

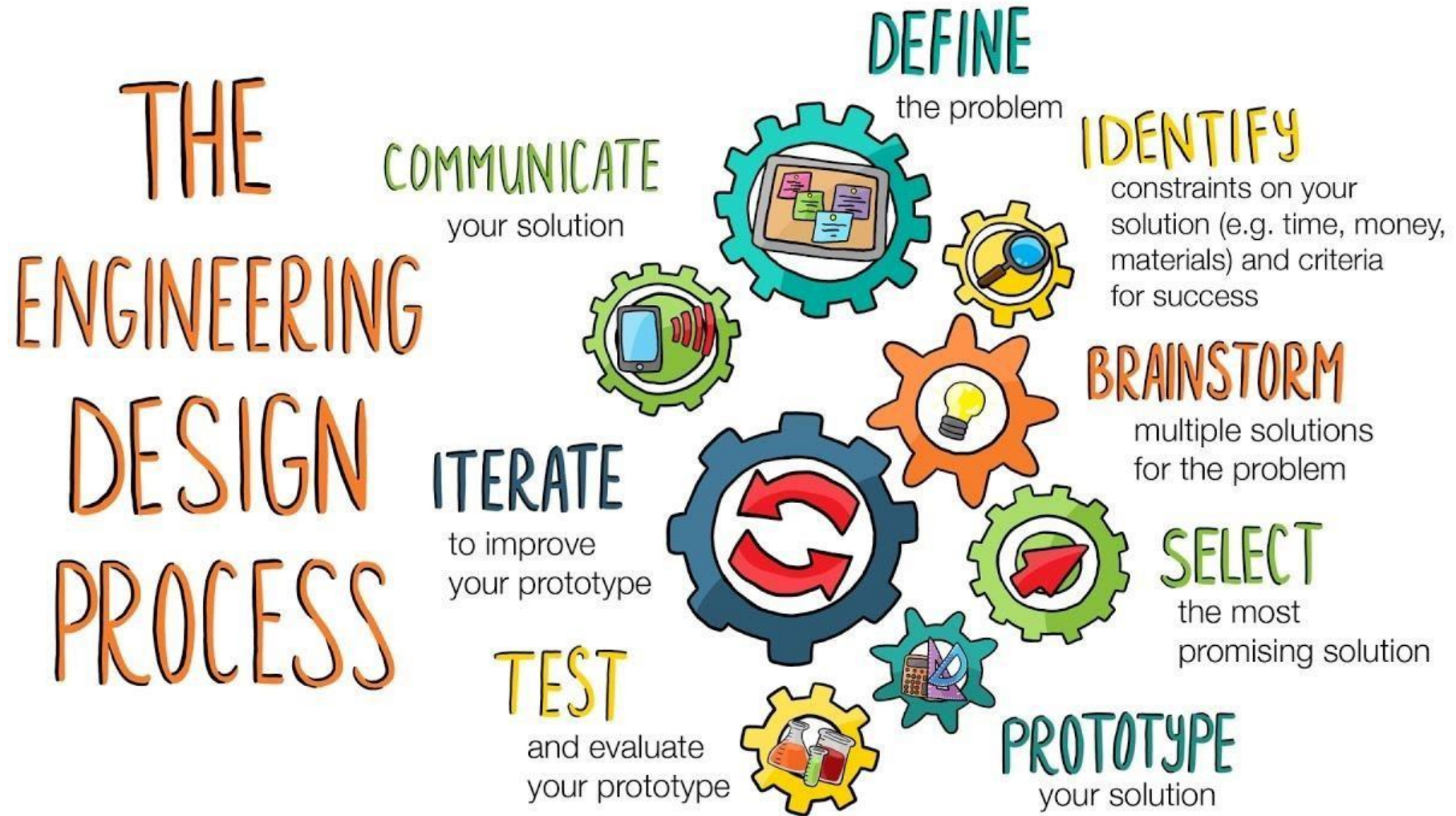
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MECH 161 – INTRODUCTION TO COMPUTER AIDED DESIGN (CAD) I

WEEK 3 – CONCEPT DEVELOPMENT AND PROTOTYPING

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What is EngineeringDesign?



Conceptualization of Design

- Conceptualization is a process that involves coming up with clear, and concise definitions.
- A concept is an idea conceived in the mind, that gives a solution to a problem which so far has been solved in an unsatisfactory way.

