Product Architecture

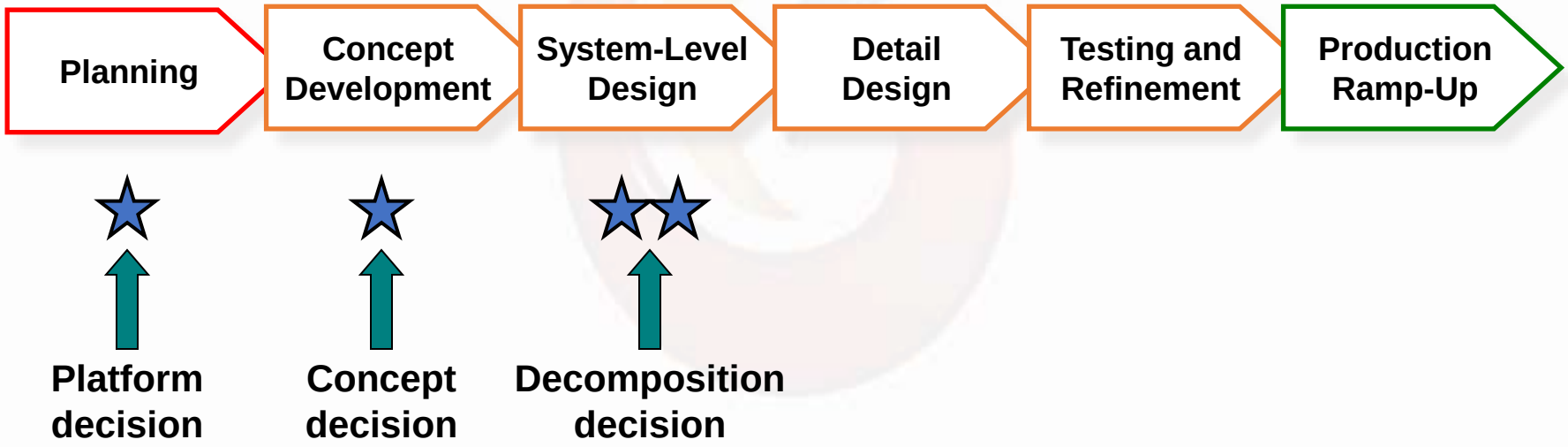
Product Architecture

Modular Product Architecture Example: Boreas Gear Backpacks

boreasgear.com

boreas™

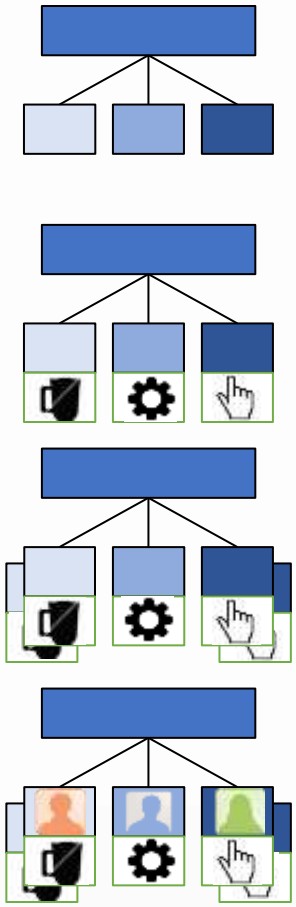
Product Development Process



- Product architecture is determined by decisions at several points in the early stages of the development process.
- Product architecture defines the embodiment of the concept and plans how it will be implemented in the downstream process.

Critical Architecture Decisions in the System-Level Design Phase of PD

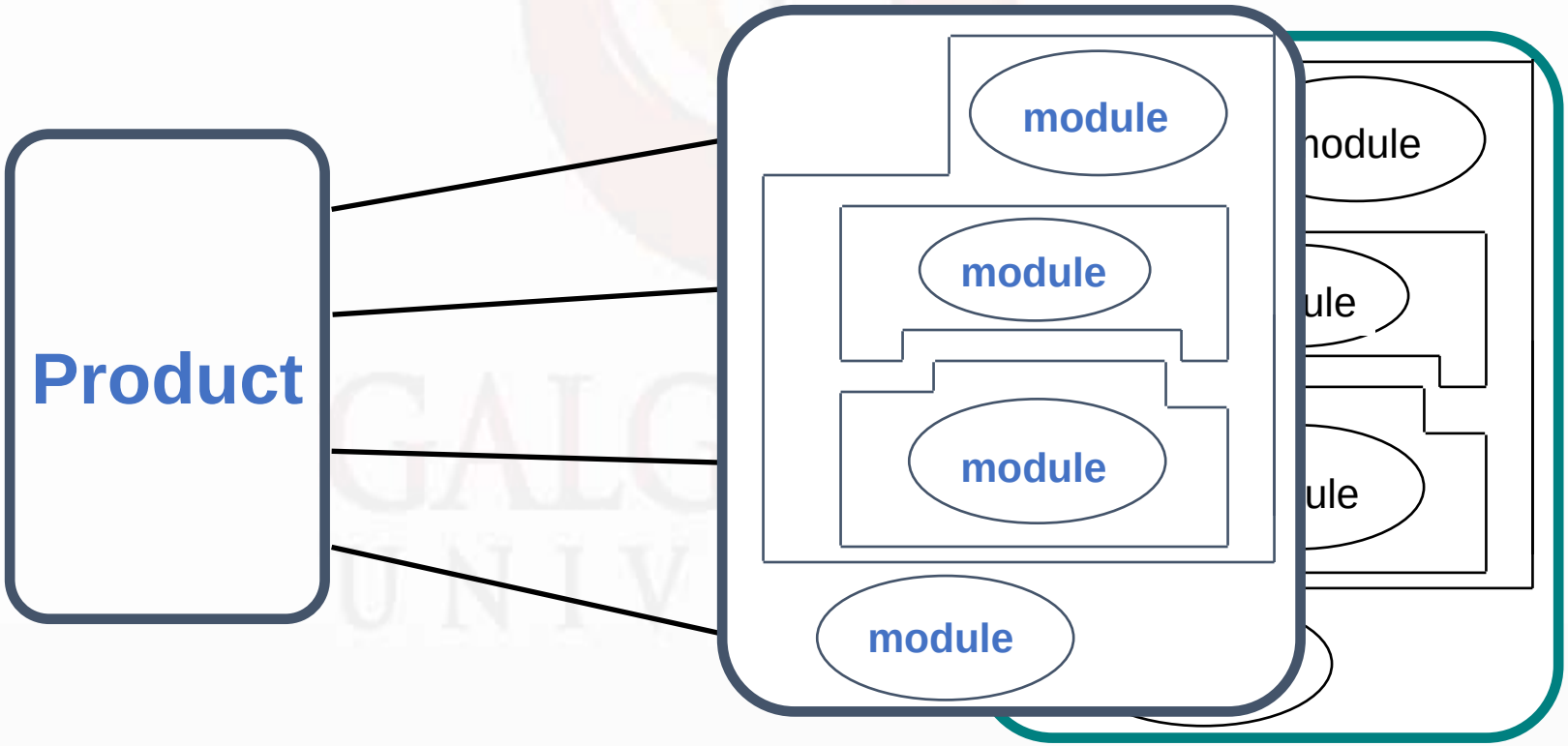
- Decomposition of the product into its sub-systems and components
- Allocation of product functions to the sub-systems and components
- Specification of modular variants of sub-systems and components
- Assignment of design responsibility for sub-systems and components



