



Mälardalen University
M.Sc.Eng. Dependable Aerospace Systems
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Project Course in Dependable Systems
22.5 credits

# Project Plan

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# DOCUMENT APPROVAL

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# Glossary

**ARP4754A**
: Aerospace Recommended Practice (ARP) Guidelines for Development of Civil Aircraft and Systems, is a published standard from SAE International, dealing with the development processes which support certification of Aircraft systems, addressing "the complete aircraft development cycle, from systems requirements through systems verification.". 7, 13

**CE**
: Chief Engineer. 8, 10, 16–18, 24

**IRDS**
: Intelligent Replanning Drone Swarm. 4

**kanban**
: A visual workflow management method that uses boards and cards to track tasks, limit work in progress, and improve process efficiency. 12

**PR**
: Pull Request. 16

**protocol**
: Set of rules or procedures that defines how a system communicates. 5

**QCM**
: Quality & Configuration Manager. 8, 10, 17, 18, 24

**RM**
: Requirements Manager. 8, 10, 17, 18, 21, 24

**SAR**
: Search and Rescue. 4

**SM**
: Safety Manager. 8, 10, 17, 18, 24

**SORA**
: JARUS guidelines on Specific Operations Risk Assessment (SORA). A structured methodology to assess and mitigate risks for specific UAS operations, ensuring safe conduct in complex or beyond-visual-line-of-sight environments. 7

**UAS**
: Unmanned Aircraft System. 3

**UAV**
: Unmanned Aerial Vehicle. 4, 9, 10

**VVM**
: Validation & Verification Manager. 8, 10, 17, 18, 24

**WBS**
: Work Breakdown Structure. 11

# 1 Introduction

This Project Plan provides team members and stakeholders with an overview of the Intelligent Replanning Drone Swarm (IRDS) project. This plan explains the background, purpose and objectives of the project and introduces the overall management approach adopted by the team. In addition, it defines how the project will be structured and controlled to ensure that activities, roles, and deliverables align with the project's dependability and safety goals.

## 1.1 Background

The original idea behind this project is the development of a fail-operational Unmanned Aerial Vehicle (UAV) swarm designed for Search and Rescue (SAR) missions. Such a swarm can also be applied in both defence and civilian operations, where the ability to operate autonomously is crucial. This concept is based on the principles of collective and individual behaviour, enabling UAVs to function independently while also coordinating as a group.

A key aspect of this concept is autonomous navigation and control in dynamic and uncertain environments, where reliability and adaptability are essential. Previous research has introduced a novel conceptual architecture that bridges the critical gap between single-UAV fault tolerance and collective swarm fault tolerance. Although fault tolerance traditionally ensures that an individual UAV can withstand failures, fault tolerance at the swarm level emphasises the ability of the group as a whole to recover and continue operating even after losing an entire UAV.

This dual focus on individual and collective dependability forms the foundation for the development of UAV swarms capable of performing effectively in challenging real-world scenarios.

The purpose of this project is to implement a swarm-level coordination logic that will ensure that a SAR mission can continue with maximum efficiency, even when individual UAVs are compromised.

## 1.2 Document Purpose

The purpose of this plan is to define how the project will be managed and executed throughout its lifecycle. This document establishes the framework for planning, coordinating, communicating, and controlling project activities. In addition, it provides guidance for all team members and ensures that the work is carried out in a consistent way with the project's dependability, safety, and quality objectives.

## 1.3 Document Scope

This document defines the overall management framework for the IRDS project. It integrates and governs activities described in associated management plans (see section 2 Related Documents) to ensure consistency and coherence across all processes.

This plan applies to the entire project lifecycle and specifies how the project is organised, scheduled, and controlled. In addition, it establishes the interrelations between management roles, artefacts, and deliverables.

Specifically, this document defines the following:

- Project context, including stakeholders, objectives, and external dependencies.
- Scope of the project and deliverables to be produced by the project team.
- Methodology, tools and lifecycle approach used to execute and monitor the project.
- Organisation, including project roles, communication channels, and responsibilities.
- Integration of subordinate management plans to ensure consistent execution of safety, quality, requirements, configuration, and verification processes.
- Schedule, milestones, and risk management structure that guide the execution of the project.

This plan serves as the top-level governing document for all activities. All management plans, artefacts, and deliverables produced during the project shall conform to the framework and principles established in this document.

## 1.4 Objectives

- Develop a decentralised replanning protocol that enables a UAV swarm to adapt collectively when individual agents experience degraded health
- Design and implement a safe consensus mechanism that allows all agents to agree on a new mission plan after fault detection
- Create adaptive task reallocation logic to redistribute tasks from compromised agents to healthy agents, and assign supportive roles to compromised agents
- Validate through simulation with fault injection, measuring improvements in mission continuity, resilience, and efficiency

# 2 Related Documents

Table 1 is a collection of documents related to this project, and table 2 is a collection of standards used in the project. For more information on related documents, see section 4.1 Deliverables & Artefacts.

| ID | Document Title | Owner (Role) | Current Version |
|---|---|---|---|
| CM-01 | Configuration Management Plan [1] | Quality & Configuration Manager | 1.1 |
| QM-01 | Quality Management Plan [2] | Quality & Configuration Manager | 1.1 |
| RM-01 | Requirements Management Plan [3] | Requirements Manager | 1.2 |
| SM-01 | Safety Management Plan [4] | Safety Manager | 1.1 |
| VV-01 | Validation & Verification Management Plan [5] | Validation & Verification Manager | 1.2 |

Table 1: Related documents within the project.

