ICTP Scientific Fabrication Laboratory

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(ICTP) Trieste, Italy

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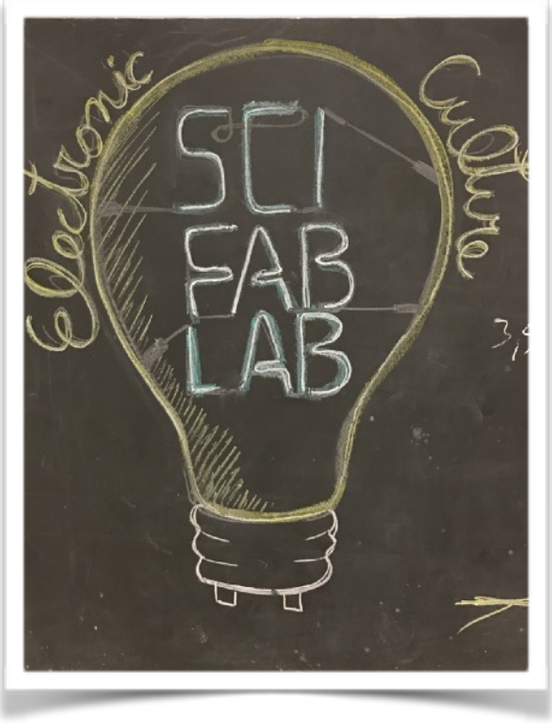
What is a FabLab?

A *fab lab* (*fabrication laboratory*) is a small-scale workshop offering (personal) digital fabrication facilities.

A FabLab is generally equipped with an array of *flexible computer-controlled tools* that cover several different length scales and various materials, with the aim to *make "almost anything"*.

It's an academic idea...

- The concept of a FabLab was first imagined at the Center for Bits and Atoms (CBA) at the Media Lab in the Massachusetts Institute of Technology, in 2001.



- The paradigm was established in 2005 with The famous book by Neil Gershenfeld "Fab: the coming revolution on your desktop—from personal computers to personal fabrication".

CENTER FOR BITS AND ATOMS

MIT MEDIA LAB

E15-001

LEGO Learning Laboratory

Smart Cities

Computing Culture

Lifelong Kindergarten

Center for Bits and Atoms

Neil Gershenfeld:

Unleash your creativity in a Fab Lab

TED2006 · 17:18 · **Filmed** Feb 2006

17 subtitle languages

View interactive transcript

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583,642 Total views

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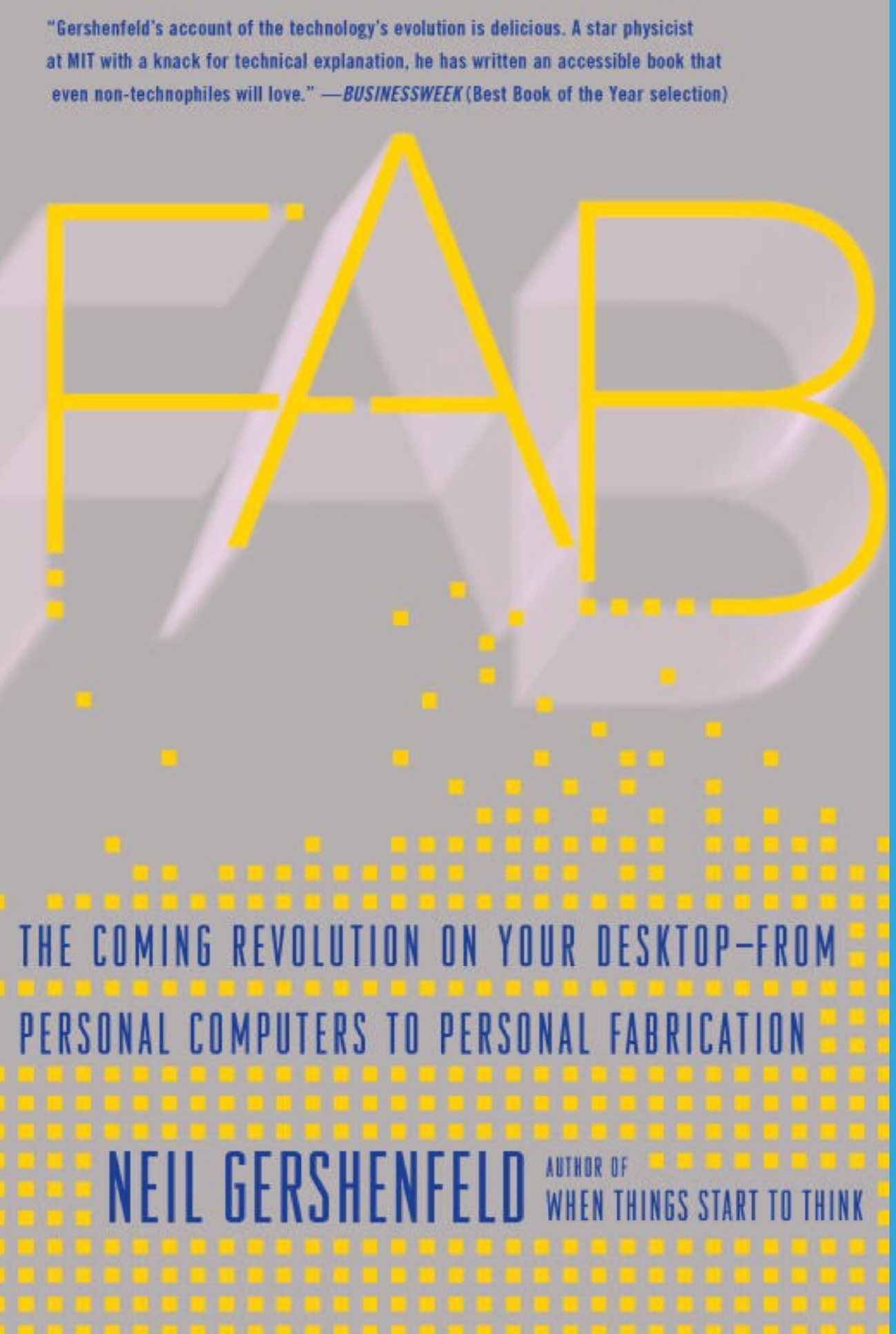
MIT professor Neil Gershenfeld talks about his Fab Lab — a low-cost lab that lets people build things they need using digital and analog tools. It's a simple idea with powerful results.



FAB: THE COMING REVOLUTION ON YOUR DESKTOP –FROM PERSONAL COMPUTERS TO PERSONAL FABRICATION

Neil Gershenfeld, 2005

FAB. PAG. 14:

In 1998 we tried teaching "How To Make (almost) Anything" for the first time. The course was aimed at the small group of advanced students who would be using these tools in their research. Imagine our surprise, then, when a hundred or so students showed up for a class that could hold only ten. They weren't the ones we expected, either; there were as many artists and architects as engineers. And student after student said something along the lines of "All my life I've been waiting to take a class like this," or "I'll do anything to get into this class." Then they'd quietly ask, "This seems to be too useful for a place like MIT —are you really allowed to teach it here?"

Students don't usually behave that way. Something had to be wrong with this class, or with all the other classes I taught. I began to suspect the latter.

FAB, PAG. 23:

This thought led to the launch of a project to create field "fab labs" for exploring the implications and applications of personal fabrication in those parts of the planet that don't get to go to MIT. As you wish, "fab lab" can mean a lab for fabrication, or simply a fabulous laboratory. Just as a minicomputer combined components—the processor, the tape drive, the keypunch, and so forth—that were originally housed in separate cabinets, a fab lab is a collection of commercially available machines and parts linked by software and processes we developed for making things. The first fab labs have a laser cutter to cut out two-dimensional shapes that can be assembled into three-dimensional structures, a sign cutter that uses a computer-controlled knife to plot flexible electrical connections and antennas, a milling machine that moves a rotating cutting tool in three dimensions to make circuit boards and preci-

FABULOUS LABORATORY

FAB LAB

FABRICATION LABORATORY

FAB LAB

DIGITAL FABRICATION LABORATORY

FAB LAB

FABLAB (DEFINIZIONE)

A Fab Lab is a **technical prototyping platform for innovation and invention**, providing stimulus for local entrepreneurship. A Fab Lab is also a **platform for learning and innovation**: a **place to play, to create, to learn, to mentor, to invent**. To be a Fab Lab means **connecting to a global community** of learners, educators, technologists, researchers, makers and innovators- -a knowledge sharing network that spans 30 countries and 24 time zones. Because all Fab Labs share common tools and processes, the program is building a global network, a distributed laboratory for research and invention.

