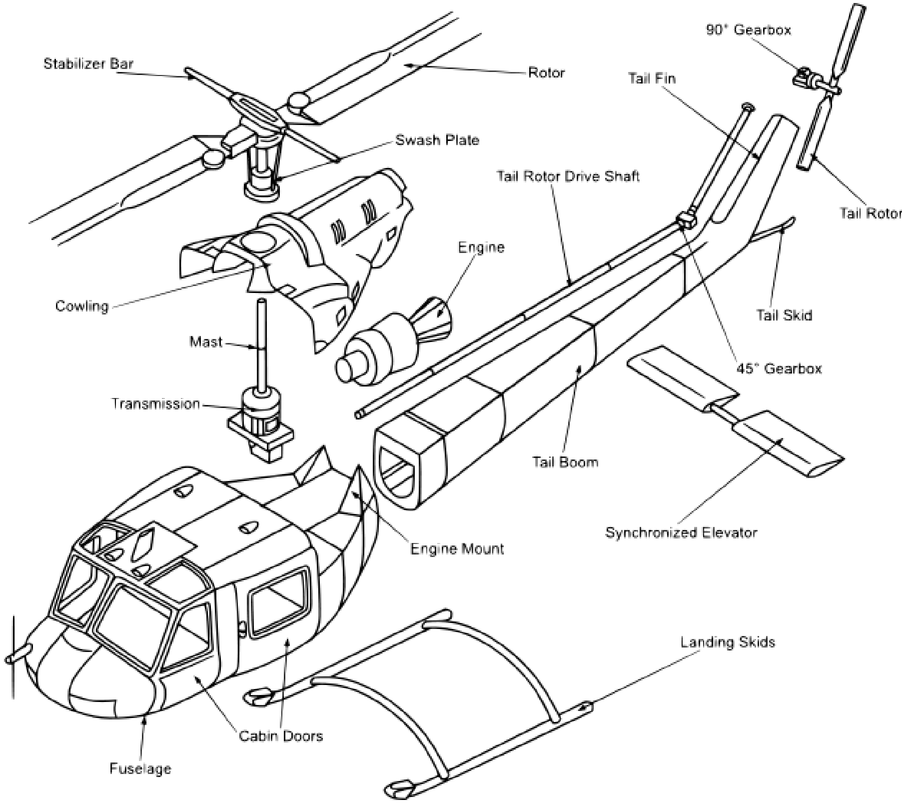
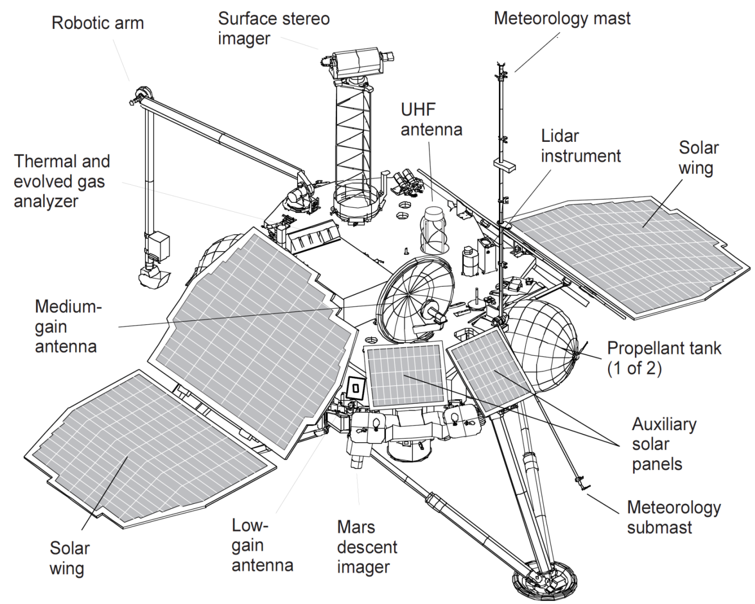
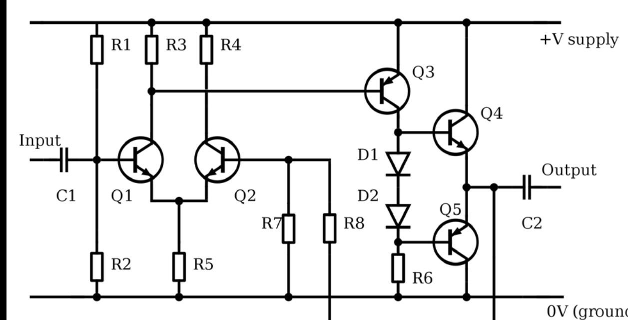