Conceptualization of a Design

- **Clarify the problem;** to develop a general understanding of the

problem.

- **Search externally;** to find existing solutions to the problem.
- **Search internally;** using of personal and team knowledge and creativity to generate solution concepts.
- **Explore Systematically;** This aims at navigating the space of possibilities by organizing and synthesizing the ideas generated.
- **Reflect on the Results and the Process;** This helps in selecting the right concept for development.

TOPIC: Design and Construct a Chair for UENR
Students with an Attached Table

□ CONCEPTS:

□ Concept 1



Concept 2



Concept 3



Concept Evaluation

Which design should I choose? Which design is “best”?

Concept evaluation is the process of ranking concepts to determine their relative merits.

This requires

- a ranked set of criteria on which each concept is rated
- a method by which to rank concepts against the reference with respect to the criteria that is both effective and efficient

Weighted Decision Matrix

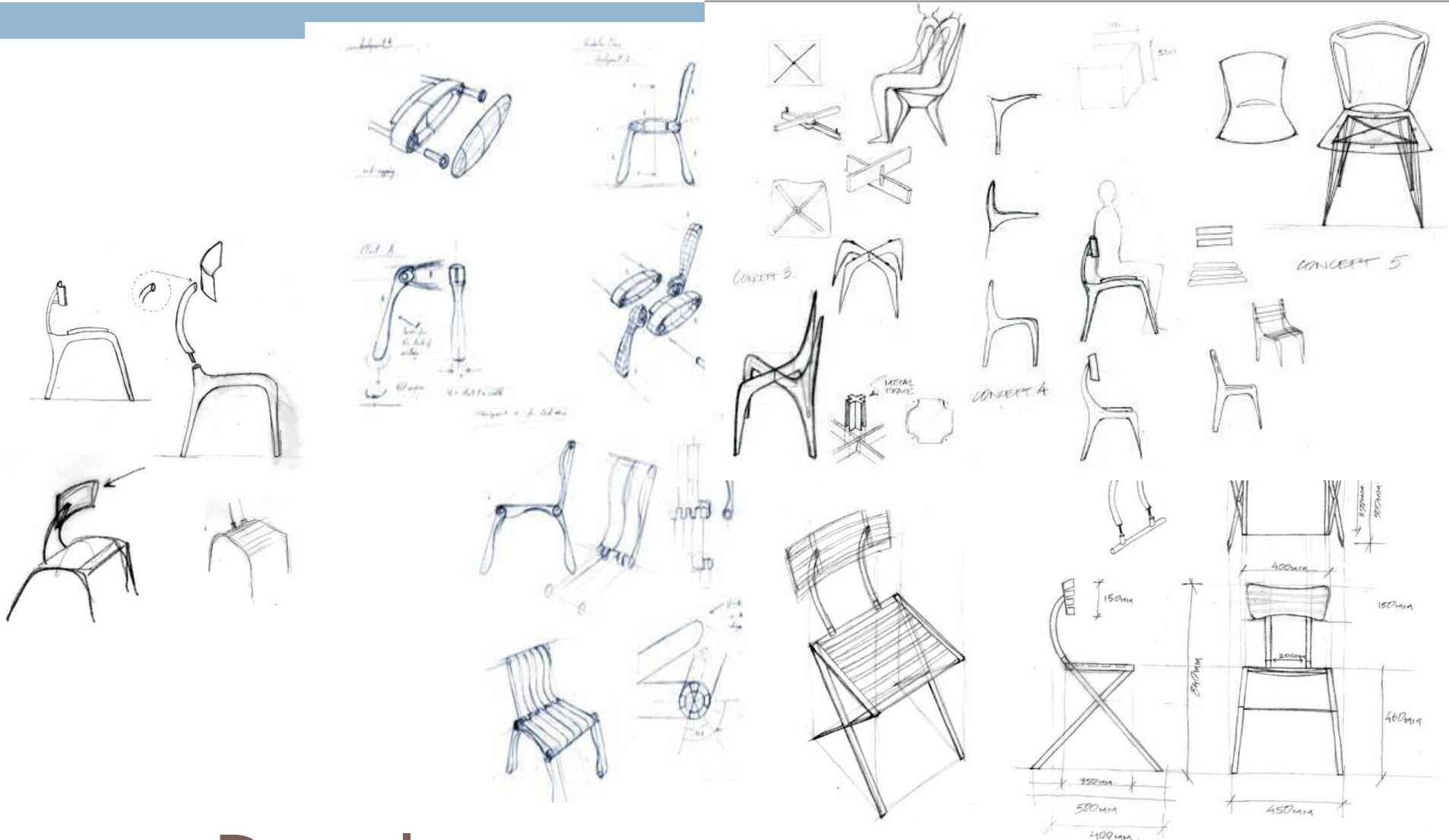
A *weighted decision matrix* is a tool used to compare alternatives with respect to multiple criteria of different levels of importance

