



Engineering design processes

Prof Claudia Eckert

Engineering design processes



- Factories of the future can only work efficiently, if the products are designed in a suitable way
 - Designs are ready on time to feed into production work planning
 - Products are designed in a way that can make use of the factories capability
 - Products meet the changing needs of customers
- The design process required to generate the next generation of products are highly complex in their own right.
- The talk will highlight some of the reasons why

Engineering design is a mix of the new and the old



Volvo diesel truck,
ca 70 component reuse

- Huge variation across
- Product classes
 - Product generations

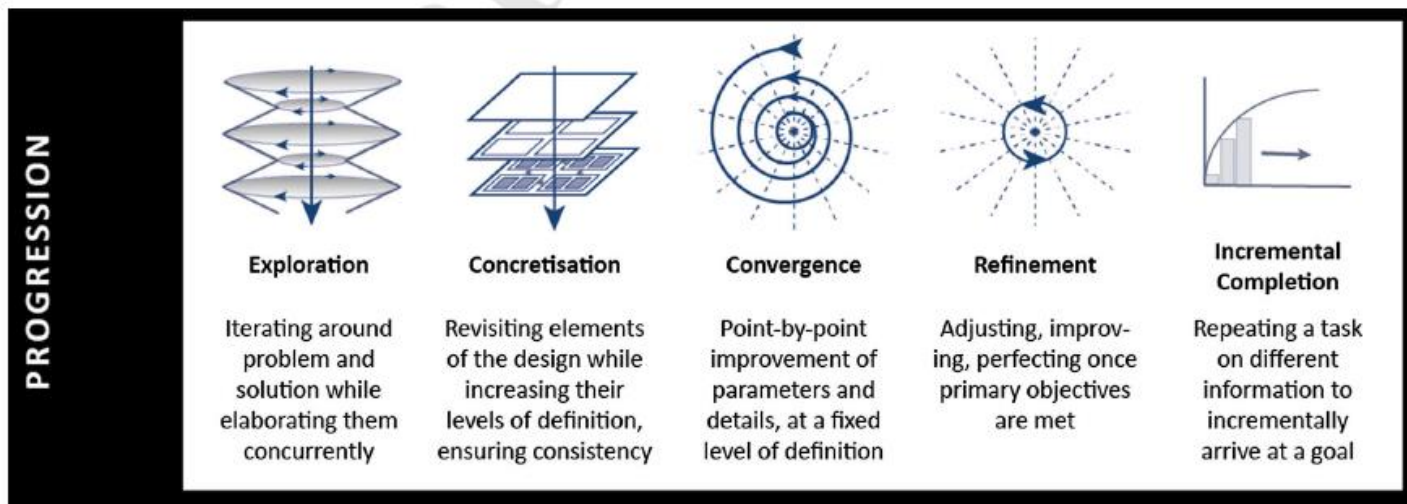


Tesla electric truck,
New development

High iterative development



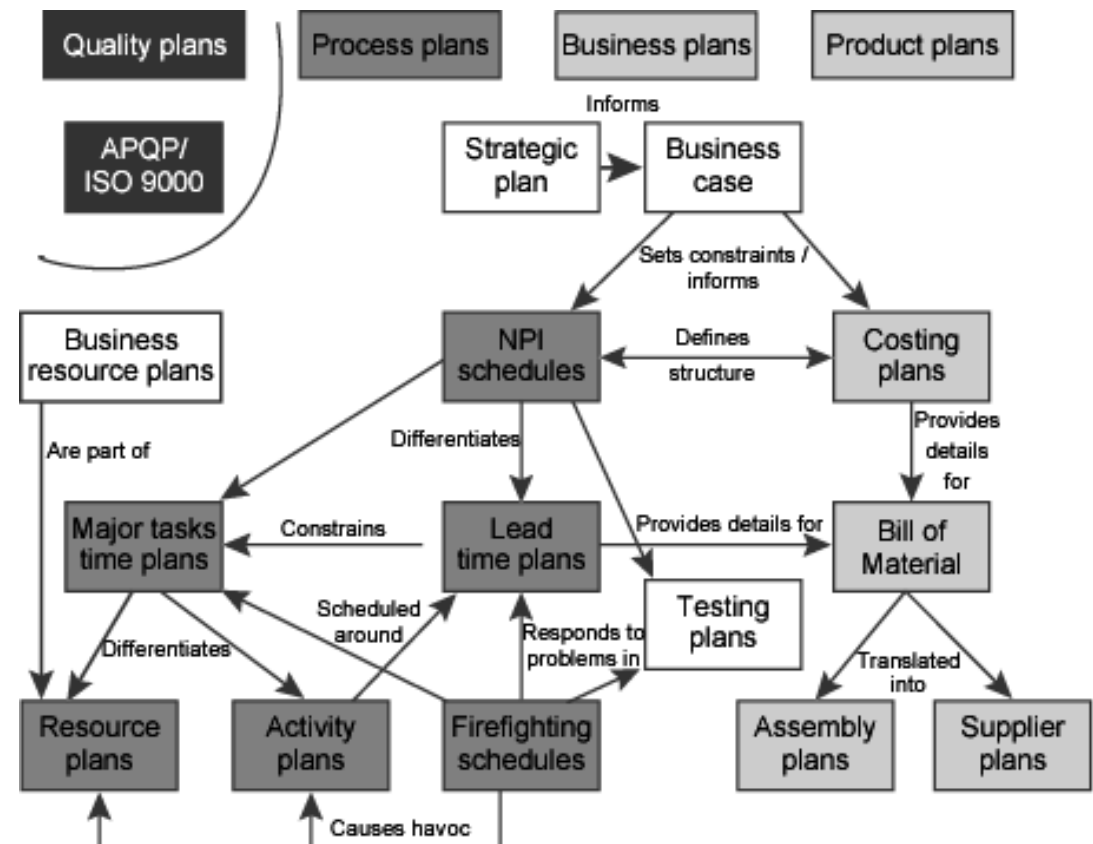
- System depend on information from each other
- System are designed in parallel
- Convergent iteration in design processes
 - Everybody shares assumptions
 - Worked out the consequences