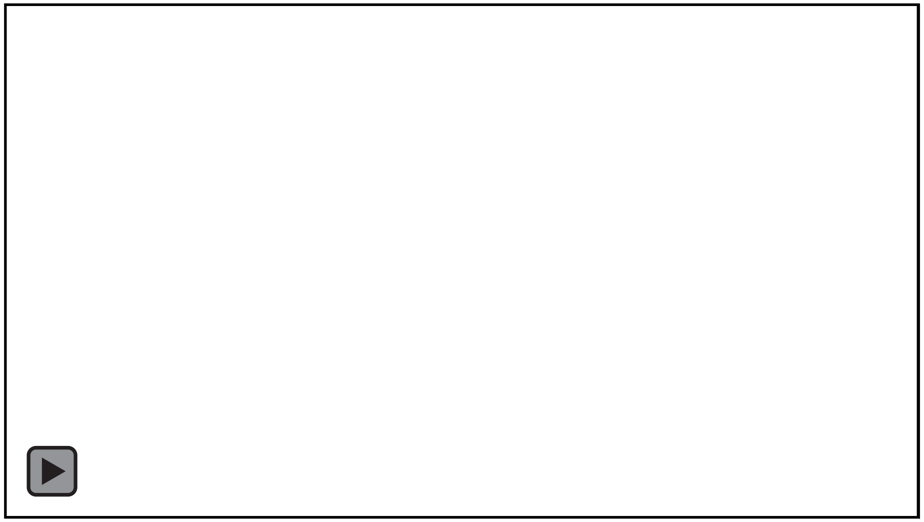


How to make (almost) everything

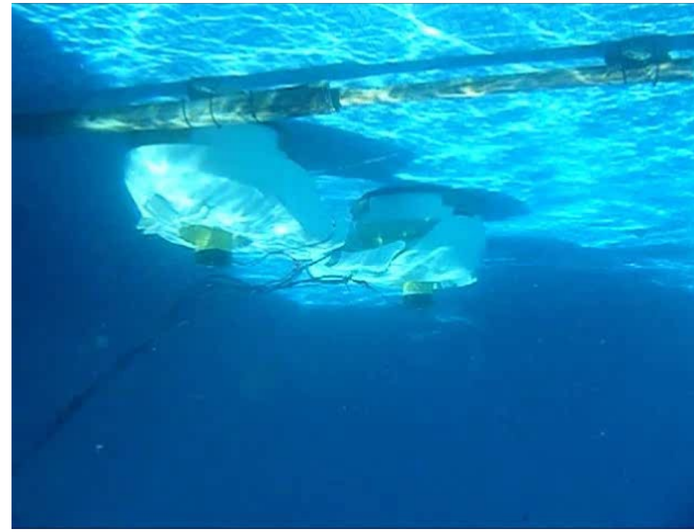
Andrés Faíña (anfv@itu.dk)



Me (at ITU)

