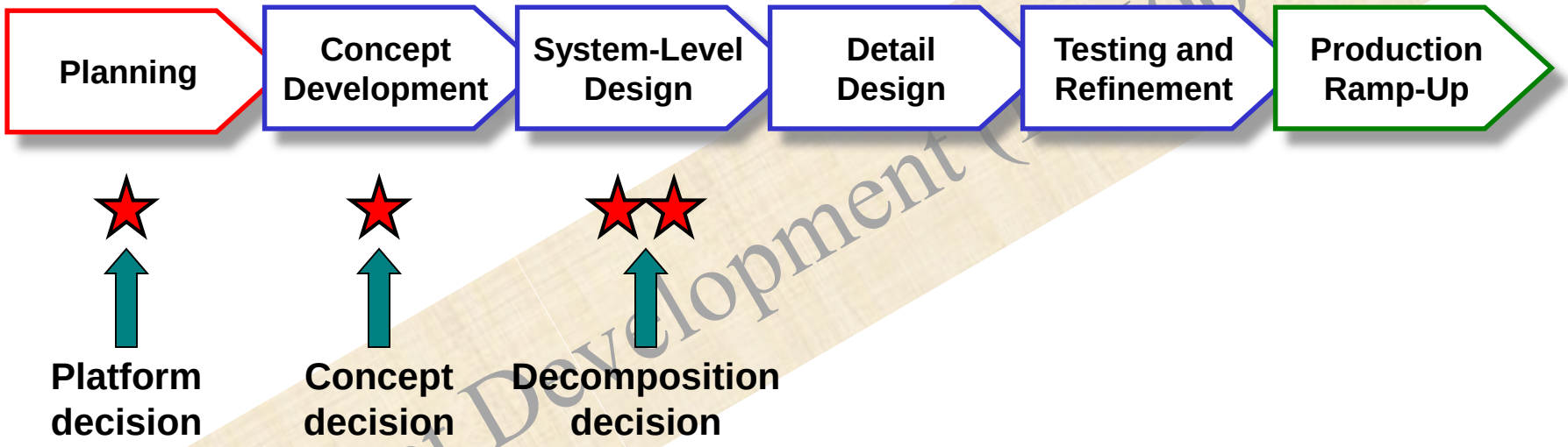
Product Architecture

Product Development Process



Product architecture is determined early in the development process.

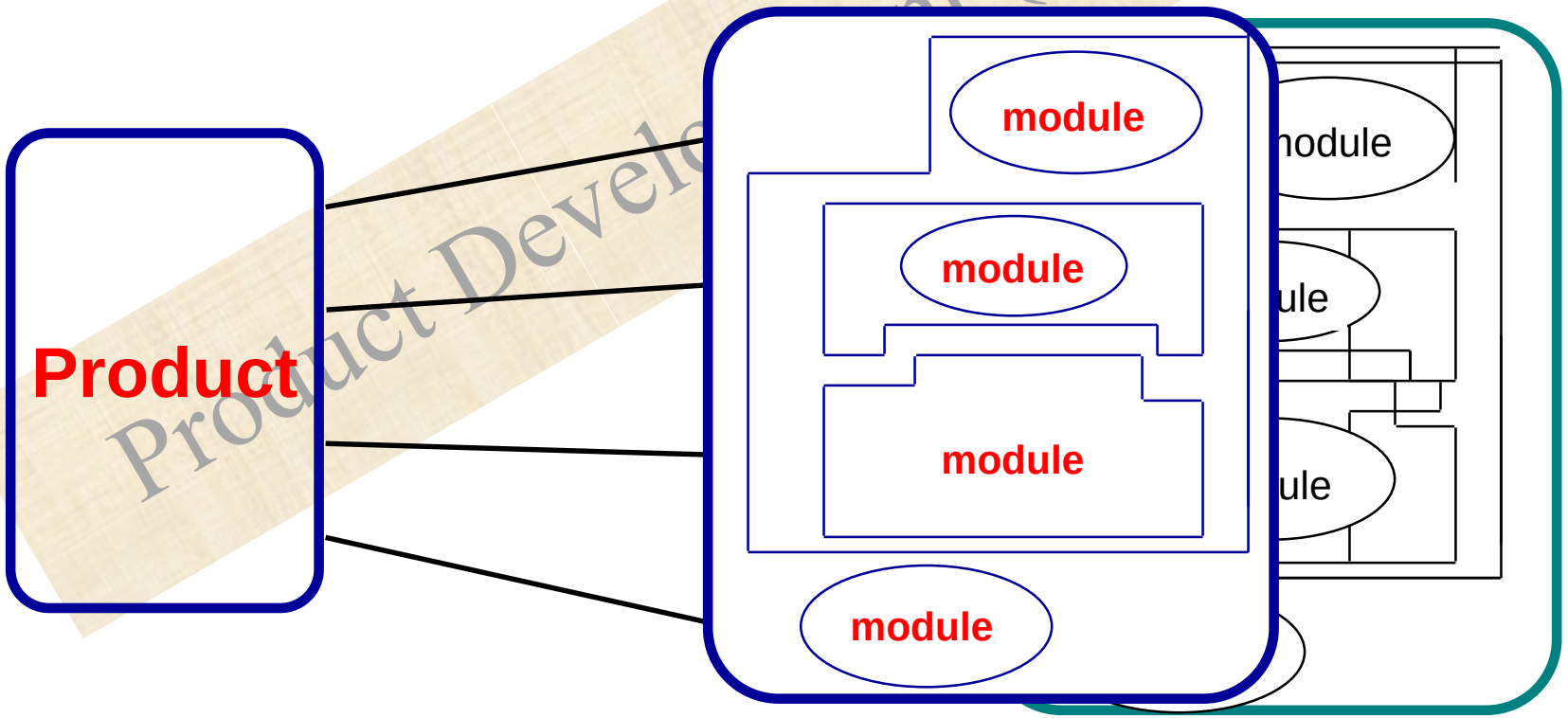
Product Architecture Example: Hewlett-Packard DeskJet Printer