| ID | Title | Relevance |
|---|---|---|
| IEEE Std 1012™-2024 | IEEE Standard for System, Software, and Hardware Verification and Validation [6] | Supports verification and validation activities across all project phases, ensuring that both system and software meet their specified requirements and intended use. |
| ISO/IEC/IEEE Std 29119-1:™-2022 | Software and systems engineering - Software testing - Part 1: General Concepts [7] | Provides the foundational concepts and high-level framework for software testing, helping the project understand what aspects of the system must be tested. |
| ISO/IEC/IEEE Std 29119-4:™-2021 | Software and systems engineering - Software testing - Part 4: Test techniques [8] | Provides test design techniques to ensure systematic and effective test coverage of the system. |
| ISO/IEC/IEEE Std 15288:™-2023 | Systems and software engineering - System life cycle processes [9] | Defines processes for the full system lifecycle, including development, verification, and validation. |
| ISO/IEC/IEEE 29148:2018 | Systems and software engineering - Life cycle processes - Requirements engineering [10] | Supports the project's requirements engineering activities by providing guidance for creating clear, consistent, and verifiable system and software requirements. |
| ISO 10007:2017 | Quality management - Guidelines for configuration management [11] | Useful for ensuring proper configuration management throughout the project lifecycle, supporting traceability, version control, and change management. |
| ISO 9001:2015 | Quality management systems — Requirements [12] | Manages overall project quality by establishing requirements for a quality management system to ensure consistent, reliable processes and deliverables. |
| ISO/IEC 25002:2024 | Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Quality model overview and usage [13] | Supports the project's software architecture work by providing guidance on evaluating software product quality, helping ensure the system meets defined quality characteristics. |
| IEEE 730-2014 | IEEE Standard for Software Quality Assurance Processes [14] | Defines the requirements for a Software Quality Assurance Plan (SQAP), supporting structured and traceable software development processes. |
| JAR-DEL-SRM-SORA-MB-2.5 | Specific Operations Risk Assessment (SORA) [15] | This methodology ensures that the system complies with the legal and safety requirements for conducting risk-based assessments of unmanned aircraft operations within Europe. |
| ARP4761™A | Guidelines for Conducting the Safety Assessment Process on Civil Aircraft, Systems, and Equipment [16] | Provides guidance on performing safety assessments to identify hazards and define corresponding safety requirements for aerial vehicles. |

Table 2: Related standards and guidelines.

## 2.1 Management Plans

Several specialised management plans support this project. Each addresses a critical aspect of the project lifecycle in more detail than this project plan can provide. Therefore, this project plan only references these areas at a high level, while dedicated management plans define the processes, responsibilities, and tools used.

- **Configuration Management Plan** [1] – Defines the processes, tools, and responsibilities to manage project configurations and change management. Since the project involves multiple deliverables and contributions from several team members, strict configuration management is essential.
- **Quality Management Plan** [2] – Defines the standards, procedures, and responsibilities to maintain quality in processes, deliverables, and documentation. This is particularly important because the project is carried out in the dependability domain, where consistency and reliability are critical.
- **Requirements Management Plan** [3] – Because requirements specification is a major activity in the dependability domain, the team has decided that the requirement specification belongs to the execution phase rather than the planning phase. The Requirements Management Plan therefore governs how requirements are captured, analysed, prioritised, and tracked throughout the project.
- **Safety Management Plan** [4] – During the execution phase of the project, activities are organised according to SORA [15] and a modified version of ARP4754A's [17] V-model, where safety management is a central element. The Safety Management Plan specifies the procedures, responsibilities, and controls to identify, assess, and mitigate safety risks.
- **Validation & Verification (V&V) Management Plan** [5] – In the modified ARP4754A V-model adopted for this project, the V&V process ensures both that the system is built correctly (verification) and that it meets the needs of the stakeholders (validation). It defines the approach, methods, and responsibilities for V&V activities.

Together, these management plans provide the detailed guidance required to ensure that configuration, quality, requirements, safety, and validation & verification are handled systematically throughout the project lifecycle.

# 3 Project Context & Stakeholders

## 3.1 Team Members

Table 3 lists people included in the project team.

| Name | Main Role | Support Role |
|---|---|---|
| Andrea Haglund | Chief Engineer (CE) | System Architect & Designer |
| Claire Namatovu | Requirements Manager (RM) | Requirements Engineer |
| Emily Zainali | Validation & Verification Manager (VVM) | Tester |
| Esaias Målqvist | Safety Manager (SM) | Safety Engineer |
| Yonatan Michael Beyene | Quality & Configuration Manager (QCM) | Quality Engineer & Configuration Engineer |

Table 3: Project team members.

## 3.2 Stakeholders

Table 4 lists stakeholders related to this project.

| Name | Role | Responsibilities | Contact Info |
|---|---|---|---|
| Luiz Giacomossi | Project Owner | Defines project objectives, approves scope and decisions, ensures expected value | luiz.giacomossi@mdu.se |
| Luciana Provenzano | Course Coordinator | Ensures compliance with course framework, provides academic oversight, evaluates results | luciana.provenzano@mdu.se |
| Julieth Castellanos | Project Advisor | Provides guidance and feedback, supports theory application, ensures academic standards | julieth.castellanos@mdu.se |

Table 4: Stakeholders.

## 3.3 SWOT Analysis

**Strengths**

- All team members are deeply committed to this project.
- The team collectively has a good level of competency and knowledge.
- Team members have previous experiences that are advantageous for this project.

**Opportunities**

- *All team members are deeply committed to this project.*
  - Higher likelihood of meeting project goals due to strong motivation.
  - Ability to take on ambitious tasks or project scopes because of strong teamwork.
  - Faster problem-solving as members are willing to put in extra effort.
  - Increased resilience during setbacks, enabling smoother project progress.
- *The team collectively has a good level of competency and knowledge.*
  - Ability to develop high-quality outputs or innovative solutions.
  - Reduced need for external assistance, saving time and resources.
  - Capability to explore advanced techniques or new technologies in the project.
  - Faster learning curves and adaptability to new requirements.
- *Team members have previous experiences that are advantageous for this project.*
  - Ability to avoid past mistakes and apply proven strategies.
  - Faster execution due to familiarity with similar tasks or processes.
  - Improved decision-making based on real-world insights.
  - Opportunity to leverage prior networks, tools, or methodologies.
  - Greater confidence in handling complex or unexpected challenges.

**Weaknesses**

- Lack of experience in project planning and management.
- Time constraint.
- Lack of hardware specification.

**Threats**

- *Lack of experience in project planning and management.*
  - Project delays due to poor task estimation and scheduling.
  - Increased risk of project failure due to inadequate oversight or coordination.
  - Communication breakdowns within the team.
  - Difficulty adapting to unexpected issues, causing further setbacks.
- *Time constraint.*
  - Rushed deliverables that may compromise quality and safety.
  - Inability to complete all required features or tasks.
  - Higher stress levels leading to mistakes or burnout.
  - Reduced ability to test, validate, or refine the project.
  - Missed deadlines impacting stakeholders' trust or project approval.
- *Lack of hardware specification.*
  - Incompatibility between project requirements and hardware.

