# Design and Innovation - CI3-

## Prototyping for a better world

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# Introduction

# Engineering and Mechanics

# What is the meaning of “Engineer” for you ?

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The word **Engineer** (Latin *Ingeniator*) is derived from the Latin words **Ingeniare** ("to contrive, devise") and **Ingenium** ("cleverness").

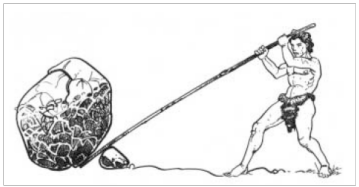


Illustration de Jean-Marie Michaud, tirée de *Aux temps anciens,les machines* de Michael et Mary Woods



# What is the meaning of “Mechanics” for you ?

# What is the meaning of "Mechanics" for you ?

**Mathematics + Physics** → Force, Matter, and Motion.

# Challenge

# Challenge

**Formez des équipes de quatre/Cinq personnes**

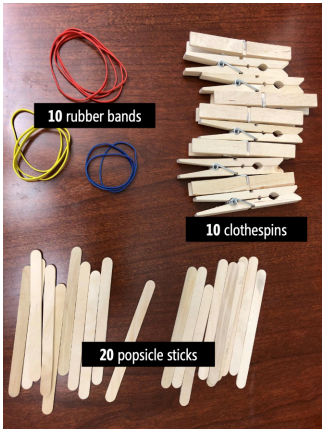
- De préférence, avec vos voisins entre les rangs.

# Challenge

Vous avez 18 minutes pour construire une **tour autoportante** qui supporte des poids calibrés avec les matériaux listées ici $\rightarrow$

Nous noterons les tours en fonction de:

1. Il résiste à au moins un poids: Oui / Non
2. $Score = heigth_{weigth} * weigth$



# 18 Minutes

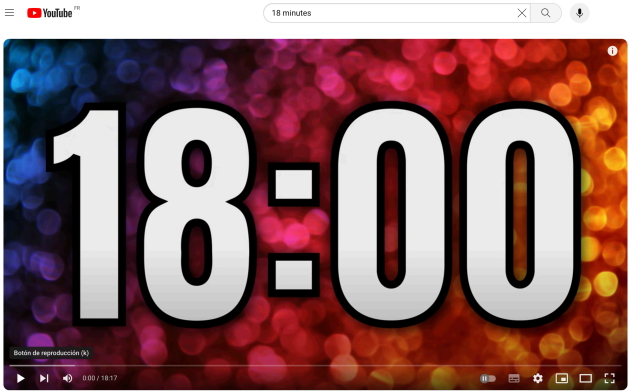


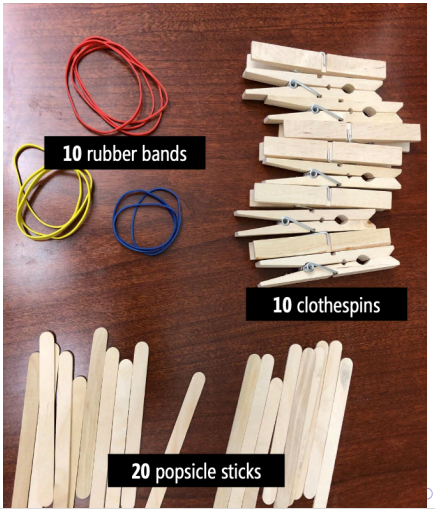

Figure 1: Timer

Timer

# Reflecting on the design process

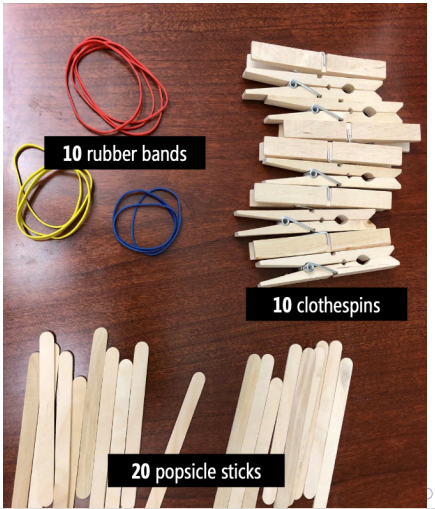
# Reflecting on the design process

- What strategies did you use to maker your towers?
- How many towers did you make?
- How did you learn?



# Reflecting on the design process

- How many teams sketched out ideas first before starting to build?
- How many teams tried multiple ideas before settling on a final design?
- How many teams tried to use the weights during the prototyping process?
- How many teams used parts in unintentional ways (took apart clothespins)?