| Criteria | Weight | Concept 1 | | Concept 2 | | Concept 3 | |
|------------|--------|-----------|-------|-----------|-------|-----------|-------|
| | | Rating | Score | Rating | Score | Rating | Score |
| Criteria 1 | 0.3 | 2 | 0.6 | 3 | 0.9 | 4 | 1.2 |
| Criteria 2 | 0.4 | 4 | 1.6 | 3 | 1.2 | 2 | 0.8 |
| Criteria 3 | 0.3 | 3 | 0.9 | 4 | 1.2 | 4 | 1.2 |

| | | | | | | | |
|--------------|-----|---|-----|---|-----|---|-----|
| Total | 1.0 | | 3.1 | | 3.3 | | 3.2 |
| Rank | | 3 | | 1 | | 2 | |

Weighted Decision Matrix – Example, the
Chair

| Criteria | Weight | Concept 1 | | Concept 2 | | Concept 3 | |
|------------|--------|-----------|-------|-----------|-------|-----------|-------|
| | | Rating | Score | Rating | Score | Rating | Score |
| Durability | | | | | | | |
| Material | | | | | | | |
| Cost | | | | | | | |
| Aesthetics | | | | | | | |
| Total | 1.0 | | | | | | |
| Rank | | | | | | | |



Concept Refinement

The concept refinement process consist of taking selected ideas from the concept and refining them to be realistic representations of the product

Concept Refinement Process may involve

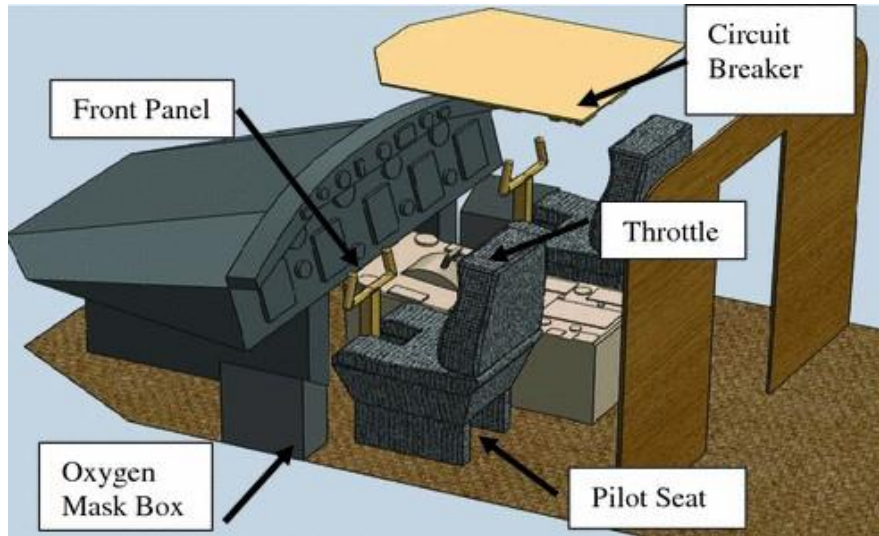
- Modification of the selected concept
- Creating of a 3D model
- This process is Iterative

Prototyping

- Here's my design; how well does it work?
- A *prototype* is a **experimental** process or version of a product that a design team typically creates during the design process to transform ideas into **tangible** forms, from paper to digital .
- The goal of a prototype is to **test the flow of a design solution** and **gather feedback on it—from both internal and external parties—**

before constructing the final product. This helps to **reduce cost** of production.

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Prototyping

Reasons for Prototyping

- Have a solid foundation from which to imagine towards **improvements**—giving all stakeholders a clear picture of the potential benefits, risks and costs associated with where a prototype might lead.
- Can adapt changes early—thereby avoiding commitment to a single, falsely-ideal version, getting stuck and later **incurring heavy costs** due to oversights.

