00 AM	Mon 6/5/23 6:00 PM	AB,DS,FB,JA,PK,PS,SH,TK,TP,JB
32	4.5.2	Verification and Validation	64 hrs	16 hrs	Tue 6/6/23 9:00 AM	Wed 6/7/23 6:00 PM	AB,DS,FB,JA
33	4.5.3	Check for Sustainable Development	32 hrs	16 hrs	Tue 6/6/23 9:00 AM	Wed 6/7/23 6:00 PM	SH,TP
34	4.5.4	Perform Sensitivity Analysis	64 hrs	16 hrs	Tue 6/6/23 9:00 AM	Wed 6/7/23 6:00 PM	TK,JB,PK,PS
35	4.6	Iterate Until Convergent Design	200 hrs	20 hrs	Thu 6/8/23 9:00 AM	Mon 6/12/23 5:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
36	4.7	Final Design	160 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	
37	4.7.1	Finalize the Design	16 hrs	4 hrs	Tue 6/13/23 9:00 AM	Tue 6/13/23 2:00 PM	FB,PS,SH,TK
38	4.7.2	State Performance Analysis	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	DS
39	4.7.3	State Aircraft System Characteristics	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	JB
40	4.7.4	State Aerodynamic Characteristics	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	AB
41	4.7.5	State Structural Characteristics	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	JA
42	4.7.6	State Stability and Control Characterist	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	PK
43	4.7.7	State Material Characteristics	12 hrs	12 hrs	Tue 6/13/23 2:00 PM	Wed 6/14/23 6:00 PM	TK
44	4.7.8	Creating CAD Model	16 hrs	16 hrs	Tue 6/13/23 9:00 AM	Wed 6/14/23 6:00 PM	TP
45	4.7.9	Create Manufacturing, Assemble and Integration Plan	12 hrs	12 hrs	Tue 6/13/23 2:00 PM	Wed 6/14/23 6:00 PM	PS
46	4.7.10	State Reliability, Availability, Maintainability, and Safety	12 hrs	12 hrs	Tue 6/13/23 2:00 PM	Wed 6/14/23 6:00 PM	SH
47	4.7.11	Perform Cost Break-Down Structure	12 hrs	12 hrs	Tue 6/13/23 2:00 PM	Wed 6/14/23 6:00 PM	FB
48	4.8	Project Organisation	36 hrs	20 hrs	Wed 5/24/23 9:00 AM	Fri 5/26/23 2:00 PM	
49	4.8.1	Create Functional Flow Diagram	4 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	TK
50	4.8.2	Create Resource Allocation	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	AB
51	4.8.3	Create Technical Risk Assessment Map	4 hrs	4 hrs	Wed 5/24/23 9:00 AM	Wed 5/24/23 2:00 PM	SH
52	4.8.4	Update Project Gantt Chart	8 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	TP,PK
53	4.8.5	Operations and Logistics Concept Description	8 hrs	8 hrs	Thu 5/25/23 9:00 AM	Thu 5/25/23 6:00 PM	TK
54	4.8.6	Perform Market Analysis	4 hrs	4 hrs	Wed 5/24/23 2:00 PM	Wed 5/24/23 6:00 PM	SH
55	4.8.7	Perform Return on Investment Analysis	4 hrs	4 hrs	Fri 5/26/23 9:00 AM	Fri 5/26/23 2:00 PM	FB
56	4.9	Draft Deliverables	400 hrs	40 hrs	Thu 6/15/23 9:00 AM	Wed 6/21/23 6:00 PM	
57	4.9.1	Write Final Report Draft	320 hrs	32 hrs	Thu 6/15/23 9:00 AM	Tue 6/20/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
58	4.9.2	Create Final Poster Draft	40 hrs	4 hrs	Wed 6/21/23 9:00 AM	Wed 6/21/23 2:00 PM	JA,AB,FB,JB,PK,PS,SH,TK,TP,DS
59	4.9.3	Create Final Presentation Draft	40 hrs	4 hrs	Wed 6/21/23 2:00 PM	Wed 6/21/23 6:00 PM	PK,PS,AB,DS,FB,JA,JB,SH,TK,TP
60	4.10	Peer Review	80 hrs	8 hrs	Thu 6/22/23 9:00 AM	Thu 6/22/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
61		Final Report (Draft)	0 hrs	0 hrs	Wed 6/21/23 6:00 PM	Wed 6/21/23 6:00 PM	
62		Poster	0 hrs	0 hrs	Wed 6/21/23 6:00 PM	Wed 6/21/23 6:00 PM	
63	4.11	Implement Feedback	200 hrs	24 hrs	Fri 6/23/23 9:00 AM	Tue 6/27/23 6:00 PM	
64	4.11.1	Write Final Report	120 hrs	12 hrs	Fri 6/23/23 9:00 AM	Mon 6/26/23 2:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
65	4.11.2	Create Final Poster	40 hrs	4 hrs	Tue 6/27/23 9:00 AM	Tue 6/27/23 2:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
66	4.11.3	Create Final Presentation	40 hrs	4 hrs	Tue 6/27/23 2:00 PM	Tue 6/27/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
67		Final Report	0 hrs	0 hrs	Tue 6/27/23 6:00 PM	Tue 6/27/23 6:00 PM	
68	4.12	Jury Summary	40 hrs	4 hrs	Mon 6/26/23 2:00 PM	Mon 6/26/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP
69	4.13	Symposium Rehearsal	80 hrs	8 hrs	Wed 6/28/23 9:00 AM	Wed 6/28/23 6:00 PM	AB,DS,FB,JA,JB,PK,PS,SH,TK,TP



