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Proof-of-concept & Rapid Prototyping

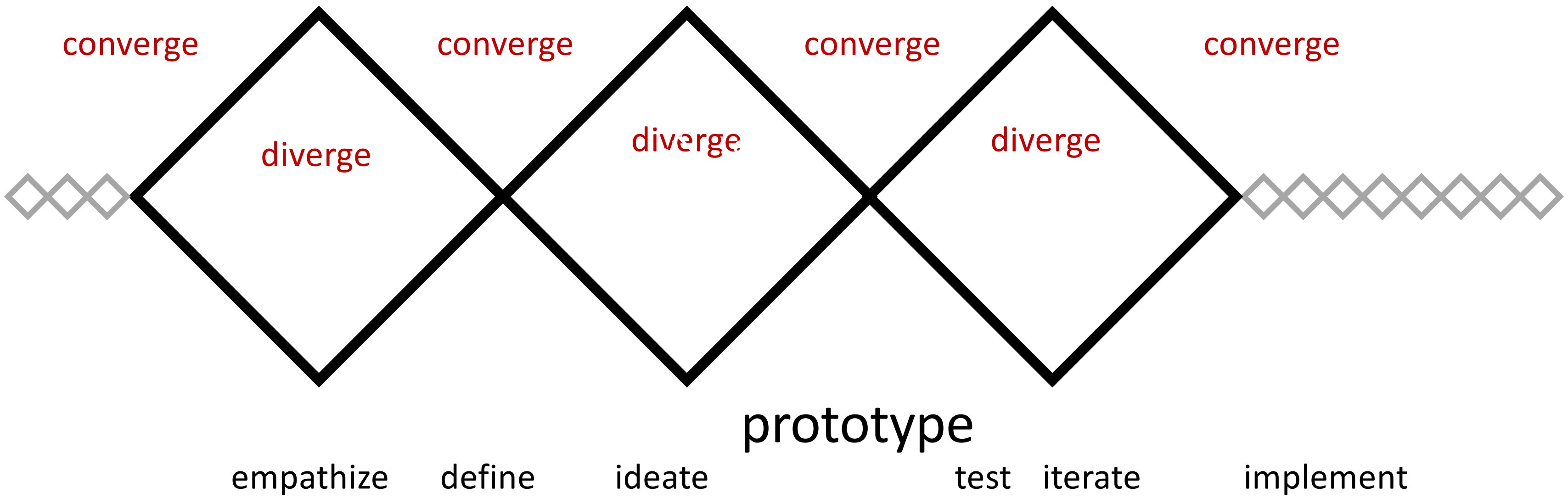
manufacturing processes

Facilities, labs and infrastructure in IITB for prototyping

Innovation Process: **Design Thinking**, Ideation, Creativity Techniques

Design thinking: empathize, define, ideate, **prototype**, test, iterate, implement

Design Process:



fabrication processes https://www.youtube.com/watch?v=Um_g8sQ_p3Y

Processes & Facilities available in PoC lab

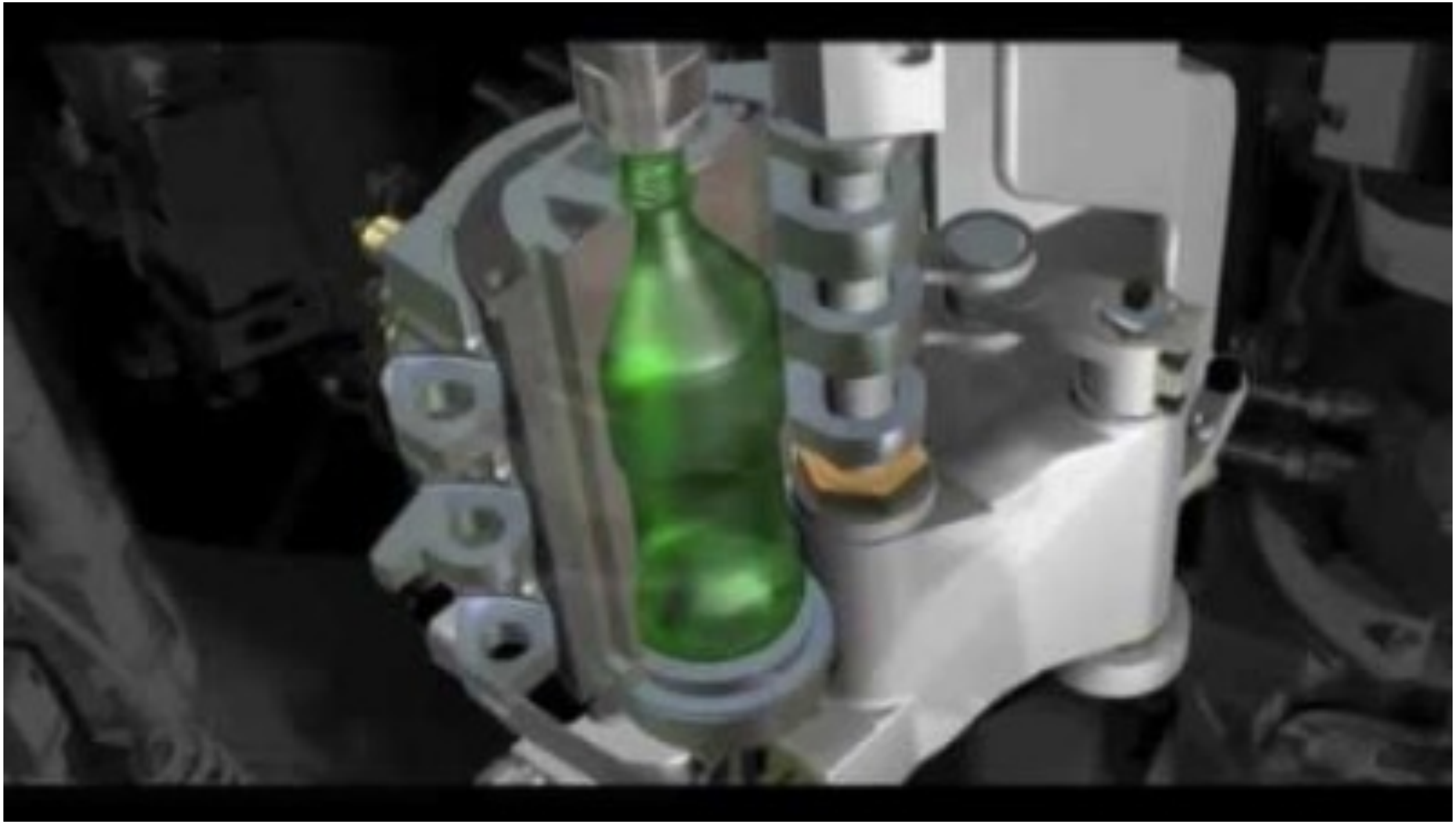
and vendor facilities

injection molding

blow molding

blow molding

injection molding + blow molding



extrusion

turning

vacuum forming

vacuum forming

Styrofoam hot wire cutting

3D printing

Resin 3D printing

Laser cutting & etching

metal forming

metal casting

finishes

paint mixing

finishes

sanding
putty
painting

Prototyping labs in IIT Bombay **Official permissions required**

POC Lab, DSSE, IDC, IIT Bombay

Opposite VMCC, Near Parabolic arc of Infy corridor

List of other useful labs:

Here is a list of labs in institute which you may find useful for your projects during ITSP.

1. Tinkerers' Lab (Mech part), Behind treelabs, near the t-joint for workshop:

Free wifi, nice ambiance and most of the instruments you might need. You can work here in peace and is open most of the time. You may find seniors who will help you. it has Mechanical as well as electrical stuff. You can work on heavy machines over there. There is a 3d printer available which has to operated under guidance.This will solve your manufacturing and mechanical problems.

2. WEL (Wadhwani Electronics Laboratory) Department of Electrical Engineering, 3rd floor:

Perhaps the best lab to design, build and test your circuits. The lab offers CROs, function generators, variable power sources, breadboards, soldering equipment and internet. Oh, I almost forgot the air conditioning.

3. PCB Printing Lab, 1st floor, Department of Electrical Engineering (Annexe):

You can get a circuit board printed here on submitting a printout of your design. For details regarding the procedure, check http://tinyurl.com/itsp-pcb

4. IDC (Industrial Design Centre), Opposite VMCC, Near Parabolic arc of Infy corridor:

The IDC labs offers facilities for preparing industrial quality finished products. The most useful for you would be the plastic studio (for bending and cutting acrylic sheets) and the wood studio.

