

PROTOTYPING MATERIALS



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DESIGN THINKING AND PROTOTYPING



PROTOTYPE

A prototype is an early sample, model, or release of a product that is built to test a concept or process.



“If a picture is worth a thousand words, then a prototype is worth a thousand meetings.”
— *Saying at IDEO*



- *The main motive behind prototyping is to validate the design of the actual product.*
- *Sometimes, creating a prototype is called materialization as it is the first step of transforming the virtual or conceptualized design into the real physical form.*
- *Prototypes are tangible and can range from paper modeling to creating mockups of application software's.*

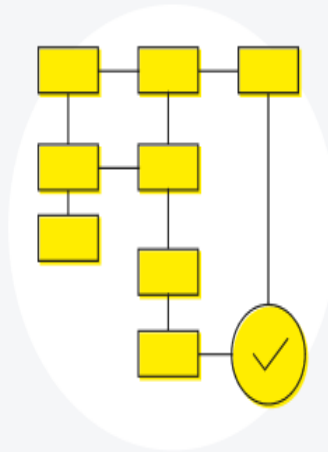
PROTOTYPE V/S MODEL

- *A model tends to lend itself to the aesthetics side of things, used to demonstrate look and feel.*
- *Prototype is more geared towards testing to see if the final piece will work as intended.*
- *Whether that is it's physical size, geometry or function.*
- *When issues are found and resolved at a prototyping stage, it can save thousands on tooling and production costs, if these issues were not discovered.*

Proof of Concept vs. Prototype vs. MVP



Validating the idea, including the technical side, and listing the features

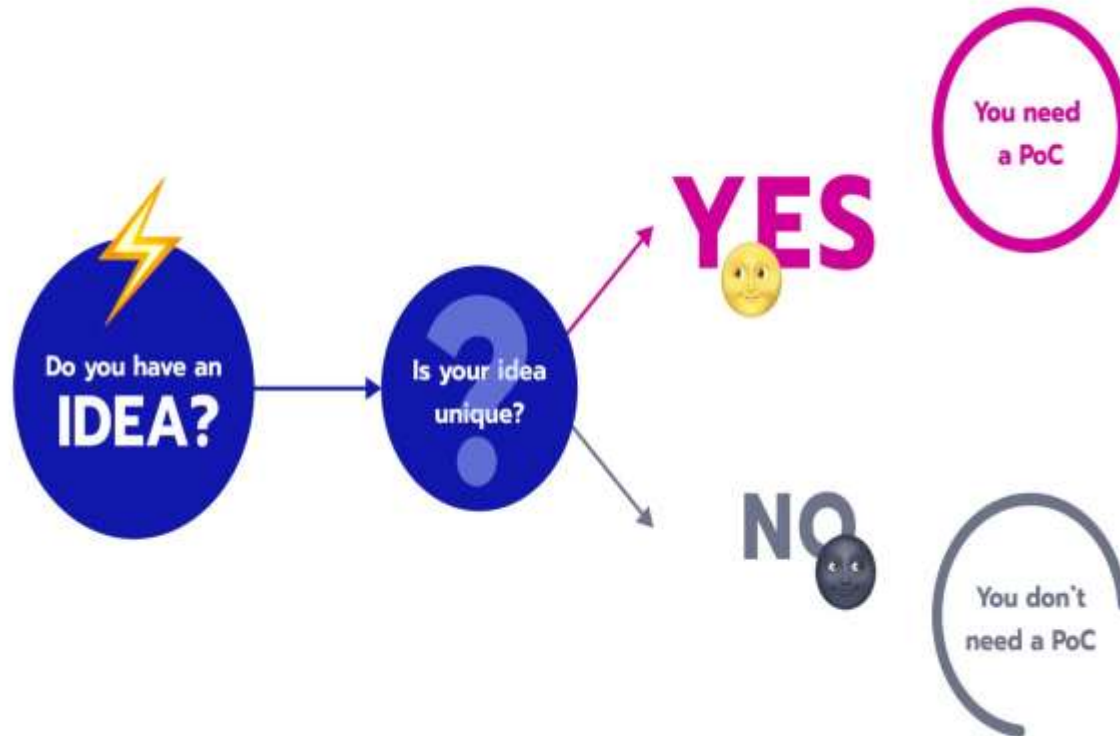


Creating a **product model** to visualize its features, testing it, and improving usability



Building a product's **functioning pilot version** and collecting feedback from real users

PROOF OF CONCEPT (POC)



A proof of concept (POC) demonstrates the feasibility of a proposed product, method, or idea.



