**ADVANCED MATHEMATICS APPLIED TO SYSTEM ENGINEERING**

Introduction

What is advanced system engineering?

This is a new approach to the development of tomorrow’s intelligent technical systems.

**What do advanced system engineers do?**

They oversee all aspects of a project or system in a variety of fields such as software, transportation and

Product of development manufacturing. In few words their role is to develop a system that creates a

Product from the beginning to the end.

**What is the difference between system and system engineering?**

A system is a group of interacting or interrelated elements that act according to a set of rules to form a

Unified whole while system engineering is an interdisciplinary field of engineering and engineering

Management that focuses on how to design, integrate and manage complex systems over their life

Cycles.

* These are the activities of system engineering
* Requirements development and management control
* Develop systems engineering plan
* Establish engineering tools and resources
* Verification and validation
* Technical planning
* Configuration management
* Baseline configuration

**What are the responsibilities of system engineers?**

* They assess systems
* They determine problems
* Provide solutions to issues that arise
* Design systems
* Upgrade systems
* Maintaining systems and brainstorming possible improvements that can be made to a system in

Future

* Main steps of system engineering process;
* Requirements analysis and management
* Functional analysis and allocation
* Design synthesis
* System analysis and control
* Verification
* Conclusion

**What is requirement analysis?**

Is a process that focuses on tasks that determine the needs or conditions to meet the new product or

Project taking account of the possibly conflicting requirements of the various stakeholders, analyzing,

And documenting, validating and managing software.

* System engineering analysis is;

Is the way of analyzing the need for a system and determine its operational concept, develop functional

Requirements, produce the system architecture, allocate the requirements among subsystems and

Manage the design of the sub systems and assures the final design is integrated.

* This is how you can analyze system engineering requirements
* Identify key stakeholders and end users
* Capture requirements
* Categorize requirements
* Record requirements
* Sign off
* Objectives of requirement analysis
* Transform needs and high level requirements
* Traceable
* Complete
* Consistent
* Stake holder approved requirements
* Their tasks
1. Customer expectations
2. Project and enterprise constraints
3. External constraints
4. Operational scenario
5. Measure of effectiveness
6. System boundaries
7. Interfaces
8. Utilization environments
9. Life cycle
10. Functional requirements
11. Performance requirements
12. Modes of operation
13. Technical performance measure
14. Physical characteristics
15. Human system integration

**What is system analysis?**

It is the process of studying a procedure to identify its goal and purposes and create systems and

Procedures that will efficiently achieve them.

Examples of system analysis are;

* Making a change to some computer code to achieve a task
* Fixing an air conditioning system
* Here is the main purpose of system analysis

Its purpose is of studying a system or it’s in order to identify its objectives, we can also say that it is a

Problem solving technique that improves the system and ensures that all the components of the system

Work efficiently to accomplish their purpose.

**What is a work breakdown structure?**

This is a project management tool that takes a step by step approach to complete large projects with

Several moving pieces by breaking down the project into smaller components.

**What is the role of work breakdown structure in system engineering?**

* Defines the total system
* Displays a product composed of hardware

**What is its purpose?**

1. Identifies products, processes and data
2. Organizing risk management analysis and tracking
3. Enabling configuration and data management
4. It helps establishing interface identification and control
5. Developing work packages for work orders and material
6. Organizing technical reviews and audits
* Benefits of work breakdown structure
* It defines and organizes the work required
* It facilitate the quick development of a schedule by allocating effort estimates to specific

 Sections of the work breakdown structure

* It can be used to identify potential scope risks if it has a branch that is not well defined
* It provides a visual of entire scope
* Allows the total system to be described through a logical breakout of product elements into

Work packages.

**What is work breakdown structure development?**

It means the defining relationships between the project goals deliverables and scope, it is also about

Creating a detailed decomposition of work planned for completion into smaller more manageable and

Measurable components.

**When should the work breakdown be developed?**

You plan it before you create the chart or the project plan

**What goal does a work breakdown structure help you to achieve?**

It makes a large project more manageable.

