Unit 5

Introduction to Digital Fabrication

Content

1. Need of digital manufacturing
2. Prototype
3. Types and roles of prototypes
4. Rapid prototyping (RPT)
5. Phases of RPT
6. Fundamentals of RPT and Advantages

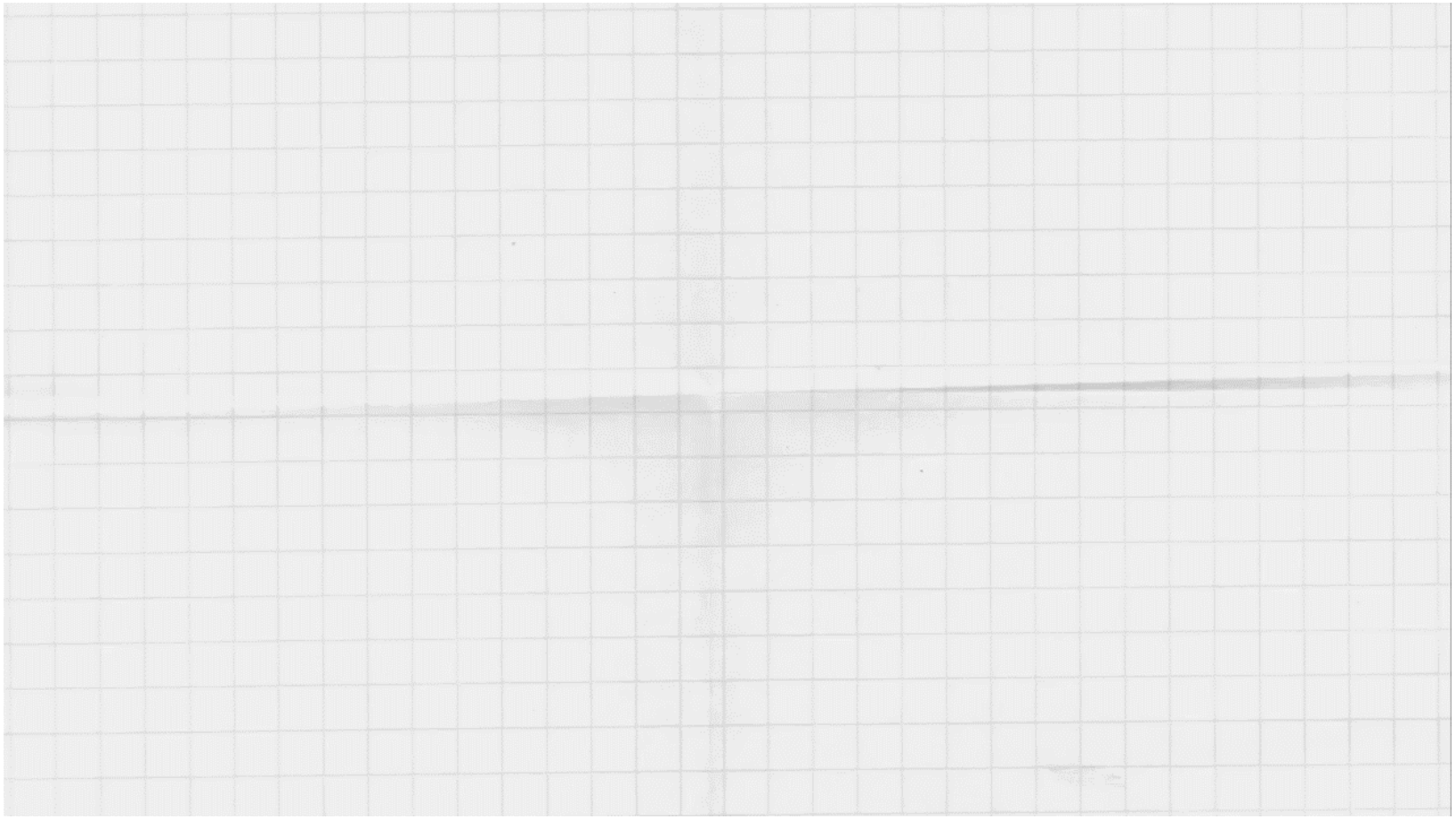
Digital Fabrication

- Digital fabrication is a design and manufacturing workflow where digital data directly drives manufacturing equipment to form various part geometries. For example 3d printing.