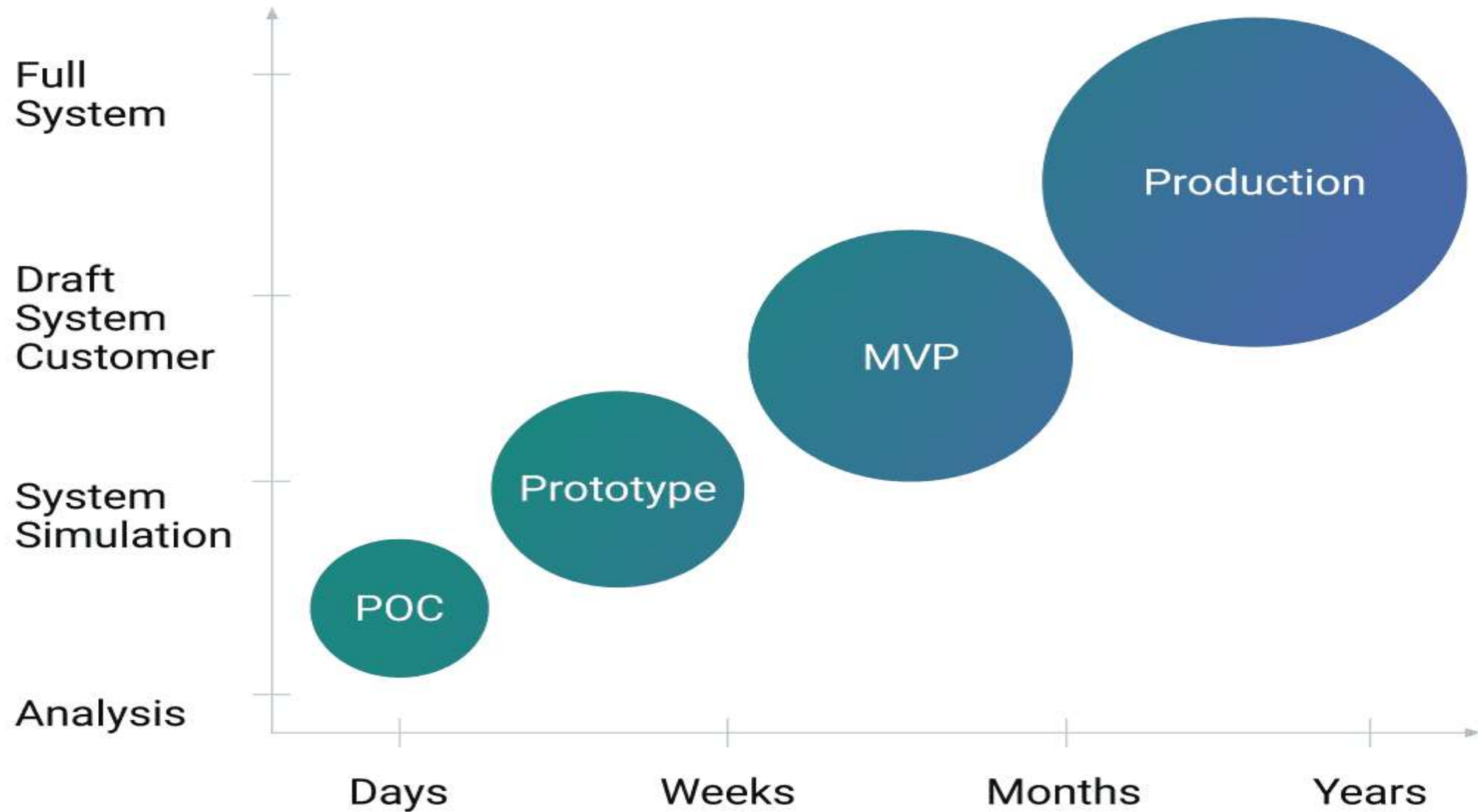
Ideation Phase



Proof of Concept



Prototype



NEED FOR PROTOTYPE

- ❖ ***Testing functionality***
- ❖ ***Gathering feedback***
- ❖ ***Refinement***
- ❖ ***Validating early concepts***
- ❖ ***Facilitating communication***
- ❖ ***Refining features and flows***

