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ICT Innovation – Spring 2018

MSc in Computer Science and MEng Telecom. Engineering
EIT Masters ITA, S&P,SDE
MA in Management of Innovation

Lecture 10 – Product Architecture (SW)

Prof. Fabio Massacci

Product Development Process

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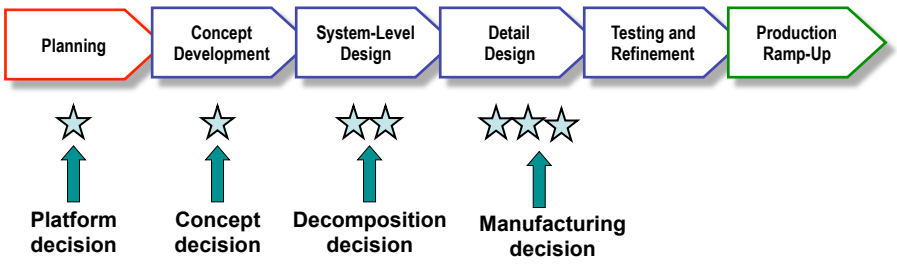
- **Product architecture is determined early in the development process**
- **Detailed design is important for "manufacturing"**
  - Software must also manufactured (aka development)
  - It may also be developed as Software Product Line or as Cloud Offering (but still Manufactured)
  - Tooling and Printing have SW analogues



Types of Architectures

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- **Modular Architecture**
  - Chunks implement one or a few functions.
- **Pros and Cons**
  - Interactions between chunks must be well defined.
  - Simplicity of design
  - Reusability for a product family or platform.
  - Can exploit FOSS libraries
- **Robust to asymmetric wear and tear of components**
  - For the bike: only stressed components must be made of high quality material (or can be replaceable)
  - What is the sw equivalent?

- **Integral Architecture**
  - A chunk may implement many functions
- **Pros and Cons**
  - Interactions between chunks can be poorly defined.
  - Harder to design
  - Make one part instead of two and integrating them
  - Performance may increase
- **Fragile to asymmetric wear and tear of components**
  - For the bike: if some part of frame wears out → must replace whole wheel
  - What is the SW Equivalent?

Sw Cost Structure: The 40-20-40 Rule

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From: R Wolverton. The Cost of Developing Large Scale Software. IEEE Transactions on Computers. 1974

TABLE II
COMPUTER PROGRAM DEVELOPMENT BREAKDOWN

	ANALYSIS AND DESIGN	CODING AND AUDITING	CHECKOUT AND TEST
SAGE	39%	14%	47%
NTDS	30	20	50
GEMINI	36	17	47
SATURN V	32	24	44

+30% Cost of Physical Modelling

+20% Cost of Computing and hardwrae

A Bit More on Cost Structure

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From: R Wolverton. The Cost of Developing Large Scale Software. IEEE Transactions on Computers. 1974

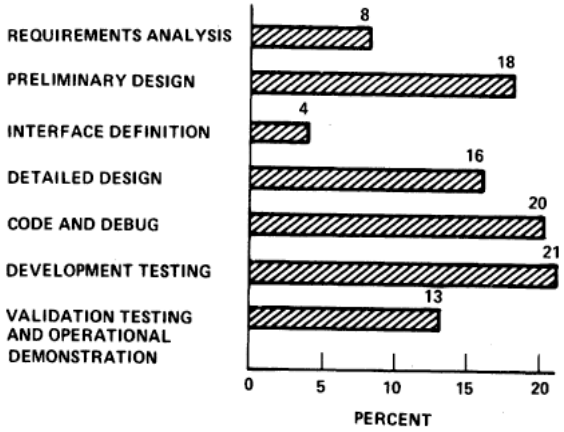

Fig. 16. Typical allocation of resources in custom software development and test.

Make or Buy?