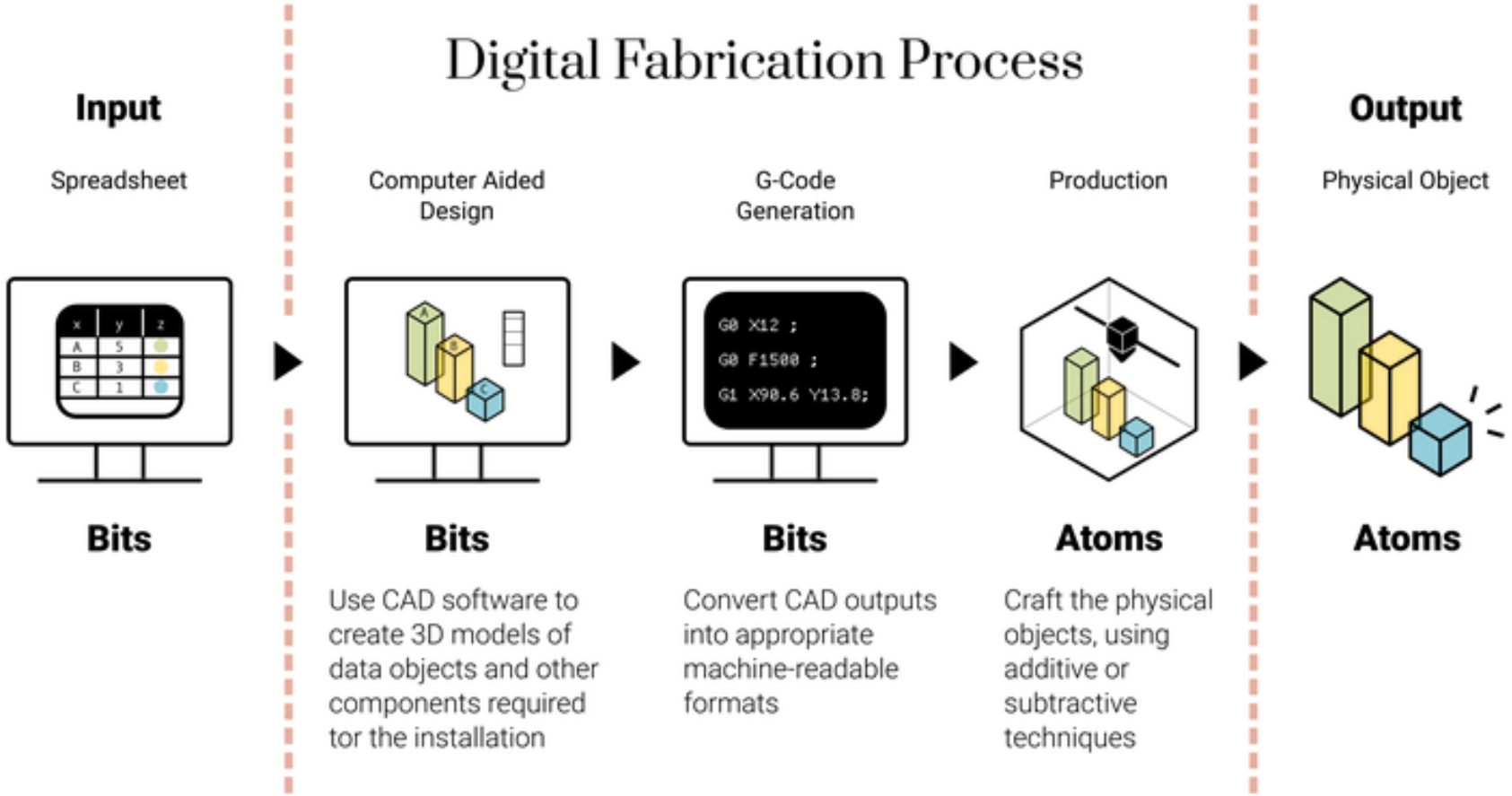
- This data most often comes from **CAD (computer-aided design),** which is then transferred to **CAM (computer-aided manufacturing) software.**

- The output of CAM software is data that directs a specific ***additive and subtractive manufacturing tool***, such as a **3D printer** or **CNC milling machine.**