 - Iteration stops when information is validated



Thinking about process models



- Companies use many different models to describe their processes
 - Activity models
 - Gateway models
 - Schedules
 - Product models ...
- What is their relationship to the final process?
- Here we discuss some metaphors:
 - Plans
 - Prediction
 - Prophecies



Trends in Engineering Design



multidisciplinary, global, incremental

robust, reliable, value for money, energy efficient, sustainable



Conservative incremental design is a way of managing risk

Information in design processes



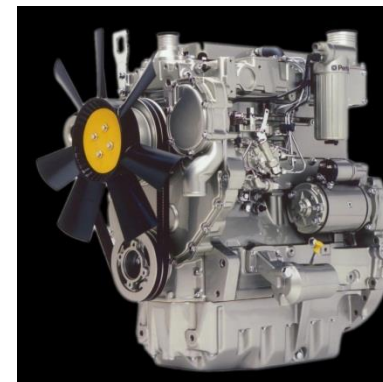
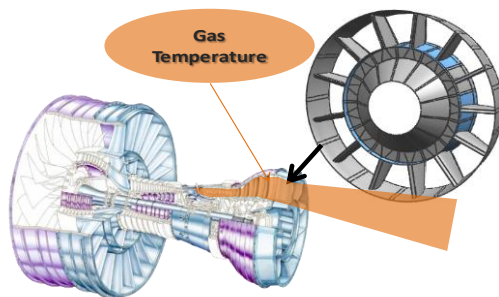
- Information mix
 - Complete specification for existing systems
 - Huge amounts of in service data for not older systems
 - Estimates how existing system will behave in new context
 - Preliminary information about new system
- Uneven quality of information
- Unknown status of information
 - Information might have been changed and not updated
 - Assumption that the information is based unclear