# Introduction to the design of mechatronic systems

# Why is it important?

# Why is it important for you as futur Engineers in Innovation ?

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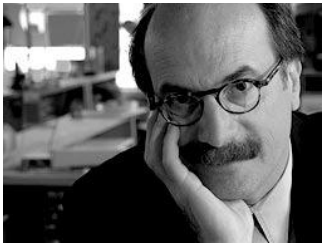
"Humans are really interesting. If you show them your idea in a prototype form, **very few people will tell you what's right about it. But everybody will tell you what's wrong with it**."



David Kelly, IDEO

# Why is it important for you as futur Engineers in Innovation?

1. Idea → Mock-up → Proof-of-Concept → Prototype


*Source : (Kattan, 2009)*

# Why is it important for you as futur Engineers in Innovation?

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2. To be able to **choose the most appropriate** design tools.


*Source : (Kattan, 2009)*

# Why is it important for you as futur Engineers in Innovation?

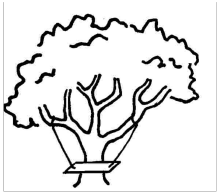
1. Idea → Mock-up → Proof-of-Concept → Prototype
2. To be able to **choose the most appropriate** design tools.
3. Fail as soon as possible.


*Source : (Kattan, 2009)*

# Fail with purpose !!

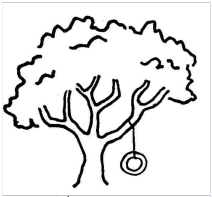
## Validation of the design hypothesis

*what marketing suggested...*



*what was manufactured...*

*as maintenance installed it...*



*what the customer wanted...*

# Learning goals of the module

1. Give you the basic skills to be able to materialize a conceptual idea into an intermediate mechatronic design object for a given concept.

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2. Learn the prototyping technologies available at the Lorraine Fab Living Lab.

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1. Give you the basic skills to be able to materialize a conceptual idea into an intermediate mechatronic design object for a given concept.
2. Learn the prototyping technologies available at the Lorraine Fab Living Lab.
3. A scientific and technical baseline to independently design and build a prototype. –**Do-It-Yourself**-

# Specific learning goals

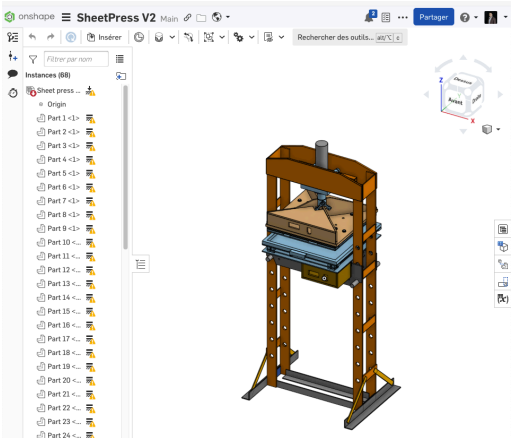
1. Prototyping phases and techniques.
2. Mechatronics design:
   - CAD Modeling
   - Description of a Kinematic chain
   - Control
   - Simulation of a simple movement transformation system
3. Fablabs and the social innovation approach.

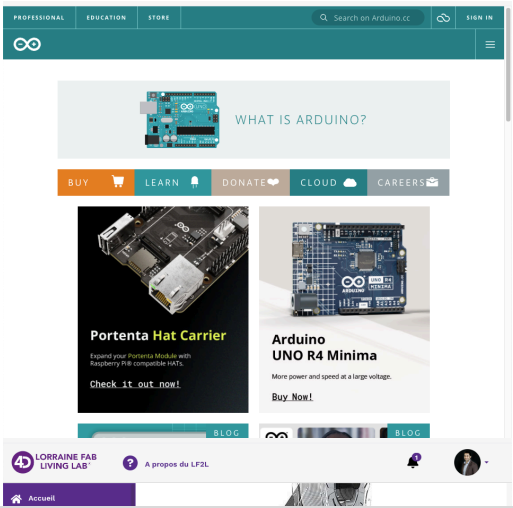
**Learning by Doing !**

# Organization of the Module Planning

| Time | Activity |
|---|---|
| 7 CM | Introduction to Mechatronic Design |
| 2 TD | Application of theory |
| TP 1-4 | **Learn Design Tools**: CAD, Laser Cut, 3D Printing |
| TP 5-9 | Projet developed by you |

# Technologies at LF2L.



# Evaluation of the Module

- 2 tests

## Individual

- Individual test (**Weight: 2/3**)

## Group

- Presentation of the mechanism

# Compromises

**What We expect from you**

**What do you expect from us**

# Prototyping: An overview

# Prototyping: An overview ?

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1. What is Prototyping ?
2. What is a prototype?
3. Why prototype?
4. When to prototype?
5. The fidelity and dimensions of prototypes
6. How to prototype. The "science" of prototyping—emerging research and industry examples supporting best practices in prototyping

# What is Prototyping ?

"The process of creating usable artifacts at a variety of fidelities of completion, in order to answer design questions and communicate design ideas; with users in the context of use."