Applications of 3D printing



Digital Fabrication Process



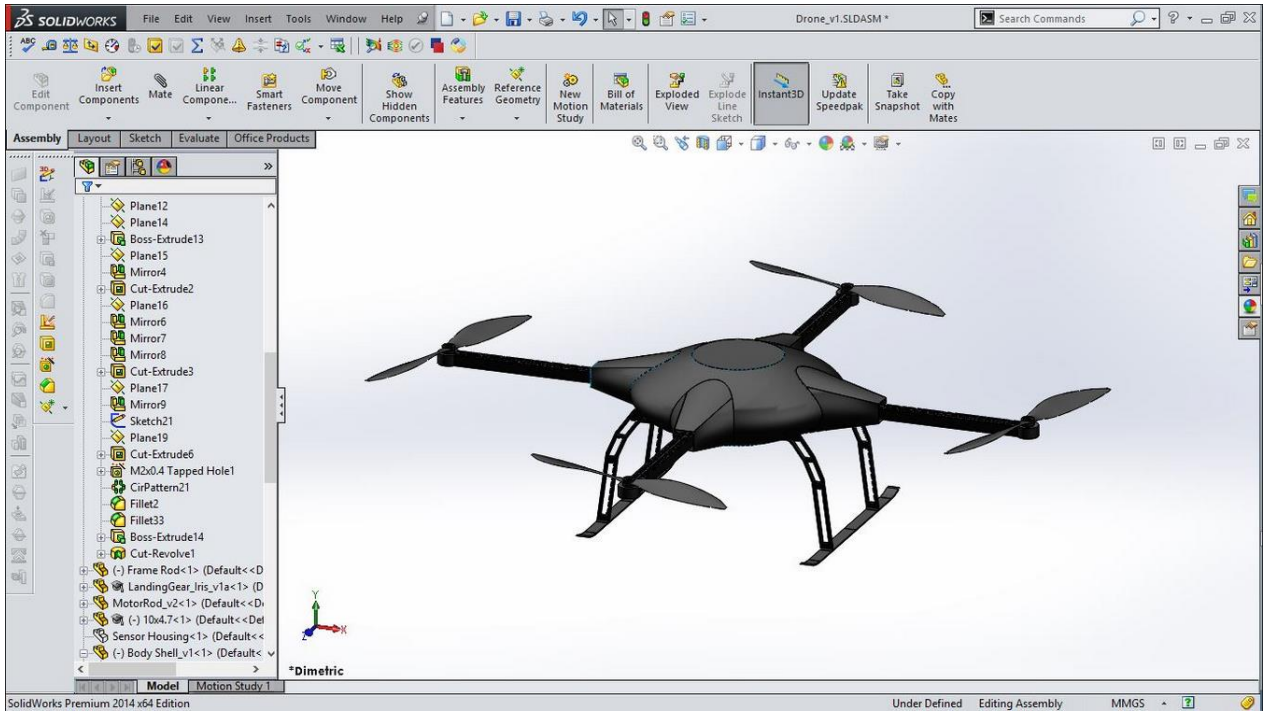
Video

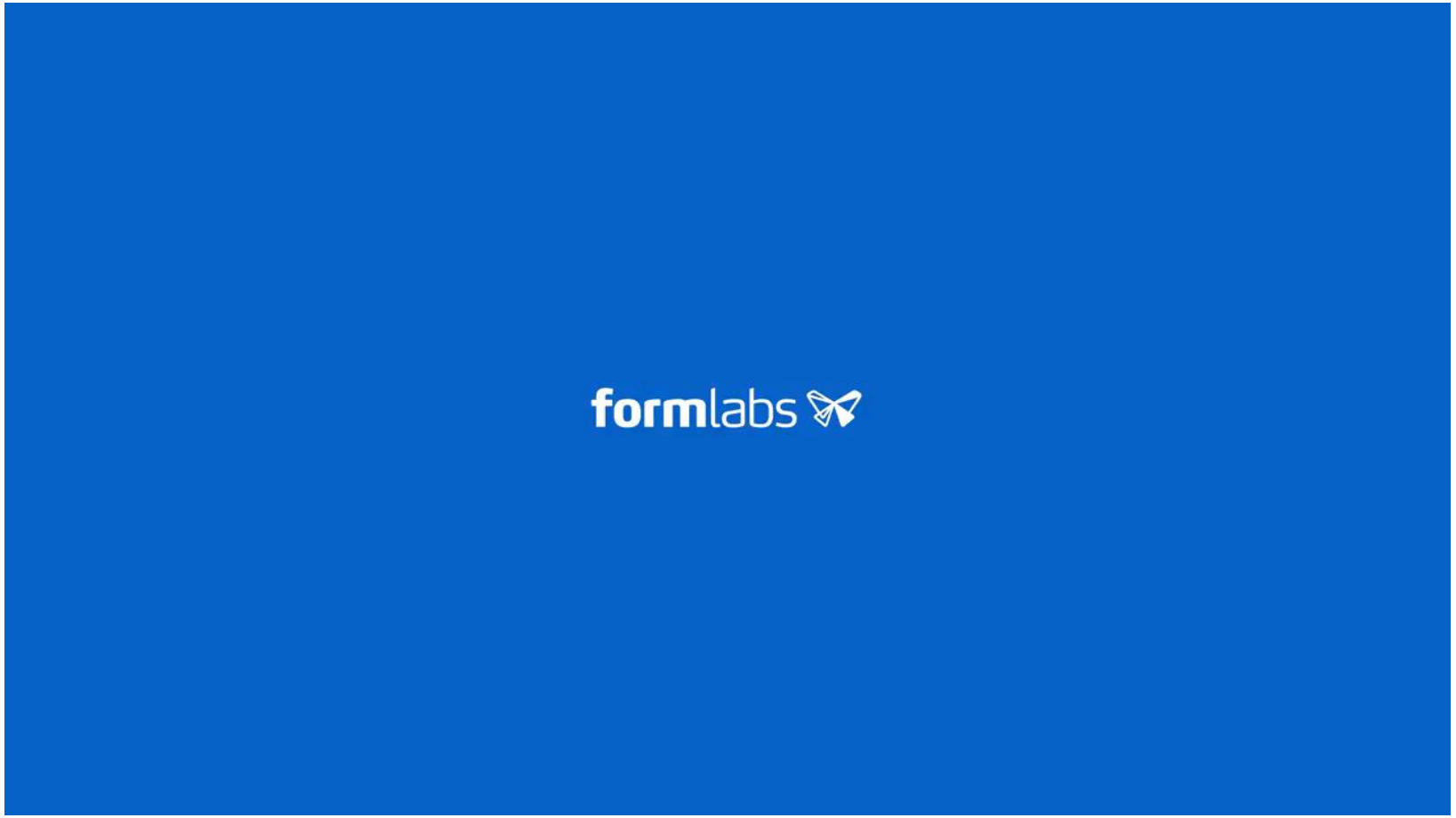
Need of digital manufacturing

- **Keep it in-house –** With a 3D printer and the right software, you can produce small batches of products on your own premises without the need for external vendors
- **Easy to test –** Have an idea? With digital fabrication, you can bring it to life and see if it's feasible. It helps you gain valuable insight into your customer needs, the marketplace and anything else that can spell the difference between success and failure
- **Save money –** Because you're only making prototypes or small batches of a product, you won't need much storage space. You can also save money on materials by using lower-grade supplies or even recycled plastic
- **Save time –** Digital fabrication accelerates the process of product development as you can create prototypes much more quickly than traditional manufacturing methods, with no need to outsource
- **Spot errors early –** Engineers like digital fabrication because it helps them spot any issues that exist within days rather than months.

Prototype

- A prototype is the first or original example of something that has been or will be copied or developed; it is a model or preliminary version. e.g.: A prototype supersonic aircraft.
- An approximation of a product (or system) or its components in some form for a definite purpose in its implementation.

