Introduction to
Product Design and Innovation

November 12th, 2014
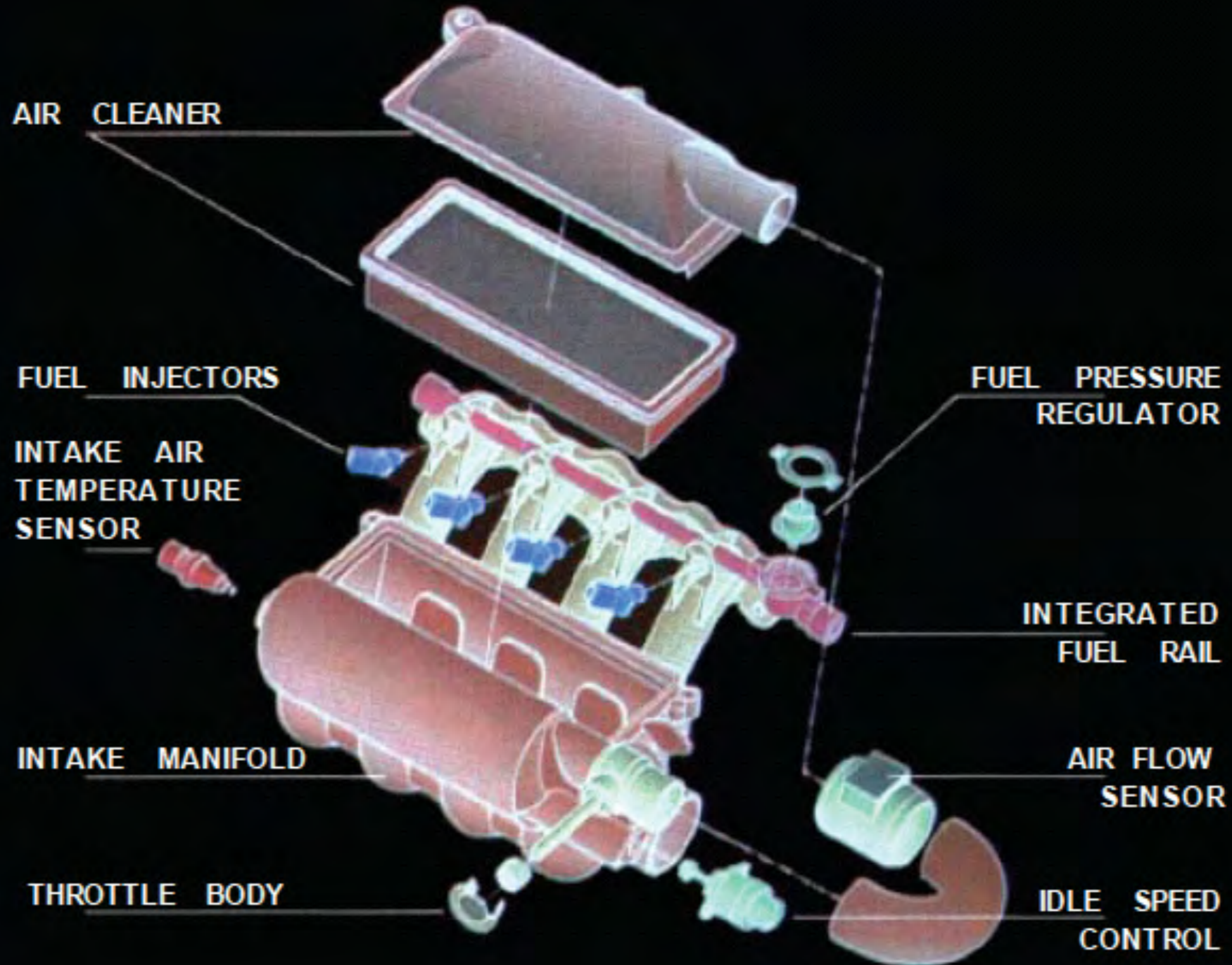
System Level Design
Detail Design
Manufacturing