QUALITIES OF A PROTOTYPE



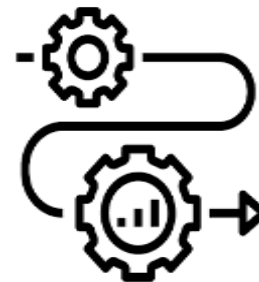
Presentation



Precision



Interactivity



Evolution

The Significance of Prototyping Material

1. Prototype Functionality Testing:

- The selected material directly impacts how well your prototype functions.*
- Different materials have varying properties, such as tensile strength, flexibility, and thermal conductivity.*
- Choosing a material that closely matches the intended final material ensures that your prototype behaves realistically during testing.*
- This is crucial for identifying and addressing design flaws and functional issues early in the development process.*

2. Realistic Representation with Prototype:

- *A prototype's primary function is to provide a tangible representation of the final product.*
- *The choice of material for the prototype can significantly affect how closely the prototype resembles the end product in terms of aesthetics, texture, and even weight.*
- *Realistic prototypes are invaluable for user testing, market research, and investor presentations, as they provide a clear vision of what the final product will be like.*

3. Cost Management via Prototyping:

- *Choosing the appropriate prototype material can result in cost-effective outcomes.*
- *Utilizing materials that closely mirror the final production materials can help circumvent unnecessary revisions and repetitive iterations.*
- *This, in turn, eliminates the necessity to start prototypes anew, a process that can consume significant time and resources.*

4. Prototype Manufacturability:

- *It's essential to carefully think about the manufacturing methods intended for the final product.*
- *The prototype material must align with these methods.*
- *Employing identical or similar manufacturing processes for both the prototype and eventual production ensures that insights gained during prototyping seamlessly apply to the final product.*

5. Risk Mitigation:

- *Selecting the right prototype material helps mitigate risks associated with production.*
- *By identifying potential manufacturing challenges or material limitations early in the development process, you can make informed decisions and adjustments, reducing the risk of costly setbacks or delays during full-scale production.*

6. User Experience Testing with Prototype

- *For consumer products, the choice of material significantly impacts the user experience.*
- *The tactile qualities, ergonomics, and overall feel of the prototype can influence user preferences and feedback.*
- *Therefore, using materials that mimic the final product's touch and feel is essential for gathering accurate user insights and refining the design accordingly.*

7. Regulatory Compliance:

- *Certain industries, such as healthcare and aerospace, have stringent regulatory requirements.*
- ***Prototyping with materials*** *that meet or closely match these regulatory standards ensures that your product is more likely to pass certification and compliance testing, saving time and resources in the long run.*

8. Marketability and Investor Confidence:

- *A well-crafted prototype with the right materials can be a powerful tool for attracting investors and gaining market traction.*
- *A realistic and aesthetically pleasing prototype can instill confidence in potential investors, partners, and customers, helping secure funding and building anticipation for the final product*

9. Material Specific Testing:

- *Depending on the project, certain material-specific tests may be necessary.*
- *For instance, if your final product will be exposed to extreme temperatures, it's essential to prototype with a material that can withstand those conditions.*
- *Prototyping with the right material allows for accurate testing of material-specific factors like heat resistance, chemical resistance, or wear and tear.*