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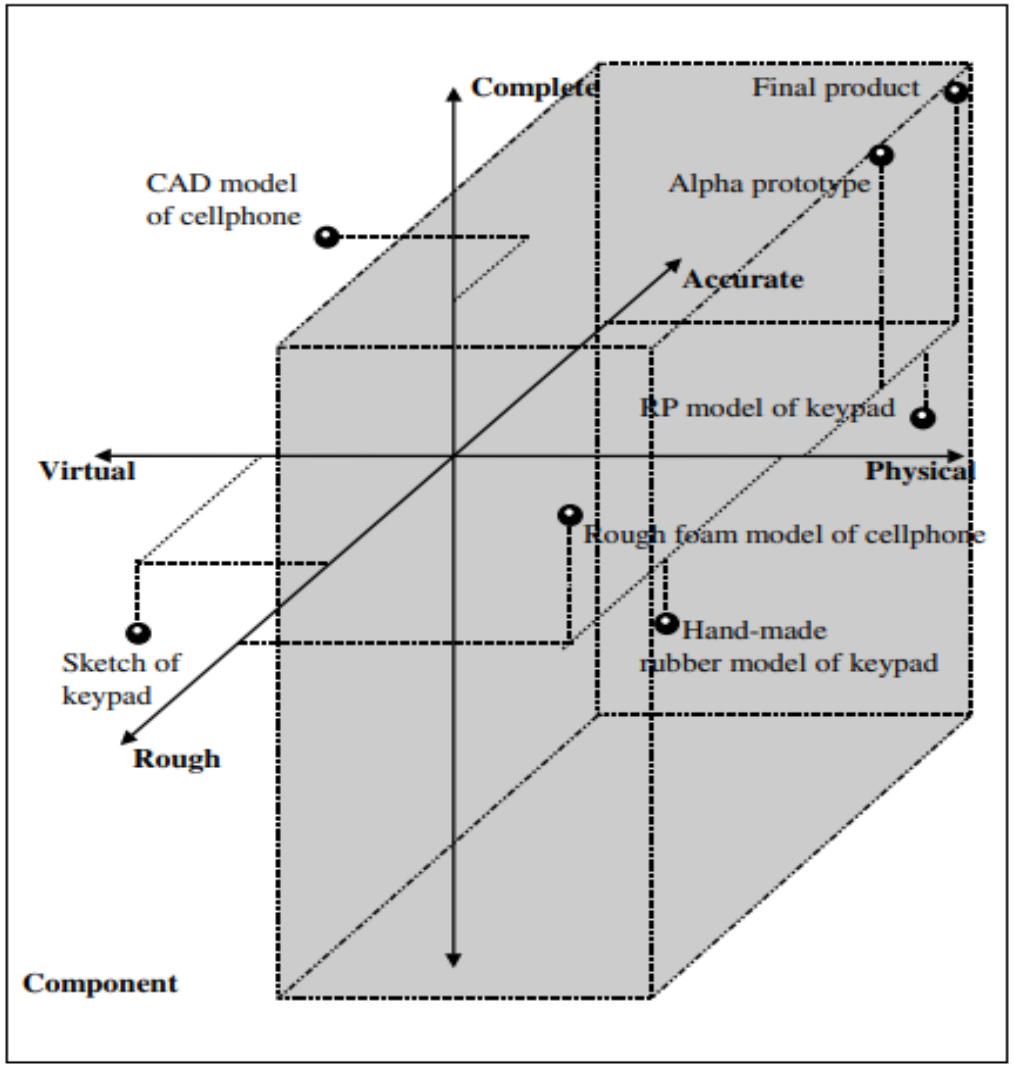
Types of prototypes

Prototype contains three aspects of interests

1. Implementation of the prototype; from the entire product (or system) itself to its sub-assemblies and components,
2. Form of the prototype; from a virtual prototype to a physical prototype, and
3. Degree of the approximation of the prototype; from a very rough representation to an exact replication of the product.