System Level & Detail Design
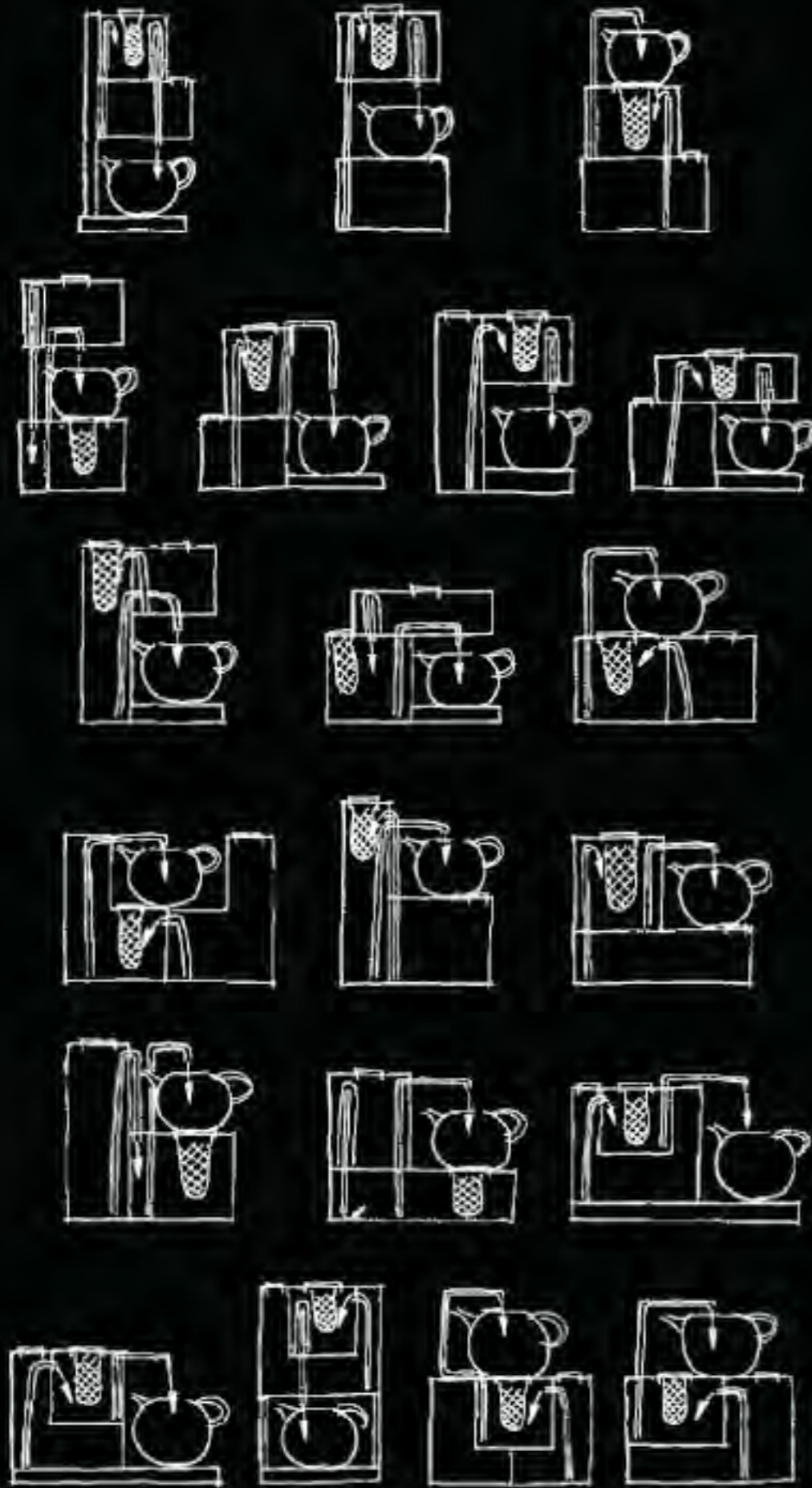

- Design Stage starts from final concept

- Clear, **systematic** process

- Requires iteration