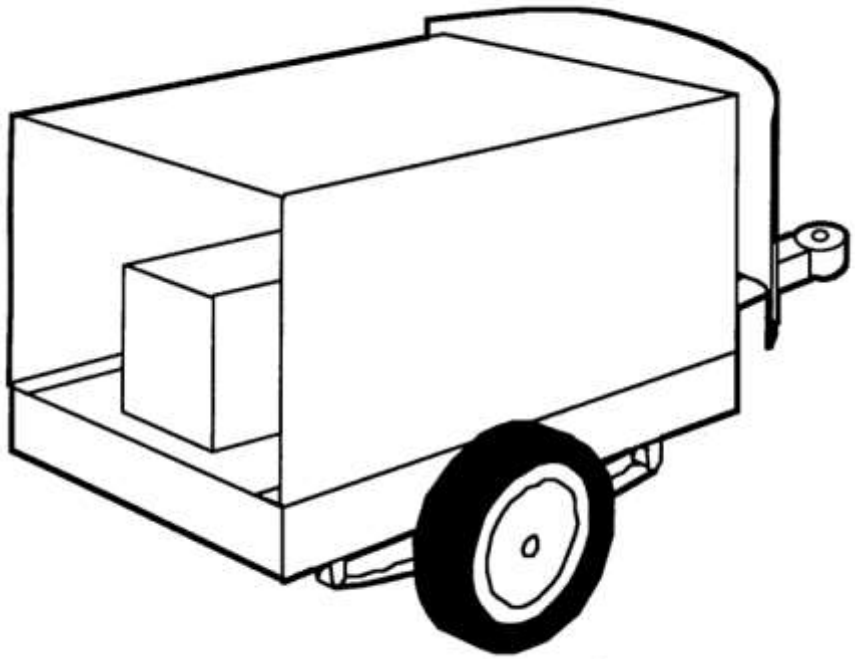
Product Architecture Example: Hewlett-Packard DeskJet Printers

Product Architecture: Definition

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

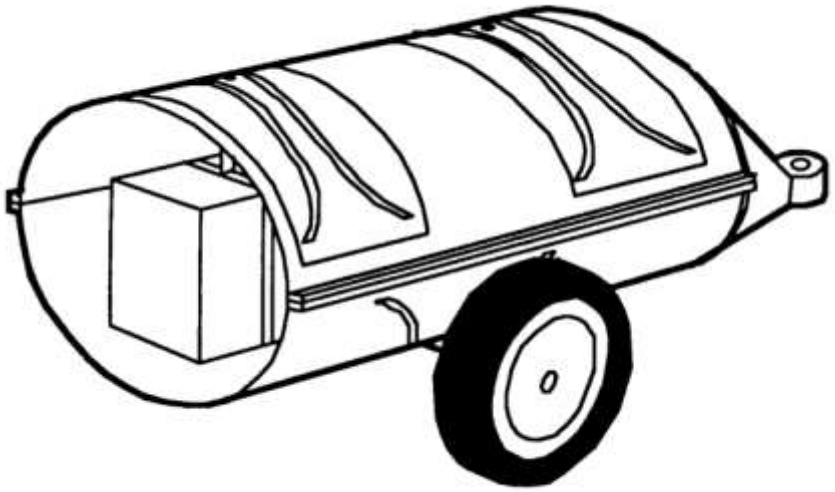


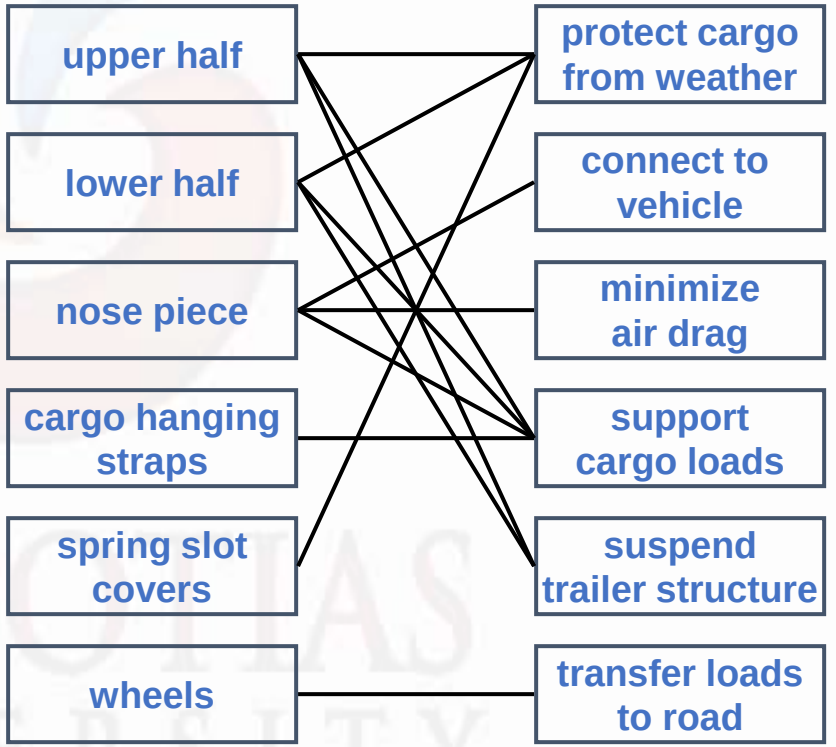
Trailer Example: Modular Architecture



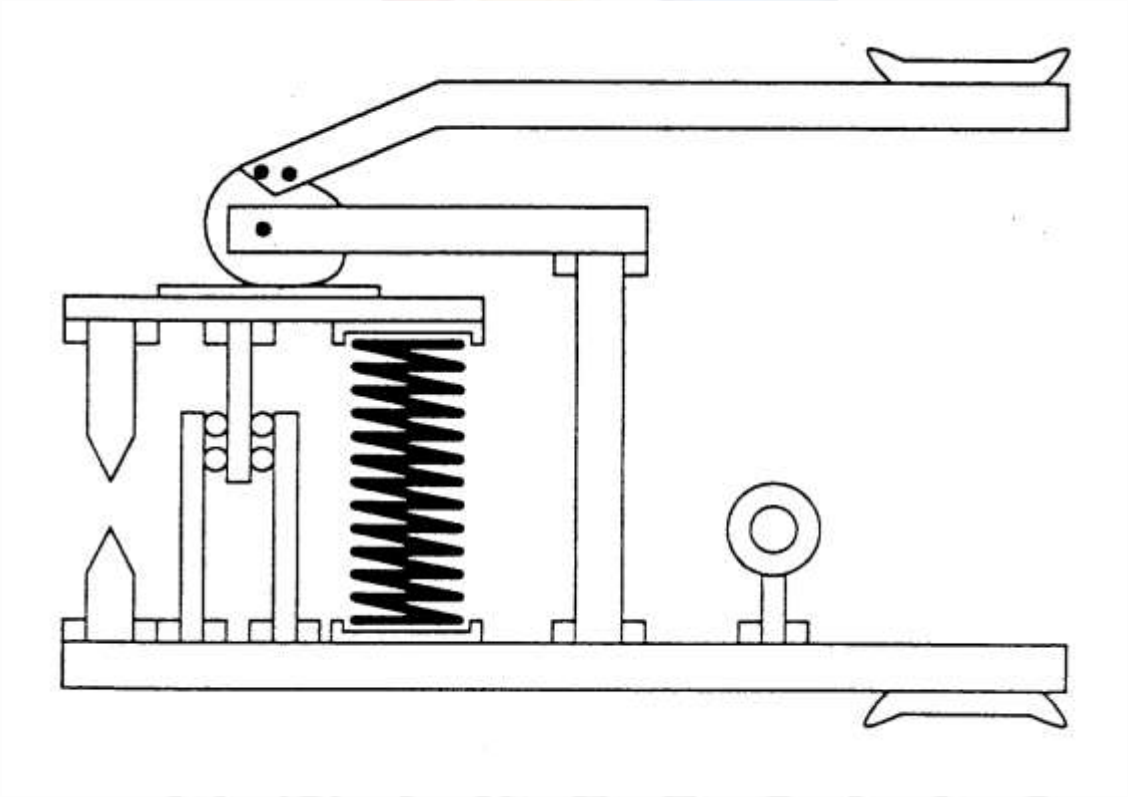
box	protect cargo from weather
hitch	connect to vehicle
fairing	minimize air drag
bed	support cargo loads
springs	suspend trailer structure
wheels	transfer loads to road

