Software System Engineering: A Tutorial

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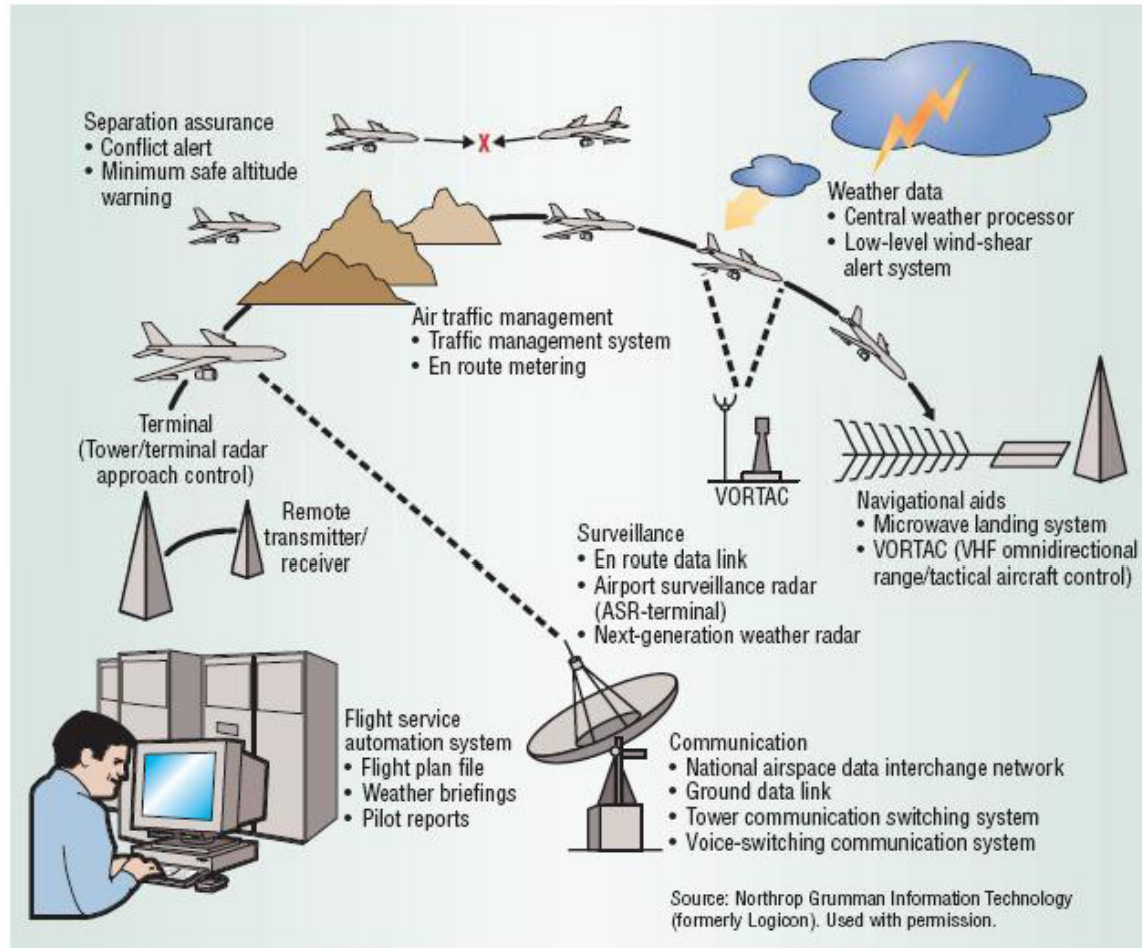
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INTRODUCTION