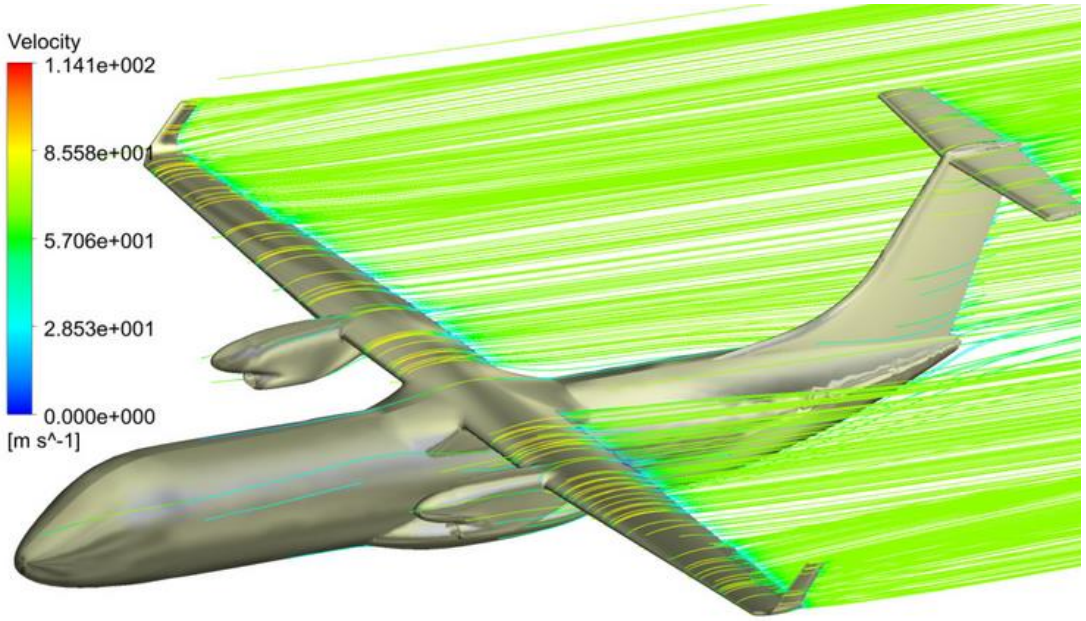
Implementation of the prototype

From the entire product

Components

Form of the prototype

virtual prototype



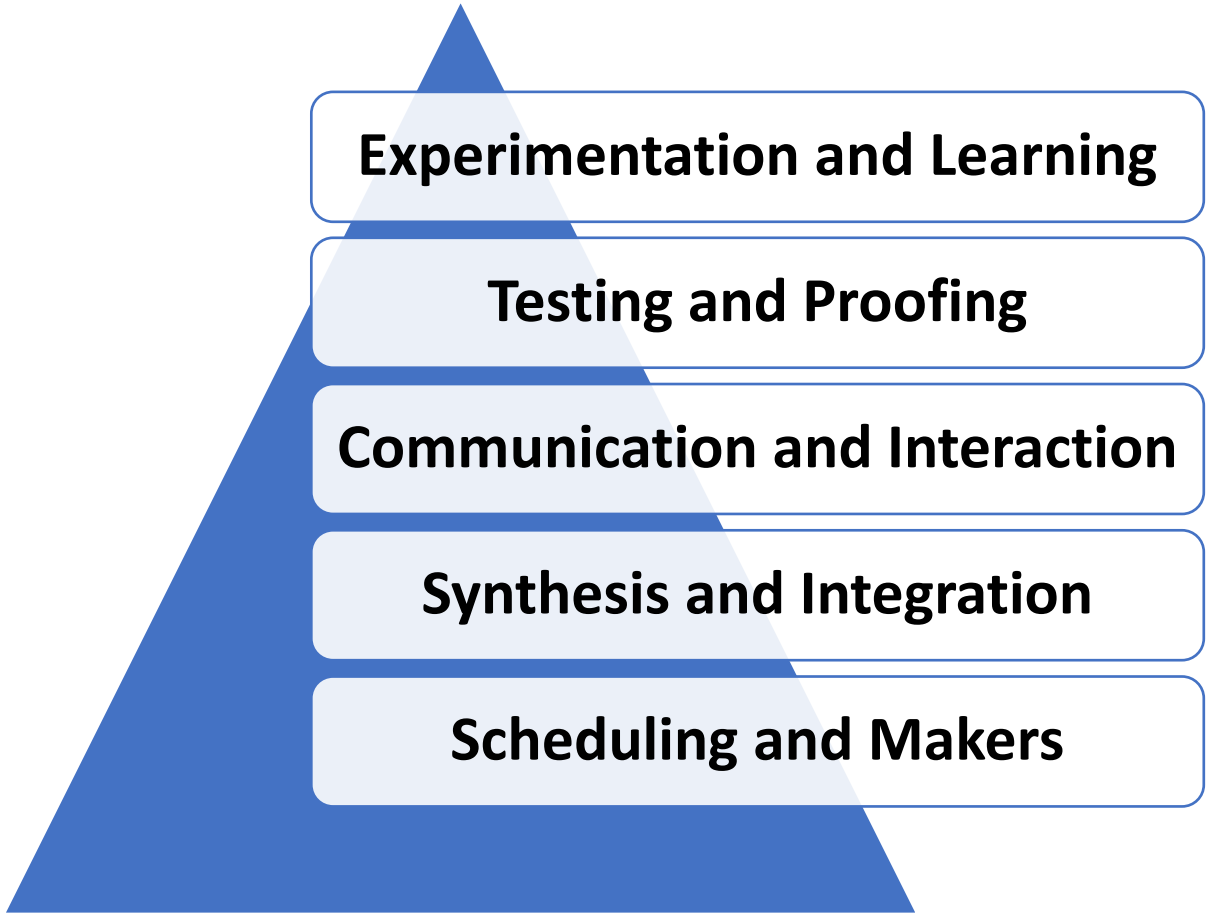
physical prototype

Degree of the approximation of the prototype

rough representation

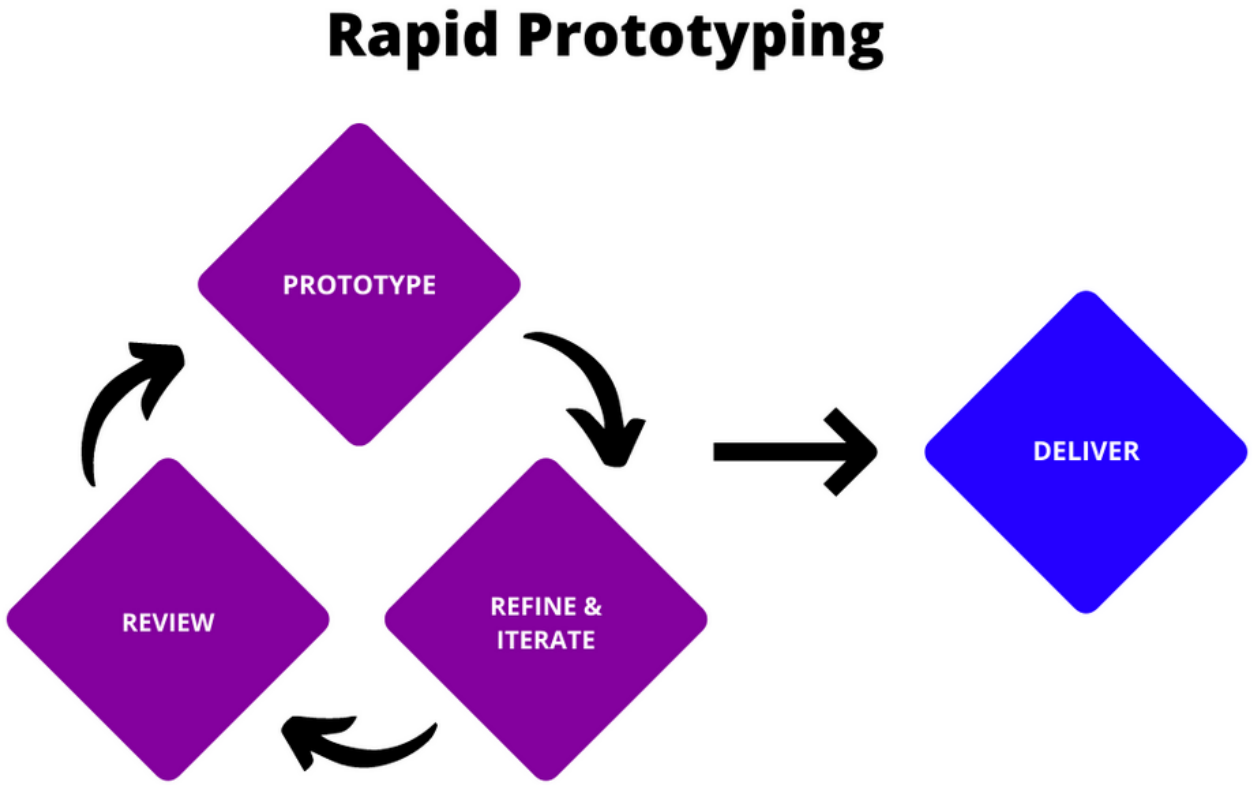