## 3.4 Dependencies & External Factors

This project is influenced by several external factors and dependencies that may affect scheduling, risk, or deliverables:

- Deadlines, Working Days and Hours
  - This project must align with submission deadlines and seminar dates.
  - Delays in intermediate activities (e.g., requirements validation and simulation results) could affect final delivery.
  - The project schedule is based on regular weekdays and standard working hours, and work is assumed to progress only during these periods, excluding weekends and public holidays.
  - Any deviations (e.g., reduced team availability) could delay milestone achievement.
- Simulation Software Availability
  - This project depends on access to a specific UAV simulation software (gym-pybullets-drones) that will be modified according to project needs.
  - If modification of the software is delayed, testing may be delayed or scaled back to adhere to delivery dates.
- Reference to UAV Specifications
  - Requirements and performance constraints are based on Harris Aerial's Carrier H6HL specifications.
  - If those specifications are updated or incomplete, assumptions may have to be revised.
- External Regulations & Standards
  - Although no physical UAV will be built, simulations must still follow standard UAV safety and performance guidelines for validity.
  - Changes in regulatory requirements may impact this project.

Several of these dependencies and external factors present potential risks to this project's timeline and quality. For example, delays in modification of the simulation software could directly impact milestone achievement. These risks, along with mitigation strategies, are further detailed in Risk Analysis & Management.

# 4 Scope

The scope defines the project's deliverables, the assumptions made, the constraints in place, and the main activities to be carried out.

## 4.1 Deliverables & Artefacts

Table 5 is a list of deliverables and artefacts to be produced in the project.

| ID | Title | Type | Responsible |
|---|---|---|---|
| CE-01 | Pre-Study | Deliverable | CE |
| CE-02 | Project Plan | Deliverable | CE |
| CE-04 | System Design Description | Deliverable | CE |
| CE-05 | Final Report | Deliverable | CE |
| CE-06 | Presentation | Deliverable | CE |
| CE-07 | Release Notes | Artefact | QCM |
| CM-01 | Configuration Management Plan | Deliverable | QCM |
| CM-02 | Configuration Change Requests | Artefact | QCM |
| QM-01 | Quality Management Plan | Deliverable | QCM |
| QM-02 | Quality Review Protocols | Artefact | QCM |
| RM-01 | Requirements Management Plan | Deliverable | RM |
| RM-02 | Requirements Specification | Deliverable | RM |
| RM-03 | Requirements Specification Guide | Deliverable | RM |
| SM-01 | Safety Management Plan | Deliverable | SM |
| SM-02 | Preliminary Safety Assurance Case | Artefact | SM |
| SM-03 | Preliminary Safety Assessment | Artefact | SM |
| SM-04 | Flight Safety Assessment | Artefact | SM |
| SM-05 | Safety Assessment | Artefact | SM |
| SM-06 | Safety Goals & Requirements | Artefact | SM |
| SM-07 | Safety Assurance Case | Deliverable | SM |
| VV-01 | Verification & Validation Management Plan | Deliverable | VVM |
| VV-02 | Requirements Checklist | Artefact | VVM |
| VV-03 | Safety Requirements Verification | Deliverable | VVM |
| VV-04 | Safety Goals Verification | Deliverable | VVM |
| VV-05 | Verification Drone Swarm Requirements | Deliverable | VVM |
| VV-06 | System Requirements Verification | Deliverable | VVM |
| VV-07 | Subsystem Requirements Verification | Deliverable | VVM |
| VV-10 | System Design Network Diagram | Artefact | VVM |
| VV-11 | Test Case Drone Swarm Requirements | Deliverable | VVM |
| VV-12 | Verification & Validation System Design | Deliverable | VVM |
| VV-13 | Test Specification | Deliverable | VVM |

Table 5: Deliverables and artefacts.

## 4.2 Assumptions & Constraints

Since certain specifications require reference to an actual Unmanned Aerial Vehicle (UAV), the team has designated Harris Aerial's Carrier H6HL [18] as the reference model. This project does not encompass hardware development, and no physical UAV will be available for testing. Instead, validation of the UAV swarm will be conducted through simulations using fault injections.

The Harris Aerial H6HL was selected for the project based on the following factors:

- **Long operational range**: The drone provides the extended range necessary for swarm operations in remote areas.
- **High payload capacity**: Its substantial carrying capability allows the integration of additional batteries, sensors, or first aid supplies for the missing Subject.
- **Six-motor configuration**: The hexacopter design increases overall system reliability, as the drone can better tolerate individual motor failures.

## 4.3 Work Breakdown Structure

This WBS desribes the main activities that have been or will be performed during the project's life cycle:

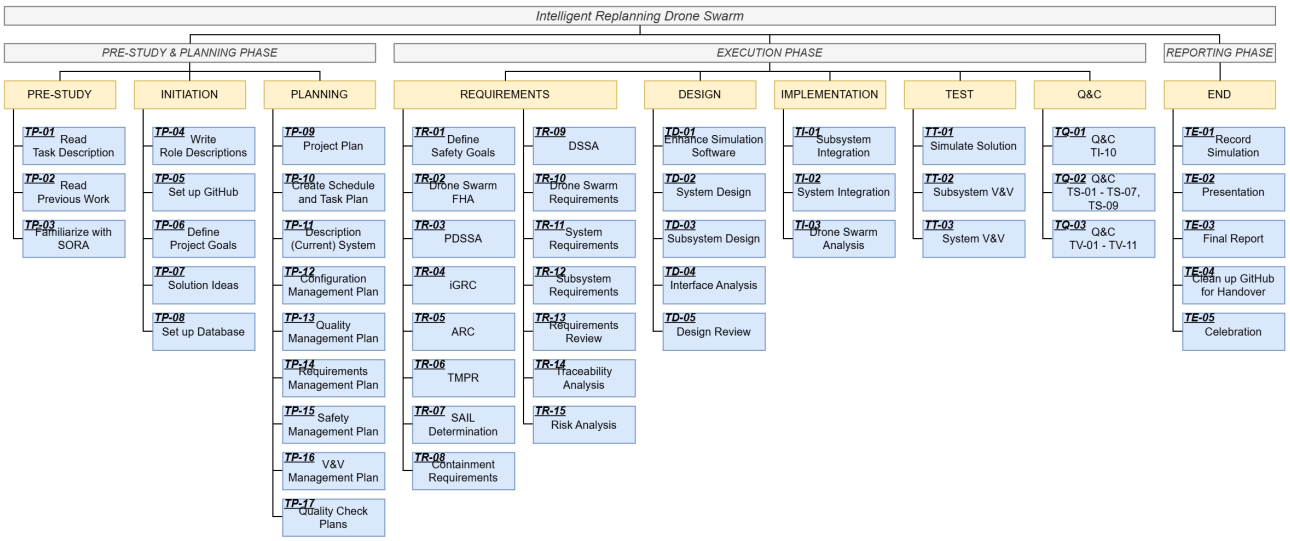


Figure 1: Work Breakdown Structure.

A vectorised version of this WBS can be found in [19].