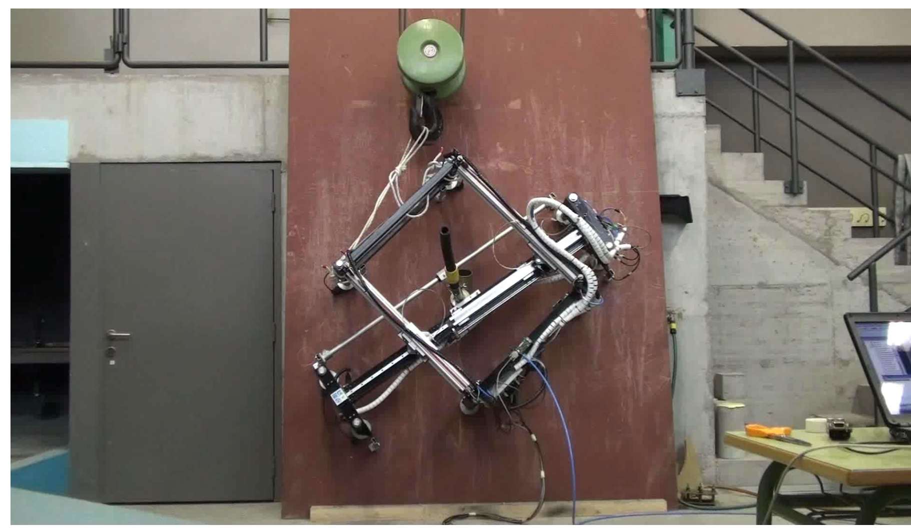


Faíña et al.,ALIFE 2016



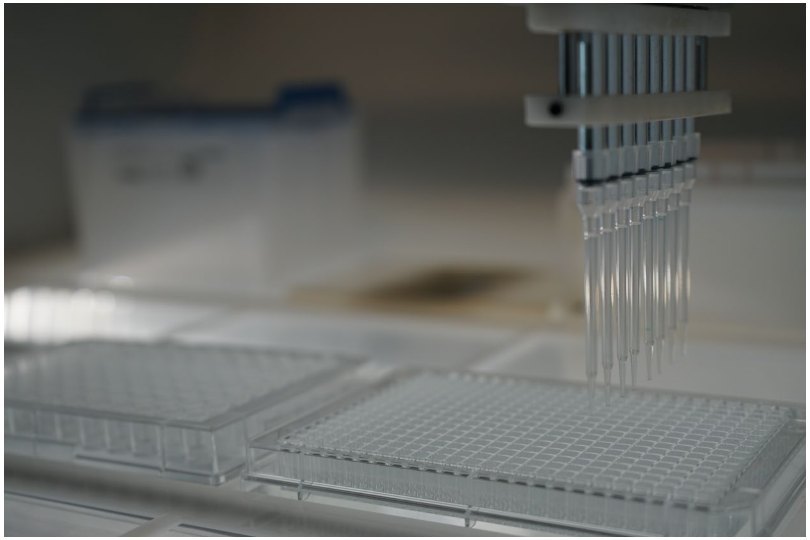
D. Souto et al., ICRA 2013

M. Naya et al., *RiE 2017*



A. Faíña et al., ICRA 2009

Me (at Flow Robotics)



http://flow-robotics.com/

Robobo

https://theroboboproject.com/en/

TAs

Martin Edvardsen

medv@itu.dk

TA on Tuesdays

Hugo Delgado de Brito

hubr@itu.dk

TA on Mondays

Feedback

Lets make a quick round:

- Name
- Why are you here
- Previous experience in
  - mechanics
  - electronics
  - software

In the meanwhile, please, fill out a small survey: https://docs.google.com/forms/d/1TicATPdZGbPcgRJpN_Y20y3sPm_Y1o3FGyoSDT1c-X4

(the link is also in LearnIT)

Intended learning outcomes

After the course, the student should be able to:

- analyse and compare the main manufacturing methods;
- model 3D parts and assemblies using Computer Aided Design (CAD) Software at beginner level;
- select the best manufacturing process for a component;
- design simple electronic systems and circuit boards;
- use different manufacturing tools to produce parts;

Moreover, after the course, **the student is able to prototype complete, but simple mechatronic systems**.

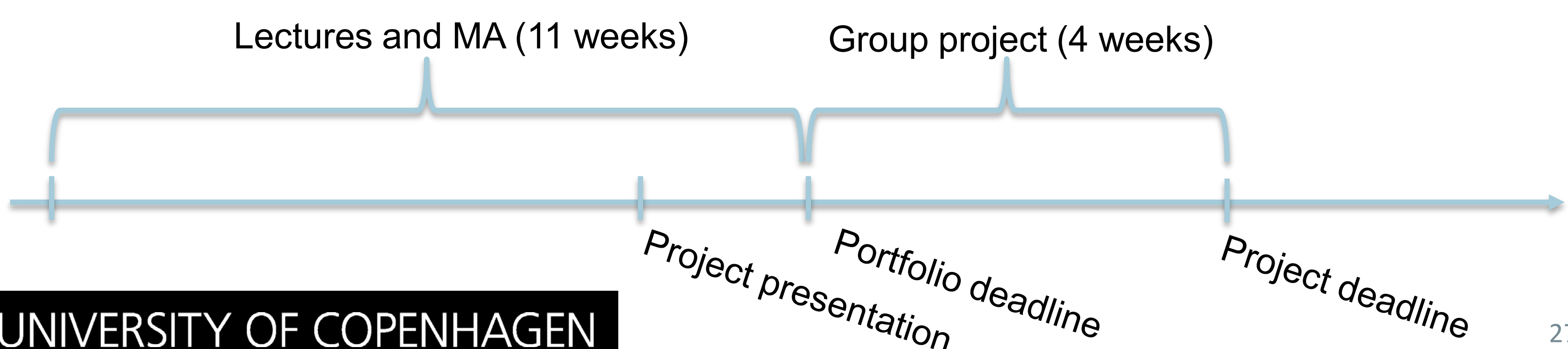
Schedule

Lecture mode, every week:

- Read some papers and watch some videos at home
- A lecture about a process (2 hours)
- Exercises about that process (2 hours)
- Work at labs/home during the rest of the week
- Write a page of what you made in a portfolio
  - (photographs and max. 5 lines of text/ lab)

Project mode (4 weeks)

Project presentation, feedback and robot race



Lectures schedule

Lecture 1: 3D modelling
Lecture 2: Assemblies and 3D printing
Lecture 3: Drawings and laser cutting
Lecture4: Machine elements
Lecture 5: Electronics, sensors and actuators
Lecture 6: Microcontroller programming
Lecture 7: Advanced Sensors
Lecture 8: PCB design
Lecture 9: Project presentation
Lecture 10: Milling/Turning and Moulding

B
A
S
I
C

Advanced

Exercises

For most exercises, there are too many students to have only one group. Therefore, we will make two exercise sessions:

Mondays from 14:00 to 16:00
Tuesdays from 14:00 to 16:00
Max. of **30 persons**

There are a few exercises that can be done in one group:

Lecture 1: 3D modelling
Lecture 4: Machine elements
Lecture 9: Project presentation

Mandatory Activities

Groups

6 basic process -> 6 small mandatory activities
Choose one MA from advanced techniques
- Specified at each lab
- Theme: Line follower robot

Hand in a portfolio (7 MA)
- describing the works carried out during the MA.
- Remember: max. 5 lines of text/lab

2 persons

Hand in a group project report
- Free choice of topic
- Small written report describing the prototype
- Technical documentation

3-4 persons

Opening hours of the labs

REAL lab will be open for students at some specific hours (TBD), check learnIT this week.

You can use these hours to:

- Take materials that you need
- Use the machines (3D printers, etc.)
- Assemble your machine
- get help from TAs

The project

Free topic but should contain:
- Mechanics (at leas one motor)
- Electronics
- Software

Groups of 3 persons
- 4 person groups are ok for big/ challenging projects

Hand in:
- Report describing design, implementation, tests, improvements
- Technical documentation:
  - Drawings
  - Schematics
  - Code
  - Bill of materials
  - Building instructions (optional, if needed)

Almost anything

Restrictions:

- Voltage < 50V (and <25V in wet environments)
- No lasers
- No industrial motors
- No toxic chemicals or explosives
- No atomic energy
- **In case of doubt, ask!**

Size limitations:

- You should be able to store and carry it

Budget limitations:

- We can buy parts using the course budget, but it is small
- Try to (1) recycle, (2) use common and cheap parts
- Workaround: If you buy the parts -> You can keep the prototype after the course

Time limitations (1 month), plan in advance!

Safety

Most manufacturing techniques are dangerous:

- Sharp edges
- Hot parts
- Power tools
- Etc.

Mandatory: Use safety material

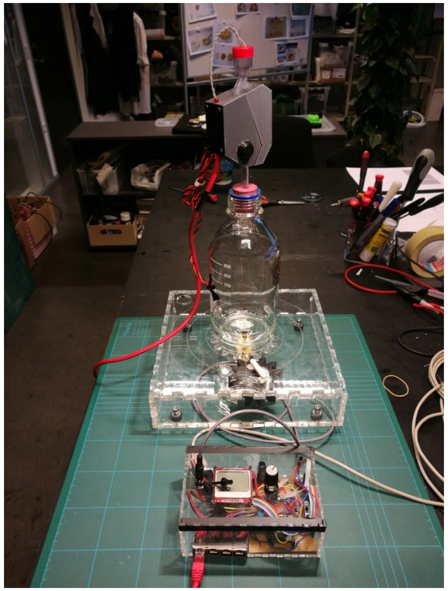
- Glasses, gloves, masks, etc.