- Show the prototype to your users so they can give you their feedback to help pinpoint which elements/variants work best and whether an overhaul is required.

Reasons for Prototyping

- Have a tool to experiment with associated parts of the **users' needs** and problems—therefore, you can get insights into less-obvious areas of the users' world (e.g., you notice them using it for additional purposes or spot unforeseen accessibility issues such as challenges to mobile use).

- Provide a sense of ownership to all concerned stakeholders—therefore fostering emotional investment in the product's ultimate success.
- Improve **time-to-market** by **minimizing the number of errors** to correct before product release.

Types of Prototyping

- Low-Fidelity Prototyping
- High-Fidelity Prototyping

- Fidelity refers to **how close** a prototype is to the final product.
- Thus, the **level of detail** and **functionality** you include in your prototype. Usually, this will depend on your product's development stage.

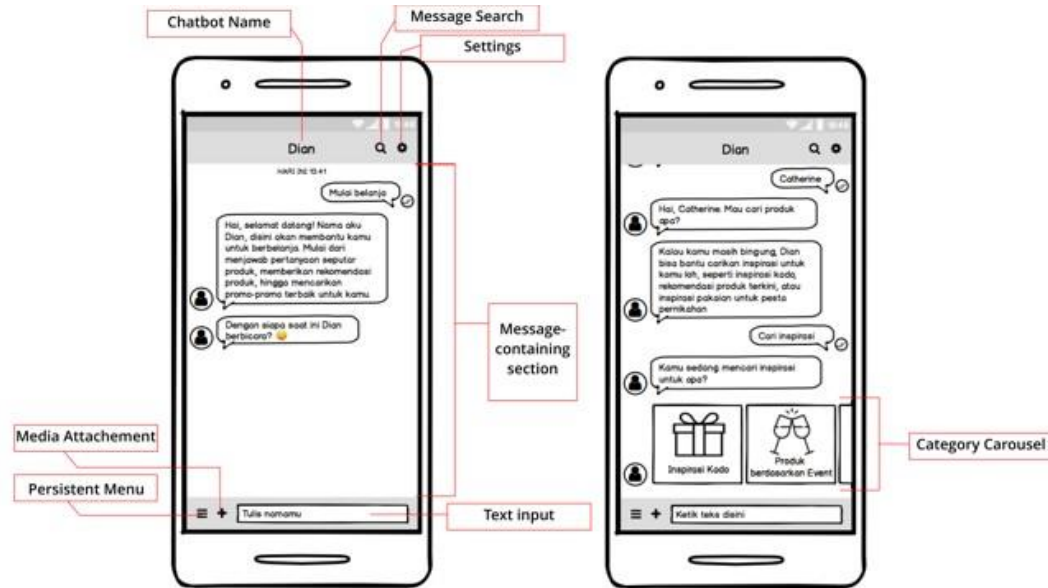
Low-Fidelity Prototyping

- Low-fidelity prototyping is a **quick, simple** way of developing a design idea into a somewhat more tangible representation of a software product.
-

- The goal of a low-fidelity prototype is to outline a product's flow and test the usefulness and usability of its functionality. Thus, low-fidelity prototypes are not as visually refined as high-fidelity prototypes. Examples of lowfidelity prototypes include
 - ▣ sketches
 - ▣ paper prototypes