# 5 Methodology

## 5.1 Tools & Techniques

This project relies on a comprehensive set of tools and techniques that support communication, coordination, development, and rigorous documentation:

| **Tool / Technique** | **Usage** |
|---|---|
| Project management model | Framework derived from [20] |
| Agile Management | Overall project management approach; applied via Scrum and Kanban in Jira |
| Daily Scrum | Daily stand-up meetings for team synchronisation and progress tracking |
| Weekly Scrum | Weekly meetings for sprint planning and progress review |
| Jira | Tracking progress, manage activities, and break activities into tasks. Note: Not connected to GitHub Pull Requests |
| Discord | Everyday communication and update announcements |
| GitHub | Main repository for source code, approved project documents, and the project's requirements database |
| SharePoint | Documents not for public use, along with documents waiting for review, and protocol templates. |
| Visual Studio Code | Main environment for local development integrated with Git and GitHub |
| Modelio | Formal system modelling |
| draw.io | Flexible diagrams and illustrative modelling |
| gym-pybullet-drones | Simulating solution and testing scenarios |
| Overleaf (LaTeX) | Preparing plans and formal reports |

Table 6: Tools and techniques.

## 5.2 Project Lifecycle & Phases

The activities carried out in this project are organised according to a combination of phases given in a course guide [21] (figure 2) and a general project management model (figure 3) found in [20]. The resulting project management model from this combination can be seen in figure 4.




Figure 2: Project phases according to given course guide.




Figure 3: Project phases according to general project management model.

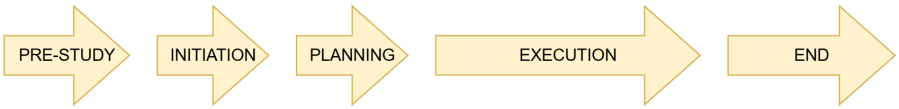


Figure 4: Project phases according to the project's modified project management model.

The project will follow a structured approach, with all key activities—quality, configuration, safety, requirements, and verification & validation—managed through their respective plans: Quality Management Plan [2], Configuration Management Plan [1], Requirements Management Plan [3], Safety Management Plan [4], and V&V Management Plan [5]. Change management and quality assurance will follow the Configuration and Quality Management Plans. Given the critical role of requirements in the dependability domain, requirements specification will occur during the execution phase, with the Requirements Management Plan governing how they are captured, analysed, prioritised, and tracked. Safety, verification, and validation activities will be carried out according to the Safety and V&V Management Plans. The project execution will follow a modified ARP4754A V-model (figure 12), ensuring systematic planning, oversight, and control throughout the lifecycle.

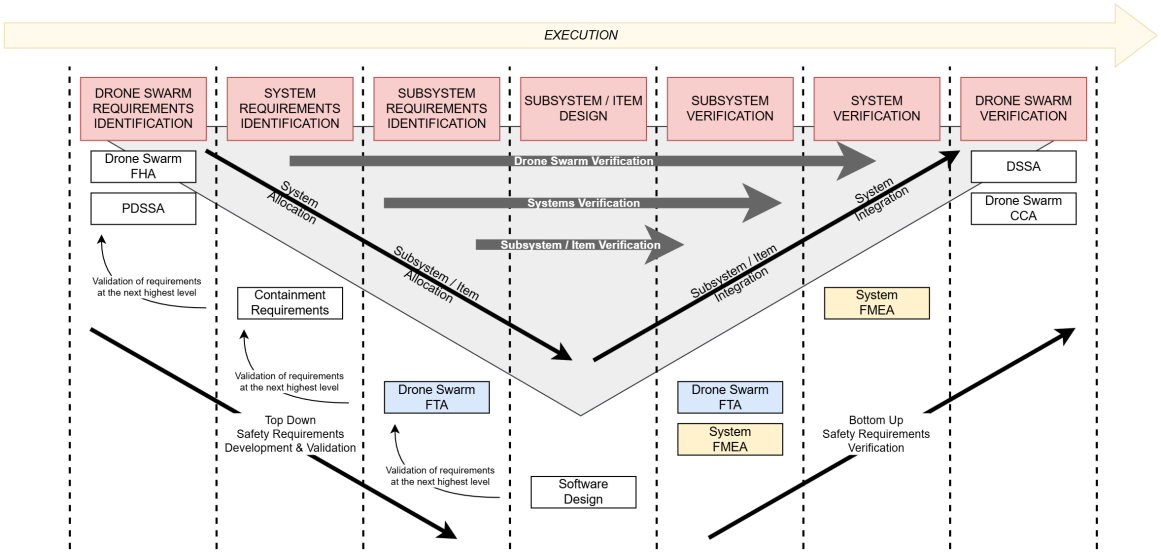


Figure 5: V-model based on ARP4754A.

Larger versions of the above figures can be found under Figures in Appendix (figures 9, 10, 11, and 12.

# 6 Project Organisation & Communication

## 6.1 Project Roles

Table 7 details what responsibilities, authorities, and dependability focus all main roles in the project have.

| Role | Responsibilities | Authority | Dependability Focus |
|---|---|---|---|
| Chief Engineer | Lead overall project execution; integrate all activities; maintain schedule; make technical trade-off decisions; ensure dependability requirements are met | Approve major technical changes; assign responsibilities and resources; sign off on final system-level deliverables | Ensures overall system reliability, safety, and robustness by integrating dependability considerations across all activities |
| Requirements Manager | Capture, analyse, prioritise, and track requirements; ensure clarity, feasibility, and verifiability; maintain traceability; coordinate with Safety, V&V, and Q&C Managers | Approve changes to requirements baseline; reject incomplete or untestable requirements; request clarifications from team members | Ensures that dependability requirements (safety, reliability, availability) are correctly captured and traceable throughout the project |
| Validation & Verification Manager | Develop and execute verification and validation plans; ensure traceability between requirements, design, and V&V results; document outcomes; support dependability assessments | Approve completion of V&V activities; reject deliverables failing verification/validation; recommend corrective actions | Confirms that system functions as intended and meets dependability requirements through systematic verification and validation |
| Safety Manager | Identify hazards and perform risk assessments; define and maintain safety requirements; ensure compliance with safety standards; coordinate with Requirements and V&V Managers | Approve safety-related design changes; halt project activities violating safety requirements; require corrective actions for hazards | Protects system and users by mitigating risks and ensuring all safety-critical aspects of dependability are addressed |
| Quality & Configuration Manager | Define quality standards; ensure deliverables meet quality criteria; manage configuration control and change management; monitor process adherence; maintain project documentation | Approve changes to controlled documents and baselines; enforce quality standards; reject outputs not meeting quality criteria | Ensures consistent quality and integrity of project outputs, supporting reliability, maintainability, and traceability of the system |

Table 7: Project roles.

