

Notes for ES

System Engineer

Consumer Needs / Requirements / Constrains -> Engineering -> Product

An approach to design, creation and operation of systems

Interdisciplinary tasks required to transform needs, requirements and constrains into a system solution.

System

A set or arrangement of elements (people, SW, HW) and processes (material, machines) that are related and interact in order to satisfy consumer and operational needs, as well as product life cycle.

Products + Processes

System Life Cycle

- Preliminary Investigation
- Offer: Rough Planning / Costs / Order Placement
- Engineering: Detailed Planning / Detailed Simulation / Documentation
- Design: Detailed Design / Initial Programming / Docs
- Realization: Procurement / Production Line / Integration Programming / Dry Sum
- Start-up
- Running / Changes: Product Data acquisition (PDA)
- Documentation

Development models

Sequential

- Waterfall model: Req -> Design -> Implementation -> Verification -> Maintenance
- V-Model

Cyclical

- Around and around go the world

System Definition

- Precedented: Design examples already exist
- Unprecedented: Architecture alternatives are unconstrained by previous work. Multiple concepts need to be evaluated

Pre-concept explanation and concept exploration and development

System Engineering Process (SEP)

Mechanisms for identifying and evolving the product and process definition of a system

System Breakdown Structure (SBS)

Describes the system and its subsystems hierarchically, dividing each component and process that comprise the system architecture

Specification Tree

- System Specification -> Product Specification -> Subsystem Specification -> Assembly Specification -> Component Specification
- Operational Procedures
- Personnel Specification

Work Breakdown Structure (WBS)

Enumerates and organizes hierarchically the tasks necessary to create the product. It works as a big to-do list. It is defined using POS(Project Overview statement). Each task is subdivided into smaller and more focused tasks until we reach the lowest possible level to complete the project.

- Task duration: Calendar time necessary to complete a task
- Task effort: Number of hours necessary to complete a task
- Estimation done via historical data, experts, average estimations, etc

Requirements analysis and specification

- Analyse necessities
- Specify requirements

Requirements

- Functional: Technical aspects of the project such as HW, SW, etc, engineering requirements (Internal)
- Non-Functional: Related to the nature of the project such as marketing, quality, context (External)
- Verification: assessment of the project requirements, in more technical terms
- Validation: assessment of the product in terms of user interactivity and real-world usage

View

- Operational: How the systems serves the user, who ist the user and how it is being used
- Functional: How the product operates and how it was developed
- Design: What design considerations were taken into account, and what are the tech requirements and interfaces between all intervenients.

Considerations

- Stakeholders expectations
- Enterprise constrains
- External constrains
- Operational scenarios
- Effectiveness measurements
- System boundaries
- Interfaces
- Functional requirements
- Performance requirements

Precedented System

Analyse system in the market and evaluate the market trend and evolution.

Unprecedented Systems

Relevant sub-systems

Tech trends and missing features in existing similar systems

System Concept

- Generate System level validated requirements baseline, verified functional and design architectures, specifications and system baseline, and SBS.
- Establish system definition: Concept, Sub-system, interfaces, Preliminary design
- Concept specification: interface specs, Preliminary sub-system specs
- Complete technical reviews: Alternative concept and system definitions reviews

Creativity

- Perceptual blocks
- Emotional blocks
- Cultural and contextual blocks
- Intellectual and expressive blocks

Concept generation

- External searching: literature, patents, similar products, interview experts
- Internal searching: Brainstorming
- Breaking down into smaller problems / Sub-functions

Concept Table

Tool for identifying different combinations, arrangements and substitutes

Concept fan

Graphical representation of design choices (decision tree)

Functional analysis and architecture

- Describe the problem (requirements analysis) in more detail
- Decompose system functions to lower-level functions
- Translate the requirements baseline into a functional architecture
- Conduct analyses to understand functional behaviour under different conditions
- Decompose the system into sub-system and define interfaces, interactions and inputs/outputs
- Objectives: Alternative subfunction arrangements and sequences -> Their functional interfaces and performance requirements
- Behaviour breakdown
- System internal block diagram

Project Constrains

- Cost
- Time
- Requirements
- Resources
- Compromise and chose 2

Creeps

- Scope: Changes to project specifications and plan / more complicated (wider scope)
- Hope: Team members hide when falling behind / Control progress more closely
- Effort: Due to lack of efficiency or a bad complexity assessment, tasks are not being completed in the expected time frame

PM Lifecycle

- Traditional: Linear model
- Incremental: Deliver in incremental stages
- Iterative: Evolves as understanding increases
- Adaptative: Purpose and goals evolve as they are reviewed
- Extreme Planning: Constant review of requirements

Inrerim Deliverables

- Divide project into sub-projects
- Define milestones and deliverables

Scope the project

- Develop and gain approval of general statement of the goal and business value of the project

Plan the project

- Identify work to be done and estimate time, cost and resources requirements and gain approval to do the project

Launch the project

- Recruit the team and establish team operating rules

Monitor and Control the Project

- Adjust to change requests and resolve problem situations to maintain project progress

Close Project

- Assure something of management requirements and issue deliverables

Project overview statement (POS)

Define the scope and the business rationale of the project

Timelines

- Calender Schedule: Absolute time intervals based on actual time
- Relative Schedule: Measured from project milestones and then define time interval between them

Gantt chart

Label each activity with its WBS and task name followed by a bar to represent its duration on the timeline

Remember the task dependency stuff

Control

- Management Controls -> Actions taken as a result of reports
- Purpose: Trade progress / Detect variance from plan / Take corrective action
- High Control: Low Risk / Can limit creativity / Increase reporting overhead

Risk Management

- Uncertain event or situation that can have a negative impact in the progress success.
- This can be created by uncertainties in planning and execution of the project.
- Objectives: Identify and manage to control uncertainties that affect the project / Find a balance between risk and opportunity

Activities

- Plan Risk management
- Manage risk profiles (acceptance risk threshold, etc)
- Analyse treat and handle risks

Quality Manual

Methodologies to follow during the project: Team / Rules / Evaluation / Management tools / Document templates

Market Survey

Understand existing solutions in the market, what are others approach to the solution in the market, which components will be developed internally, externally, or even bought. Allows to focus the team efforts in innovative solutions.

Budget

Analyse financial viability of the project

Two Phases: - Elaboration: Before the project begins / estimation / project value / scheduling - Execution: During the project / periodic evaluation and revision (status of the project)

Initials: - Human Resources - Consumables - Trips - External Services

Key Performance Indicators

- Indicators and that help understand the status of the project

Project Management Manual

- Project and objectives
- Project lifecycle
- Risk management
- Management platforms and tools