Conditions Leading to Change



Findings from cross industry workshop

- Complexity: products, platforms, variants
- Product proliferation
- Legislation and regulation
- Technology infusion
- Changing customer needs
- Competitors
- Large scale uncertainties
- Changes throughout the development process



Summary of Causes of Change

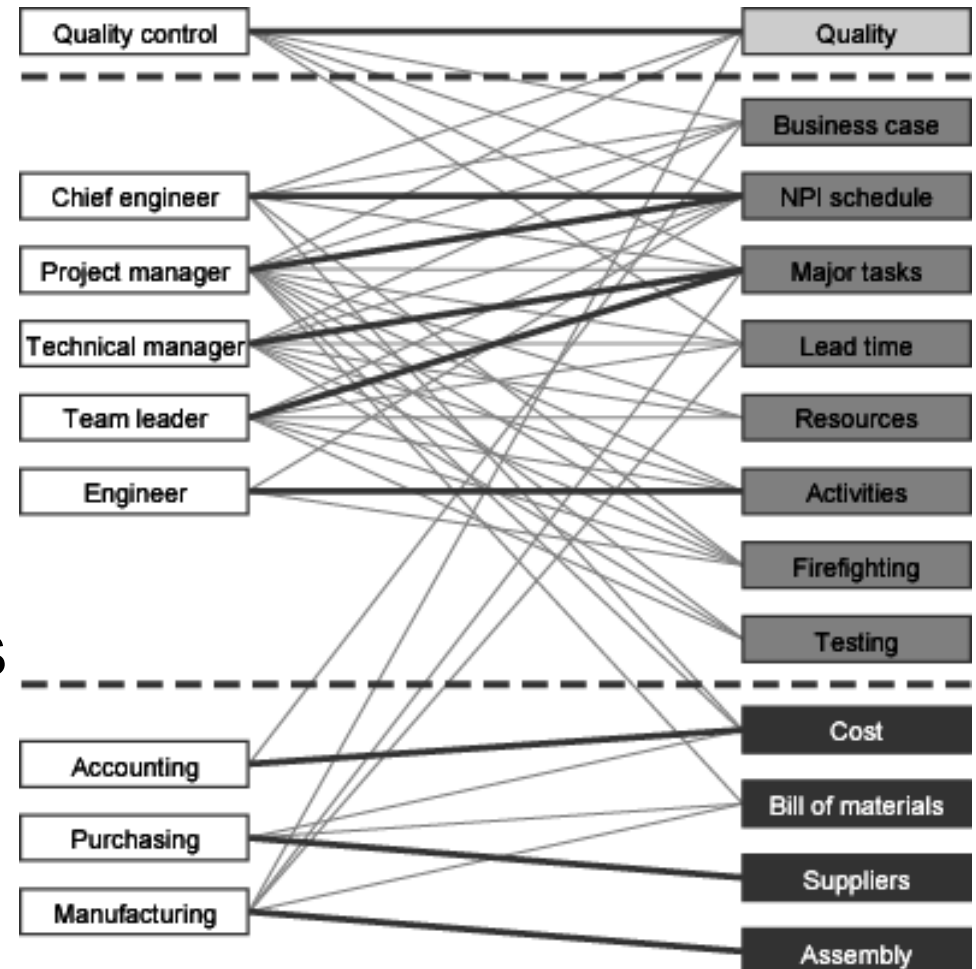


Changes in:	Cars (US)	Cars (D)	Car parts	Aero engine	Defence aero	Defence vehicle	Fire engines	Printers	Oil
Requirements	✓	✓	✓	✓		✓	✓		
Regulations	✓	✓		✓	✓	✓	✓	✓	
Competition / market	✓						✓	✓	✓
Technology	✓		✓	✓	✓		✓	✓	✓
Quality, cost, capability	✓	✓			✓		✓	✓	
Sustainability					✓			✓	
Errors / problems / system integration		✓	✓	✓		✓		✓	
Project management		✓		✓	✓	✓	✓		✓
Change to use of product	✓			✓					
Design for service/upgrades /technology obsolescence	✓			✓	✓	✓	✓		

