<u>Highly Confidential Document</u>

Systems Engineering Management Plan (SEMP)

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1 Introduction

System Engineering Management Plan (SEMP) describes the overall technical management and integration activities for the Design, Development, Test, and Evaluation (DDT&E) and deployment of the Project. It is documented to provide a technical management plan, system engineering and integration (SE&I) tools and processes that will guide the SE&I activities and assist the project in keeping within performance goals and cost & schedule requirements. The SEMP provides the communication bridge between the project management team and the technical implementation teams.

The Systems Engineering Management Plan will guide all activities throughout the lifecycle of the systems engineering effort. The SEMP captures what activities must be done, as well as how they will be done. The SEMP also defines the way that the effort will be managed, to include assignment of roles and responsibilities, decision making, conflict and issue resolution, communication and feedback, formal and informal reviews, risk management, etc. In essence the SEMP defines how people, process, and product integrate and interact in order to manage a system through its lifecycle.

The SEMP is created once a systems engineering effort is launched and the resources leading the effort are identified. The Systems Engineering Lead (manager or staff depending on scope of project) will own the SEMP. The SE Lead shall identify a core team to work with to develop the SEMP. The team shall draft the SEMP as part of the planning activities for the effort. The SEMP shall guide all activities and will be updated as the effort progresses and throughout the systems engineering lifecycle. It should be configuration controlled and readily available to all interested parties. The SEMP shall be finalized once the effort is complete. It should be archived and serve as the official comprehensive document for the effort. It is the responsibility of the SE Lead to ensure that the SEMP is updated and current at all times, and configuration is maintained. It is also the responsibility of the SE Lead to ensure that the details outlined in the SEMP are being implemented and followed.

1.1 Purpose

The System Engineering Management Plan describes the contractor’s proposed efforts for planning, controlling and conducting a fully integrated engineering effort. The plan will be used to understand and evaluate the contractors engineering work efforts as part of the contract monitoring process.

2 Systems Engineering Process Planning

2.1 Organizational Responsibilities

2.1.1 Customer Responsibilities

- Review and approval of Specifications as per the joint discussions and on agreed lines.
- Review and approval of schematics and Documents generated during the course of development.
- Review and approval of ATP/Test Plan for the Unit.
- Participating in joint meetings held with sub-vendors for finalization of specs/procurement of few subsystems/components.
- Testing the Unit as per the ATP and acceptance of the system once the ATP is passed.

2.1.2 Company Responsibilities

- Study, design Development and fabrication of the Unit.
- Firmware and Software Development.
- Design and development
- Integration and Testing.
- Environmental tests
- Delivery of Unit and Logistic support.
- Project Management, System Engineering, Hardware Development, Software / Firmware Development, Manufacturing and Procurement, Quality Assurance, Transportation, System Assembly, Integration and Testing, Integrated Logistics Support (ILS) Package including Spares and System Maintenance.

2.1.3 Project Team Composition

The project is headed by a Project Manager and supported by the project teams of respective domains of Hardware, Software, Firmware and Testing & Integration. Each of these project teams headed by the respective domain leader and supported by sufficient numbers of Engineers to perform the tasks.

2.2 Project Schedule

Project Scheduling in a project refers to roadmap of all activities to be done with specified order and within time slot allotted to each activity. A Project Manager tends to define various tasks for scheduling a project, it is necessary to

- Break down the project tasks into smaller in a manageable form.
- Find out various tasks and correlate them.
- Estimate time frame required for each task.
- Assign adequate number of work-units for each task.
- Calculate total time required for the project from start to finish.