10. Environmental Impact:

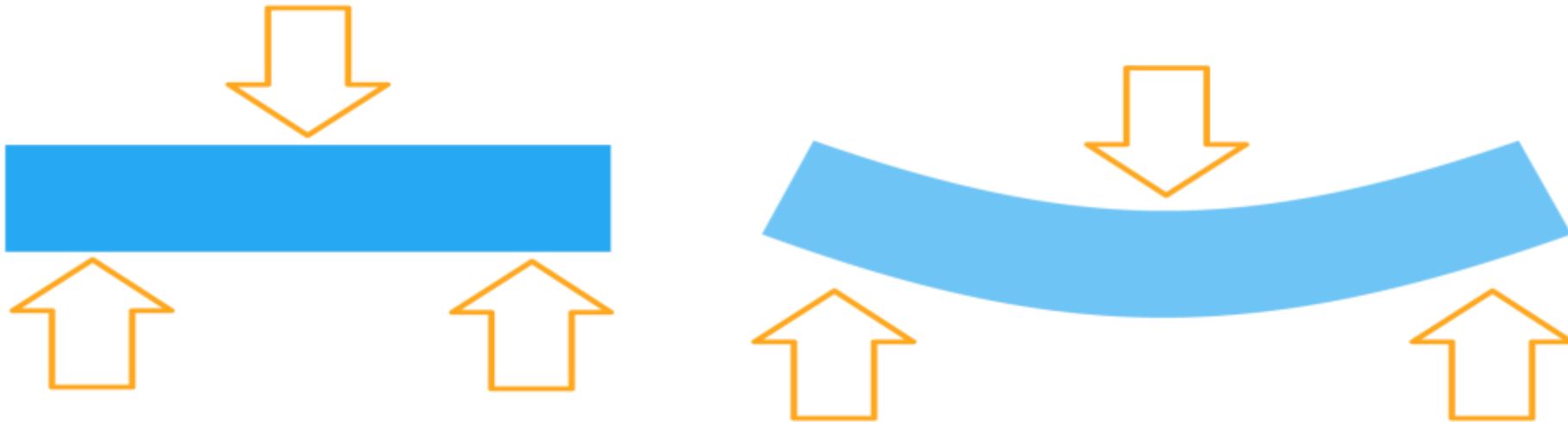
- *In today's environmentally conscious world, the environmental impact of materials cannot be overlooked.*
- *Choosing sustainable and recyclable materials for your prototypes aligns with sustainability goals and demonstrates a commitment to eco-friendliness, which can be a significant selling point for certain products and markets.*

Characteristics of Prototype Material

Strength and Durability: The material's ability to withstand mechanical stress, impacts, or environmental conditions is crucial for functional prototypes

Elastic Modulus: How Stiff Is It?

Elastic modulus is a material's resistance to elastic deformation under stress



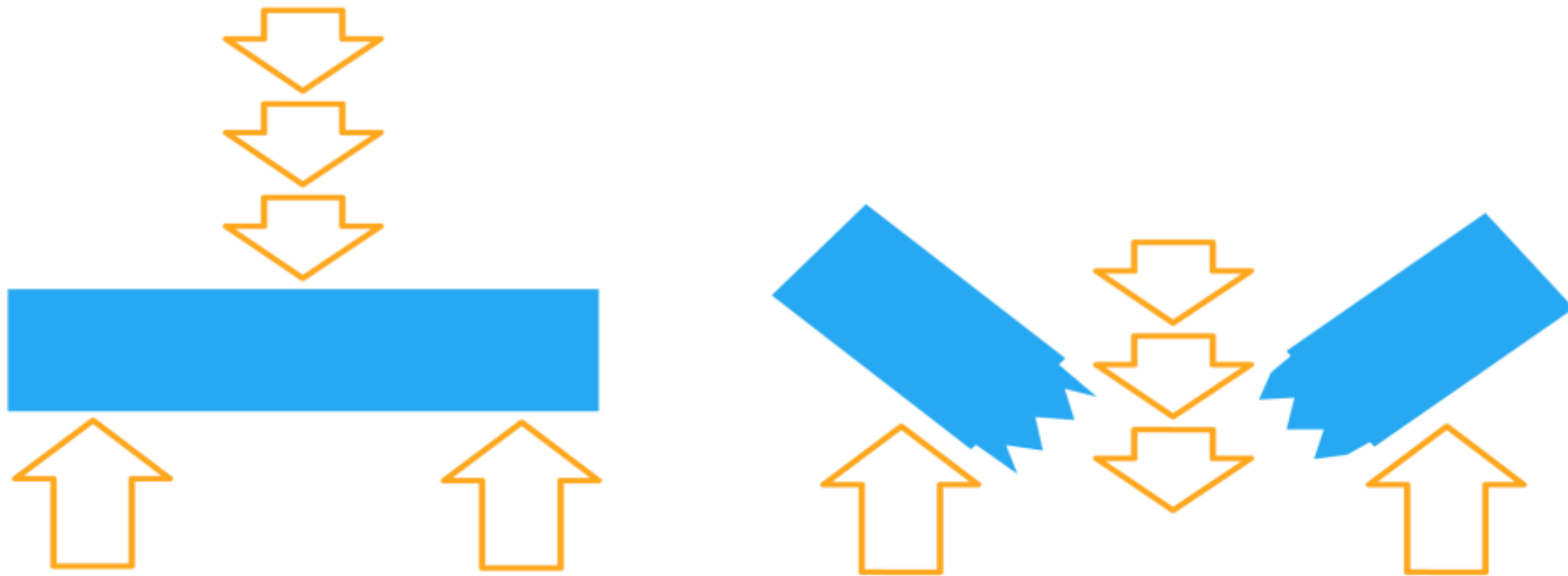
Elongation: Will It Bend and Stretch?