Questions asked

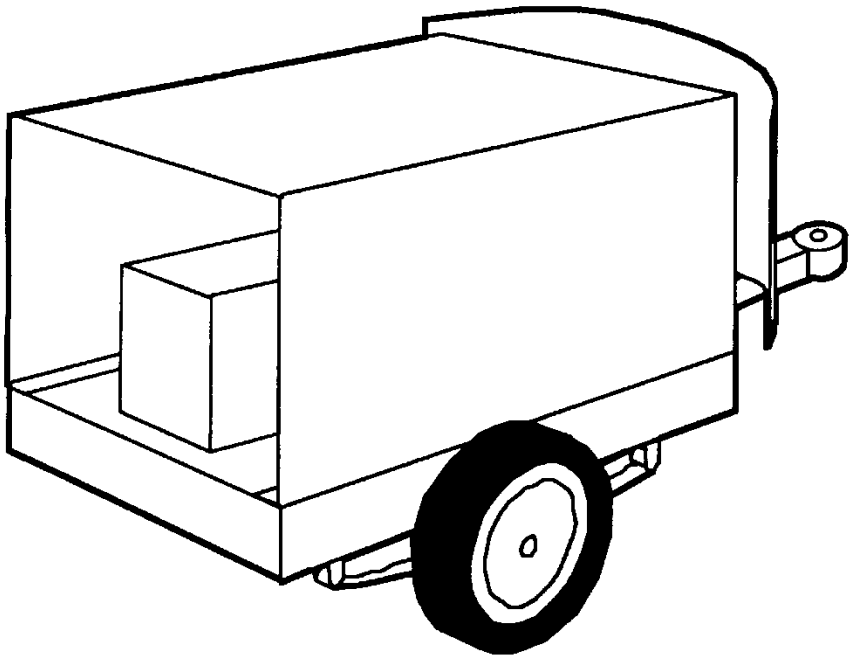
- How would the architecture of the product impact their ability to offer product variety?
- What would be the cost implications of different product architectures?
- How would the architecture of the product impact their ability to complete the design within time?
- How would the architecture of the product influence their ability to manage the development process?

What is Product Architecture?

The arrangement of functional elements into physical chunks which become the building blocks for the product or family of products.

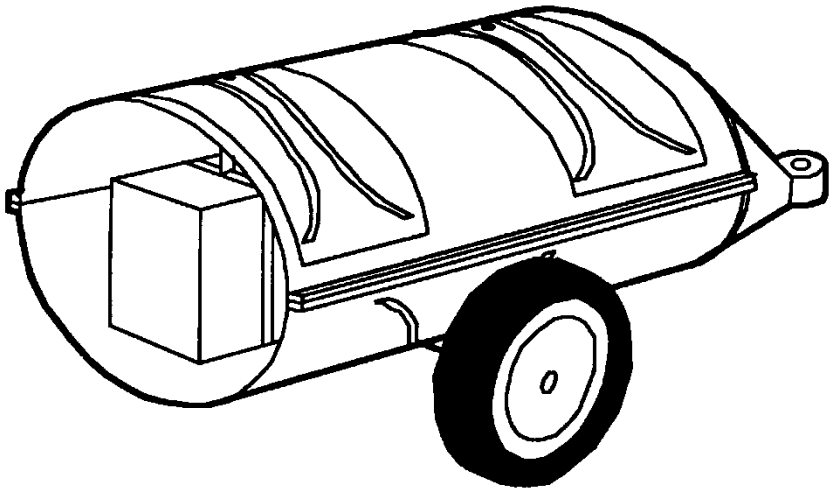


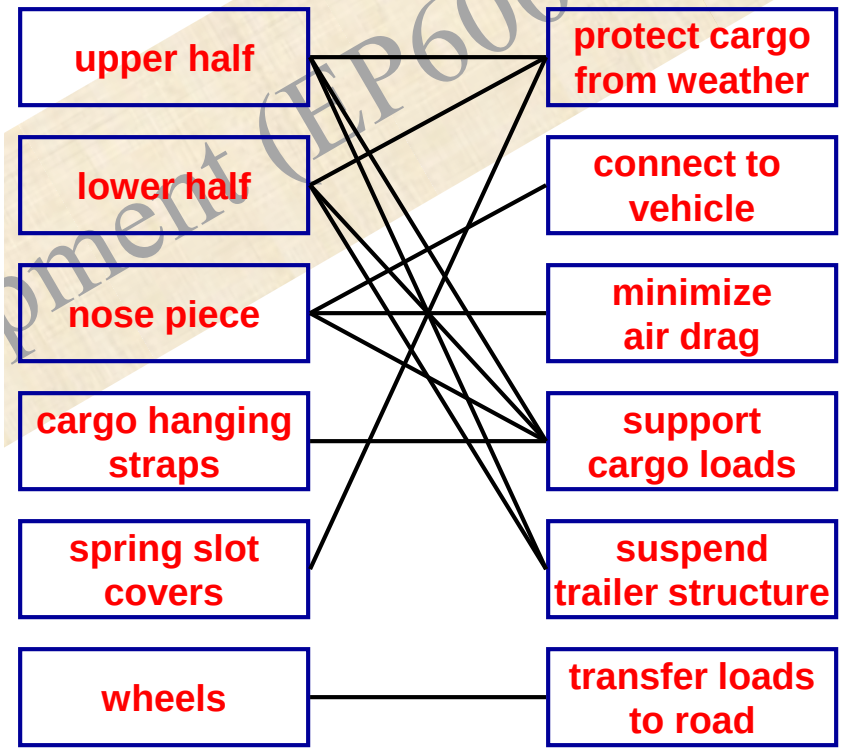
Trailer Example: Modular Architecture



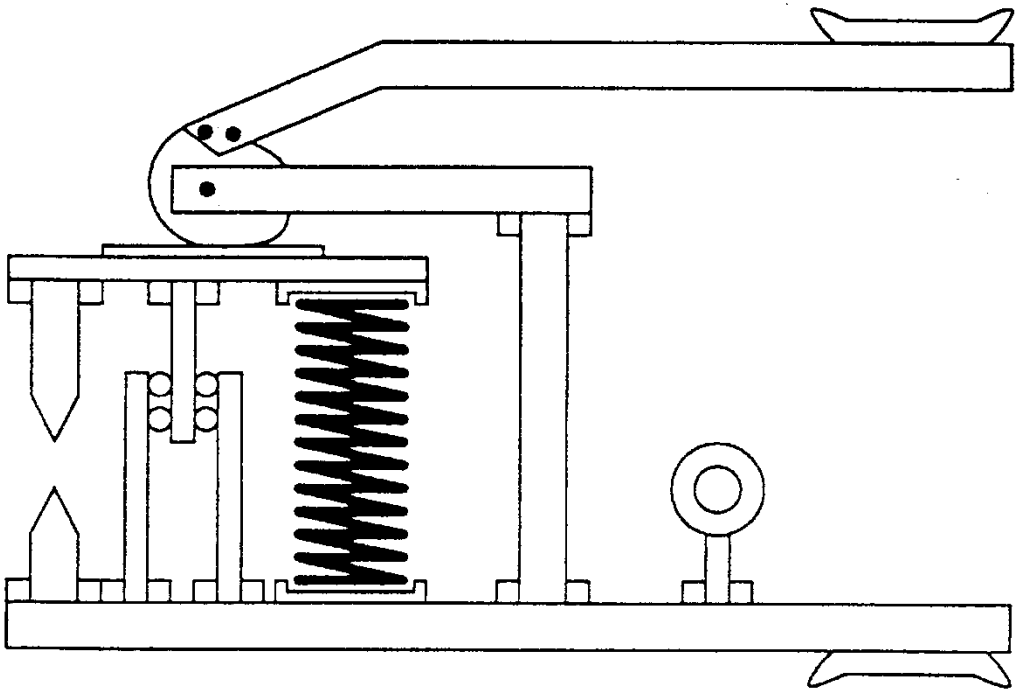
box	protect cargo from weather
hitch	connect to vehicle
fairing	minimize air drag
bed	support cargo loads
springs	suspend trailer structure
wheels	transfer loads to road