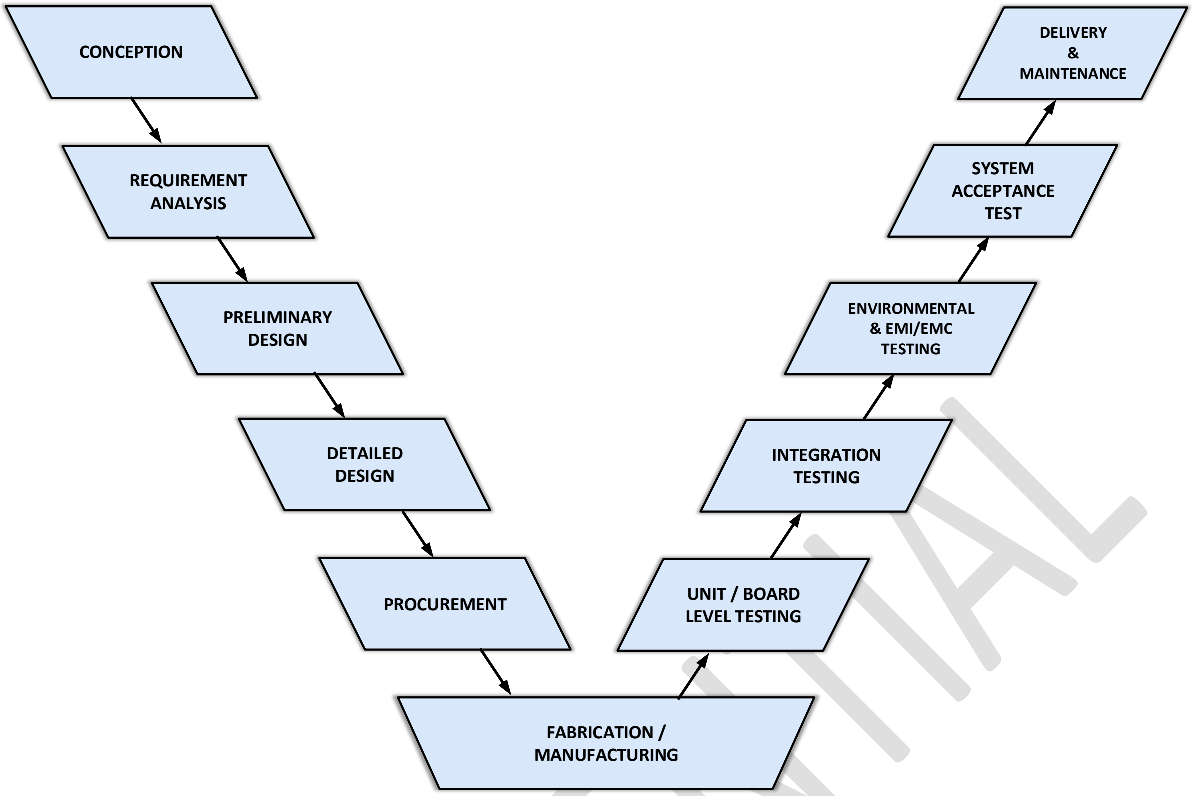
Project Schedule is represented in the form of a Gantt Chart that illustrates the project activity's schedule with a Start Date, Duration and End Date. Moreover, it also illustrates which activities are taking place in parallel.

2.3 V-Model

The V-Model is an SDLC model where execution of processes happens in a sequential manner in a V-shape. It is also known as Verification and Validation model.

The V-Model is an extension of the waterfall model and is based on the association of a testing phase for each corresponding development stage. This means that for every single phase in the development cycle, there is a directly associated testing phase. This is a highly-disciplined model and the next phase starts only after completion of the previous phase.

The V-Model is shown below.



2.4 Constraints

With any project, there are limitations and risks that need to be addressed to ensure the project's ultimate success. The three primary constraints that project managers should be familiar with are time, scope, and cost. These are frequently known as the triple constraints or the project management triangle. The triple constraints of project management

Time Constraint: The time constraint refers to the project's schedule for completion, including the deadlines for each phase of the project, as well as the date for rollout of the final deliverable.

Scope Constraint: The scope of a project defines its specific goals, deliverables, features, and functions, in addition to the tasks required to complete the project.

Cost Constraint: The cost of the project, comprises all of the financial resources needed to complete the project on time, in its predetermined scope.

3 System Engineering Process Application

3.1 Tailoring

Tailoring is the process of referencing framework documents, standards and other relevant sources and utilizing those elements that provide processes, tools and techniques that are suitable for that particular organization. It also includes modifying existing processes currently in use by the organization. As such, the process of tailoring is a process of customizing a project management methodology. The result of tailoring is that the project management methodology will be suitable for use in specific types of projects, and a tailored methodology will reflect the size, complexity and duration of the project as appropriate for the organizational context along with adaptation to the industry within which the project is undertaken.

Project Tailoring means adapting requirements and specifications of a project to current operational needs of an organization through reviewing, modifying and supplementing the project data. It is a consistent process to ensure that the project is performed correctly according to the organization’s operational and business requirements. The process is carried out when the project is finished and there is a need to tailor or fit its product to the business needs.

Tailoring a project is intended to help a management team to ensure that planning, control, governance and use of the project and its deliverables are done in the right way so that the team can continue work towards project deployment and maintenance. The team needs to be sure that the project approach, strategies, controls, processes, roles, jobs and other content are aligned with organizational goals.

3.2 Requirement Analysis & Validation

3.2.1 Requirements Analysis

Requirements Analysis is an important aspect of project management. Requirements analysis involves frequent communication with system users to determine specific feature expectations, resolution of conflict or ambiguity in requirements as demanded by the various users or groups of users, avoidance of feature creep and documentation of all aspects of the project development process from start to finish.

Requirements analysis is a team effort that demands a combination of hardware, software and human factors engineering expertise as well as skills in dealing with people.