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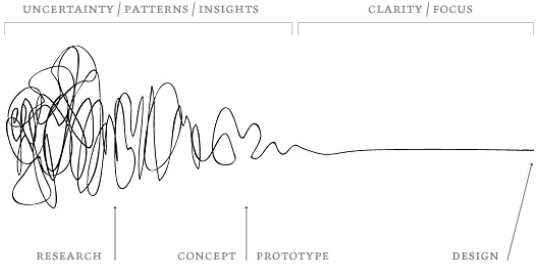

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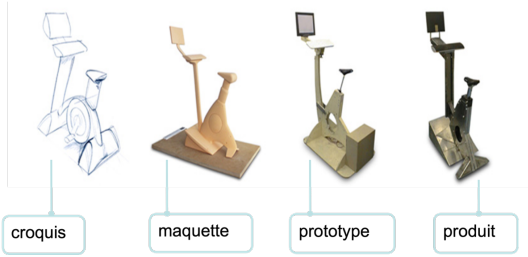

# What is Prototyping ?

"The process of creating usable artifacts at a variety of fidelities of completion, **in order to answer design questions** and communicate design ideas; with users in the context of use."

- Representation
- Precision
- Interactivity
- Evolution

# What is Prototyping ?

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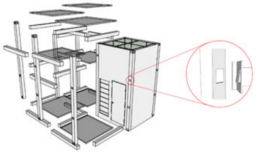

**Figure 28.** (Left) Usage of low-fidelity prototypes for design development of next generation refuge shelters via a series of hackathons in which many low fidelity concepts were constructed; (right) design concept informed by these low-fidelity models – a top scoring submission in IKEA's 'What Can Design Do' challenge, 2016.

# What is Prototyping ?

"The process of creating usable artifacts at a variety of fidelities of completion, in order to answer design questions and communicate design ideas; **with users in the context of use.**"

Primary Users: Individuals directly using and adopting tech

Secondary Users: Not direct users, but still affected by use

Tertiary Users: sales, manufacturers, etc.

# What is a Prototype?

**A prototype is a tangible artifact that requires interpretation**.


Interaction Design –
Simulation of Process


Industrial Design –
Form Models


Electrical Engineering –
Breadboard, Schematic


Product Design –
Simple Concept


Architect –
Model & Rendering


Creative Writing –
Storyboard Process


CompSci –
Test Code/Program


Mechanical Engineering –
Full product design

# What is a Prototype?

**A prototype is a tangible artifact that requires interpretation**.

- Prototypes are designed to answer questions.


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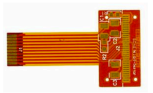
# What is a Prototype?

**A prototype is a tangible artifact that requires interpretation.**

| | | |
|---|---|---|
| **What is the general size of the device? What are some critical aspects to consider?** |  | **Client comments on the length of the probe and the angle of the handle.** |
| **Can we fit all the components within the housing? Is the force of the grip appropriate?** |  | **Team learns about handle force and angle, which then alter the next iteration.** |
| **Does this flexible PCB integrate into the device? Is the electrical-mechanical communication working?** |  | **Team finds out that there is not enough space for components, and that it is communicating.** |

# What kind of prototype?

**A prototype is a tangible artifact that requires interpretation**.

- Product, Process and Service prototype

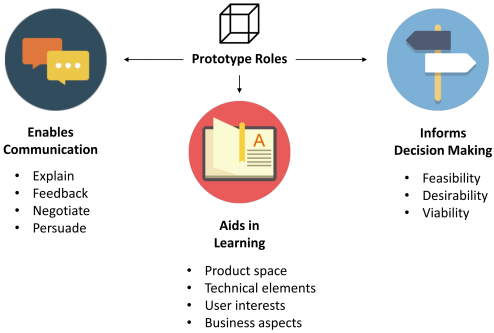
Product

Process

Service/Experience

# What role for the prototype?

**Communcation** **Aids in Learning** **Decision making**



# What benefits ?

Sony PlayStation 1 controller prototypes

Microsoft mouse prototypes

1. **Cognitive benefits:** *e.g.*, prototypes support creativity—they help use capture and generate ideas (prototyping is generative!)
2. **Facilitate exploration of design space:** prototypes can target and manifest different attributes in a design space
3. **Permit early and iterative evaluation:** prototypes can be tested in various ways including traditional usability studies and informal user feedback, throughout design process
4. **Allow you to fail fast:** relatedly, prototypes allow you to try out and experiment with multiple ideas rapidly & fail (& learn!)
5. **Rapid prototyping** prevents feeling attached to an idea simply because you invested effort into it
6. **To communicate:** help designers, engineers, managers, software devs, clients, and users to understand & discuss

# In summary?

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*Our bodies, physical actions, and use of tools and the environment shape how we think. The act of prototyping engages our bodies and senses in thought and can be faster/easier/better than mental operations alone*

# Next time: Information and Energy chains