- Software systems have become larger and more complex than ever

Example of this concept

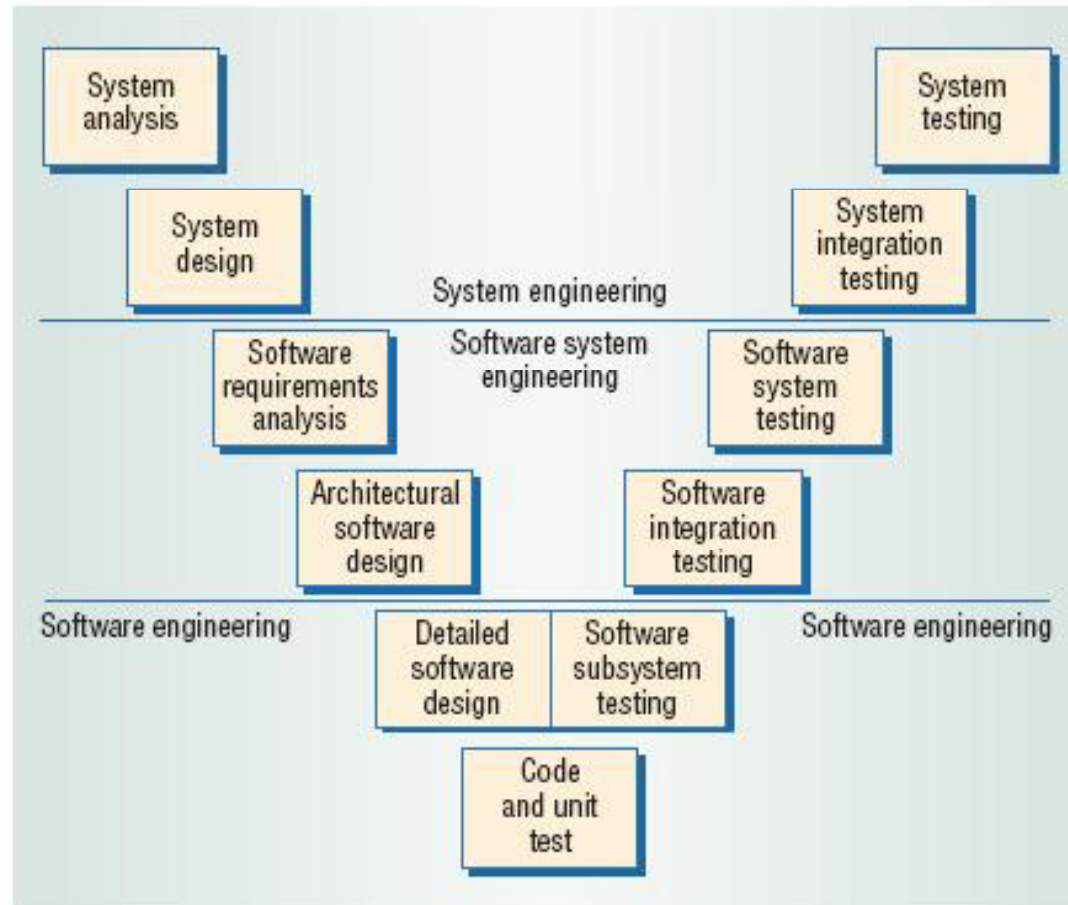*Air traffic control system environment.*

SYSTEM and SYSTEM ENGINEERING

- ## System
  - A collection of elements **related** in a way that allows the accomplishment of a **common object**

- ## System Engineering
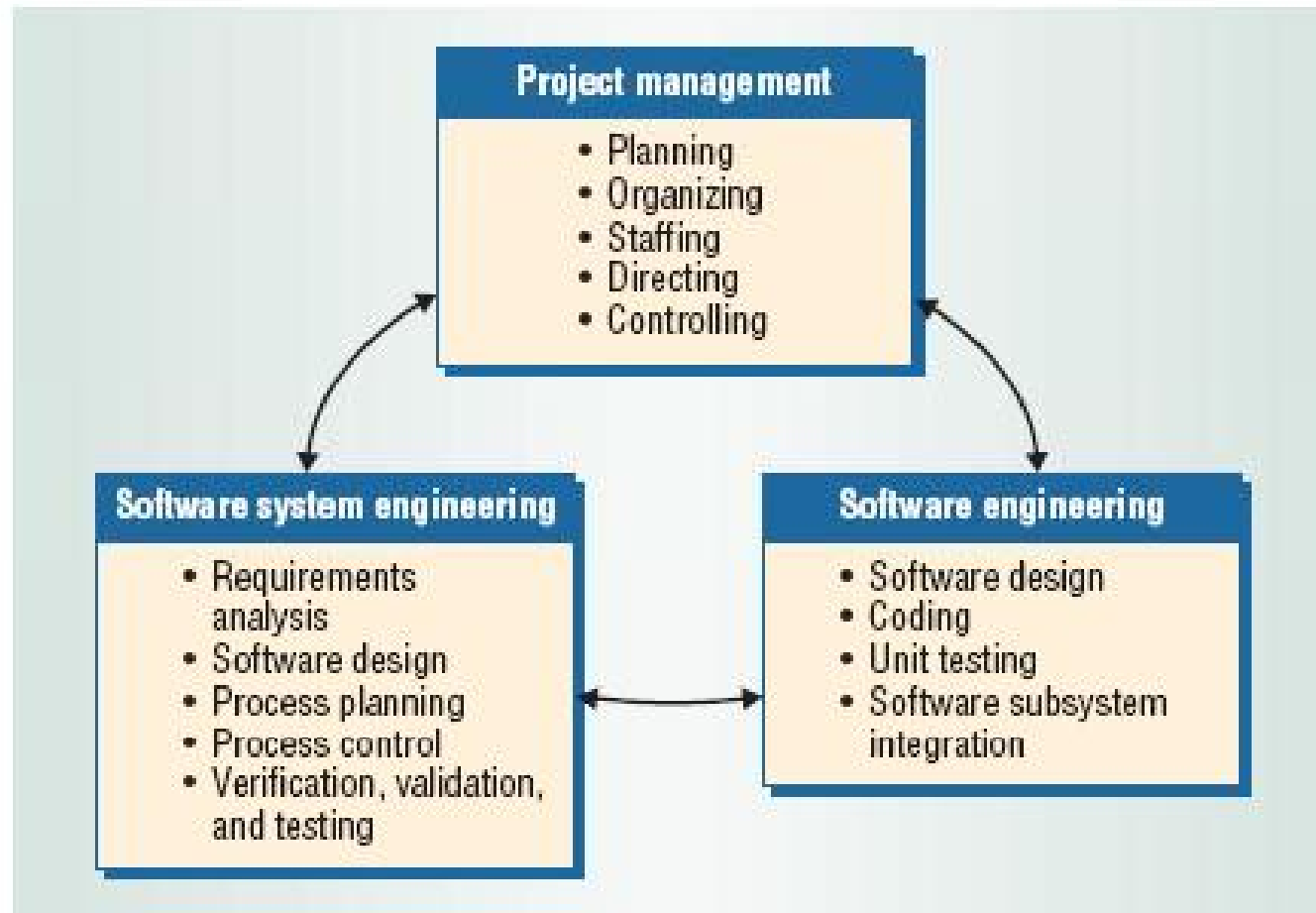 - The overall technical management of a system-development project