Mandatory: Follow protocols and instructions

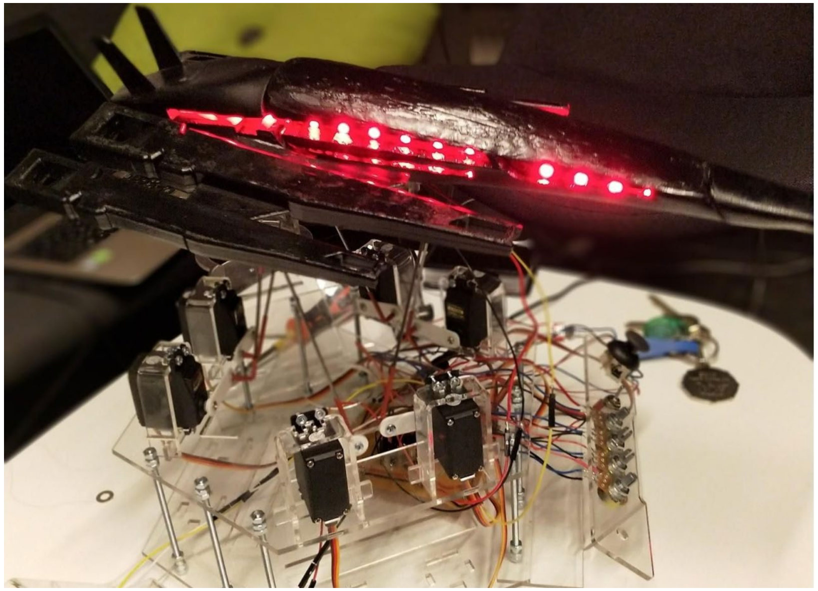
Some techniques need supervision after the lab:

- Milling and injection machines

Some projects from last year



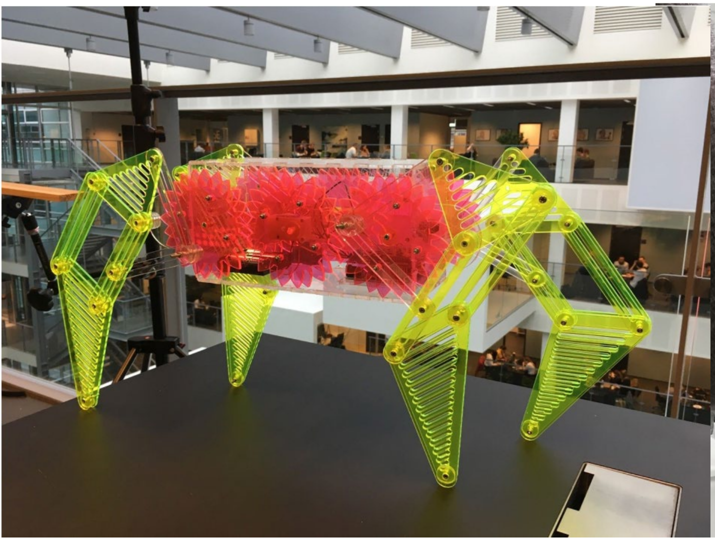
Brew Master



The Normandy + Stewart platform

Drawing device

Theo Jansen robot



Hand wash device

Smart HUB

Exam

Short presentation of 15 minutes by all the members of the team

Group questions (10 minutes) about you project

Individual questions (10 minutes) about:
- topics of the course

Feedback and grade (5 min)

More information about the exam before the group project. Probably, on project presentation

Historic context

before 1760: Artisan and workshops

1760-1840: Industrial revolution

Steam powered factories

Large-scale manufacture of machine tools

From 1880: Electricity

50s: Computers

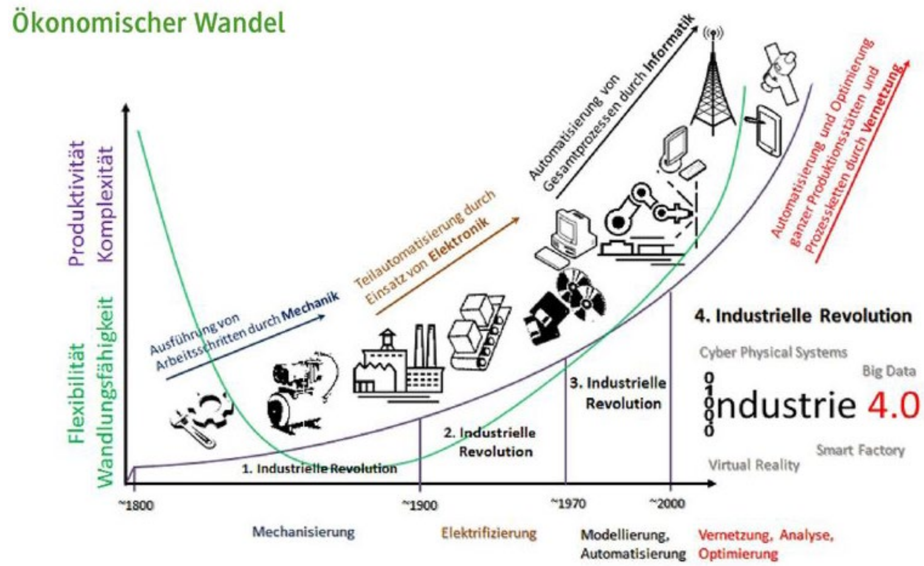
Digital fabrication (CNC)