5. Mechanical Workshop, End of Infy corridor nearest to Mechanical Department:

As you would already know, the Mechanical Workshop has machines for welding, shaping, lathe and wood work.

6. MAV lab, Aerospace Department (Annexe), below HSS Department:

Mainly useful for aero-modelling projects, it provides instruments for thrust measurement, CNC foam cutting etc.

7. NSL (New Software Lab), Ground floor, old CSE building:

It offers free WiFi and a cool atmosphere to work in. Bless the awesome Air conditioning there. Due to some sessions for the department NSL will be available only during night time. We are also giving you access to NSL computers.

8. UMIC Lab, Between old CSE building and treelabs (t-joint near workshop path):

Used by ASME and IGVC teams, has free wifi and almost all components you might need. While they will provide you with consumables, you might not get big stuff. The people over there are highly experienced and will help you out with any difficulties you might be having.

itc Institute Technical Council

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tools @ POC lab:

software

2d

- coreldraw
- illustrator
- autocad
- inkspace
- powerpoint
- GIMP
- Miro

for

- laser cutting
- vinyl cutting etc

software

3d

- Blender
- fusion 360
- solidworks
- FreeCAD
- LibreCAD

for

- 3d printing
- machining

physical tools

- hand tools
- powertools
- adhesives
- finishing

electronics

- Arduino
- raspberry pi
- electronics tool kit

programimg:

- chatgpt
- bard
- bing

https://www.promptstacks.com/

reading material from web:

Types of Prototypes

There are several types of prototyping that can be used in the innovation process, depending on your specific goals, resources, and the stage of development. Here are some common types of prototypes:

1. Paper Prototypes: These are low-fidelity prototypes created by hand, typically using sketches, sticky notes, or printouts. Paper prototypes are quick and inexpensive to produce, allowing you to test and validate the basic concepts and user interactions before investing in more advanced prototypes.

2. Mock-ups: Mock-ups are static, non-functional representations of a product or interface. They can be created using graphic design tools or prototyping software. Mock-ups focus on visual aspects and layout and help you communicate the look and feel of the final product without implementing any functionality.

3. Wireframes: Wireframes are simplified, black-and-white or grayscale representations of a product or interface. They outline the structure, layout, and key components but do not include visual design details. Wireframes are useful for testing usability and navigation, as well as gathering feedback on the overall information architecture.

4. Digital Prototypes: Digital prototypes are interactive representations of a product or interface that simulate its functionality and user interactions. They can be created using prototyping tools or by developing a basic version of the product using programming or scripting languages. Digital prototypes allow for more realistic user testing and validation of features and user flows.

5. Functional Prototypes: Functional prototypes are advanced prototypes that closely resemble the final product in terms of functionality. They can be used to test and refine technical aspects, demonstrate key features, and gather feedback on the overall user experience. Functional prototypes often involve a combination of hardware and software components, depending on the nature of the innovation.

6. Proof-of-Concept Prototypes: These prototypes are developed to validate the feasibility of a concept or technology. They focus on demonstrating a specific technical capability or solving a particular problem. Proof-of-concept prototypes are often used to secure funding, attract potential partners or investors, and gain support for further development.

7. Virtual or Augmented Reality Prototypes: These prototypes leverage virtual or augmented reality technologies to create immersive and interactive experiences. They are particularly useful for testing and refining user interactions in simulated environments, such as gaming, training, or architectural design.

Remember, the choice of prototype type depends on your specific needs, available resources, and the stage of development. It's common to start with low-fidelity prototypes in the early stages to quickly iterate and gather feedback, and then gradually move towards more advanced prototypes as the concept matures.

Process of PoC Prototyping

1.Define Objectives: The first step in creating a proof of concept is to clearly define the objectives or goals of the concept or idea that you want to validate. What are you trying to achieve? What problem are you aiming to solve? Define the specific outcomes you expect from the POC, such as demonstrating technical feasibility, evaluating performance, or assessing market potential.

2.Identify Key Assumptions: Identify the key assumptions underlying your concept or idea. These are the critical factors that need to be proven or disproven through the POC. For example, if you are developing a new technology, an assumption could be that it can achieve the desired performance levels, or if you are testing a new product idea, an assumption could be that there is a market demand for it.