Elongation is a material's resistance to breaking when stretched.



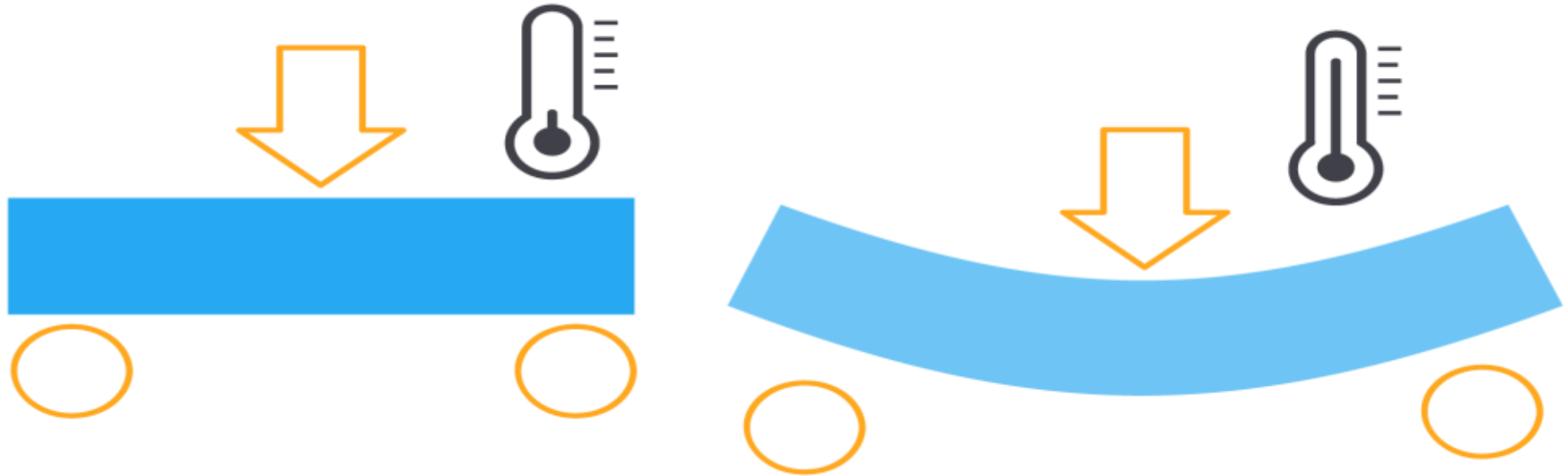
Impact Strength (Toughness): Can It Absorb Shock?

Impact strength is a material's ability to absorb shock and impact energy without breaking.



Heat Deflection Temperature: Does It Tolerate Heat?

Heat deflection temperature (HDT) is the temperature at which a material deforms under a specified load



Creep: Will It Deform Under Long-Term Stress?

Creep is a material's tendency to move slowly or deform permanently under mechanical stresses.

Weight: *The weight of the material can affect the prototype's overall feel and functionality, particularly in applications like aerospace or automotive design.*

Thermal Conductivity: *If your prototype needs to manage heat or cold, the material's thermal properties are essential*

Chemical Resistance: For prototypes exposed to specific chemicals or environments, resistance to corrosion or chemical reactions is vital

Size and Form: Consider whether the material is available in the size and form (sheets, rods, powders) that meet your project's requirements.