70s/80s: Personal computer

Design: Mainframes

80s/90s: 3D printing

2000: DIY, Fablabs, Open source (hw/sw), Digital revolution



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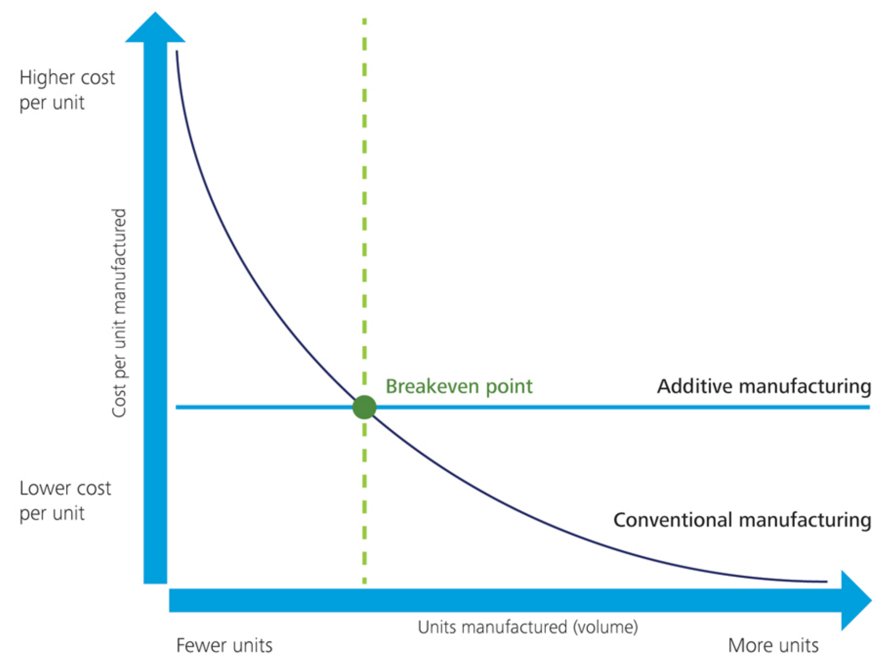

Source: Mark Cotteleer and Jim Joyce, *3D opportunity: Additive manufacturing paths to performance, innovation, and growth*, Deloitte University Press, http://dupress.com/articles/dr14-3d-opportunity/, accessed March 17, 2015.

Graphic: Deloitte University Press | DUPress.com

The original “How to make (almost) anything”

MIT´s course (from 1998)

Aimed for researchers and technical students…

But most of the students did not have a technical background

Neil Gershenfeld

Read: “How to Make Almost Anything, The Digital Fabrication Revolution” (LearnIT)

“the students... were answering a question I didn't ask, which is: What is this stuff good for? And the answer is: Not to make what you can buy in stores, but to make what you can't buy in stores. It's to personalise fabrication”, Neil Gershenfeld

A thing that you cannot buy in stores

“Think globally, fabricate locally” - Fablabs

A small-scale workshop offering digital fabrication
- stimulus for local entrepreneurship
- learning and innovation

Fablabs in Copenhagen

Labitat

https://labitat.dk/

Fablab Nordvest

http://fablabnordvest.dk/om-fablab-nordvest/

Copenhagen Fablab

http://valby.copenhagenfablab.dk/

Guldminen

http://www.guldminenkbh.dk/

Malmö Makerspace

http://malmomakerspace.se/

DTU Skylab (DTU students only)

http://www.skylab.dtu.dk/about_us

Resources at ITU

3D printers (Real, IxD, Pitlab)
Milling machine (Dirty lab)
Laser cutter (Dirty lab)
Soldering stations (IxD, Real)
Injection moulding machine (Real)
Drilling and sanding tools (Real, Dirty lab)

Electronic components (Real, IxD, Pitlab)
Mechanic components (Real, Dirty lab)

Ready?

Let´s start!

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