exact replication of the product

Roles of the Prototypes

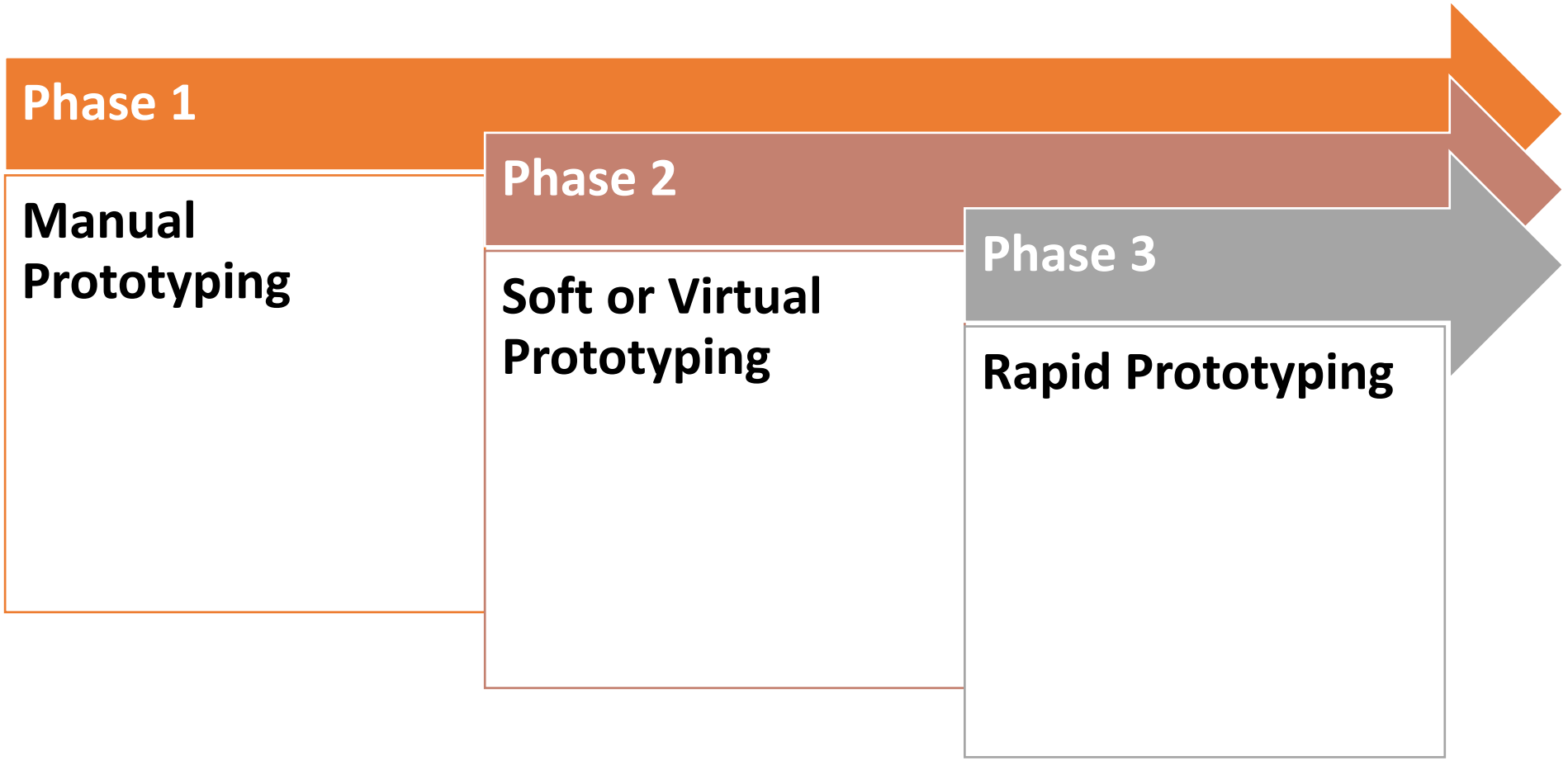


Rapid Prototyping

- Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer-aided design data.
- “As the name implies, rapid prototyping is a process of creating a prototype rapidly to evaluate the features or some part of the product.”