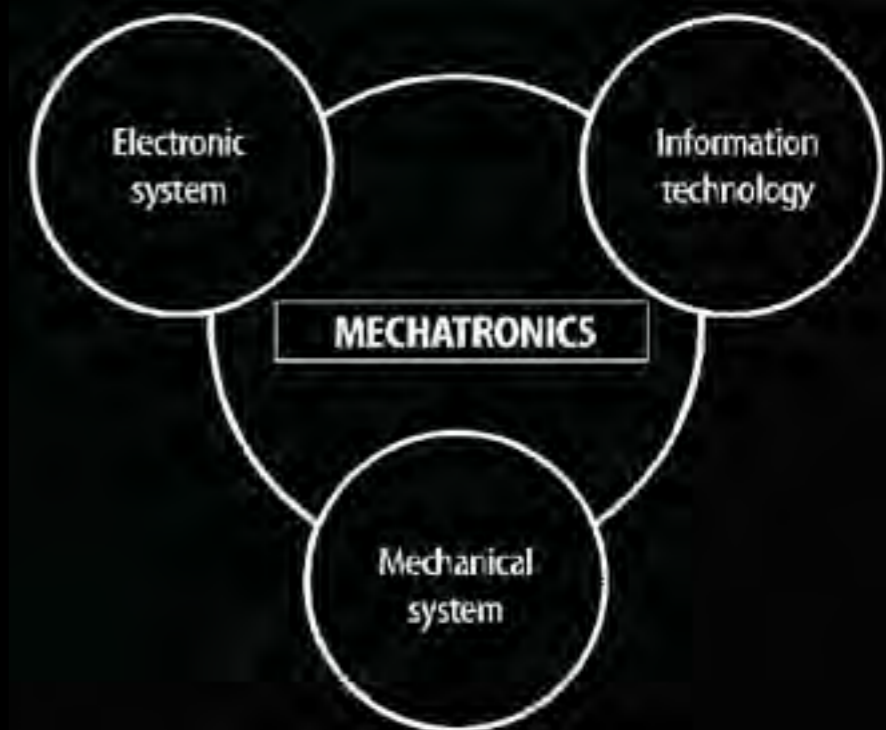
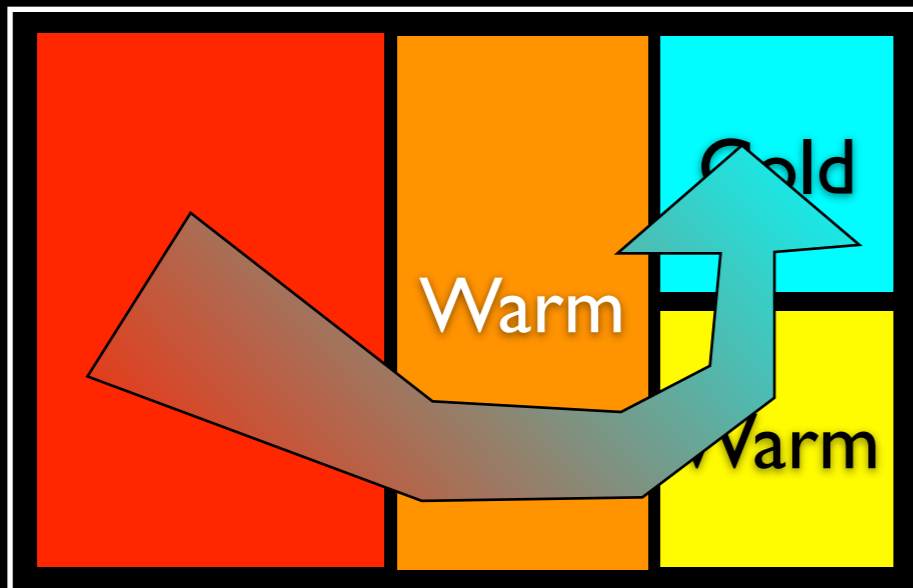- Convergen and divergent stages: <><><>
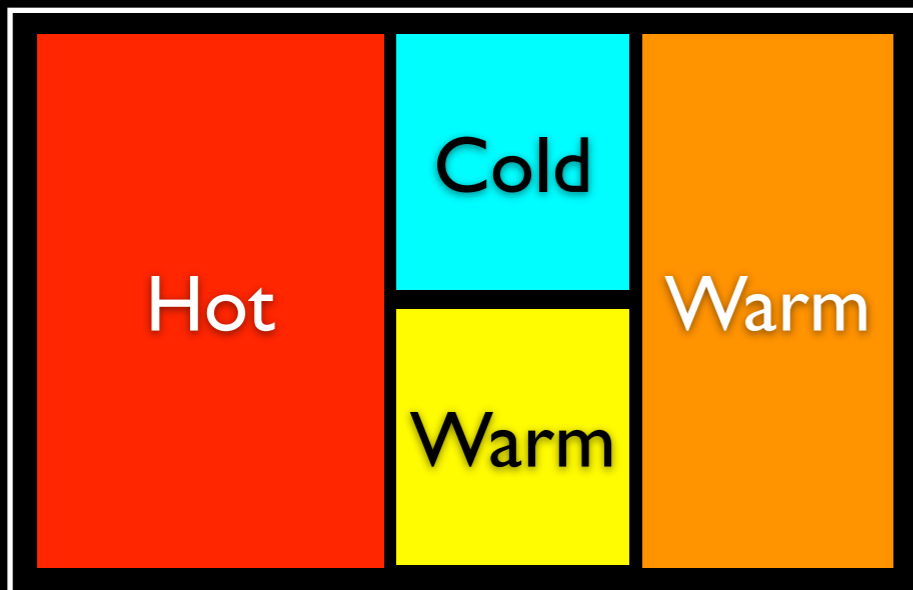
System level design