Trailer Example: Integral Architecture

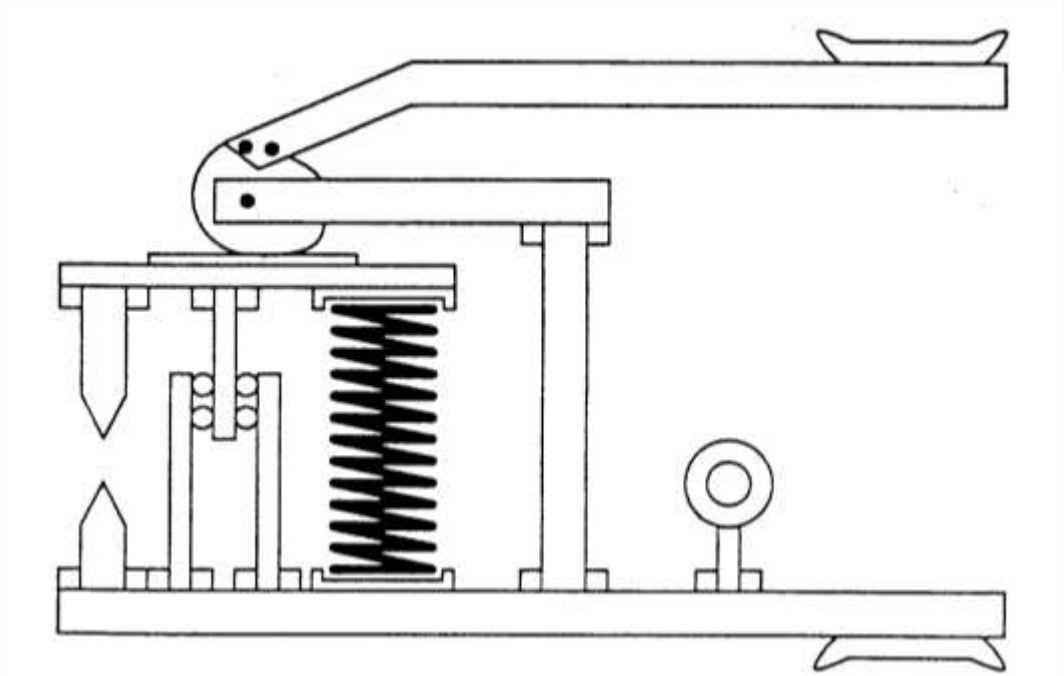


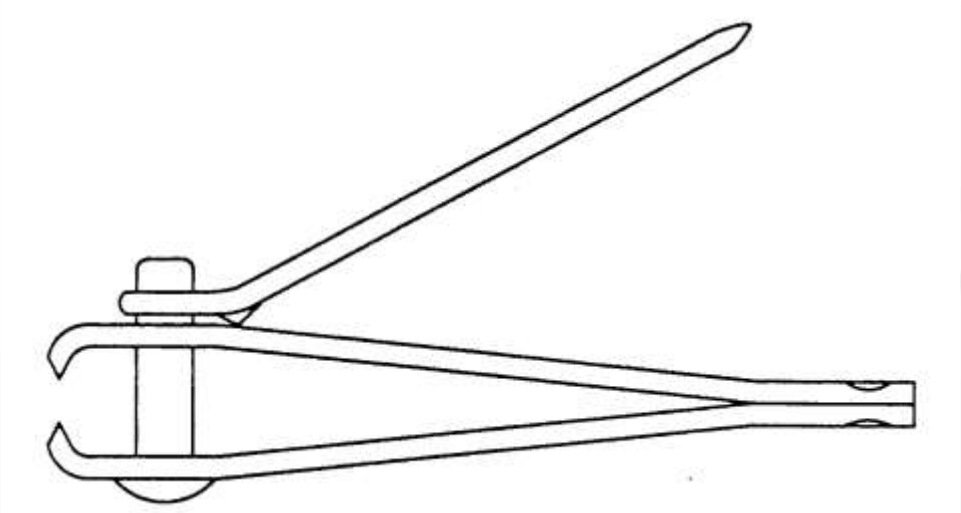


What is this?



Nail Clippers?





Modular Product Architectures

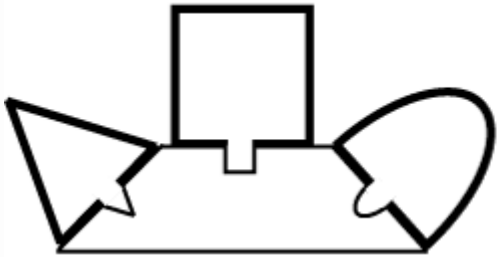
- Chunks implement one or a few functions entirely.
- Interactions between chunks are well defined.
- Modular architecture has advantages in simplicity and reusability for a product family or platform.

Swiss Army Knife

Sony CD Walkman

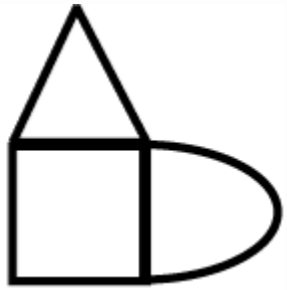
Platform Architecture of the Sony Walkman