Phases of Rapid Prototyping



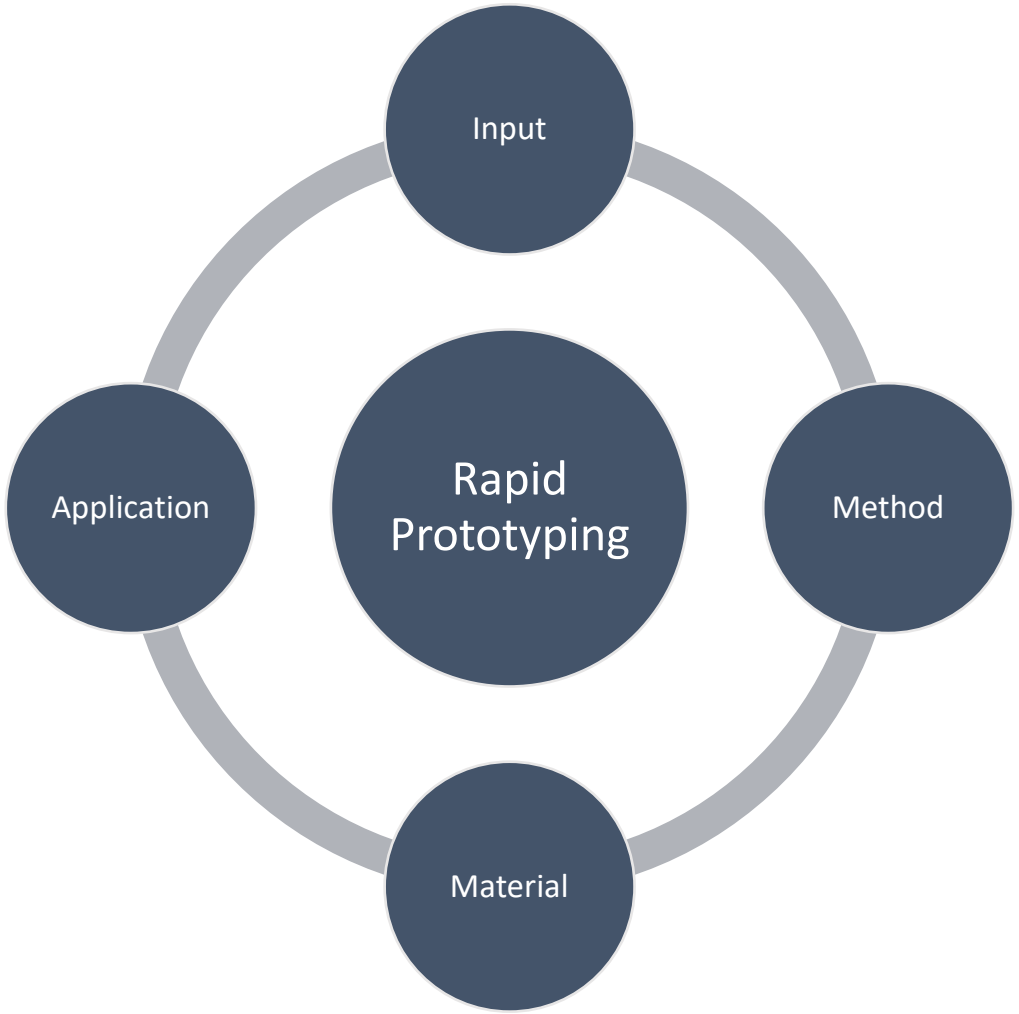
Difference between geometric modeling and prototyping