## 6.2 Communication

The types of communication that will be used during the project will be:

- Daily in-person scrum meetings with a duration of approximately 15 minutes that handle:
  - **Yesterday's achievements:** Describe what you were able to do yesterday.
  - **Today's achievements:** Describe what you intend to do today.
  - **Blockers:** Describe anything that you need answering or unblocking.
- Weekly in-person scrum meetings with a duration of approximately one hour that will handle:
  - **Progress:** Review all activities and tasks done.
  - **Slowed down:** Activities and tasks that have not made the progress the team was expecting.
  - **Stopped:** Activities and tasks stopped in their tracks.
- Discord for written communication, with text channels:
  - **general**: For any communication about the project that does not belong in any other channel.
  - **digital-spaces**: To keep track of which digital spaces we use and direct links to them.
  - **github**: For announcing updates about the project's GitHub repository and its branches.
  - **sharepoint**: To announce when files have been uploaded to SharePoint.
  - **latex**: For LaTeX templates, acronyms used, etc.
  - **irrelevant**: For anything else.

## 6.3 Task Management

Managing, assigning, and breaking down activities and tasks shall be done in Jira to make it easier to track progress and to get a graphical representation of the project's timeline and progress.

In Jira, the progress of tasks and activities will be kept track of by using a kanban approach (figure 6), where:

- **TO DO** is for tasks that have not yet been started,
  - or for tasks with outputs that did not get approval from a review and ***need*** adjustments.
- **IN PROGRESS** is for tasks that are currently being worked on,
  - or for tasks with outputs that did not get approval from a review and are ***getting*** adjustments.
- **TO BE REVIEWED** is for tasks that have outputs that need to be reviewed,
  - or for tasks with outputs that did not get approval from a review, have been adjusted, and are then ***waiting for additional*** reviewing.
- **IN REVIEW** is for tasks with outputs that are currently being reviewed
  - or for tasks with outputs that did not get approval from a review, have been adjusted, and are then ***getting additional*** reviewing.
- **DONE** is for tasks that are finished and tasks with outputs that have been approved through a review.

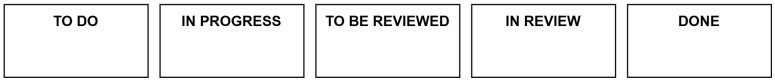


Figure 6: Kanban board.

## 6.4 File Management

- The project's GitHub repository stores source code, approved documents, and the project's requirements database.
- SharePoint is used as storage for files that are not for public use, documents waiting for review, and protocol templates.

## 6.5 Git

### 6.5.1 Pull Requests

- All changes to the main branch must go through a Pull Request (PR).
- A PR may only be merged if:
  - It has been approved by the Chief Engineer.
  - It has been approved by at least one other reviewer who is not the author of the change.
- All PRs must include:
  - A clear description of the change and its purpose.
  - References to related activities or tasks.
- The author of the PR is responsible for resolving all review comments before merging.
- Squash merges are preferred to keep the commit history clean, unless there is a reason to preserve individual commits.

### 6.5.2 Branching Strategy

- The main branch represents the public-ready state of the project and is visible to the public.
- All changes must be done in feature branches.
  - Naming convention: feature/<short-description> (e.g., feature/id-list).
- Optionally, a develop branch may be used to integrate multiple changes before merging into main.
  - This branch represents the ”next public-ready candidate.”
  - There can only be one develop branch at a time.
- Branches should be deleted after merging to avoid clutter.

### 6.5.3 Commit Standards

- Commits should be small, focused, and logically grouped.
- Commit messages must:
  - Use imperative mood (e.g., ”Add login validation” instead of ”Added login validation”).
  - Clearly describe the purpose of the change.

# 7 Project Schedule & Milestones

## 7.1 Milestones

Table 8 describes the project's milestones.

| ID | Description | Target End Date | Responsible |
|---|---|---|---|
| INL1 | Pre-study & Planning Phase | 2025-10-05 | All team members |
| INL2 | Execution & Validation Phase | 2025-11-16 | All team members |
| INL3 | Reporting Phase | 2025-12-07 | All team members |
| SEM3 | Presentation | 2025-12-11 | All team members |

Table 8: Milestones.

## 7.2 Timeline

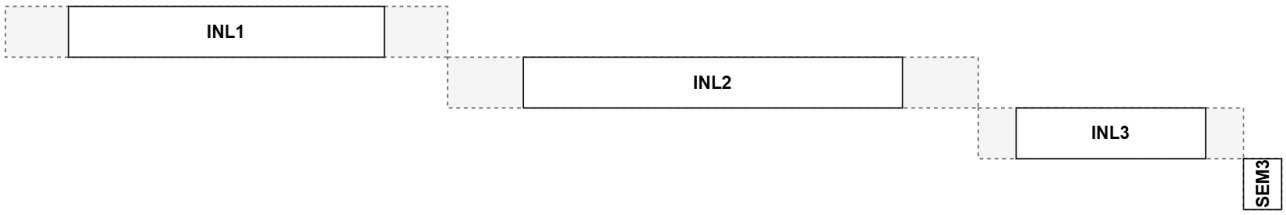


Figure 7: Timeline of milestones.

## 7.3 Activities

Time is given in days, where one day equals eight hours. Times for each activity has been roughly estimated by their respective managers.

| ID | Activity | Time | Dependency | Responsible |
|---|---|---|---|---|
| TP-01 | Read Task Description | 1/2 | Project assigned | All |
| TP-02 | Read Previous Work | 1 | TP-01 | All |
| TP-03 | Familiarize with SORA | 1 | TP-02 | All |
| TP-04 | Write Role Descriptions | 1 | TP-03 | All |
| TP-05 | Set up GitHub | 1 | TP-07 | CE |
| TP-06 | Define Project Goals | 1/2 | TP-04 | All |
| TP-07 | Solution Ideas | 2 | TP-06 | All |
| TP-08 | Set up Database | 10 | TP-07 & V-model | RM |
| TP-09 | Project Plan | 10 | TP-07 | CE |
| TP-10 | Create Schedule and Task Plan | 2 | TP-09 | CE |
| TP-11 | Description (Current) System | 1 | TP-07 | CE |
| TP-12 | Configuration Management Plan | 2 | TP-07 | QCM |
| TP-13 | Quality Management Plan | 4 | TP-07, & Quality requirements from standards & within project | QCM |
| TP-14 | Requirements Management Plan | 12 | TP-07 | RM |
| TP-15 | Safety Management Plan | 8 | TP-07 & standards chosen | SM |
| TP-16 | V&V Management Plan | 12 | TP-07 | VVM |
| TP-17 | Quality Check Plans | 4 | TP-13 | QCM |