Examples of Low-Fidelity Prototyping

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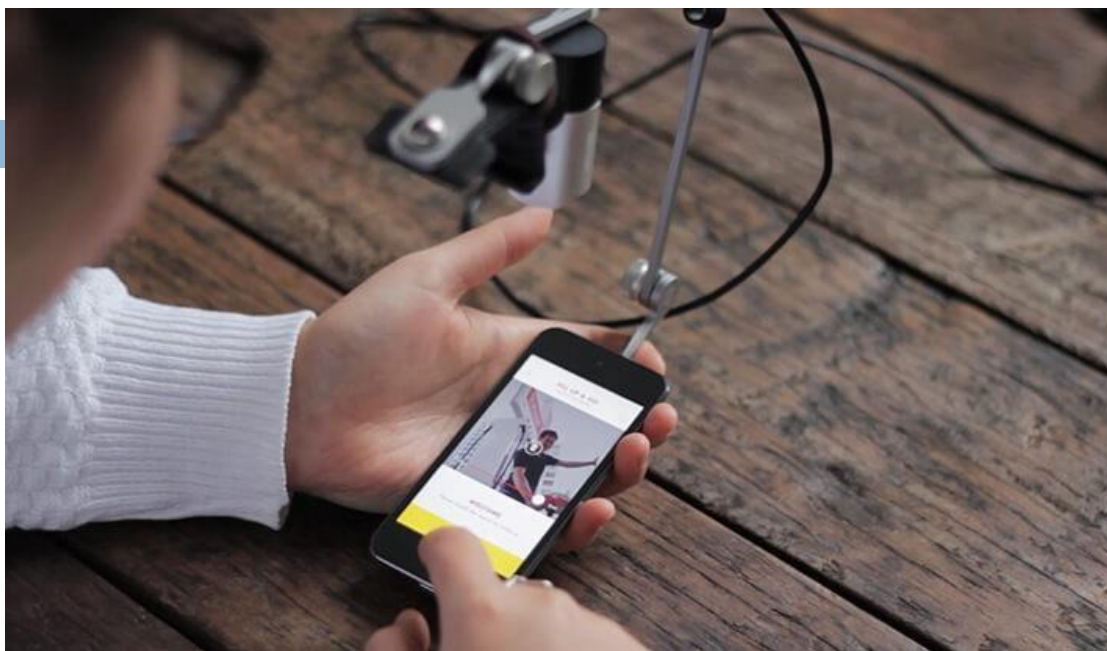


High-Fidelity Prototyping

- High-fidelity prototypes are **more advanced** than their low-fidelity counterparts.

- They are more **aesthetically pleasing, and their function is closer** to that of the final product.
- You'll typically create high-fidelity prototypes further along in the design process, once a team has a firm grasp of what they want the finished product to embody.
- High-fidelity prototypes are sometimes better for usability testing than low-fidelity prototypes. Examples of high-fidelity prototypes include
 - ▣ interactive prototypes
 - ▣ digital prototypes
 - ▣ coded prototypes

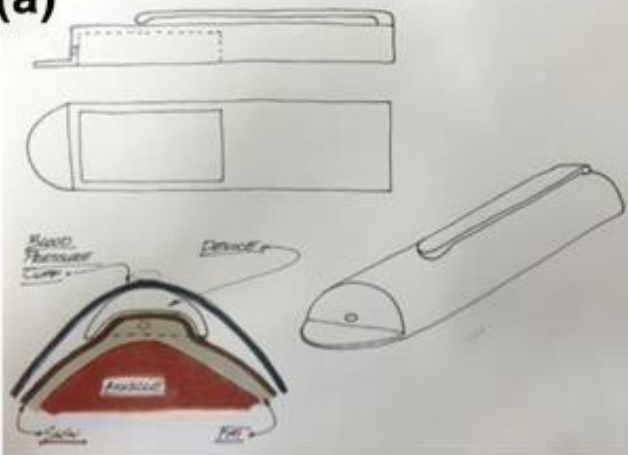
Examples High-Fidelity Prototyping



Low-Fidelity vs High-fidelity Prototyping

Virtual

(a)



(c)