**What is a work tracking system?**

Is a system that assigns tasks to departments or personal in order to update the work status as it flows

Through production.

**What is the purpose of system design?**

Is to provide sufficient detailed data and information about the system and its system elements to

Enable the implementation with architectural entities.

* Benefits of system engineering
* Helps to avoid omissions and invalid assumptions
* Manage real world changing issues
* Produce most efficient economic and robust solution

**What is a purpose of a system engineer?**

A system engineer helps ensuring the elements of the system fit together to accomplish the objectives

Of the whole and ultimately satisfy needs of the customers and other stakeholders who will acquire and

Use the system.

**Configuration management**

This is an engineering system process for establishing and maintaining consistency of a product

Performance, functional, and physical attributes with its requirements, design and operational

Information.

**Why is configuration management important in information technology?**

 Configuration management helps the engineering teams to build robust and stable systems through the

Use of tools that automatically manage and monitor updates to configuration data.

* Here is the main objective of configuration management:
* Record
* Identify
* Control
* Report
* Audit
* Verify service assets and configure items

**What is system engineering planning?**

This is a living document that details the execution management and control of the technical aspects of

An acquisition program from conception to disposal.

 **What are the system engineering planning process?**

* It supports new application development from requirements analysis with models to

Component selection

* Design
* Modification
* Implementation
* Integration
* Archival placement
* Here is the purpose of a system engineering management plan:
* It focuses on the technical plan of the project and the system engineering process to be used for

The project.

* It also details out the engineering tasks especially too provide detailed information on the

Process to be used.

**What should be included in a system engineering management plan?**

1. Technical project planning and control
2. Systems engineering process
3. Engineering specialty

**Why engineering plans?**

* To assure all the technical activities that are identified and managed
* To communicate the technical approach to the broad development team
* Document decisions and technical implementation
* Establishing criteria to judge how the system development effort is meeting customer

Management needs.

* To address the scope of the technical effort required to develop the system
* It also describes what must be accomplished and how the system engineering will be done
* These are the elements of technical plan
* They define the scope and objectives of the technical effort
* They identify constraints and risks
* Establishing roles and responsibilities
* Dividing the program scope and objective into discrete elements
* Identifying technical reviews and audits as well as their timing
* Description of how the system engineering process will be tailored and structured to complete
* The objectives stated in the strategy
* Organizes a plan that describes the organizational structure that will achieve the engineering

Objectives

* A resource plan that identifies the estimated funding and schedule necessary to achieve the

Strategy.

* An introduction that states the purpose of the engineering effort and a system being developed
* A technical strategy description that ties the engineering effort to the higher level management

Planning.

**This is how a technical plan should be written**

* Evaluate existing technology
* Recognize innovation requirements and concerns
* Prepare a technology vision statement
* Develop a budget and timeline
* Write technology plan
* Keep track of the projects implementation
* Guarantee stakeholder buy in
* The purpose of a technical planning process is;

To establish and maintain plans directing a programs technical effort.

**What are the specialty technical plan that is used?**

* Programmatic
* Environment
* Safety
* Occupational health

**What is technology strategy?**

It is the overall plan which consists of objectives, principles and tactics relating to use of technologies

Within a particular organization.

**This is how a technical strategy should be created**

* Proceed from general to specific
* Articulate the business drivers
* Select the technology principles
* Flesh out the strategy, architecture and roadmap
* Decide on specific vendors and products
* Clearly what does a technical strategy document mean or do?

It defines a vision for the role technology plays in support of the business, it also defines the vision for

How technology supports the business strategy. The values, principles and guidelines which inform our

Architecture and decisions.

* Here is the purpose of technical strategy

It is to ensure a long term vision focused on the future that looks into the horizon to try predicting what

The organization business needs will be based on the market and competition.

* These are the examples of using technology strategy
* Analytics and reporting
* Architectural initiatives
* Audit trail
* Business activity monitoring
* Business rules
* Collaboration tools
* Communication technology
* Computation

**What is a strategy impact?**

It clearly mention the purpose of the investment, it is also a detailed roadmap to achieve the impact and

Provides a long term vision of how such an impact will be achieved as well as how the investment will be

Measured to determine success of the impact vision.