Table 9: List of Activities.

| ID | Activity | Time | Dependency | Responsible |
|---|---|---|---|---|
| TR-01 | Define Safety Goals | 2 | TP-07 | SM |
| TR-02 | Drone Swarm FHA | 2 | TP-15 | SM |
| TR-03 | PDSSA | 2 | TR-02 | SM |
| TR-04 | iGRC | 2 | TP-15 | SM |
| TR-05 | ARC | 2 | TP-15 | SM |
| TR-06 | TMPR | 2 | TR-04, TR-05 | SM |
| TR-07 | SAIL Determination | 2 | TR-04, TR-05 | SM |
| TR-08 | Containment Requirements | 2 | TR-04, TR-05, TR-06, TR-07 | SM |
| TR-09 | DSSA | 2 | TR-01, TT-01 | SM |
| TR-10 | Drone Swarm Requirements | 2 | TP-08, TP-14 | RM |
| TR-11 | System Requirements | 4 | TRR-02 | RM |
| TR-12 | Subsystem Requirements | 5 | TRR-03 | RM |
| TR-13 | Requirements Review | - | - | VVM |
| TR-14 | Traceability Analysis | - | - | VVM |
| TR-15 | Risk Analysis | - | - | VVM |
| TD-01 | Enhance Simulation Software | 6 | TP-07 & PC for simulation | CE |
| TD-02 | System Design | 2 | TRR-03 | CE |
| TD-03 | Subsystem Design | 4 | TDV-01 | CE |
| TD-04 | Interface Analysis | - | - | CE |
| TD-05 | Design Review | - | - | VVM |
| TI-01 | Subsystem Integration | 1 | TDV-02 | CE |
| TI-02 | System Integration | 1 | TIV-01 | CE |
| TI-03 | Drone Swarm Analysis | - | - | VVM |
| TT-01 | Simulate Solution | 6 | TD-01, TIV-02 | CE |
| TT-02 | Subsystem V&V | - | - | CE |
| TT-03 | System V&V | - | - | CE |
| TQ-01 | Q&C TI-10 | 1/2 | TI-10 | QCM |
| TQ-02 | Q&C TR-01 - TR-07, TR-09 | 6 | TR-01 - TR-07, TR-09 | QCM |
| TQ-03 | Q&C TRR-01 - TDV-03 | 6 | TRR-01 - TDV-03 | QCM |
| TE-01 | Record Simulation | 1/2 | TT-01 | CE |
| TE-02 | Presentation | 5 | TP-10, TR-01, TR-08, TT-01 | All |
| TE-03 | Final Report | 10 | TT-01 | All |
| TE-04 | Clean up GitHub for Handover | 1 | TT-01 | CE |
| TE-05 | Celebration | 0 | TE-03 | All |

Table 9: List of Activities.

## 7.4 Network Schedule

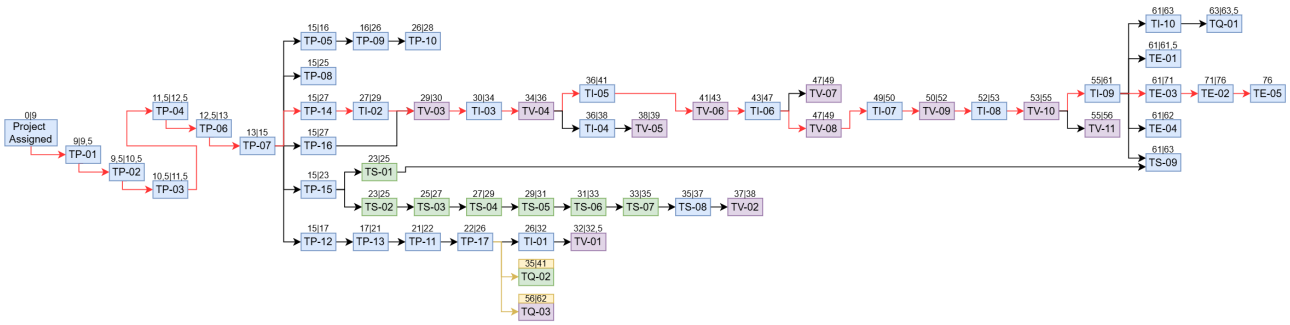


Figure 8: Network schedule of activities within the project. Red arrows indicate the path of criticality. Activity TQ-02 is dependent on other activities of the same colour (green). Activity TQ-03 is dependent on other activities of the same colour (purple).

The critical path analysis states that this project needs at least 76 work days to complete. The number of work days available until the final report shall be submitted is 70, and the number of work days available until the date of presenting the project is 73 - this means that activities on the path of criticality must be tracked closely and any deviations must be noted and handled as soon as possible, and if possible: complete the activities in less time than what has been estimated for them.

# 8 Risk Analysis & Management

## 8.1 Identified Risks

| Risk ID | Risk Description | Source | Impact | Likelihood | Mitigation Strategy |
|---|---|---|---|---|---|
| R-01 | Outdated or incomplete UAV specifications | Reference UAV Specifications | Medium | Low | Validate Carrier H6HL specs early; adjust assumptions if updates occur |
| R-02 | Regulatory changes affecting UAV assumptions | External Regulations & Standards | Low | Low | Monitor relevant UAV standards; adapt simulations if required |
| R-03 | Reduced progress due to limited time | Time Constraint | High | Medium | Plan internal deadlines with buffer time; avoid scheduling critical activities in parallel |
| R-04 | Sudden illness among team members | Health and Work Environment | Medium | Low | Keep stress levels low, Ensure breaks |
| R-05 | Delayed ”Read Task Description” (TP-01) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-06 | Delayed ”Read Previous Work” (TP-02) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-07 | Delayed ”Familiarize with SORA” (TP-03) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-08 | Delayed ”Write Role Descriptions” (TP-04) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-09 | Delayed ”Define Project Goals” (TP-06) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-10 | Delayed ”Solution Ideas” (TP-07) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-11 | Delayed ”Set up Database” (TP-08) | Time Estimation, Programmer Availability | High | Medium | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, plan work properly, more than one person carries out the task |
| R-12 | Delayed ”Requirements Management Plan” (TP-14) | RM | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |

Table 10: Risk Log.