3.2.2 Requirements Validation

Requirements validation is the process whereby the requirements that have been developed are validated against the original stakeholder expectations, user requirements and project constraints. The process will furthermore focus on the identification of gaps and to determine and confirm that the full spectrum of inputs has been taken into account and that the system will indeed be able to fulfil its full life cycle requirements.

3.3 Design Verification

Design Verification is a method to confirm if the system performance specifications meets the input specifications by examining and providing evidence. The goal of the design verification process during system development is ensuring that the system performance specifications is the same as specified. Design input is any physical and performance requirement that is used as the basis for designing purpose. Design output is the result of each design phase and at the end of total design effort.

3.4 Functional Analysis & Verification

Functional analysis describes the problem defined by the requirements in more detail and allocates functions and related performance to lower levels of the design. Each of the activities is important to ensure completeness of the process and the eventual design. The end result of this process will be a functional architecture that is subject to a functional verification aimed at confirming the functional architecture and completeness of the architecture.

4 System Engineering Controls

4.1 Interface Management

Interface definition and management will be one of the key aspects underpinning the project. During the initial phases of the project, interfaces will be identified and high level requirements will be captured in the requirements specifications. This will be followed by the development of separate documents for the interfaces and as the design of each particular piece of equipment progresses, the interfaces will be refined. These documents will exist on all levels of the project with varying degrees of detail and will include mechanical, functional, data and electrical aspects.

4.2 Data Management

The data generated during the project will be captured within the design files and as such will be submitted and managed as part of the central repository. When submitting data to the repository it must be ensured that the data is complete, well referenced and well documented. There will be instances when it will be necessary to refer back to data in the repository and failure to comply with these guidelines will lead to confusion and rework.

4.3 Risk Management

Risk management is the process of identifying, assessing and controlling threats to an organization's capital and earnings. These threats, or risks, could stem from a wide variety of sources, including financial uncertainty, legal liabilities, strategic management errors, accidents and natural disasters. IT security threats and data-related risks, and the risk management strategies to alleviate them, have become a top priority for digitized companies. As a result, a risk management plan increasingly includes companies' processes for identifying and controlling threats to its digital assets, including proprietary corporate data, a customer's personally identifiable information (PII) and intellectual property.

4.3.1 Risk Identification

For this project, risk identification was conducted in the initial project risk assessment meeting. The project manager chaired the risk assessment meeting and made note of the risks possible from the team members.

4.3.2 Risk Qualification and Prioritization

Once risks are identified it is important to determine the probability and impact of each risk in order to allow the project manager to prioritize the risk avoidance and mitigation strategy. Risks which are more likely to occur and have a significant impact on the project will be the highest priority risks while those which are more unlikely or have a low impact will be a much lower priority.

4.3.3 Risk Monitoring

One effective way to monitor project risks is to add those risks with the highest scores to the project schedule with an assigned risk manager. This allows the project manager to see when these risks need to be monitored more closely and when to expect the risk manager to provide status updates at the bi-weekly project team meetings. The key to risk monitoring is to ensure that it is continuous throughout the life of the project and includes the identification of trigger conditions for each risk and thorough documentation of the process.

4.3.4 Risk Mitigation and Avoidance

The risks for this project will be managed and controlled within the constraints of time, scope, and cost. All identified risks will be evaluated in order to determine how they affect this triple constraint. The project manager, with the assistance of the project team, will determine the best way to respond to each risk to ensure compliance with these constraints.

4.4 Configuration Management

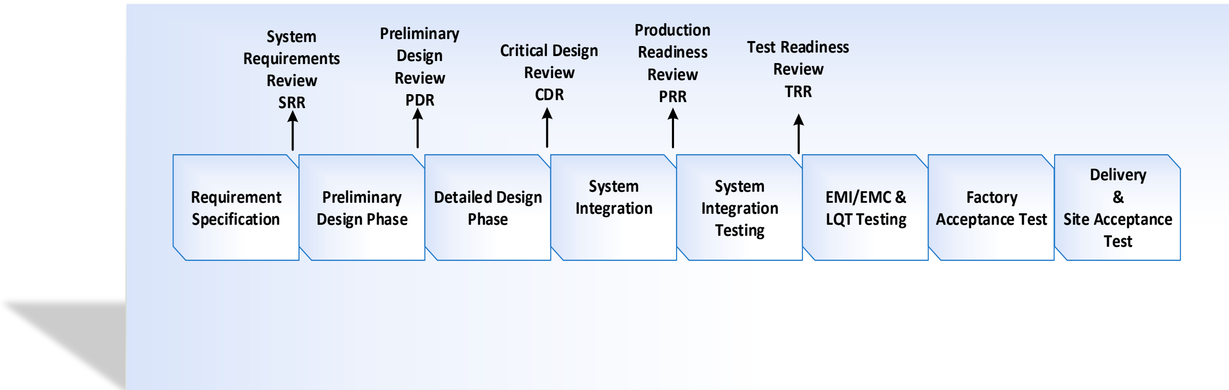
Configuration management planning involves making decisions about what needs to be controlled within a product configuration, when we establish a controlled configuration, how we change a controlled configuration, and what amount of effort we are going to expend to manage configurations. The decisions we make are formalized in a configuration management plan, which becomes part of the documentation for the product or system that we are building. This plan explains how we will control the configuration of the system we are building.