AIR CLEANER

FUEL INJECTORS

INTAKE AIR
TEMPERATURE
SENSOR

INTAKE MANIFOLD

THROTTLE BODY

FUEL PRESSURE
REGULATOR

INTEGRATED
FUEL RAIL

AIR FLOW
SENSOR

IDLE SPEED
CONTROL

System Level

- Overall layout

- Product architecture

- Interfaces between sub-systems

- Joining

- BoP

* Pahl & Beitz, 1977

Layout Drivers

- Balance between units

- Energy flow

- Accessibility

- Protection
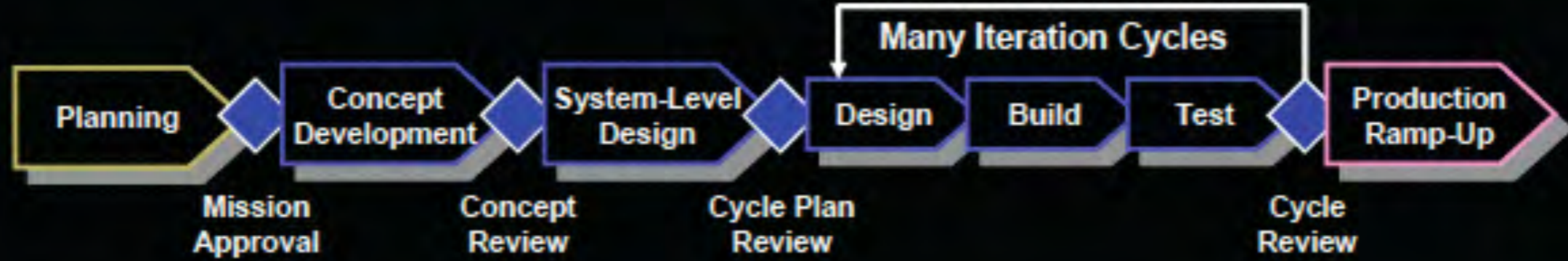
- DFA

System level design

- Manufacturing & assembly process
- Maintainability
- Accessibility, usability
- Compactness
- Aesthetics
- Number of parts & sub-assemblies
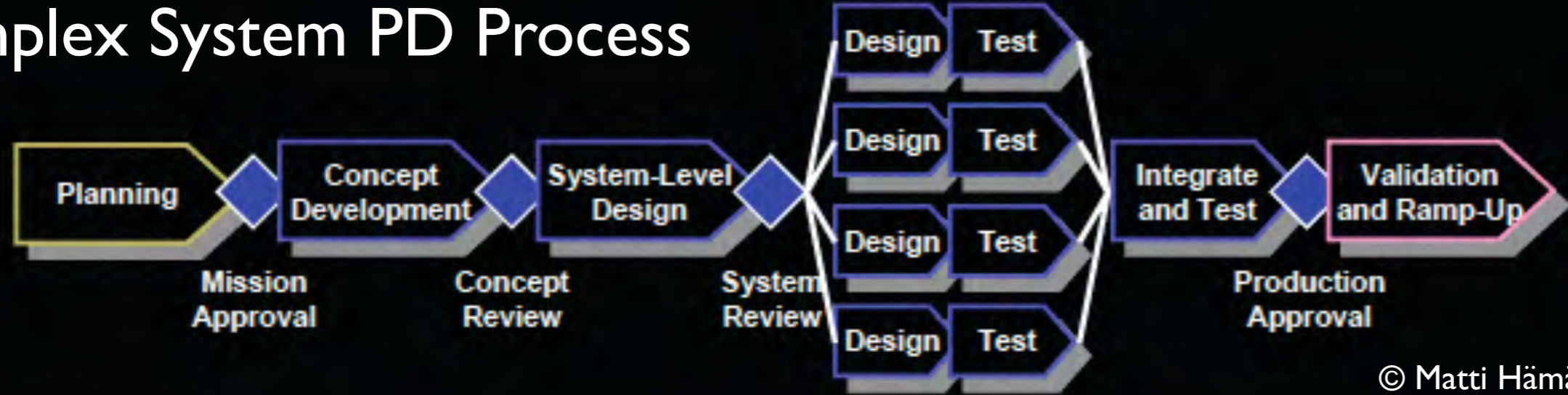 - → Bill of Parts

Detail Design

Generic PD Process

Rapid Iteration PD Process

Complex System PD Process

Detail design