| Risk ID | Risk Description | Source | Impact | Likelihood | Mitigation Strategy |
|---|---|---|---|---|---|
| R-13 | Delayed ”Enhance Simulation Software” (TI-01) | Programmer Availability | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, Start activity early |
| R-14 | Delayed ”Drone Swarm Requirements” (TI-02) | Time Estimation, Database issue | High | Medium | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, more than one person carries out the task |
| R-15 | Delayed ”System Requirements” (TI-03) | Time Estimation, Database issue | High | Medium | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, more than one person carries out the task |
| R-16 | Delayed ”Item Requirements” (TI-05) | Time Estimation, Database issue | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, more than one person carries out the task |
| R-17 | Delayed ”Item Design” (TI-06) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-18 | Delayed ”Item Integration” (TI-07) | Time Estimation | High | Medium | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task, more than one person carries out the task |
| R-19 | Delayed ”System Integration” (TI-08) | Time Estimation | High | Medium | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-20 | Delayed ”Simulate Solution” (TI-09) | Time Estimation, Simulation Software | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-21 | Delayed ”Drone Swarm Req. Validation” (TV-03) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-22 | Delayed ”System Req. Validation” (TV-04) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-23 | Delayed ”Item Req. Validation” (TV-06) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-24 | Delayed ”Item Verification” (TV-08) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |

Table 10: Risk Log.

| Risk ID | Risk Description | Source | Impact | Likelihood | Mitigation Strategy |
|---|---|---|---|---|---|
| R-25 | Delayed ”System Verification” (TV-09) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-26 | Delayed ”Drone Swarm Verification” (TV-10) | Time Estimation | High | Low | If time estimation is exceeded, a new deadline shall be implemented and within half of the next tasks allocated time. Additional support shall be given in order to complete the task |
| R-27 | Delayed ”Presentation” (TE-02) | Time Estimation | High | High | If time is exceeded, set a new deadline within 1 day and add additional support to complete the task, work continuously with presentation framework during project |
| R-28 | Delayed ”Final Report” (TE-03) | Time Estimation, Delayed Deliverables | High | High | If time is exceeded, set a new deadline within 1 day and add additional support to complete the task, work continuously with report framework during project |

Table 10: Risk Log.

## 8.2 Monitoring & Control

- Risks will be reviewed and identified during weekly scrums, and updates and/or additions will be made in table 10.
- High-impact and medium to high likelihood risks (R-03, R-11, R-14, R-15, R-18, R-19, R-27, and R-28) will be prioritised and closely monitored.
- Mitigation actions will be assigned to specific team members to ensure accountability.
- Any risk escalation beyond the control of the team will be reported to the project owner and the course coordinator.
- Team availability will be monitored regularly to prevent scheduling conflicts. Internal deadlines will be adjusted in advance if reduced working days are expected.

# 9 Approvals

Table 11 lists items that will need approval and which approval method will be used.

| ID | Title | Responsible | Approval Method | Status |
|---|---|---|---|---|
| CE-01 | Pre-Study | CE | Review | Approved |
| CE-02 | Project Plan | CE | Review | Approved |
| CE-04 | System Design Description | CE | Review | Approved |
| CE-05 | Final Report | CE | Review | Approved |
| CM-01 | Configuration Management Plan | QCM | Review | Approved |
| QM-01 | Quality Management Plan | QCM | Review | Approved |
| RM-01 | Requirements Management Plan | RM | Review | Approved |
| RM-02 | Requirements Specification | RM | Review | Approved |
| RM-03 | Requirements Specification Guide | RM | Review | Approved |
| SM-01 | Safety Management Plan | SM | Review | Approved |
| SM-02 | Preliminary Safety Assurance Case | SM | Review | Approved |
| SM-03 | Preliminary Safety Assessment | SM | Review | Approved |
| SM-04 | Flight Safety Assessment | SM | Review | Approved |
| SM-05 | Safety Assessment | SM | Review | Approved |
| SM-06 | Safety Goals & Requirements | SM | Review | Approved |
| SM-07 | Safety Assurance Case | SM | Review | Approved |
| VV-01 | Verification & Validation Management Plan | VVM | Review | Approved |
| VV-13 | Test Specification | VVM | Review | Approved |

Table 11: Items needing approvals.

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# Appendix

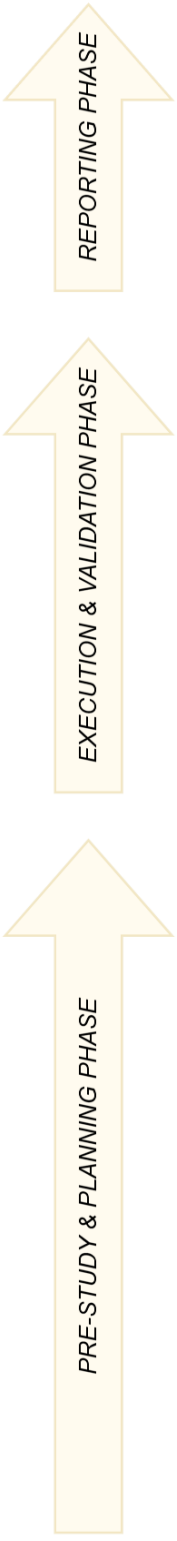


Figure 9: Project phases according to given course guide.

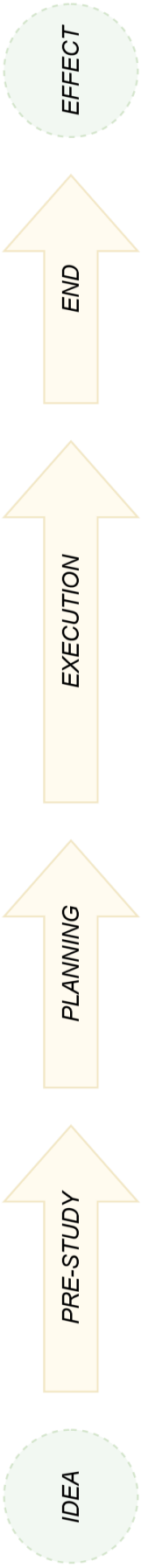


Figure 10: Project phases according to general project management model.