Trailer Example: Integral Architecture

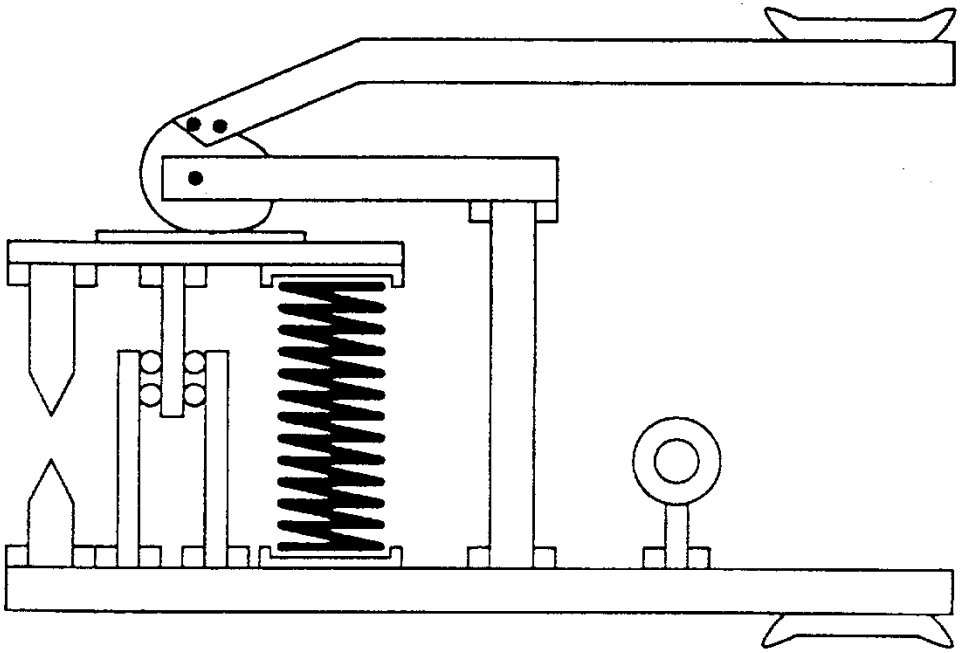


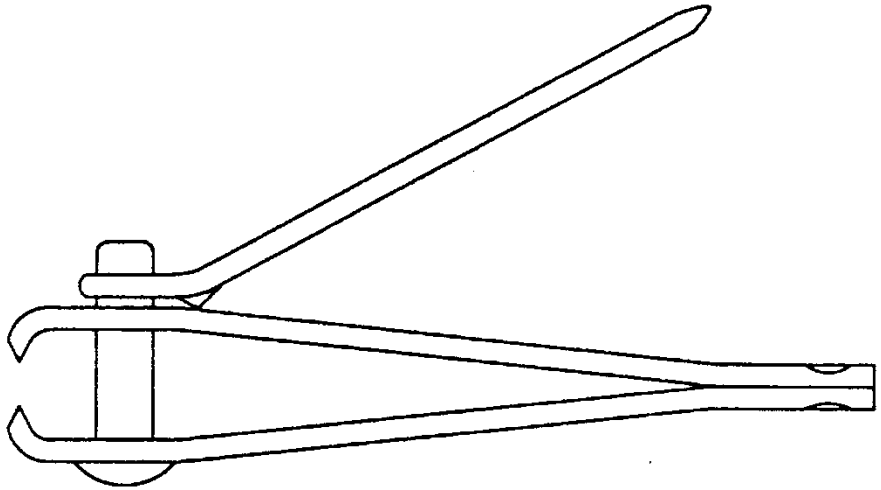


What is this?



Nail Clippers?





Modular Product Architectures

- Chunks implement one or a few functions entirely.
- Interactions between chunks are well defined.
- Modular architecture has advantages in simplicity and reusability for a product family or platform.

Swiss Army Knife

Sony Walkman

Platform Architecture of the Sony Walkman

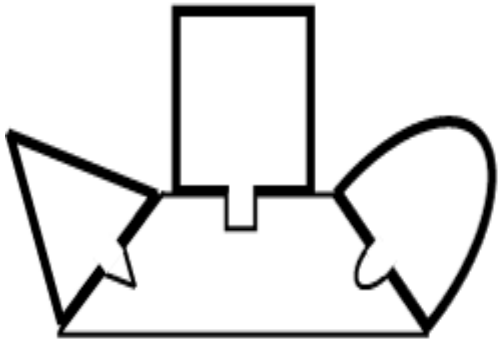
Integral Product Architectures

- Functional elements are implemented by multiple chunks, or a chunk may implement many functions.
- Interactions between chunks are poorly defined.
- Integral architecture generally increases performance and reduces costs for any specific product model.