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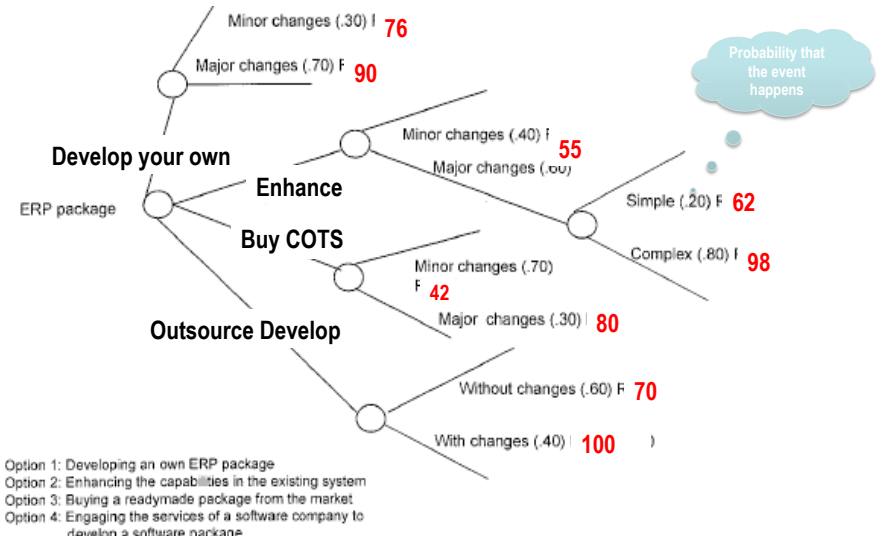

Option 1: Developing an own ERP package
Option 2: Enhancing the capabilities in the existing system
Option 3: Buying a readymade package from the market
Option 4: Engaging the services of a software company to develop a software package

From: SS Rao. Enterprise resource planning: business needs and technologies. Industrial Management & Data Systems, 2000

Effort Drivers when using COTS

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COCOMO II Cost Factor	Source of COTS Integration Effort				
	COTS Assessment	COTS Tailoring	Glue Code Development	Application Volatility	System IV&V
Reliability, Data, Complexity, Docum'n	+		++	+	++
Required Reuse			+		+
Platform Difficulty	+	+	++	+	+
Personnel Capability	++	+	++	++	++
Process (tools, sites, etc.)			+	+	+
Schedule	+		+		+
Architecture/Risk Resolution	+		++	++	++

Fundamental Decisions – What is different for SW?

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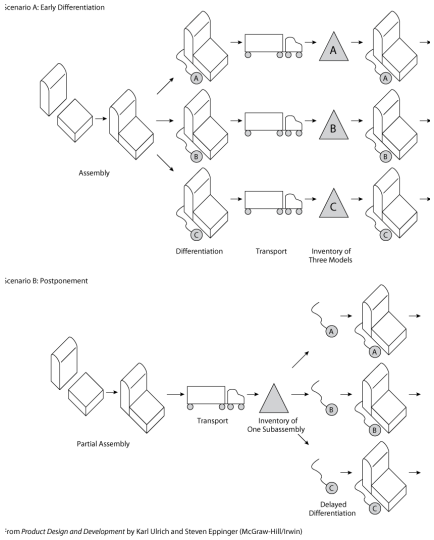
- Integral vs. modular architecture?
- What type of modularity?
- How to assign functions to chunks?
- How do we produce and assembly chunks?
- How many different products do we want?



Textbook

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Product Design and Development
Karl T. Ulrich and Steven D. Eppinger
5th edition, Irwin McGraw-Hill, 2012

1. Introduction
2. Development Processes and Organizations
3. Opportunity Identification
4. Product Planning
5. Identifying Customer Needs
6. Product Specifications
7. Concept Generation
8. Concept Selection
9. Concept Testing
10. **Product Architecture**
11. Industrial Design
12. Design for Environment
13. **Design for Manufacturing**
14. Prototyping
15. Robust Design
16. Patents and Intellectual Property
17. Product Development Economics
18. Managing Projects