- Principle: *Value to Customer > Price > Cost*

- DFM, DFA

- Documentation

- Once the Big Questions are solved, you can start making the blueprints

Detail design

- Each part has to be designed & manufactured
- Determine for each individual component
  - Material
  - Manufacturing method
  - In-house, off-shore, outsource?
  - Standardization
  - Cost

Manufacturing

Manufacturing

Simple guidelines of manufacturing:

1) If you are not the expert, find somebody who is!

2) Always think about *alternative manufacturing methods!*

3) Keep manufacturing in your mind throughout the design process – not just in the end!

4) Prototype can be made from *different materials* and using *different methods*; both still need to be designed!
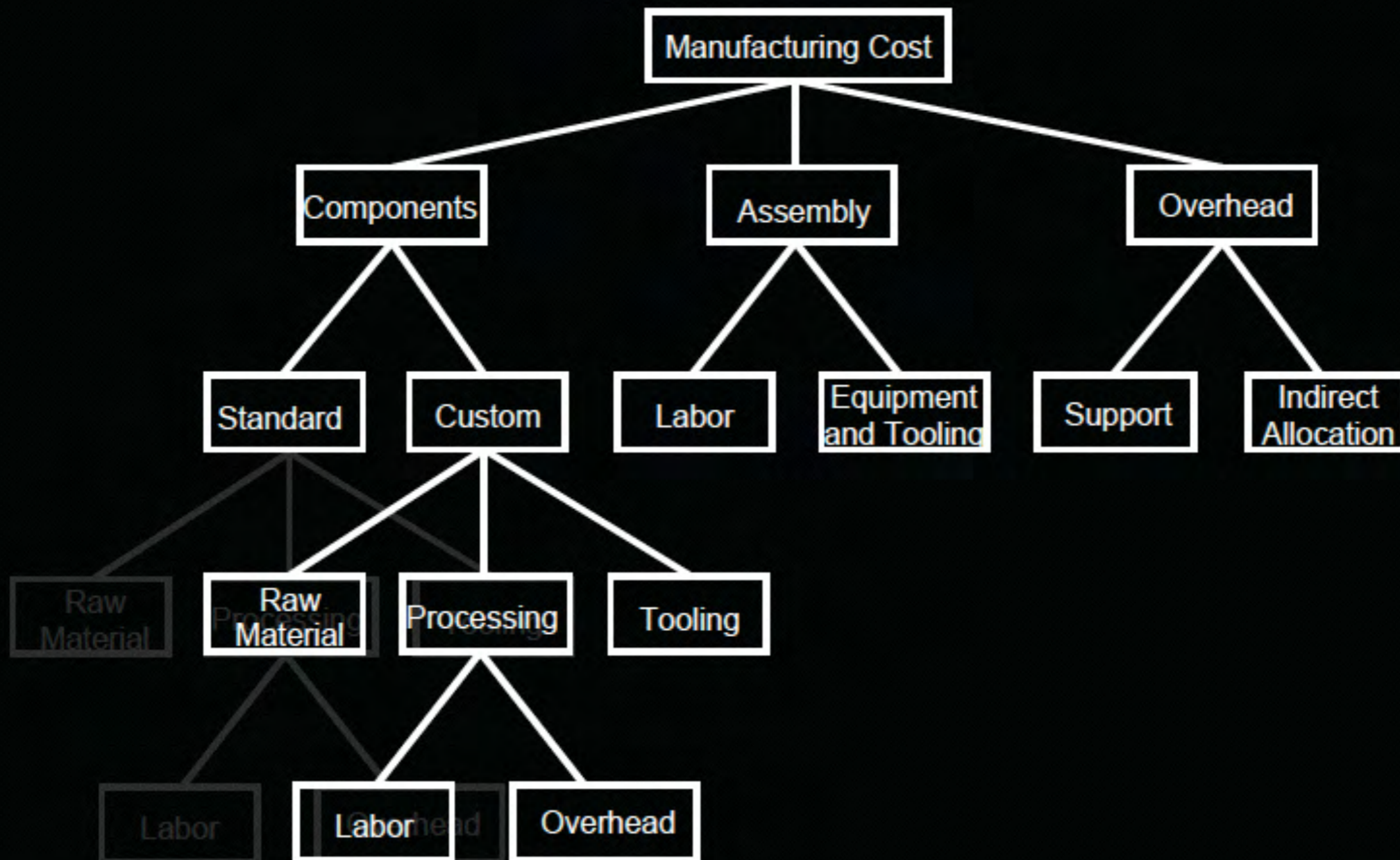
Prototype?