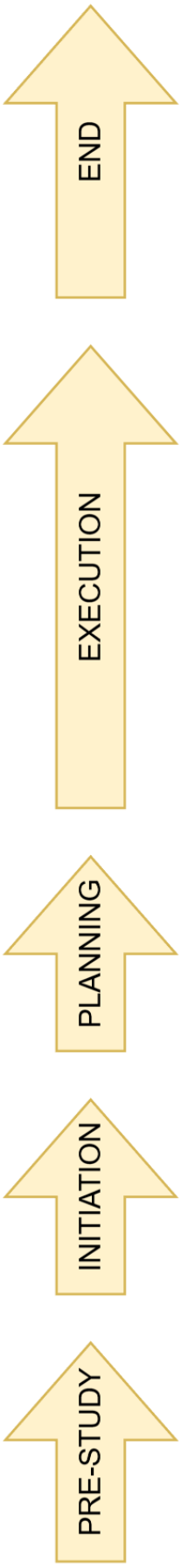


Figure 11: Project phases according to the project's modified project management model.

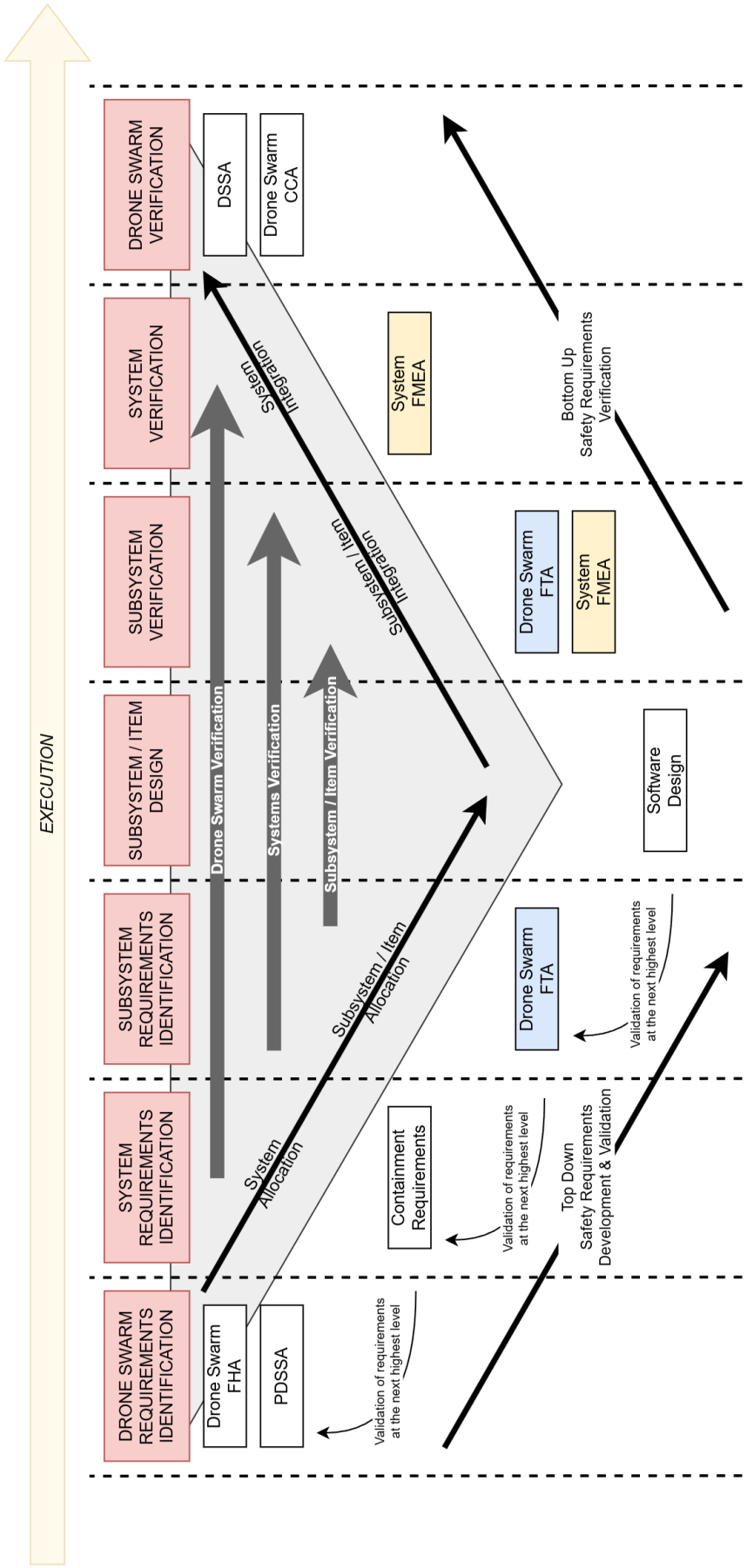


Figure 12: V-model based on ARP4754A.

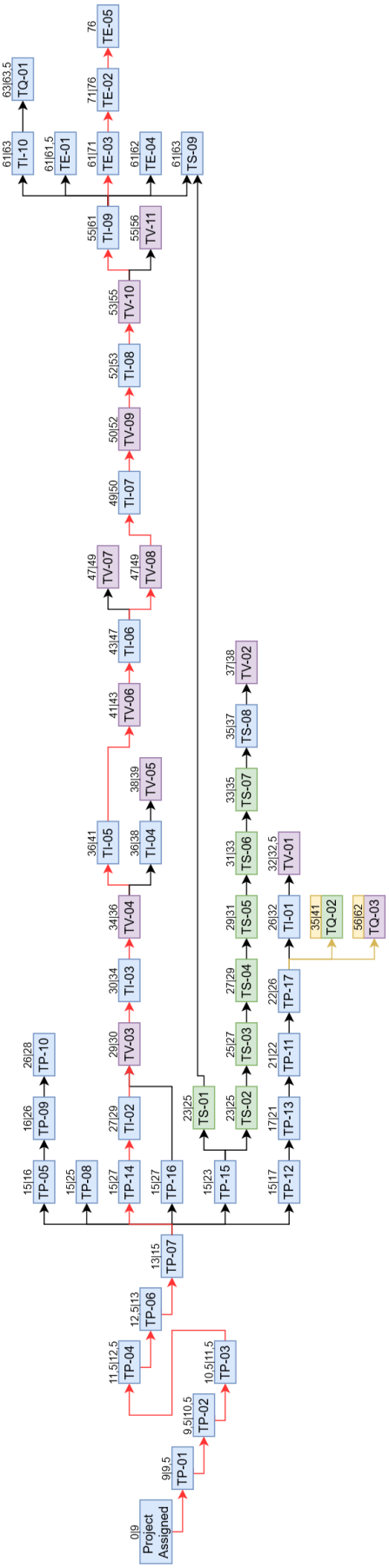


Figure 13: Network schedule of activities within the project. Red arrows indicate the path of criticality. Activity TQ-02 is dependent on other activities of the same colour (green). Activity TQ-03 is dependent on other activities of the same colour (purple).