Types of Modularity

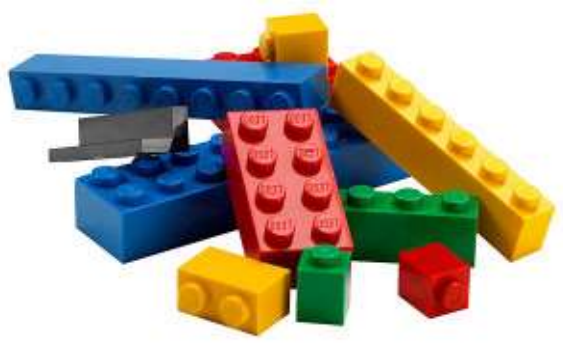


Slot-Modular Architecture

Bus-Modular Architecture



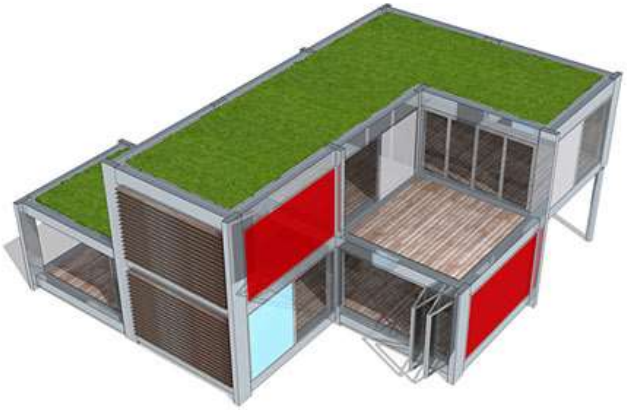
Sectional-Modular Architecture



Modular Architecture Examples

Sectional Furniture

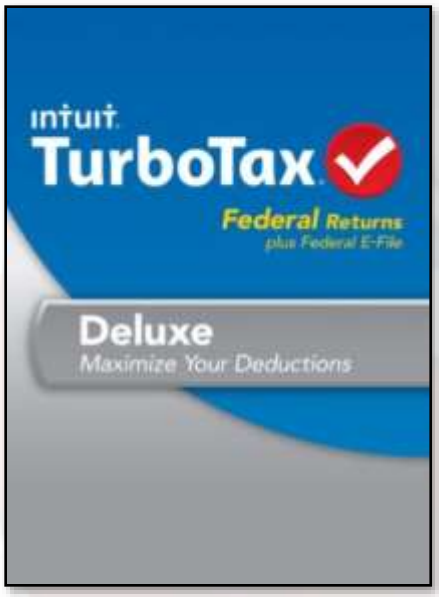
DIN Audio System

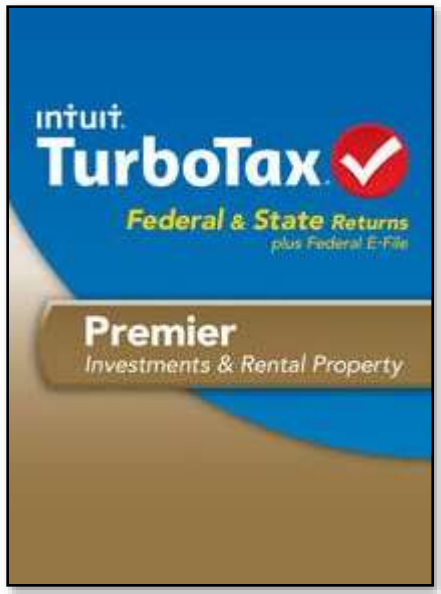


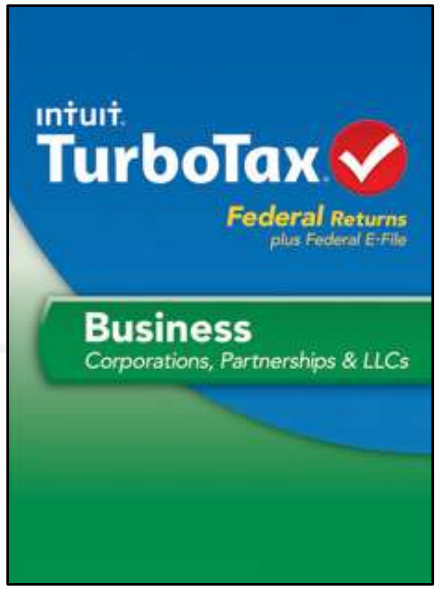
Modular Home

Smartphone OS

Modular Software Architecture Example







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

Integral Architecture Examples

BMW Motorcycle Frame

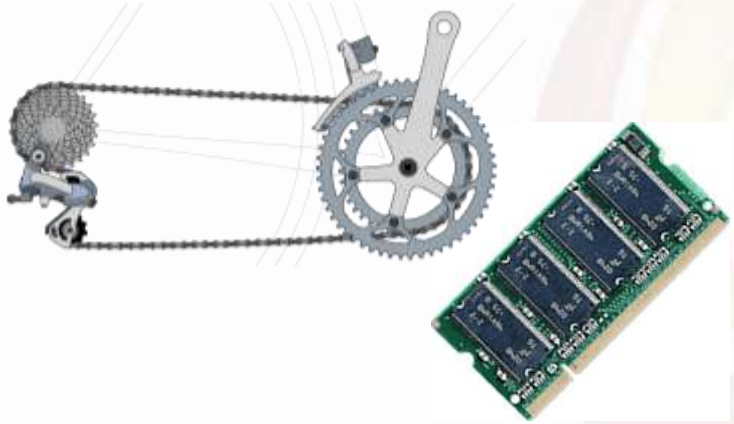
F/A-18 Super Hornet

MacBook Air Unibody

Taurus Audio/Climate Controls

Implications of Product Architecture (1)

Upgrade or Add-Ons



Flexibility in Use

Wear or Consumption

Production Variety

Implications of Product Architecture (2)

Standard Components

Holistic Performance

Manufacturing Cost

Delayed Differentiation

Coffee Maker Product Family

BRAUN

Modular or Integral Architecture?

Samsung Phone

Apple MacBook Air

Google Project Ara
Modular Smartphone Concept

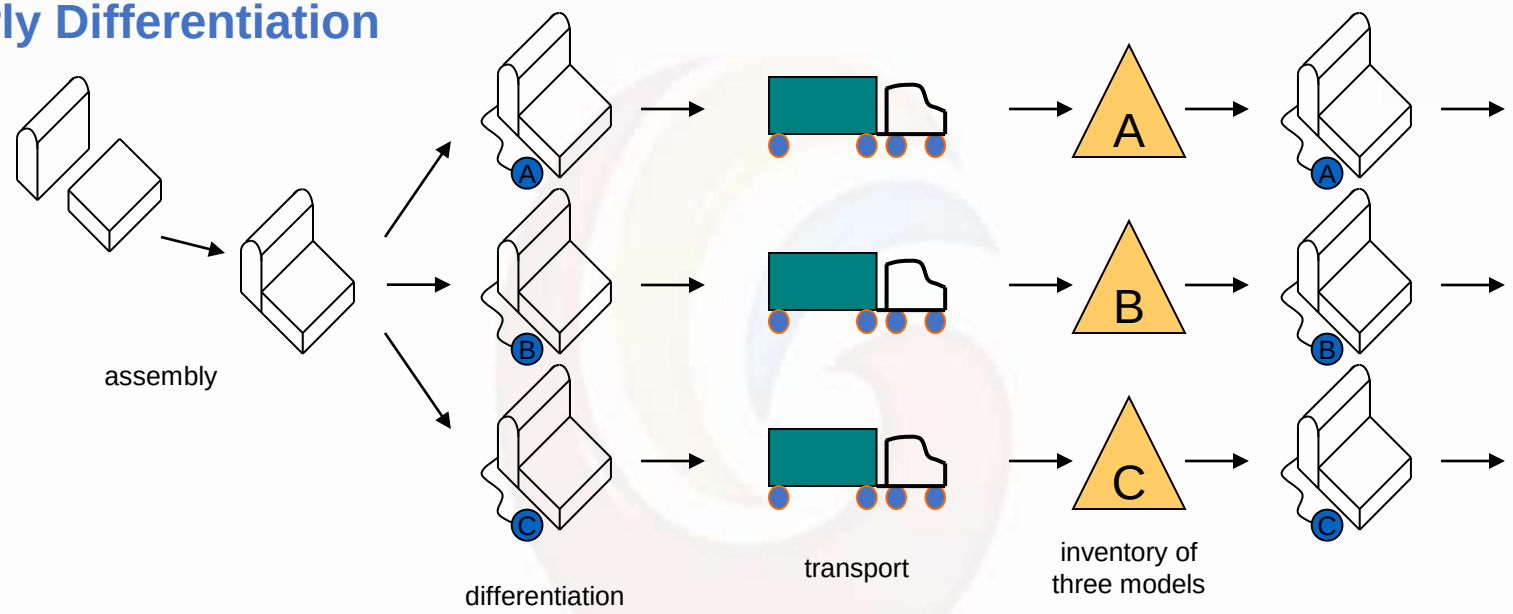
Choosing the Product Architecture

Architecture decisions relate to product planning and concept development decisions:

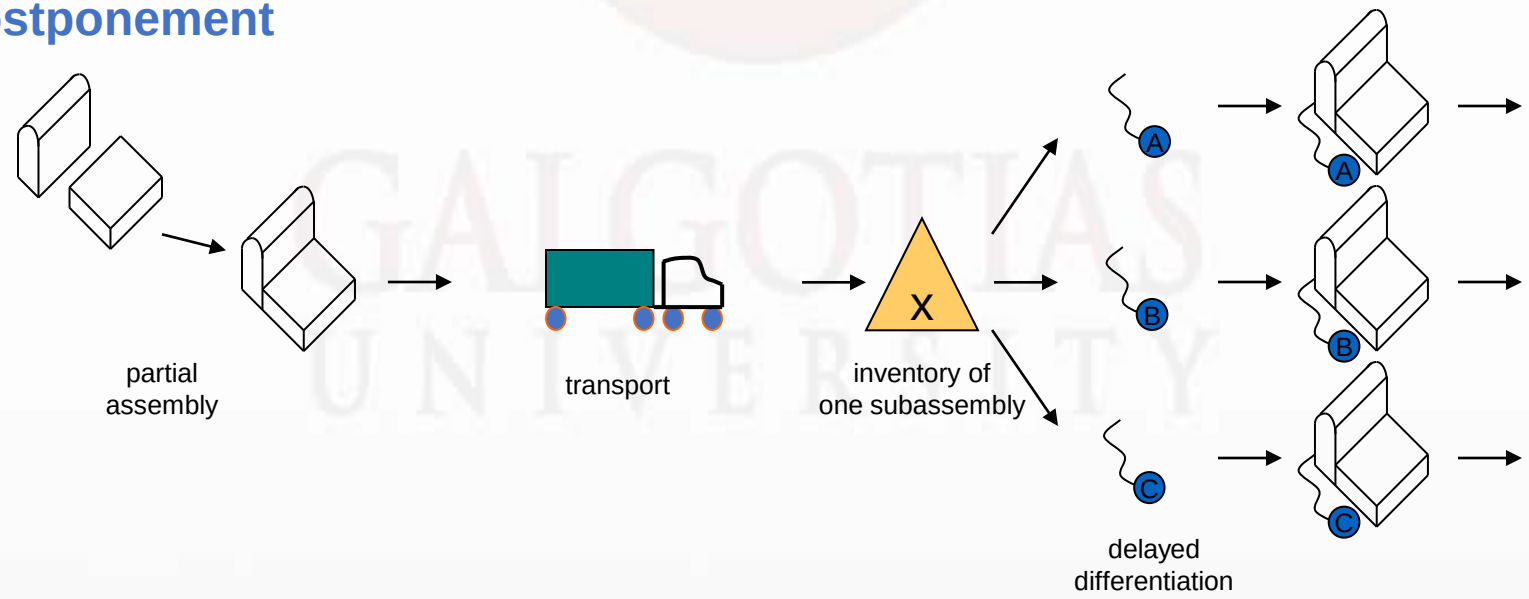
- Product Change (copier toner, camera lenses)
- Product Variety (computers, automobiles)
- Standardization (motors, bearings, fasteners)
- Performance (racing bikes, fighter planes)
- Manufacturing Cost (disk drives, razors)
- Project Management (team capacity, skills)
- System Engineering (decomposition,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

Modularity Enables Delayed Differentiation

Early Differentiation



Postponement



Ford Taurus
Integrated Control Panel

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).