Electrical Parameters: *If your prototype includes electronic components,, the material's electrical conductivity or insulating properties are crucial*

Magnetic Parameters: *For projects involving magnetic components or fields, consider the material's magnetic characteristics.*

UV Resistance: *Materials exposed to sunlight or UV radiation may require resistance to prevent degradation.*

Sound and Vibration Characteristics: *Materials used in acoustic or vibration-related applications should have suitable acoustic and vibration damping properties.*

Transparency or Opacity: *The level of transparency or opacity can be crucial for prototypes involving displays, lenses, or visual elements.*

Cost: *The price of the material can significantly impact your project's budget, so it's essential to balance cost with other characteristics.*

Ease of Prototyping: Some materials are better suited for specific prototyping methods, such as injection molding, 3D printing, etc.

Ease of Machining: Consider how easily the material can be shaped, cut, or molded to create your prototype's desired form.

Availability and Recyclability: *Ensure that the chosen material is readily available and accessible for your prototyping needs. Sustainability concerns may lead you to select materials that are recyclable or have a minimal environmental footprint..*

Common Prototype Materials

- *Plastics*

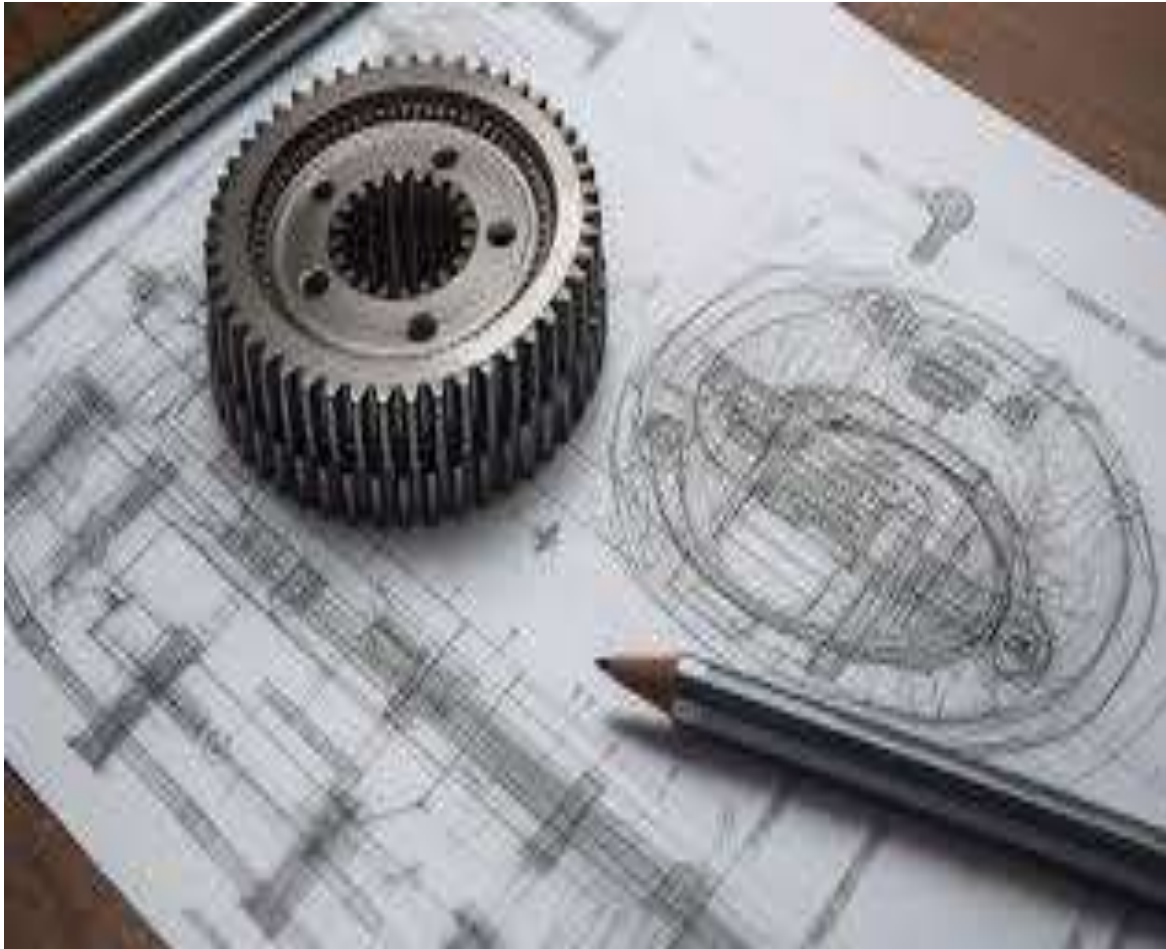


Various types of plastics, such as ABS, PLA, polycarbonate, and acrylic, offer different properties to suit specific applications.