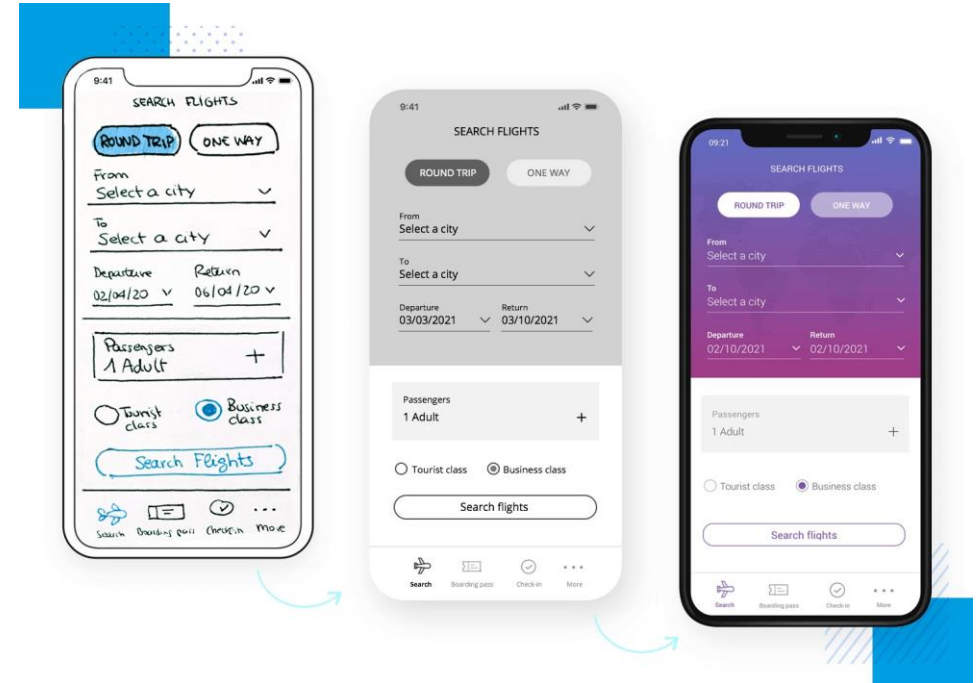


Tangible

(b)



(d)



Low-Fidelity vs High-fidelity Prototyping

Construction
Kits



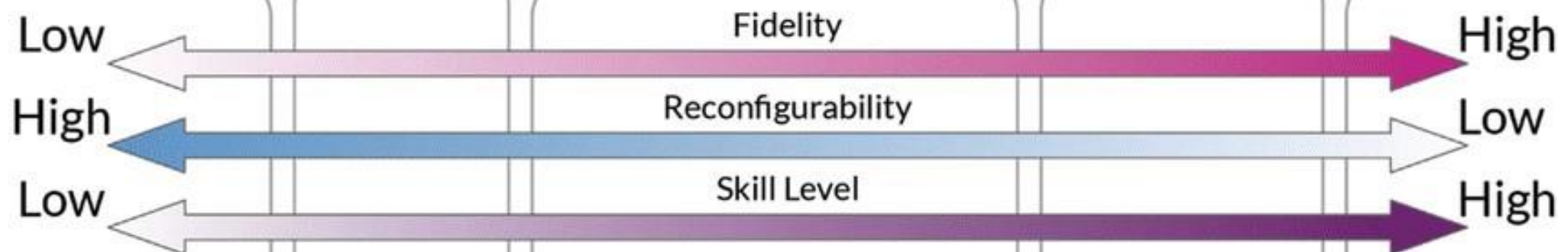
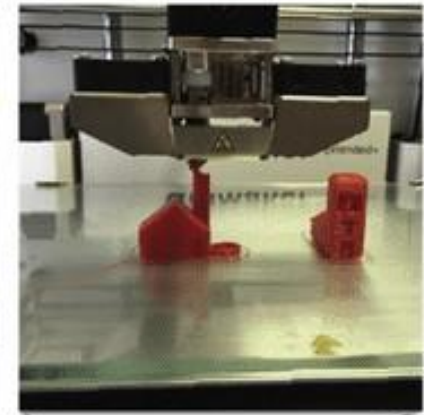
Cardboard
Modelling