5 System Engineering Review

Project Review is a process of examining and auditing planned tasks, activities, procedures, events and other work components of a project to identify whether the project's requirements can be fully addressed by the planned amount of work and to determine what additional resources are necessary to match the work with the requirements. It is an attempt to align current working environment with the requirements prior to the project implementation process gets started.

The purpose of the project review process is to provide a team with a clear and unambiguous understanding of the steps required to complete the project as per requirements. Reviews support and facilitate internal and external project communications, and provides insight into the activities, results and the progress of the engineering effort in the project.

It is important that reviews be well planned, well executed and well followed through. The high level life cycle phases that will be adopted for the Project is shown below.



Although the phases are shown sequentially they will overlap with the next phase starting before the preceding phase has been completed. This approach facilitates iterations taking place between activities at various levels of the project, and is in line with the iterative nature of the system engineering process. Note that Figure 6.1 is not intended to provide an indication of the duration of each phase but does provide insight on which of the phases has to be completed within the overall project and system phases.

The following reviews have been identified as part of the Unit:

- System Requirements Review (SRR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Production Readiness Review (PRR)
- Test Readiness Review (TRR)

5.1 System Requirements Review (SRR)

The SRR will primarily reviews the definition of the specific building item as reflected in its relevant Requirement Specification. The review will typically be conducted after the conclusion of the requirement analysis and validation activities.

Documents to be reviewed during the SRR will include:

- Finalized requirement specification (including the cross verification matrix indicating the kind of tests to be performed for each of the requirements) - System Requirement Specification document
- First draft of the architectural design description document.
- Updated block diagram of the relevant system, element or subsystem.
- First draft interface control documents (internal and external).
- First draft acceptance test plan/ procedure.
- Updated risk register and related mitigation strategies.
- Updated requirements traceability matrix/database.
- Strategy and plans for proceeding to the next phase.
- Updated Cost, schedule, etc.

5.2 Preliminary Design Review (PDR)

The PDR will be conducted at the end of the preliminary design phase and is aimed to review and confirm the final design of the item as reflected in its relevant Architectural Design Description Document. The review will be performed at the conclusion of the functional analysis, verification, synthesis and design verification activities at the end of the preliminary design phase.

Documents to be reviewed during the PDR will include:

- Revised and final requirements specification.
- Final architectural design description document.
- Final interface control documents (internal and external).
- Final block diagram.
- Acceptance test plans and procedures.
- First draft integration plan.
- Updated requirements traceability matrix/database.
- First high level estimate of consumables, spares and test equipment.
- Updated risk register and relating mitigations strategies.

5.3 Critical Design Review (CDR)

The CDR will be performed at the end of the detailed design phase and will determine whether the item under review is ready to enter the production phase. The following high level activities are foreseen:

- Confirmation of the requirement specification and design description baseline
- Review of all aspects of the production process as well as the supporting documents and manufacturing process.
- Review of test and verification plans/procedures.
- Review of updated risk registers.
- Presentation of final design data on costs, power, etc.
- Review of integration and test plans.

5.4 Production Readiness Review

The production review will be performed at the end of the production phase. The main aim of this review will be to confirm that the items produced do comply with requirements and is ready to go into full scale production. In this regard test and verification results will be reviewed and manufacturing data packs will be audited. The output from this review will be utilized in the full scale production phase to produce the items against the approved set of baseline documents.

5.5 Test Readiness Review (TRR)

A Test Readiness Review (TRR) is conducted to determine if the system under review is ready to proceed into formal testing by deciding whether the test procedures are complete and verify their compliance with test plans and descriptions. A TRR is normally conducted before each major test configuration item including hardware and software and provides management with the assurance that a system has undergone a thorough test process and is ready for turnover to the next test phase.

6 Project Milestones

A milestone is a specific point within a project’s life cycle used to measure the progress toward the ultimate goal. Milestones in project management are used as signal posts for a project's start or end date, external reviews or input, budget checks, submission of a major deliverable, etc. A milestone is a reference point that marks a significant event or a branching decision point within a project.

7 Deliverables

A deliverable is an element of output within the scope of a project. It is the result of objective-focused work completed within the project process. Deliverables in project management can be internal or external. An internal deliverable is work undertaken within the company — people outside the organization do not see it. An external deliverable is work done for a client, customer, or stakeholder with the goal of generating revenue. In either case, it usually means that the deliverable is expected on a specific date.