- *ABS is durable and often employed in functional prototypes.*
- *PLA, biodegradable and easy to 3D print, is ideal for concept models.*
- *Polycarbonate's strength makes it suitable for robust prototypes.*
- *Acrylic, transparent and visually appealing, is used for visual prototypes and displays.*

These plastics can be machined, injection molded, or 3D printed, offering a wide range of possibilities for creating prototypes across industries, from consumer goods to healthcare devices, aerospace, packaging design, consumer electronics, architecture, toys and games, industrial equipment, environmental products, and custom fabrications

- **Metals**



- ***Metals***

Metals like aluminum, steel, and titanium are chosen for their strength and durability.

Metals are indispensable in prototype development due to their strength and durability.

Aluminum, steel, and titanium are commonly used, especially in aerospace, automotive, and industrial prototypes.

Their robustness ensures that prototypes can withstand mechanical stress and environmental conditions.

- ***Rubber and Silicone***



• **Rubber and Silicone**

- *These materials are ideal for prototypes involving seals, gaskets, or flexible components, common in automotive and medical industries.*
- *Their unique properties include elasticity, flexibility, and resistance to heat and chemicals.*
- *This makes them perfect for prototypes of gaskets, seals, and components requiring shock absorption or vibration dampening.*
- *They are crucial in the automotive sector for testing vehicle parts, and in the medical field for creating prototypes of medical devices and prosthetics, ensuring both safety and functionality.*

- *Ceramics*



- ***Ceramics***

- *Ceramics are chosen for prototypes requiring high-temperature resistance and electrical insulation, such as electronic components.*
- *They're employed in industries like electronics, aerospace, and medical devices to prototype components that require these characteristics.*
- *Ceramic prototypes ensure functionality and reliability under extreme conditions, such as in the production of heat-resistant electronic parts or medical implants, where electrical isolation and biocompatibility are crucial*

- ***Bioplastics***



- **Bioplastics**

- *These environmentally friendly plastics are made from renewable sources like cornstarch, sugarcane, or potato starch, and are suitable for sustainable product prototypes.*
- *They are used in prototype development with an environmental focus.*
- *Bioplastics are versatile and can mimic the properties of conventional plastics.*
- *They find applications in creating prototypes for eco-friendly packaging, disposable cutlery, and various consumer products, aligning with the growing demand for environmentally responsible materials and products.*

- *Polyurethane Resins*



• ***Polyurethane Resins***

- *These resins can mimic a wide range of materials and are commonly used in model-making, visual prototypes, and functional testing.*
- *They offer the ability to simulate a wide range of properties, from rigid to flexible, and can replicate the appearance of various materials.*
- *They are known for their ease of use and ability to capture intricate details, making them popular in industries like automotive, consumer goods, and healthcare.*
- *These resins enable designers to create realistic and functional prototypes, facilitating effective product development.*