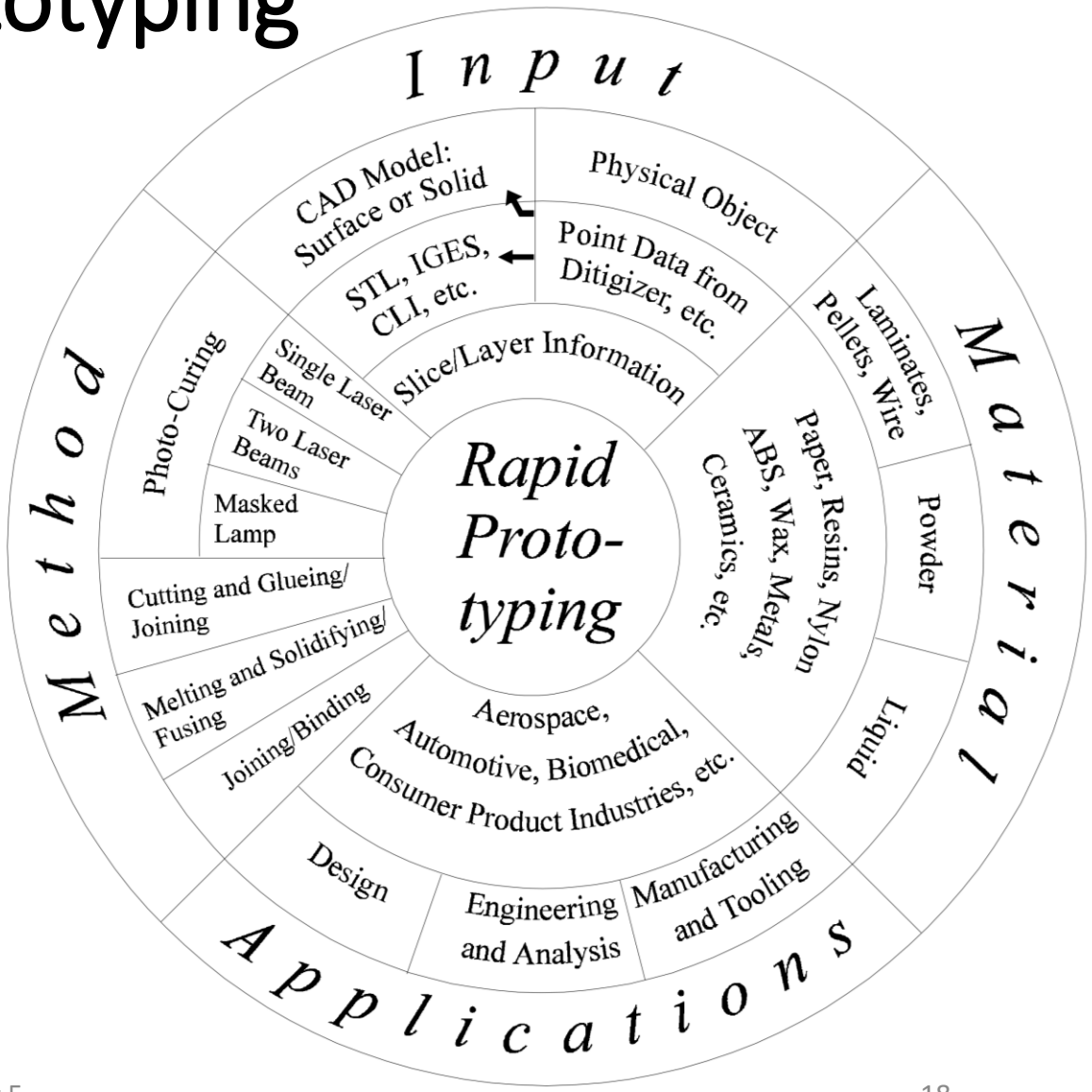
Geometric Modeling	Prototyping

❶ **First Phase: 2D Wireframe**
• Started in mid-1960s
• Few straight lines on display may be:
  • circuit path on a PCB
  • plan view of a mechanical component
• "Natural" drafting technique
	❶ **First Phase: Manual Prototyping**
	• Traditional practice for many centuries
	• Prototyping as a skilled crafts is:
	  • traditional and manual
	  • based on material of prototype
	• "Natural" prototyping technique

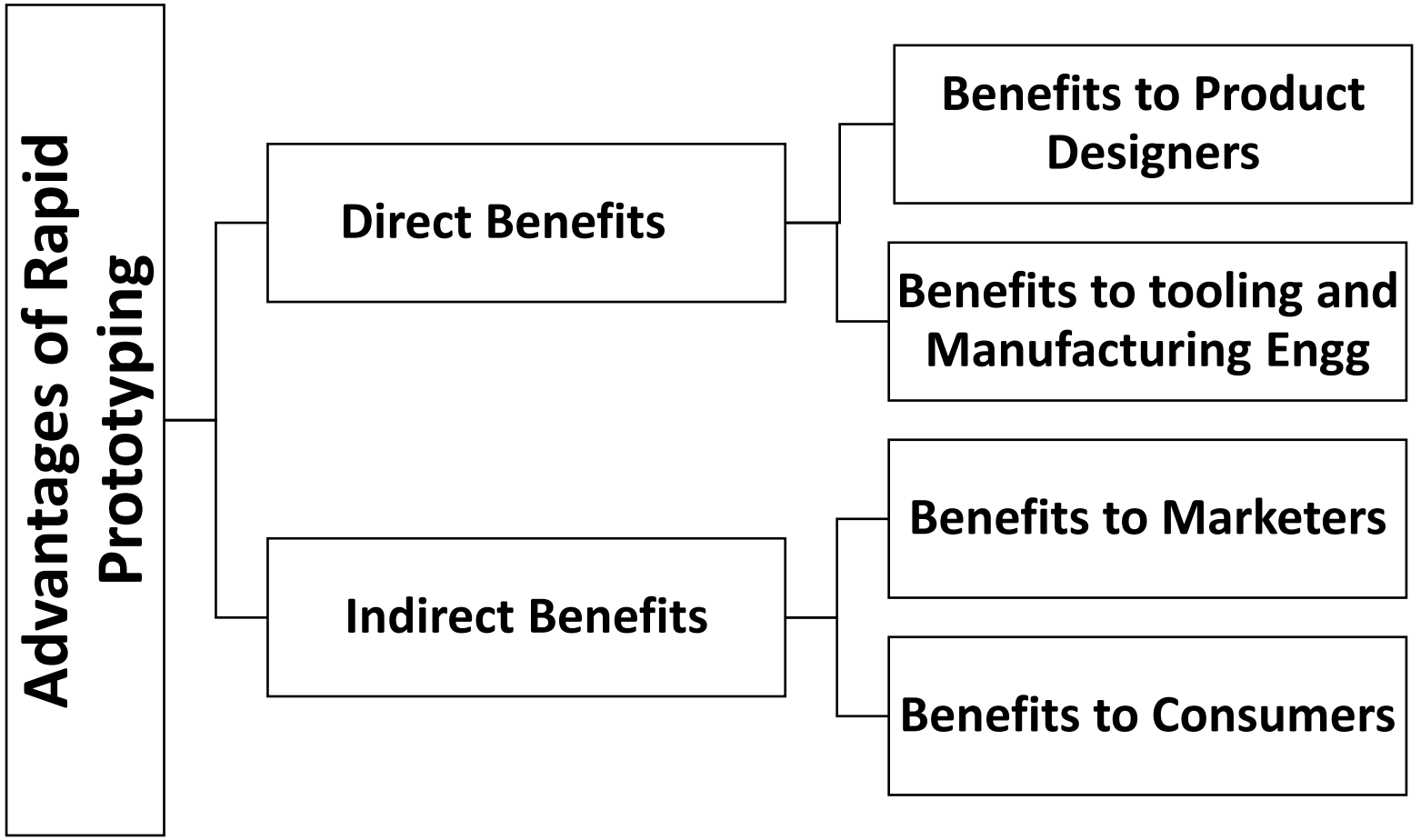
❷ **Second Phase: 3D Curve and Surface Modeling** • Mid-1970s • Increasing complexity • Representing more information about precise shape, size and surface contour of parts	❷ **Second Phase: Soft or Virtual Prototyping** • Mid-1970s • Increasing complexity • Virtual prototype can be stressed, simulated and tested, with exact mechanical and other properties
❸ **Third Phase: Solid Modeling** • Early 1980s • Edges, surfaces and holes are knitted together to form a cohesive whole • Computer can determine the inside of an object from the outside. Perhaps, more importantly, it can trace across the object and readily find all intersecting surfaces and edges • No longer ambiguous but exact	❸ **Third Phase: Rapid Prototyping** • Mid-1980s • Benefit of a hard prototype made in a very short turnaround time is its main strong point (relies on CAD modeling) • Hard prototype can also be used for limited testing • Prototype can also assist in the manufacturing of the products

Fundamentals of Rapid Prototyping





Advantages of Rapid Prototyping



Thanks