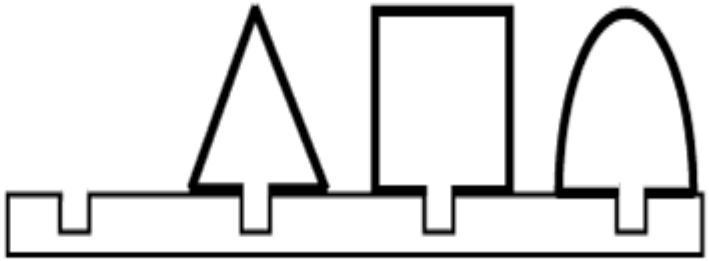
High-Performance Wheels

Compact Camera

Types of Modularity



Slot-Modular
Architecture



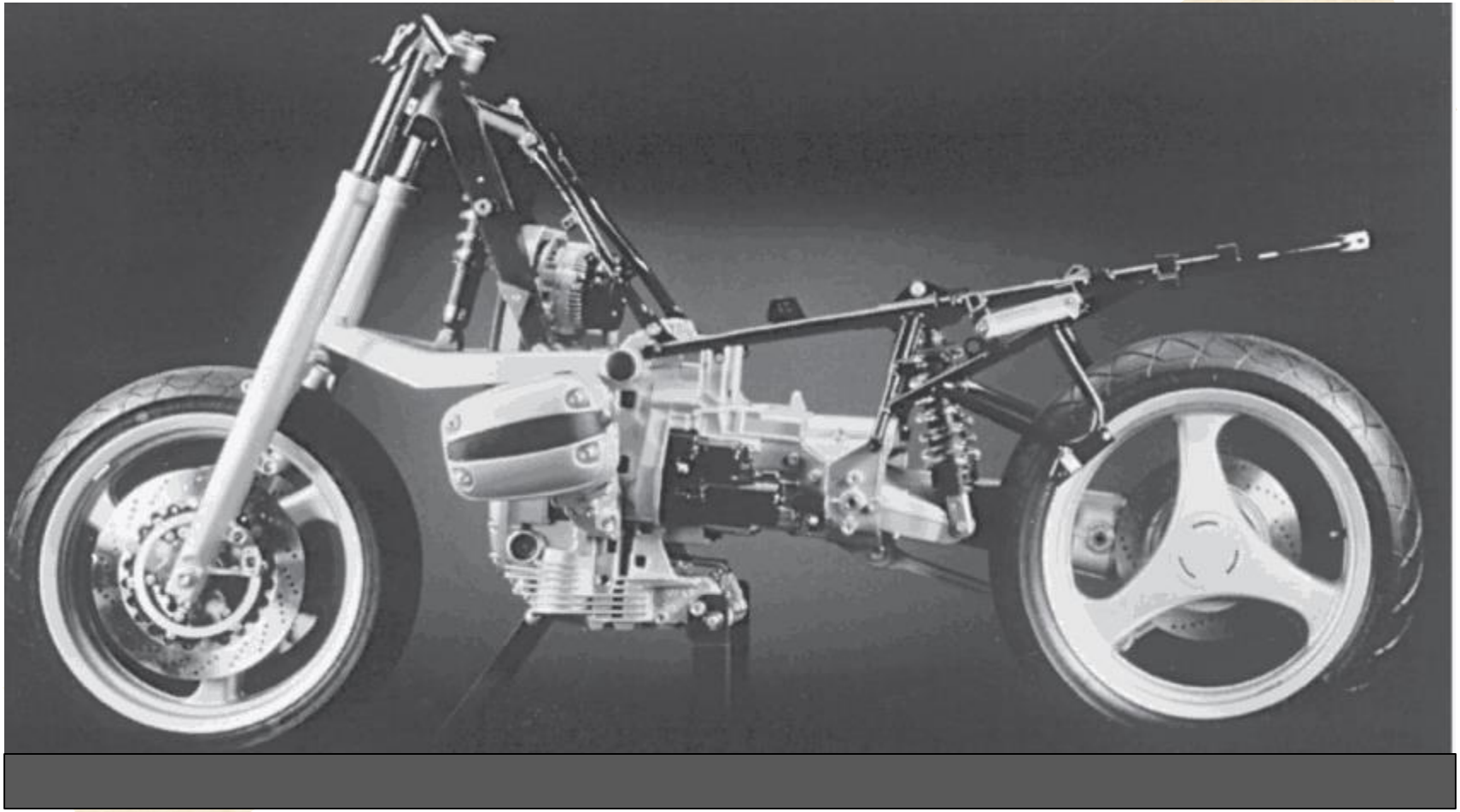
Bus-Modular
Architecture

Sectional-Modular
Architecture

Choosing the Product Architecture

Architecture decisions relate to product planning and concept development decisions:

- Product Change (copier toner, camera lenses)
- Product Variety (computers, automobiles)
- Standardization (motors, bearings, fasteners)
- Performance (racing bikes, fighter planes)
- Manufacturing Cost (disk drives, razors)
- Project Management (team capacity, skills)
- System Engineering (decomposition, integration)

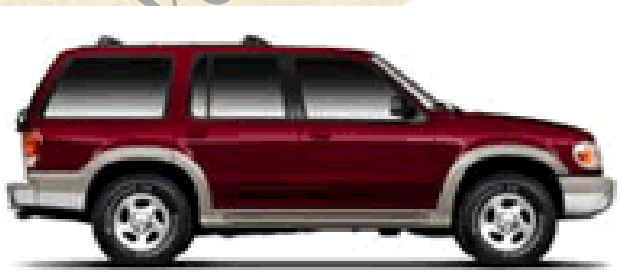


Ford Taurus
Integrated Control Panel

Modular or Integral Architecture?

Motorola StarTAC Cellular Phone

Apple iBook

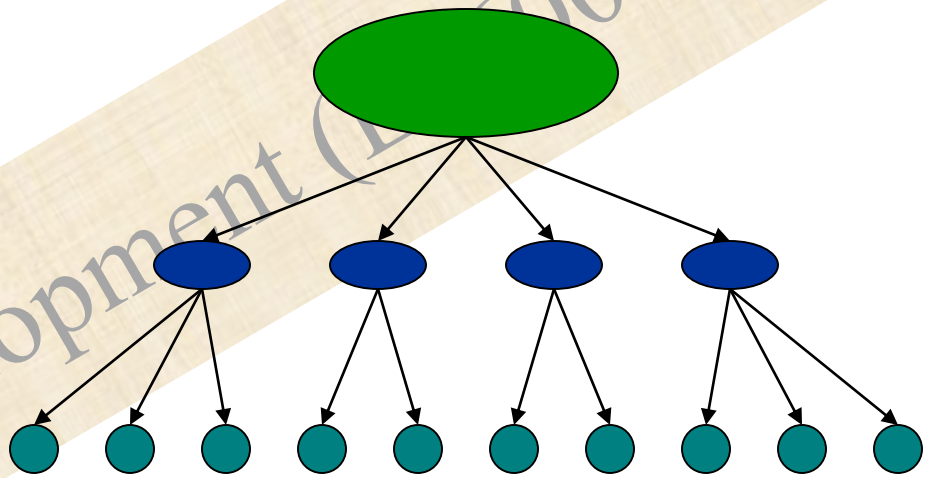


Ford Explorer

Rollerblade In-Line Skates

The concepts of integral and modular apply at several levels:

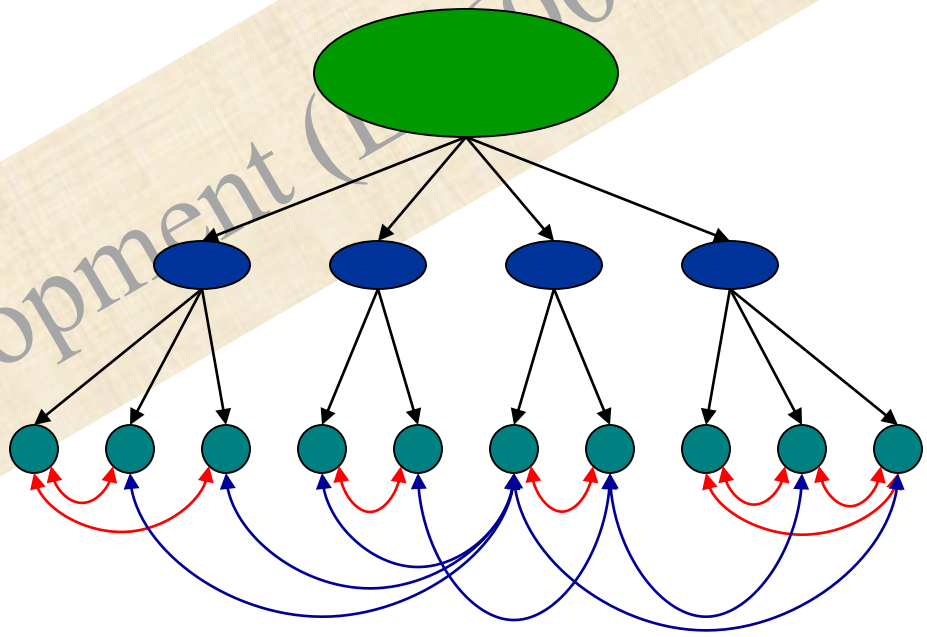
- system
- sub-system
- component



Product Architecture = Decomposition + Interactions

Interactions within chunks

Interactions across chunks

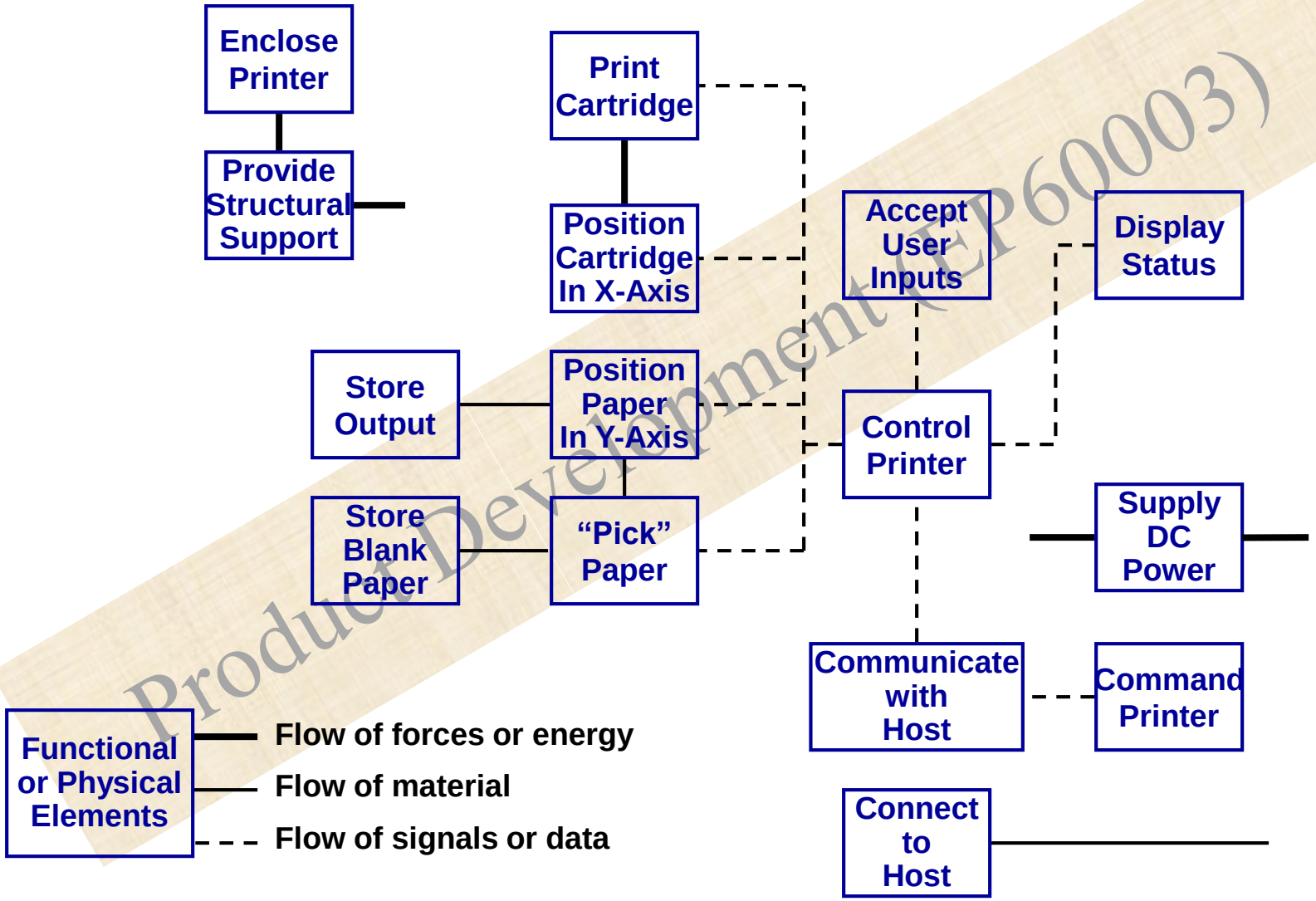


Establishing the Architecture

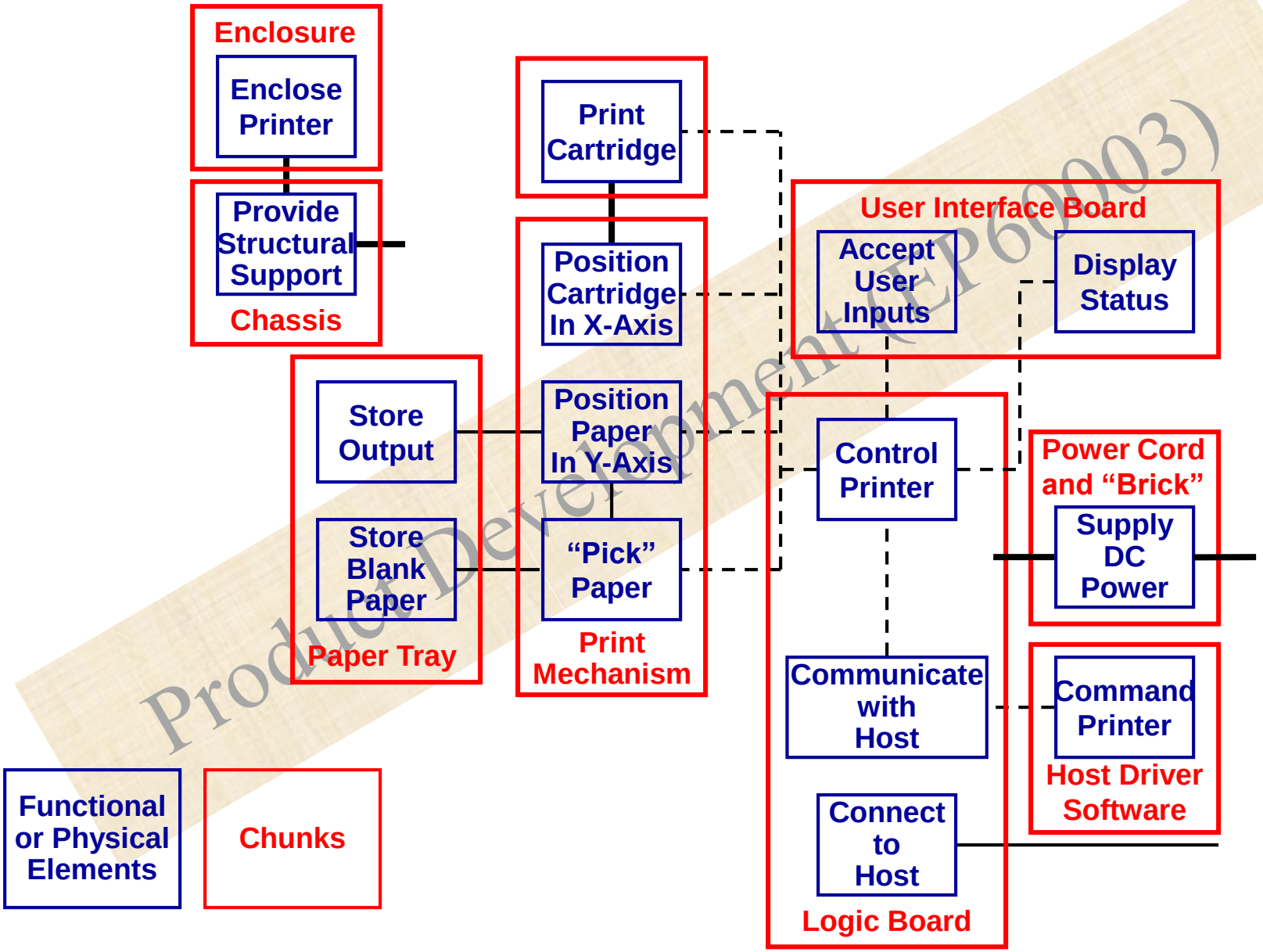
To establish a modular architecture:

- Create a schematic of the product
- Cluster the elements of the schematic
- Create a rough geometrical layout
- Identify the fundamental & incidental interactions

DeskJet Printer Schematic



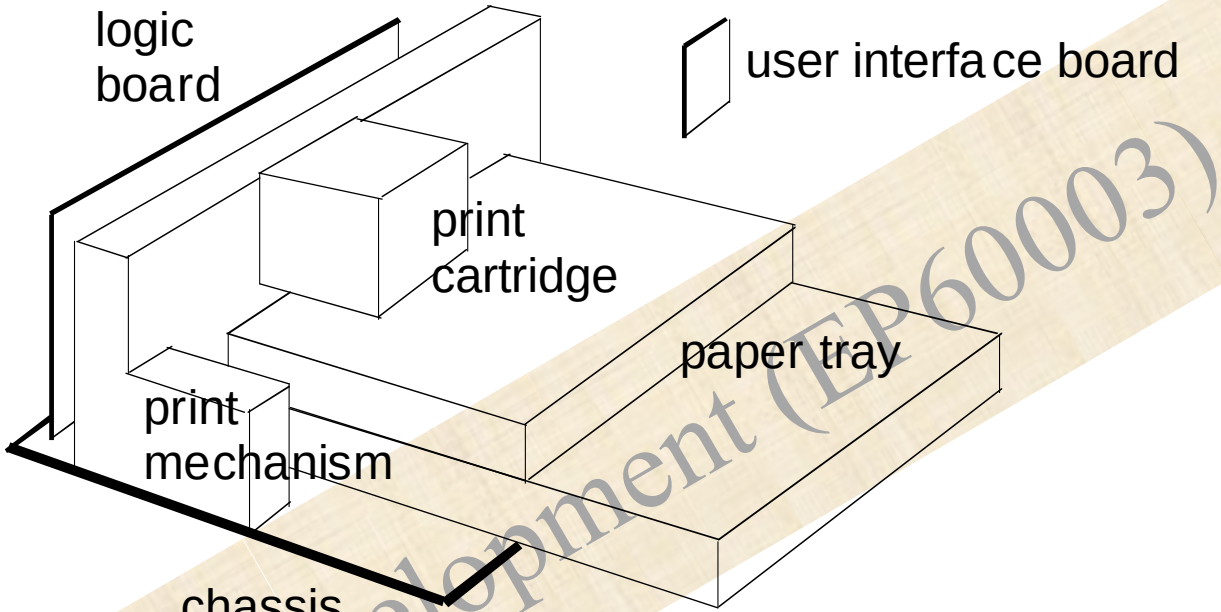
Cluster Elements into Chunks

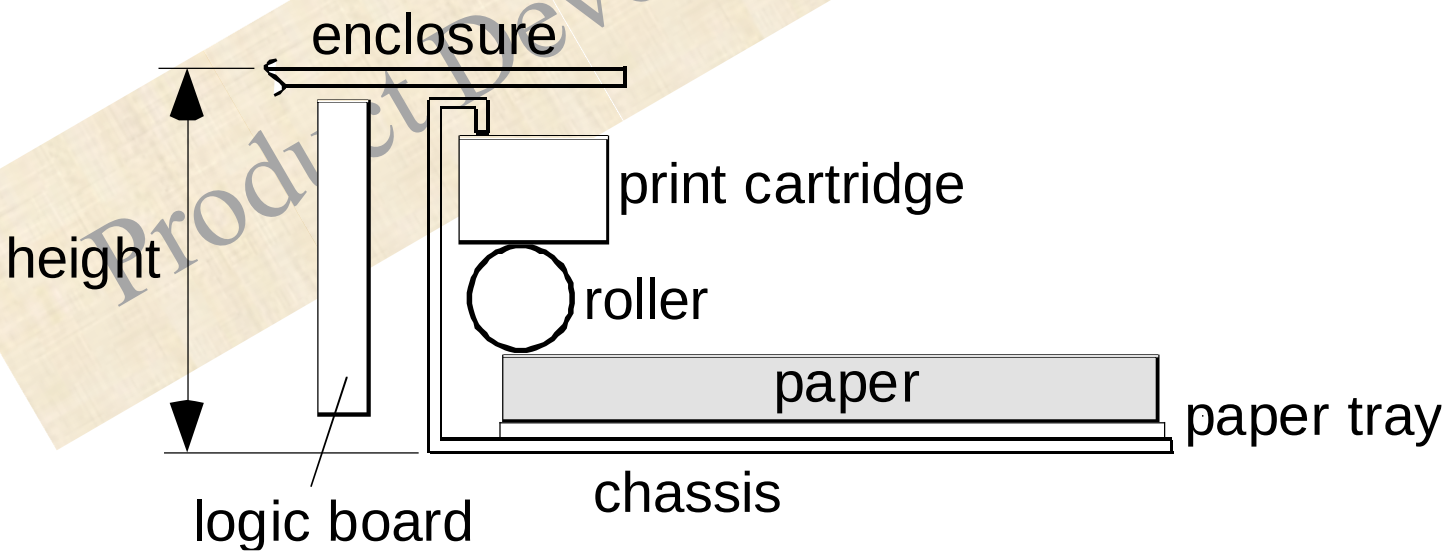


When is it advantageous to cluster?