3.Plan and Design: Develop a plan and design for your POC. This includes determining the scope, scale, and timeline of the POC. Decide what aspects of the concept you will test, how you will test them, and what resources you will need. Design the experiments, simulations, or demonstrations that will help you validate the key assumptions.

4.Build Prototype: Create a prototype or a simplified version of the concept that you can use in the POC. This could be a physical prototype, a digital prototype, or a combination of both, depending on the nature of your concept. The prototype should be designed to specifically test the key assumptions and capture relevant data.

5.Conduct Experiments or Simulations: Implement the plan and design of your POC by conducting experiments, simulations, or demonstrations with the prototype. Follow the plan and design carefully, collect data, and document the results. This data will be used to evaluate the performance of the concept and validate the key assumptions.

6.Analyze Results: Once the experiments or simulations are completed, analyze the data and results obtained. Evaluate the performance of the concept based on the objectives and key assumptions defined earlier. Did the POC provide evidence that the concept is feasible, viable, and meets the desired outcomes? What were the strengths and weaknesses identified? What insights or learnings were gained?

7.Refine and Iterate: Based on the analysis of the results, refine and iterate the concept as needed. If the POC did not validate the key assumptions or if issues were identified, consider making changes to the concept, the prototype, or the testing approach. Iterate the POC process and conduct additional rounds of testing if necessary.

8.Communicate Findings: Finally, communicate the findings of the POC to relevant stakeholders, such as team members, decision-makers, investors, or partners. Present the evidence and insights gained from the POC, and provide recommendations for next steps, based on the results. This will help in decision-making and gaining support for further development or investment.

Remember, a proof of concept **is not meant to be a final product or solution**, but rather a small-scale and focused validation of the feasibility or viability of a concept or idea. It is an iterative process that helps reduce risks, gather data, and make informed decisions. By carefully planning, designing, executing, analyzing, and iterating the POC, you can gain valuable insights and evidence to support the development and implementation of your concept or idea.

Physical model/prototype fabrication processes

In fabrication, which refers to the process of creating or manufacturing products or parts, several basic operations are commonly involved. These operations can vary depending on the specific manufacturing process and the materials being used. Here are some fundamental operations in fabrication:

1. **Cutting:** Cutting is the process of separating materials into desired shapes or sizes. It can be done using various techniques, such as sawing, shearing, laser cutting, or waterjet cutting. Cutting is often the initial step in the fabrication process to create raw material or workpieces.

2. Joining: Joining involves connecting or bonding separate components together to form a cohesive structure. Common joining methods include welding, soldering, brazing, adhesive bonding, riveting, or fastening with screws, nuts, or bolts. Joining operations ensure that multiple parts come together securely.

3. Forming: Forming operations reshape materials to achieve desired shapes or configurations. Examples include bending, stretching, stamping, deep drawing, rolling, or extrusion. Forming can be performed using mechanical force, heat, or a combination of both, depending on the material properties and the desired outcome.

4. Machining: Machining is a subtractive manufacturing process that involves removing material from a workpiece to create the desired shape or surface finish. Common machining operations include milling, turning, drilling, grinding, or honing. Machining operations are typically performed using machine tools like lathes, milling machines, or CNC (Computer Numerical Control) machines.

5. Finishing: Finishing operations are performed to enhance the appearance, surface quality, or durability of the fabricated part. These operations may include sanding, polishing, buffing, coating (such as painting or powder coating), plating, or surface treatment processes like anodizing or electroplating.

6. Assembly: Assembly involves combining individual components or fabricated parts to create the final product. It includes tasks such as fitting, aligning, fastening, or integrating different parts together to achieve the desired functionality and structure.

7. Testing and Inspection: Testing and inspection are crucial operations in fabrication to ensure the quality, functionality, and compliance of the fabricated products. Various testing methods, such as dimensional measurement, non-destructive testing, stress testing, or functional testing, are employed to verify the integrity and performance of the fabricated parts.

These basic operations are often performed in combination and may be repeated iteratively during the fabrication process. The specific sequence and techniques used depend on factors such as the desired design, material properties, production volume, and the capabilities of the fabrication equipment available.