Challenges for design processes



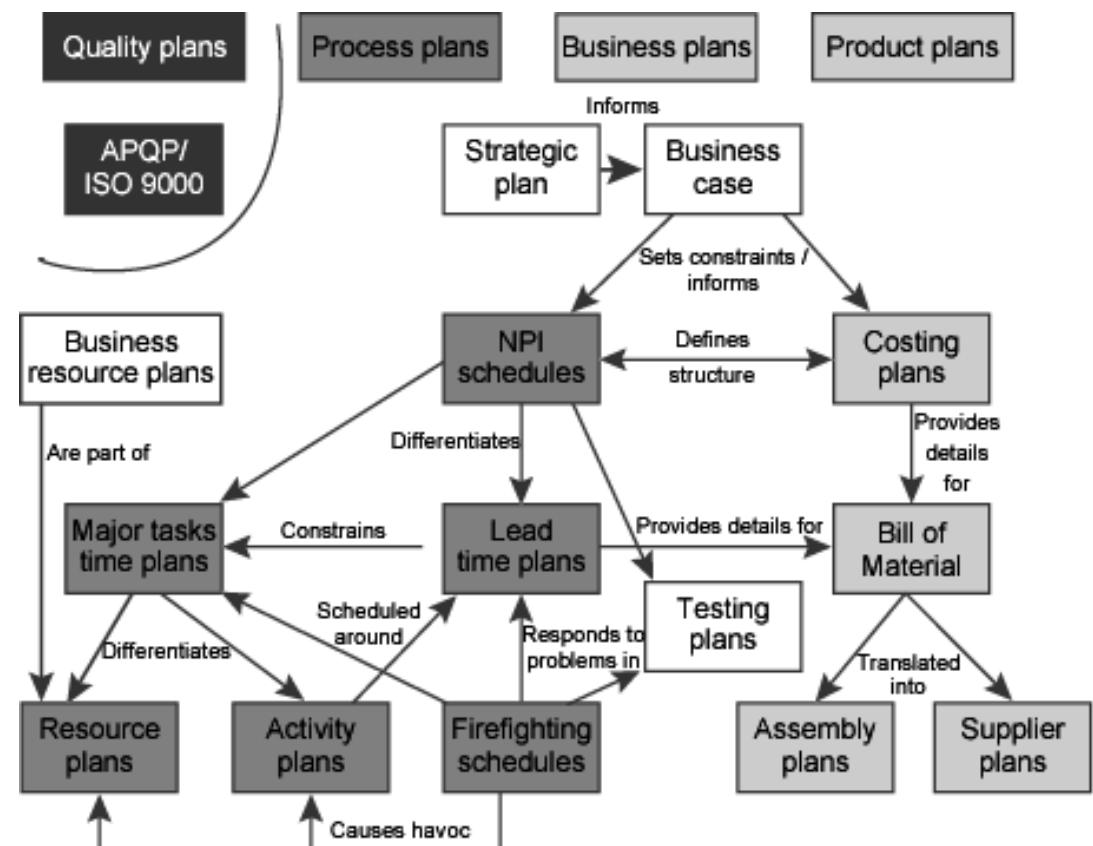
- Design processes need to be
 - Planned
 - Resources
 - Managed
- Design processes are very difficult to describe
- Processes can only be interacted through models



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What makes engineering design processes complex



- Uncertainty around the product and its requirements
- Partial and uneven information
- Information dependency between activities
- Processes that are difficult to express
- Partial views of individuals