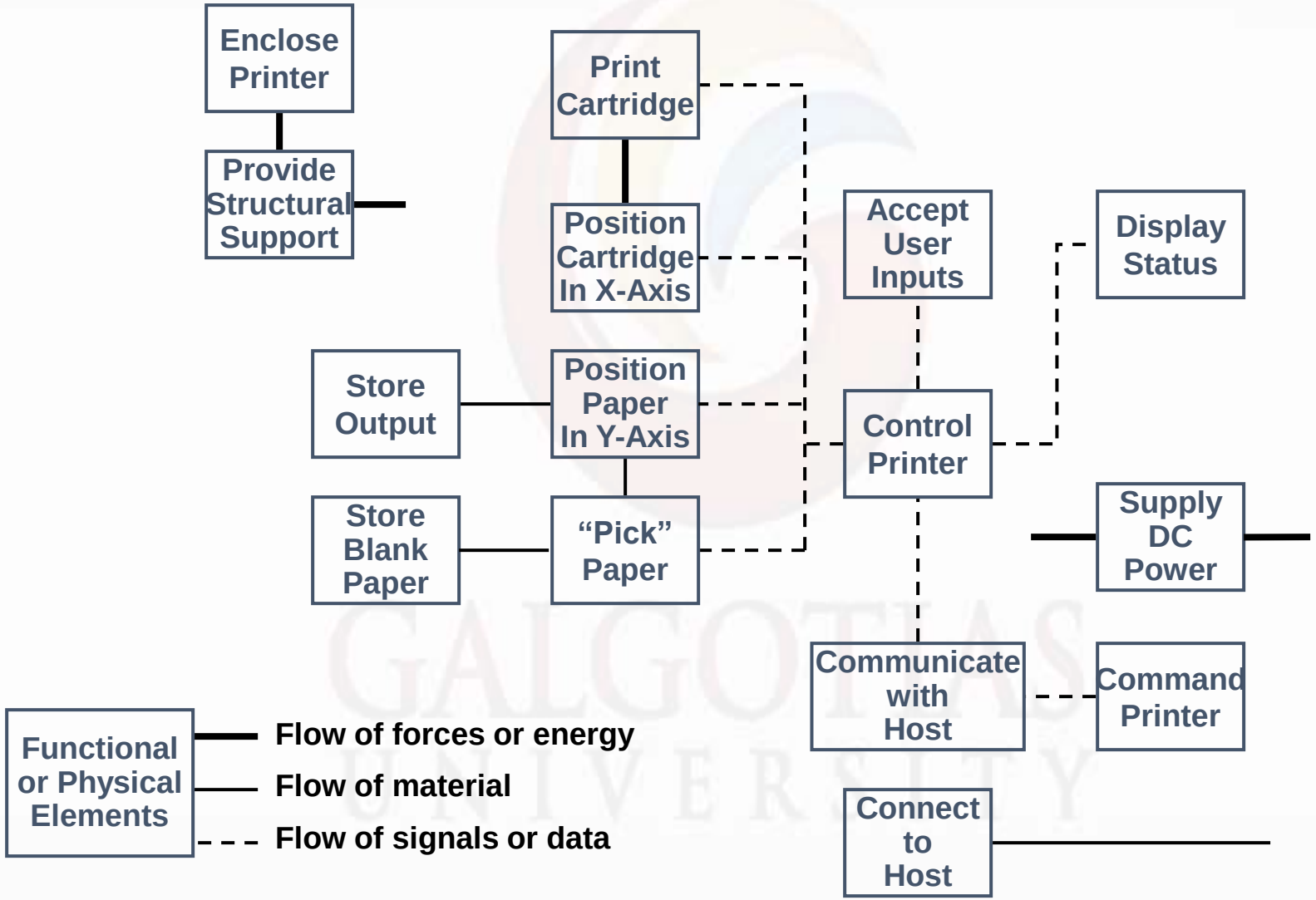
Product Architecture: Conclusions

- 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

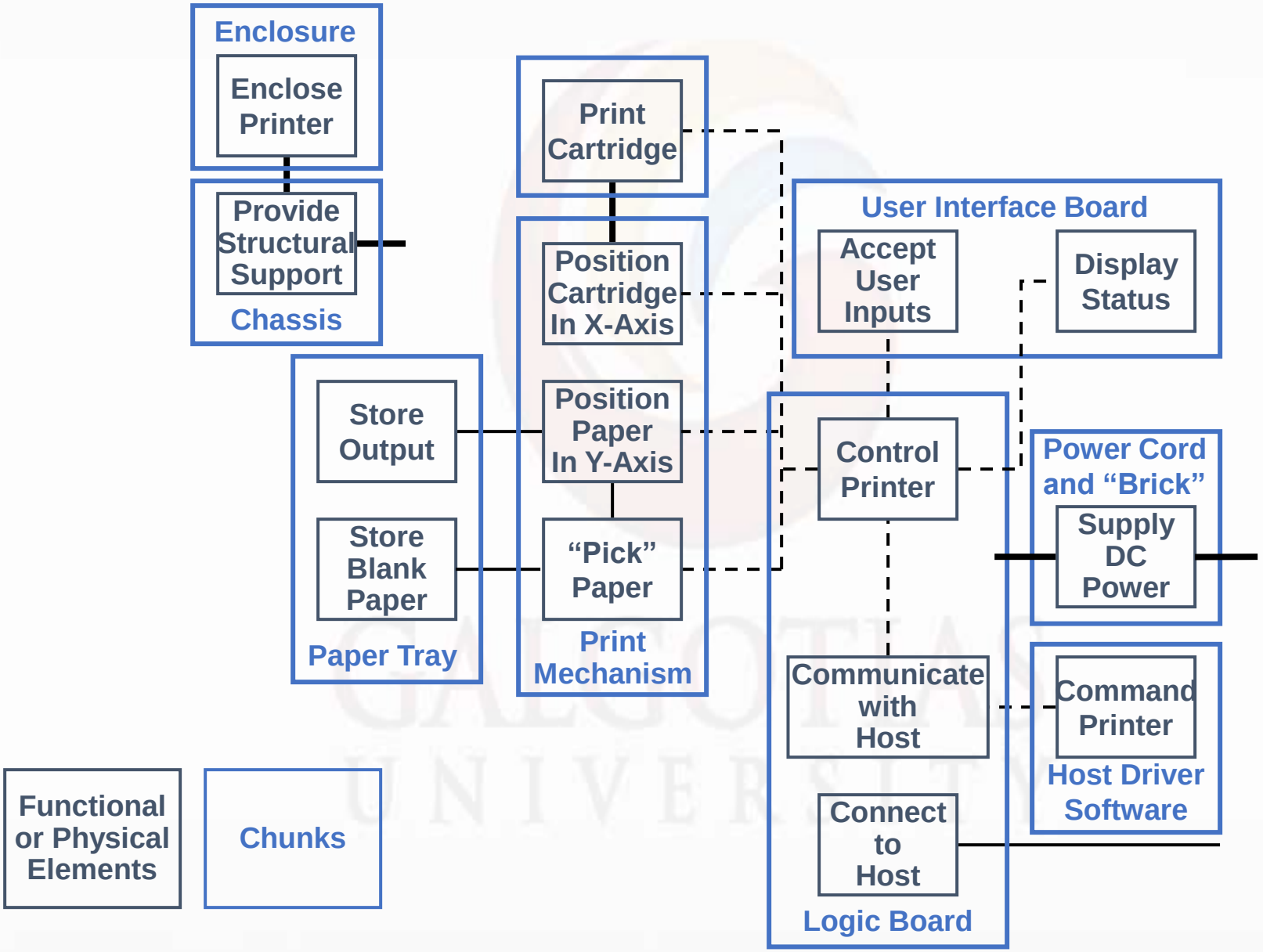
Establishing the Architecture

To establish a modular architecture, create a schematic of the product, and cluster the elements of the schematic to achieve the types of product variety desired.