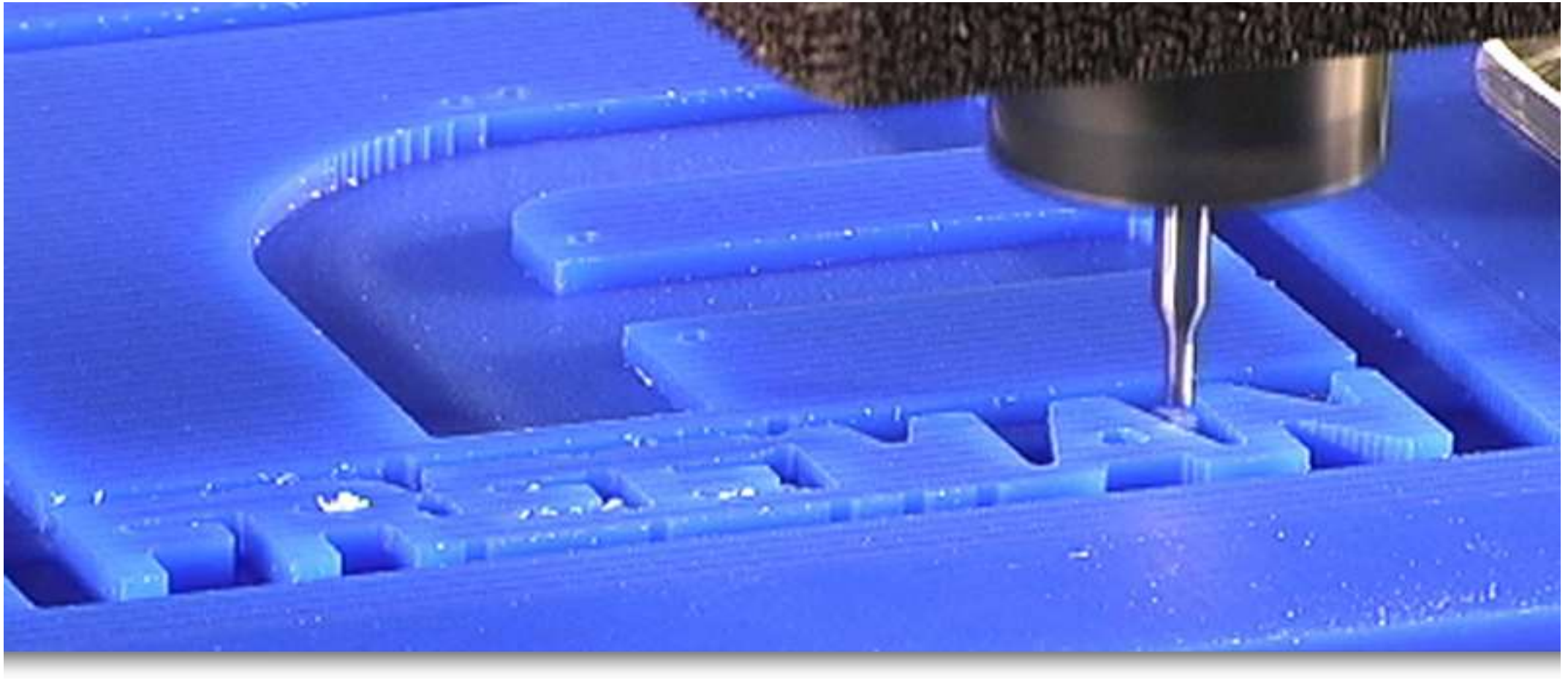
- *Foam*



• *Foam*

- *Foam materials, including foam boards and foam core, are lightweight and suitable for architectural models, packaging, and product design prototypes.*
- *They are often used in architecture, packaging design, and model making.*
- *Foam is easily cut, carved, and sanded to create intricate shapes and structures. It's especially suitable for creating detailed architectural models, product packaging prototypes, and visual displays.*
- *Foam's ease of manipulation and cost-effectiveness make it a popular choice when precision and aesthetics are key considerations in the prototyping process.*

Machinable Wax



Machinable Wax

- *Machinable wax is a specialized prototyping material known for its ease of machining.*
- *It's typically used for creating intricate and detailed prototypes, molds, and patterns.*
- *Machinable wax is soft and can be carved, milled, or turned with CNC machines and other machining tools, making it ideal for precision work.*
- *Its main advantage is that it allows for the creation of prototypes with fine details and complex geometries, which are difficult to achieve with many other materials.*
- *This makes it valuable in industries like jewelry design, dental prosthetics, and engineering*

Acrylic Glass (Plexiglass)



Paper and Cardboard

- *Paper-based materials are used for rapid prototyping and packaging design, often created through laser cutting or 3D printing.*
- *Paper and cardboard are economical and accessible prototyping materials, known for their versatility in creating quick and low-cost prototypes.*
- *Paper can be easily cut, folded, and glued, while cardboard provides more structural support. Laser cutting and 3D printing on paper-based materials are common techniques.*
- *These materials are valuable for early-stage design exploration, mock-ups, and initial user testing due to their affordability and ease of manipulation*

Wood and wood composites



Bamboo Solar Bike

A radically organic and comprehensive bike frame that creates and stores its own power.



Thank you