**What is cyber risk analysis?**

It is the step in the overall risk management assessment process, the analysis is meant to examine each

Risk to the security of information systems, devices and data.

* This is how you can conduct a cyber-risk analysis
* Determine information value
* Identify and prioritize assets
* Identify cyber threats
* Identify vulnerabilities

**What is supply chain risk management?**

Is the implementation of strategy to manage both every day and exceptional risks along the supply chain

Based on continuous risk assessment with the objective of reducing vulnerability and ensuring

Continuity. It can also be defined as a systematic process for managing cyber supply chain risk

Exposures, threats throughout the supply chain and developing risk response strategies to the risks

Presented by the supplier the supplied products and services or supply chain.

**Why is supply chain risk management important?**

Because it plays more than a helpful addition role to your operations, it is also essential to your success

In events for example disaster, unpaid bills so it’s purpose is to prevent issues and provide loss

Mitigation if risk occurs.

* Ways to manage risk in the supply chain
* Identify and prioritize risks
* Create risk awareness in your company
* Strengthen cyber security defenses
* Take up insurance
* Perform due diligence when choosing your suppliers
* Conduct regular views

**We will need to know if advanced system engineering is connected with software engineering or**

**Cyber risk analysis.**

Here we will get to know that software engineering deals with designing and developing software of the

Highest quality while system engineering is the sub discipline of engineering which deals with the overall

Management of engineering projects during their life cycle.

Is a system engineer similar to software engineering?

A system engineer in information technology does some of the same work as a software engineer in that

He or she develops software components, like system engineers, software engineers typically they might

Have some several years of experience working with multiple programming languages and they are

Capable of collaborating with hardware engineers.

**Can a system engineer do coding?**

It is impossible, because system engineering is mostly about gathering requirements and concepts

Before any design starts in engineering. It is a branch of engineering which defines what the problem is

And what is required in a solution.

* Advantages of system engineering
* It helps to avoid omissions
* Invalid assumptions
* Manages real world changing issues
* Produce most efficient, economic and robust change

**This the purpose of system engineering**

It leads the development of the concept of operations and resulting system architecture, defining

Boundaries, defining and allocating requirements, evaluating design, balancing technical risk between

Systems and assessing interfaces.

**What is the value of system engineering?**

Its value is to influence the design when incurred costs are low and design changes are easy.

Issues that may occur in system engineering;

* Requirements engineering
* Reliability
* Logistics
* Coordination of different teams
* Testing and evaluation
* Maintainability
* Benefits of system engineering
* Reduces risk of schedule and cost overruns
* It increases likely that the implementation will meet the user’s needs
* Improves stake holder participation
* Shorter project cycles
* More adaptable and resilient systems
* Verified functionality and fewer defects
* Better documentation

**What is system engineering process?**

It is an application of systems analysis to the design and procurement of hardware systems to

Accomplish specific needs, it can also be an effective tool of management when well defined and

Implemented.

**What are the principles of system engineering?**

* principle govern process
* seek alternative systems perspective
* understand enterprise concept
* integrate system engineering
* project management

**These are the system elements of system engineering**

* hardware
* software
* equipment
* facilities

**What is system engineering management?**

System engineering management is concerned with the overall process of defining, developing,

Operating, maintaining and ultimately replacing quality systems.

* How to manage system engineering
* establish clear project from the beginning
* build a strong project team
* encourage an environment of self-motivation
* create milestones
* break it down
* use job management tools to manage your workflow
* Follow these steps in system engineering
* requirement analysis and management
* functional analysis and allocation
* system analysis and control
* verification

**Conclusion**

To conclude in this lesson we have seen that advanced system engineering is a methodical and

Multidisciplinary that approach the design realization technical management and retirement of a

System, we can also that it is an element that function together in order to produce the capability

 Required to meet a need.

Reference

Book: modern advanced mathematics for engineers

Author: Dimitri Romanov

I read notes and research