Prototype?

DFM

- Design for Manufacturing (DFM) is a development practice emphasizing manufacturing issues throughout the product development process

- Successful DFM results in lower production cost without sacrificing product quality

Manufacturing costs

DFA – Design For Assembly

DFA *in the Large*
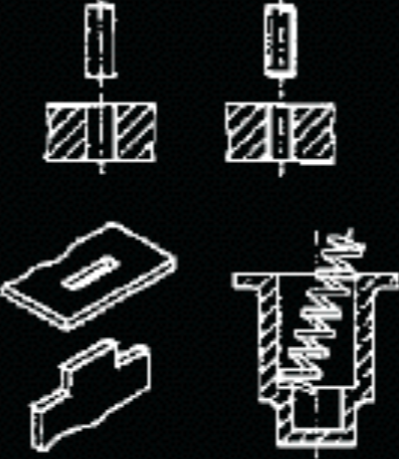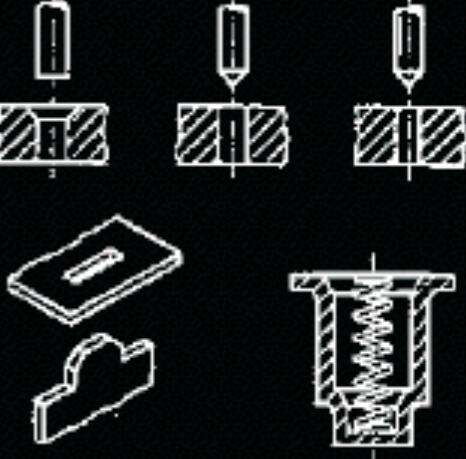- Simplify the design
- Minimize parts count

DFA *in the Small*
- Make assembly easier and more reliable
    - Easy to handle, Easy to insert
    - One motion per component
    - Vertical assembly

DFA Principles

1. Minimize parts count.
2. Encourage modular assembly.
3. Stack assemblies.
4. Eliminate adjustments.
5. Eliminate cables.
6. Use self-fastening parts.
7. Use self-locating parts.
8. Eliminate reorientation.
9. Facilitate parts handling.
10. Specify standard parts.

DFA – Examples

© Matti Hämäläinen (2014)