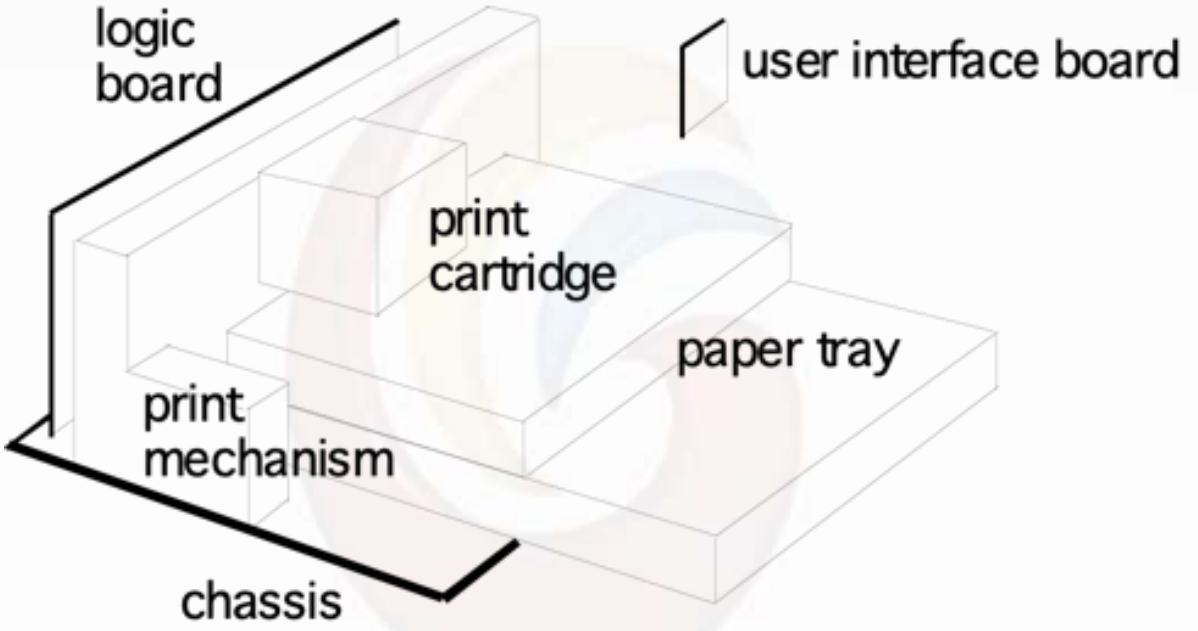
DeskJet Printer Schematic

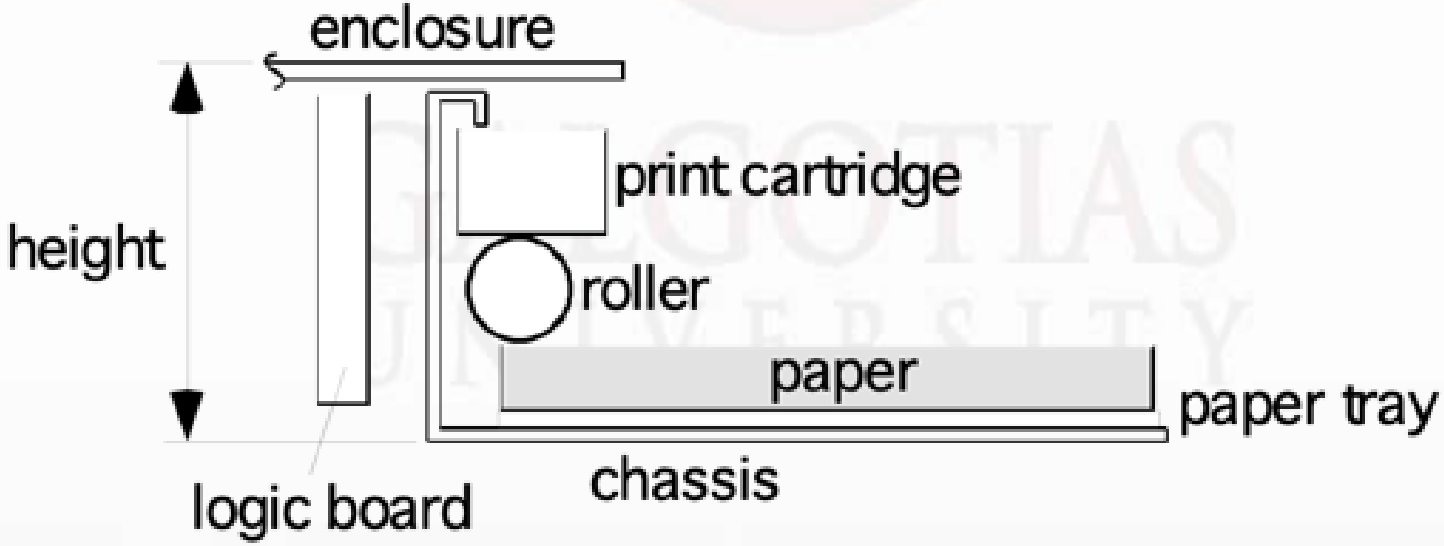


Cluster Elements into Chunks

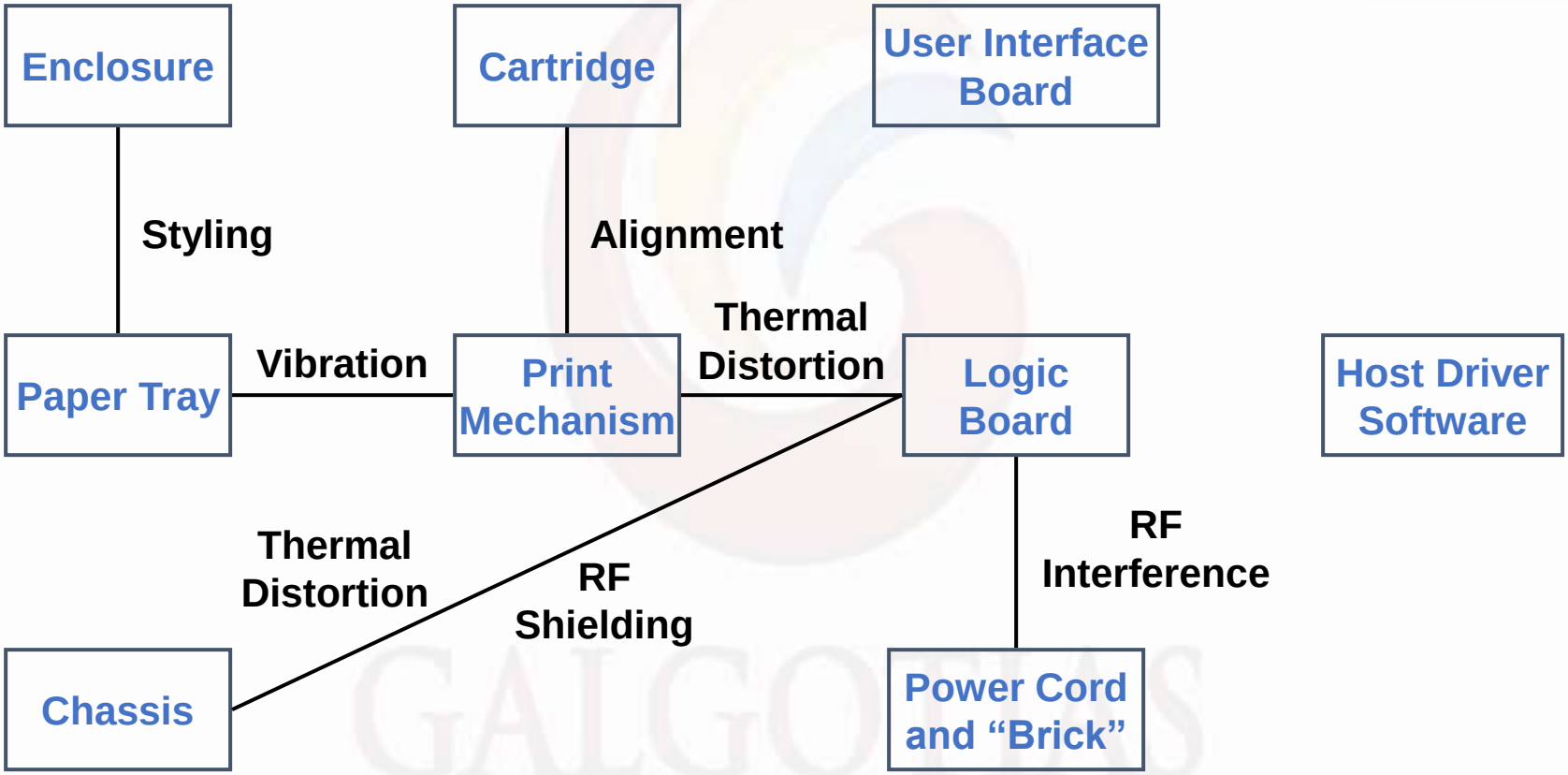


Geometric Layout





Incidental Interactions



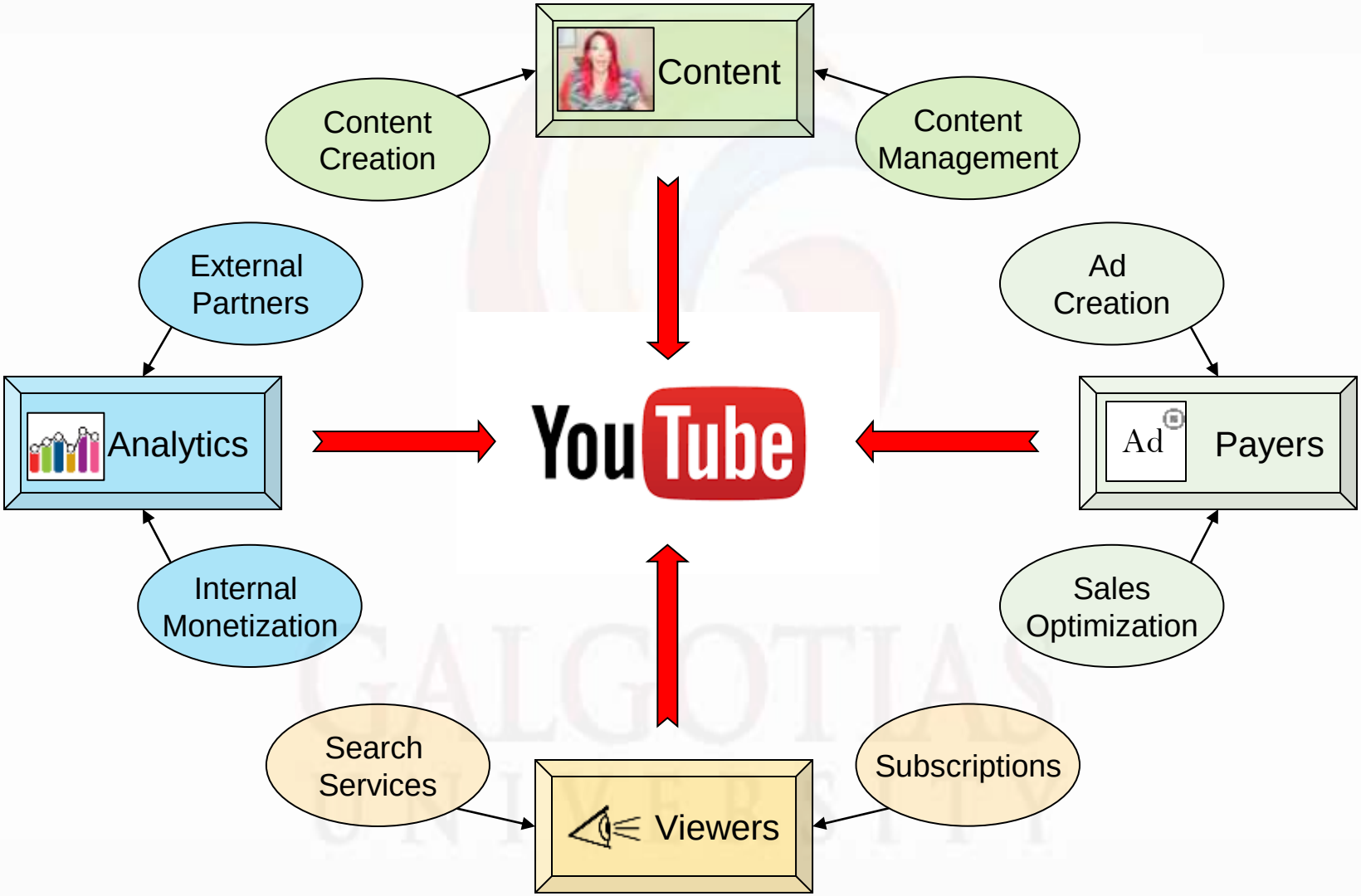
Planning a Modular Product Line: Commonality Table