SOFTWARE SYSTEM ENGINEERING (SwSE)

- A technical and management process

SwSE and software engineering

SwSE and project management

THE FUNCTION OF SwSE

System engineering function	SwSE function	SwSE function description
Problem definition	Requirements analysis	Determine needs and constraints by analyzing system requirements allocated to software
Solution analysis	Software design	Determine ways to satisfy requirements and constraints, analyze possible solutions, and select the optimum one
Process planning	Process planning	Determine product development tasks, precedence, and potential risks to the project
Process control	Process control	Determine methods for controlling project and process, measure progress, and take corrective action where necessary
Product evaluation	Verification, validation, and testing	Evaluate final product and documentation

Table 1. System engineering functions correlated to software system engineering (SwSE).

Requirement analysis

- Determine needs and constraints by analyzing system requirements allocated to software

Software design

- Determine ways to satisfy requirements and constraints, analyze possible solutions, and select the optimum one

Process planning

- Determine product development tasks, precedence, and potential risks to the project

Process planning (cont.)

Table 2. Process planning versus project planning.	
Software system engineering planning activities	**Project management planning activities**
Determine tasks to be done	Determine skills necessary to do the tasks
Establish order of precedence between tasks	Establish schedule for completing the project
Determine size of the effort (in staff time)	Determine cost of the effort
Determine technical approach to solving the problem	Determine managerial approach to monitoring the project's status
Select analysis and design tools	Select planning tools
Determine technical risks	Determine management risks
Define process model	Define process model
Update plans when the requirements or development environment change	Update plans when the managerial conditions and environment change

Process control

- Determine methods for controlling project and process, measure progress, and take corrective action where necessary

Process control (cont.)

Table 3. Process control versus project control.	
Software system engineering control activities	**Project management control activities**
Determine the requirements to be met	Determine the project plan to be followed
Select technical standards to be followed, for example, IEEE Std. 830	Select managerial standards to be followed, for example, IEEE Std. 1058
Establish technical metrics to control progress, for example, requirements growth, errors reported, rework	Establish management metrics to control progress, for example, cost growth, schedule slippage, staffing shortage
Use peer reviews, in-process reviews, software quality assurance, VV&T, and audits to determine adherence to requirements and design	Use joint acquirer-developer (milestone) reviews and SCM to determine adherence to cost, schedule, and progress
Reengineer the software requirements when necessary	Replan the project plan when necessary

Verification, validation and testing (VV&T)

- Evaluate final product and documentation

SUMMARY AND CONCLUSIONS

- SwSE is not cheap, but it cost effective