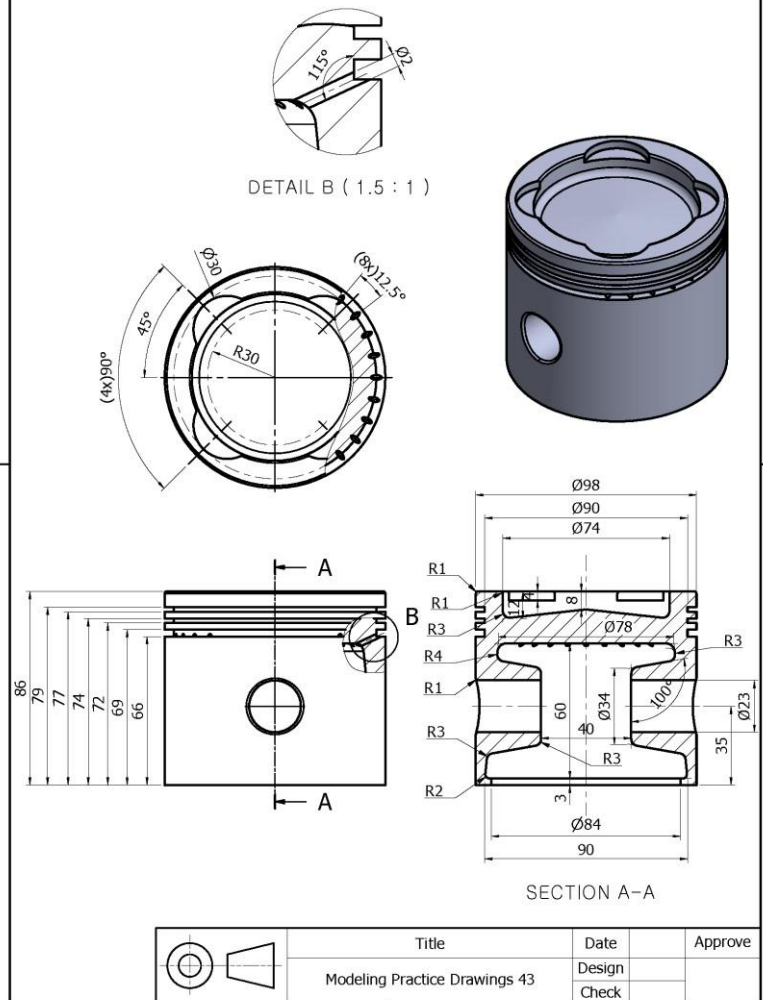
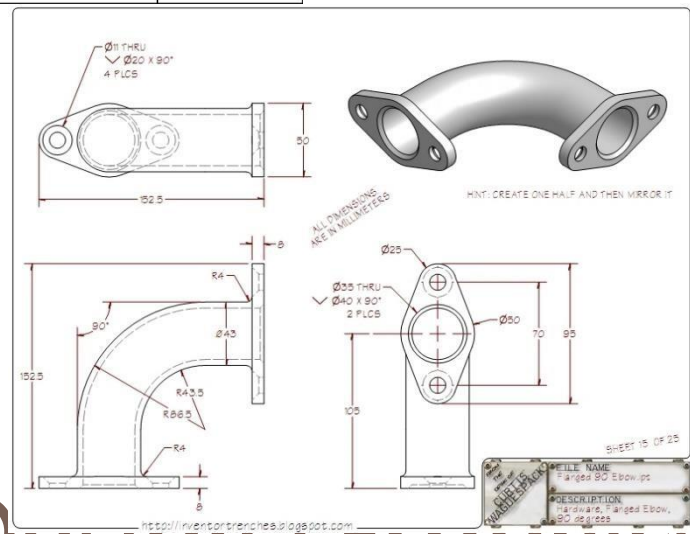
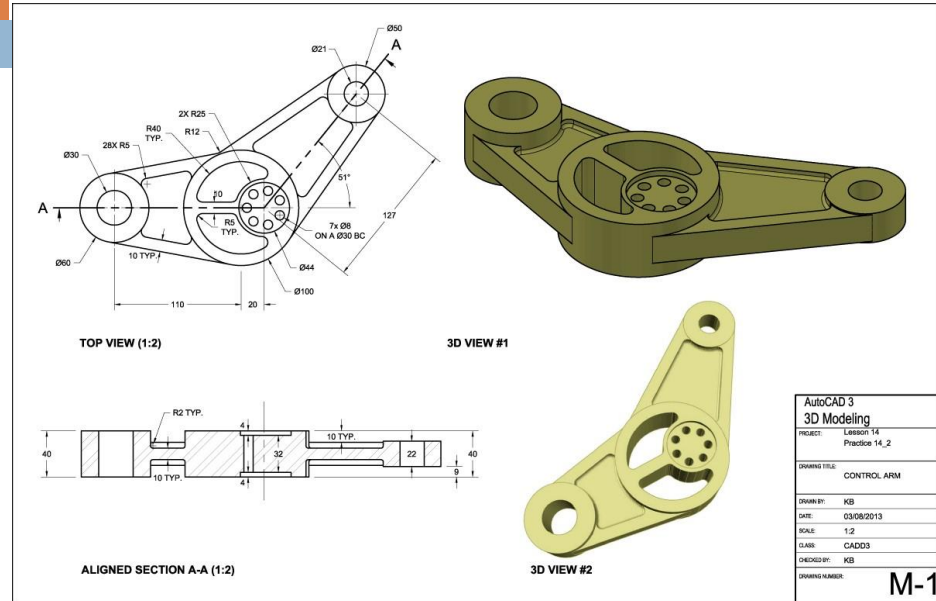


Clay
Modelling



Low Cost
3D Printing





Questions