Module	Variants	Family	Student	Home Office
Print Cartridge	2	Manet	Picasso	Picasso
Print Mechanism	2	Aurora	Narrow Aurora	Aurora
Paper Tray	2	Front-in Front-out	Front-in Front-out	Tall Front-in Front-out
Logic Board	2	Next-gen with parallel port	Next-gen board	Next-gen board
Enclosure	3	Home style	Youth style	Soft office style
Driver Software	5	Version A-Mac Version A-Win	Version B-Mac Version B-Win	Version C

Differentiation versus Commonality

Trade off product variety and production complexity

[Digital] Platform Ecosystem



In-Class Exercise

1. Work in groups of 2 to 4.
2. Pick a product or service:

sports betting

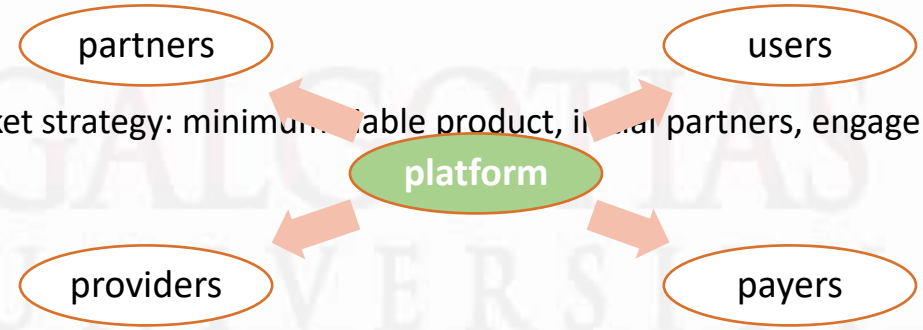
kitchen appliances

home purchase

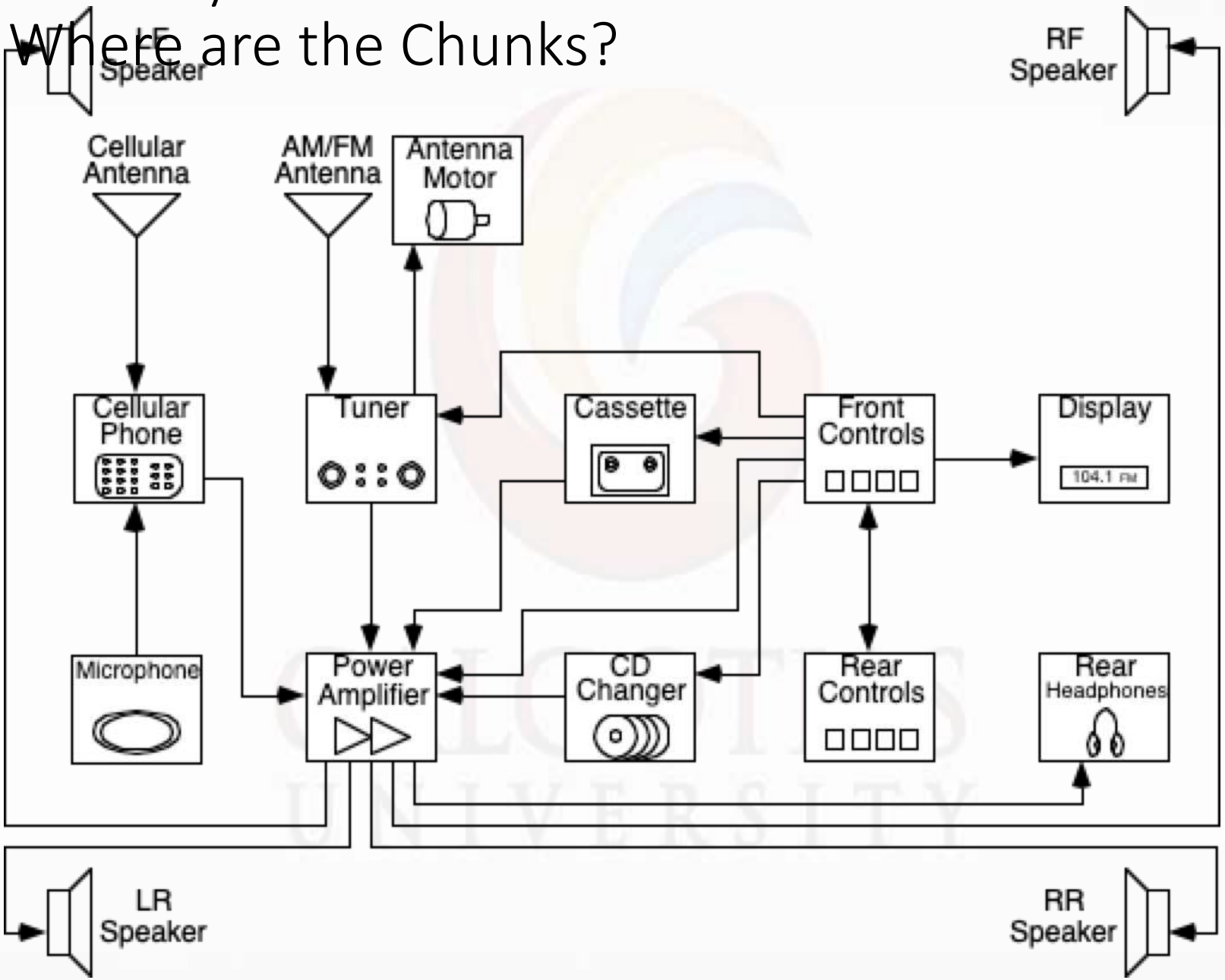
any other product or service

3. Develop a multi-sided platform strategy:

4. Discuss the go-to-market strategy: minimum viable product, initial partners, engagement methods, business model.



Audio System Exercise: Where are the Chunks?



References

1. Karl T. Ulrich and Steven D. Eppinger (2009), Product Design and Development, 4th Edition, Tata McGraw-Hill Publishing Company Limited, ISBN: 978-0-070-14679-2
2. Stephen C. Armstrong (2005), Engineering and Product development Management– The Holostic Approach, Cambridge University Press, ISBN: 978-0-521-01774-9.
3. IbrahimZeid (2006), Mastering CAD/CAM, 2nd Edition, Tata McGraw-Hill, ISBN: 978-0-070-63434-3.
4. Anoop Desai, Anil Mital and Anand Subramanian (2007), Product Development: A Structured Approach to Consumer Product Development, Design, and Manufacture, 1st Edition, Butterworth-Heinemann, ISBN: 978-0-750-68309-8.

Thank you