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Task | Split | Milestone | Summary

6
Project Rules

By Sebastian Harris, Thomas van de Pavoordt

Any project needs to be guided by some set of rules to ensure consistency and clarity throughout the project. Section 6.1 will set out the rules for both internal and external meetings. Section 6.2 will then show the basic day-to-day schedule on which the work hours will be based. Finally, Section 6.3 will close off with the set of rules determined for the group.

6.1. Internal-External Meetings

By Thomas van de Pavoordt

To guide the group and keep the supervisors informed, both internal and external meetings are set-up. Internal meetings are held twice a day: once in the morning at 9:00 to wrap up the day before and discuss the plan for the day itself. The second meeting is held after lunch to recap on the work already done, summarize the work still in progress and/or reallocate resources. These internal meetings will be initiated by the Team Leader or Project Manager.

Regular external meetings are scheduled every Tuesday at 9:00 with the supervisors to inform them on the progress of the group and ask any questions that were gathered and not deemed critical. Any critical questions will be immediately handled by the External Affairs Manager, either by mailing or messaging software like Microsoft Teams. Intermediate meetings, feedback meetings or meetings with other external contacts will also be arranged by the External Affairs Manager when necessary.

6.2. Day-to-day organization

By Timo de Kemp, Thomas van de Pavoordt

The general daily structure will thus consist of 2 intra-group meetings, 4 work session sprints, a lunch break, two coffee breaks, and a dedicated time slot for logbook completion as a final daily task. Additional meetings with external parties, such as professors and mentors, will be integrated into the work sessions. Table 6.1 below helps visualize the group's general daily structure.

Table 6.1: *Day-to-day schedule (Grey represents a meeting, blue work time and green breaks.)*

Time	Event
09:00 - 09:30	Session Planning
09:30 - 10:30	Work Session
10:30 - 10:45	Coffee Break
10:45 - 12:00	Work Session
12:00 - 12:30	Lunch Break

Time	Event
12:30 - 13:00	Recap + Session Planning
13:00 - 15:30	Work Session
15:30 - 15:45	Coffee Break
15:45 - 17:30	Work Session
17:30 - 18:00	Wrap-up + Logbook

Iterations to this structure are, of course, to be expected in order to accommodate extra meetings and such, but with this template, proper workflow and basic organization can be achieved.

6.3. Internal Rules

By Sebastian Harris, Thomas van de Pavoordt

As within all teams, a set of internal rules is created to minimize certain risks and improve inter-team relations. According to the risks discovered in Table 4.1 and the mitigation strategies of Table 4.3 the following rules were set down and agreed upon by the team. These rules are not an exhaustive list and must be complemented as needed over time.

6.3.1. Rules on Scheduling

- All Members shall communicate their absences ahead of time to the rest of the team.
- In case of absence, the absentee shall catch-up on missed hours within a week of their absence.
- All Members shall organize non-project-related events outside of the scheduled project hours.
- A work day is defined between 8:45 and 18:00.
- All Members shall arrive no later than 9:00.
- All Members shall take into account possible transportation delays in order to arrive within the agreed time window.
- All Members shall leave no earlier than 17:45.
- All Members shall be physically present unless of a force majeure, when they shall attend virtually.
- All Members shall aim to complete tasks within the allocated schedule of the Gantt Chart.
- All Members shall ensure a Library Room is booked on Monday in case other rooms are full.

6.3.2. Rules on Communication

- Communication shall always be constructive.
- Communication shall be done with respect to the other member.
- Communication outside of hours shall be reserved for urgent or otherwise exceptional situations.
- Communication shall be done with the entirety of the team.
- Official Communication shall be done via Microsoft Teams.
- Urgent Communications shall be done via phone calls if necessary.
- Informal Communication shall be done via WhatsApp.