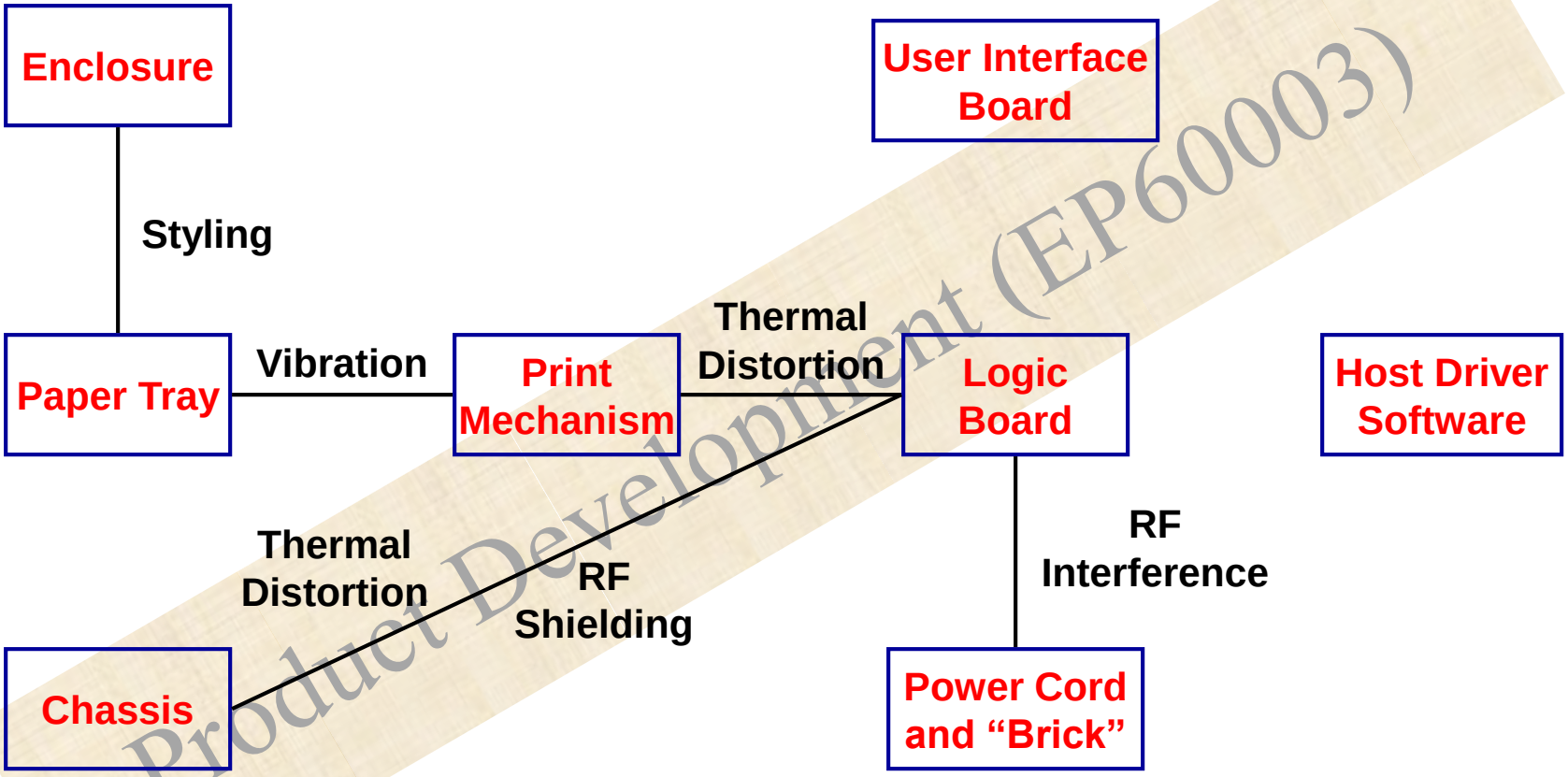
- Geometric integration & precision
- Function sharing
- Capabilities of vendors
- Similarity of design or production technology
- Localization of change
- Accommodating variety
- Enabling Standardization
- Portability of the interfaces