6.3.3. Rules on Work Processes

- Members without a task shall ask the Project Manager for an assignment.
- Members shall regularly save and back up their work in the respective cloud storage tools.
- Members shall be aware of the progress of both their main and secondary technical role.
- Members shall update their work progress in the Gantt Chart.
- Members shall seek to complete follow-up tasks autonomously.
- Members shall update each other twice a day in scheduled meetings on their progress.

6.3.4. Rules on Work Environments

- Reporting shall be done in Overleaf
- Project Management shall be done in Microsoft Project
- References shall be reported in Zotero

7 Sustainable Development Project Approach

By Sebastian Harris

The Sustainable Development Approach for this project can be separated into two main categories. First, all aspects respective to the Design can be found in Section 7.1 while the sustainability aspects related to the well-being of the team are in Section 7.2.

7.1. Design Sustainability

By Sebastian Harris

The Design itself must follow certain sustainability requirements as defined in Chapter 2. This mainly entails using local resources for both the propulsion and electrical systems. This is achieved by following a Sustainable Development Approach and ensuring that sustainability is involved within the design process of the product and not rated at the end of the product. The appointment of a Sustainability Manager will ensure not only integrated sustainability but also improve traceability. As only one person will oversee this aspect of the design, they can more easily influence other systems in order to meet the goals. This also will lead to one person maintaining a constant mental overview of the state of the project from a Sustainability aspect. Furthermore, the presence of Dr. Paardekooper will provide valuable insight and advice into the planetary science of Mars, leading to more accurate information for the Sustainability Manager.

Although the requirements for sustainability given by the project itself are limited, there are external factors influencing the design. International agencies will lead to the creation of additional requirements for sustainability. This process will be included at the start of the Requirement Generation when Stakeholders will be analyzed.

From an Organizational standpoint, the Sustainability Manager will organize regular meetings in order to remain updated with the state of the design. In this role, it is also the responsibility of the Sustainability Manager to investigate the morals of the design team in order to determine if any additional constraints are present. This, along with a team-wide brainstorming of sustainable values, will allow to creation an additional set of requirements for the design. These requirements will be used when developing designs in order to ensure the final product reflects the definition of sustainability (which will be explicitly defined in later stages of the design) of the design team.

7.2. Team Sustainability

By Sebastian Harris

As a project where 10 students are working 40 hours each week for 10 weeks, stress, conflict, and friction will be present. To ensure the team maintains a healthy environment and is sustainable with respect to its members, a Team Leader is appointed in order to oversee these terms. Mainly, regular breaks and lunches will ensure work sessions do not over-extend and cause fatigue to members. This is done by introducing coffee breaks at 10:30 and 15:30.

Furthermore, an Organizational Risk Assessment will analyze potential risks within the team, leading to improved Project Rules aimed at reducing friction between teammates. By having commonly agreed-upon definitions of start times, end times, and tardiness, the team can be kept accountable without having personal definitions for the delay.

Regarding Team Involvement, the use of a SWOT Analysis ensures that all members are assigned tasks in which they are proficient while being given the opportunity to improve and tackle their weaknesses. A Sustainable environment is further achieved by the improvement of its elements; thus, by allowing each member to improve and become better, the environment also improves.

A
Per-member SWOT analysis

Table A.1: *SWOT analysis of team members*

Name	Strength	Weakness	Opportunity	Threat	Role
J.A	fast typing, dedicated	its hard to keep concentrated for the long work hours	Having general knowledge on the topic	I get sick often. I might need to get a visa during project days	Secretary
A.B	attention to detail, creative	lack of patience	access to DelftBlue	sick	External Affairs Manager
F.B	Very dedicated, looking to produce the best quality of work	Short concentrationspan	Clear way of thinking	Could get into too much detail	Budget Manager
J.B	Keeping track of tasks, good technical skills	Over-planning and focusing on details too much	Know people from aerodynamics lab	I might miss a couple of hours to get a visa	Compliance Manager
P.S.	Seeing the big picture. Thinking outside the box	Go more deep than necessary, leading to detriment elsewhere	Having general knowledge on the topic that might be useful	Might have to miss a session due to visa work with the IND.	Systems engineer
T.K	Planning, keeping track of people's performance	Not focussed on the details too much, like to discuss a lot	CFD experience	Have to leave early sometimes to work	Project Manager
S.H	Communication, Planning, Presentations	Experience Limited to Course Projects	Network with external companies,	Might need to miss a session for security clearance	Team Leader
P.K	Dedicated, detailed, good technical skills	Communication	Good knowledge of organizational techniques	Have to leave on 11.5 due to Masters entrance exam	Graphics Design Manager
D.S	High work standards, broad technical skills, expert at programming	Can be too opinionated	Completed Computer Science betchelor which can help with any programing needed	I will need to get a visa during the DSE	IT & file manager
T.P	Perfectionistic, good technical skills	Keep track of everything, keeping me from work	Good technical knowledge of the topic	Getting sick, missing a train	Sustainability manager