Geometric Layout

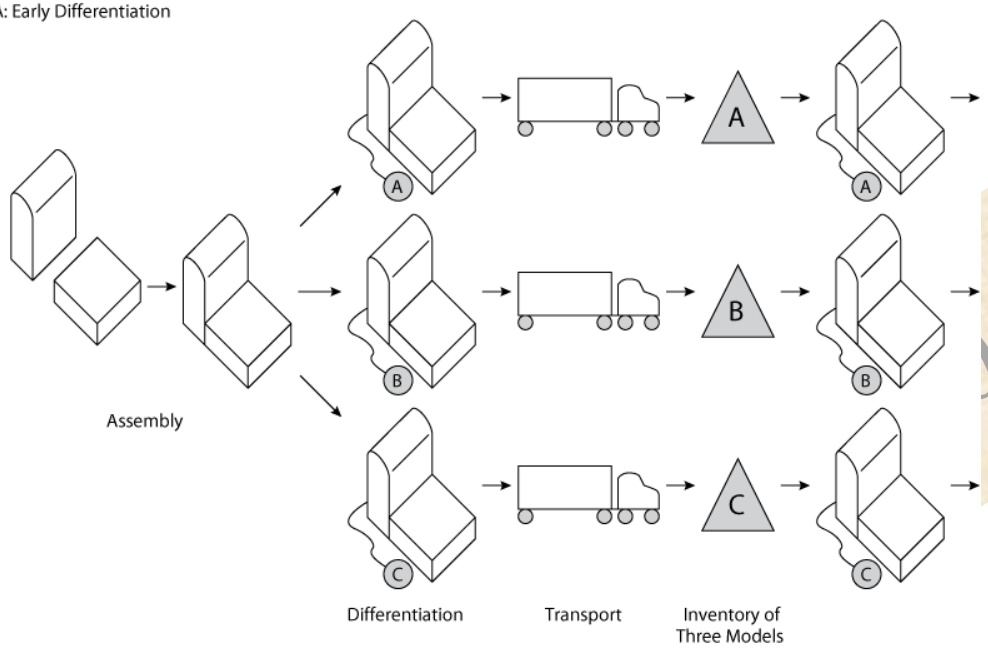




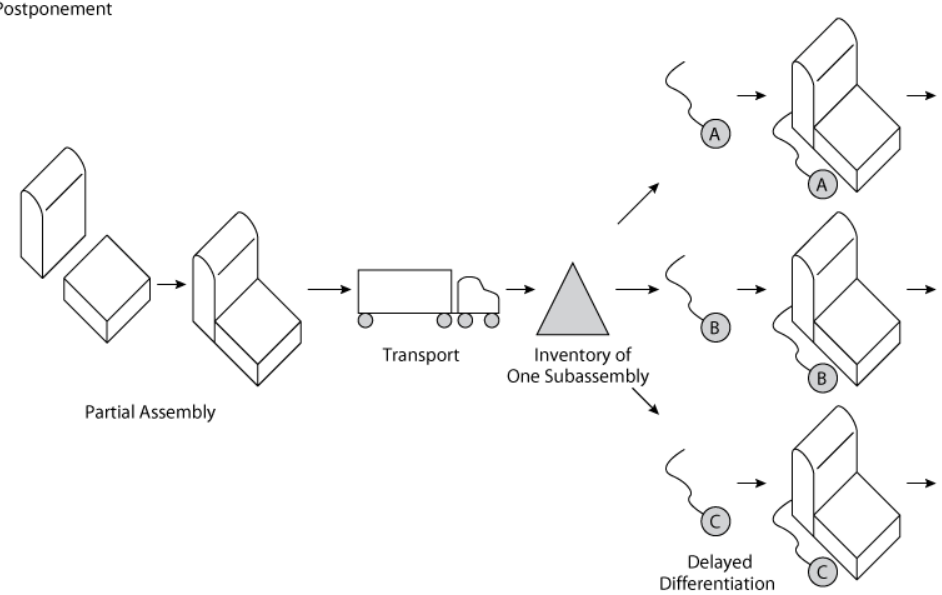
Incidental Interactions

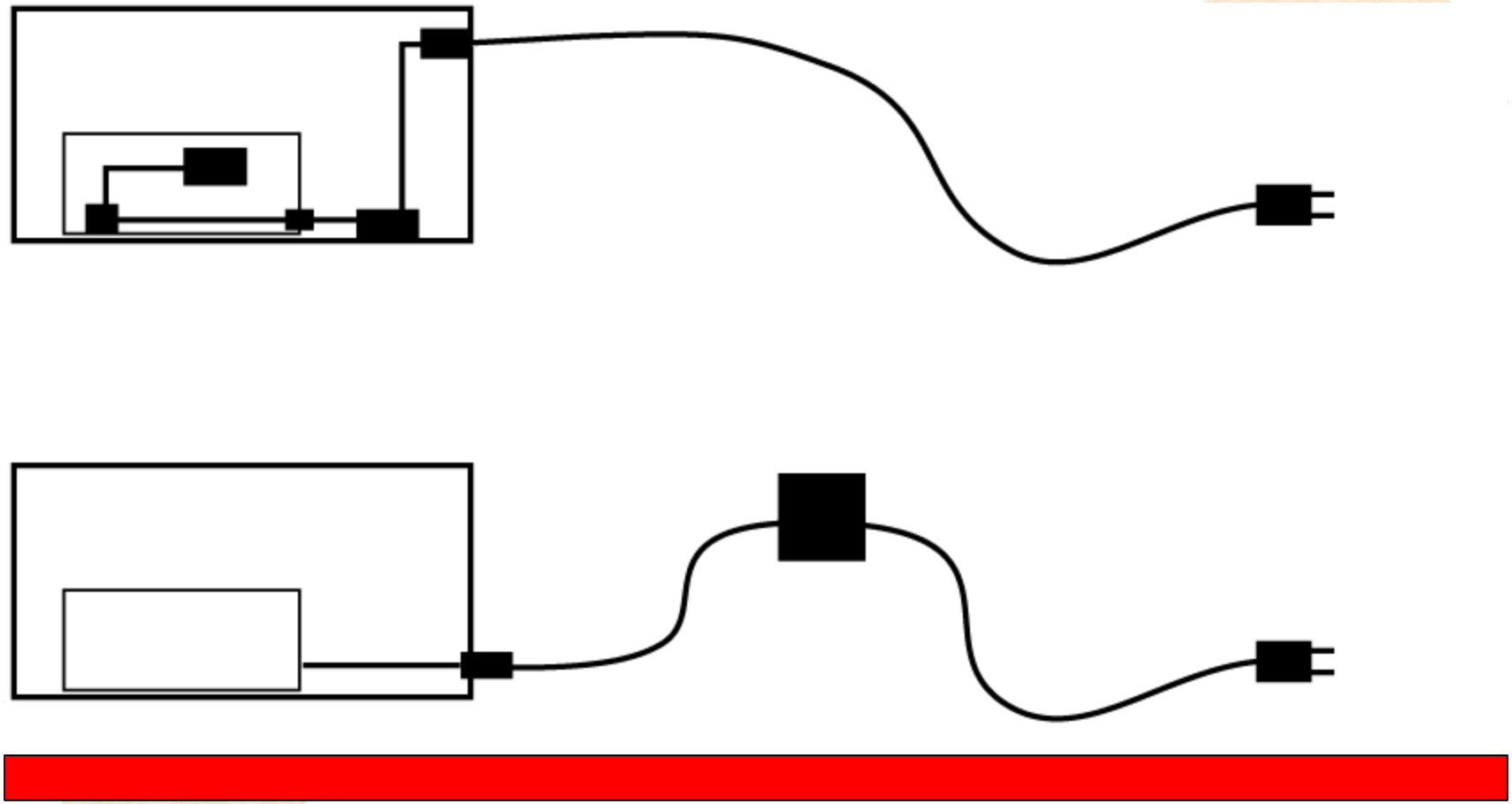


Scenario A: Early Differentiation



Scenario B: Postponement





Planning a Modular Product Line: Differentiation Table

Differentiating Attributes	**Family**	**Student**	**SOHO** (small office, home office)
Black Print Quality	“Near Laser” Quality 300dpi	“Laser” Quality 600dpi	“Laser” Quality 600dpi
Color Print Quality	“Near photo” Quality	Equivalent to Dj600	Equivalent to Dj600
Print Speed	6 pages/minute	8 pages/minute	10 pages/minute
Footprint	360mm deep x 400mm wide	340mm deep x 360mm wide	400mm deep x 450mm wide
Paper Storage	100 sheets	100 sheets	150 sheets
Style	“Consumer”	“Youth Consumer”	“Commercial”
OS	Mac & Windows	Mac & Windows	Windows

Planning a Modular Product Line: Commonality Table

Chunks	Number of Types	Family	Student	SOHO (small office, home office)
Print cartridge	2	“Manet” Cartridge	“Picasso” Cartridge	“Picasso” Cartridge
Print Mechanism	2	"Aurora" Series	Narrow "Aurora" series	"Aurora" series
Paper tray	2	Front-in Front-out	Front-in Front-out	Tall Front-in Front-out
Logic board	2	“Next gen” board with parallel port	“Next gen” board	“Next gen” board
Enclosure	3	Home style	Youth style	“Soft office” style
Driver software	5	Version A-PC Version A-Mac	Version B-PC Version B-Mac	Version C

Differentiation versus Commonality

Trade off product variety and production complexity

Fundamental Decisions

- Integral vs. modular architecture?
- What type of modularity?
- How to assign functions to chunks?
- How to assign chunks to teams?
- Which chunks to outsource?

Practical Concerns

- Planning is essential to achieve the desired variety and product change capability.
- Coordination is difficult, particularly across teams, companies, or great distances.
- Special attention must be paid to handle complex interactions between chunks (system engineering methods).

Product Architecture: Conclusions

- Architecture choices define the sub-systems and modules of the product platform or family.
- Architecture determines:
  - ease of production variety
  - feasibility of customer modification
  - system-level production costs
- Key Concepts:
  - modular vs. integral architecture
  - clustering into chunks
  - planning product families