A Fab Lab is comprised of off-the-shelf, industrial-grade fabrication and electronics tools, wrapped in open source software and programs written by researchers at MIT's Center for Bits & Atoms. Currently Fab Labs include a laser cutter that makes 2D and 3D structures, a sign cutter that plots in copper to make antennas and flex circuits, a high-resolution NC milling machine that makes circuit boards and precision parts, a large wood router for building furniture and housing, and a suite of electronic components and programming tools for low-cost, high-speed microcontrollers for on-site rapid circuit prototyping. Originally designed for communities as prototyping platforms for local entrepreneurship, Fab Labs are increasingly being adopted by schools as platforms for project-based, hands-on STEM education. Users learn by designing and creating objects of personal interest or import. Empowered by the experience of making something themselves, they both learn and mentor each other, gaining deep knowledge about the machines, the materials, the design process, and the engineering that goes into invention and innovation. In educational settings, rather than relying on a fixed curriculum, learning happens in an authentic, engaging, personal context, one in which students go through a cycle of imagination, design, prototyping, reflection, and iteration as they find solutions to challenges or bring their ideas to life.

FABFOUNDATION

Estratto da: http://www.fabfoundation.org/fab-labs/what-is-a-fab-lab/

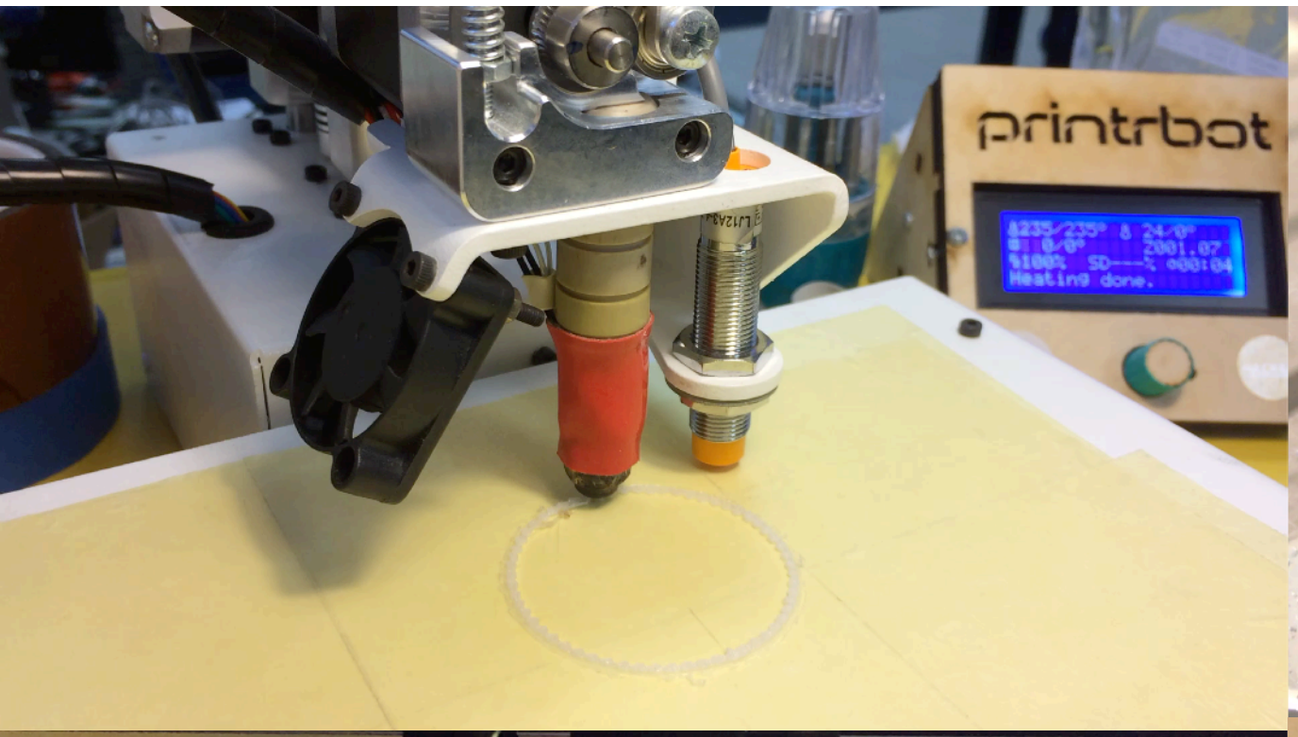
IL FAB CHARTER

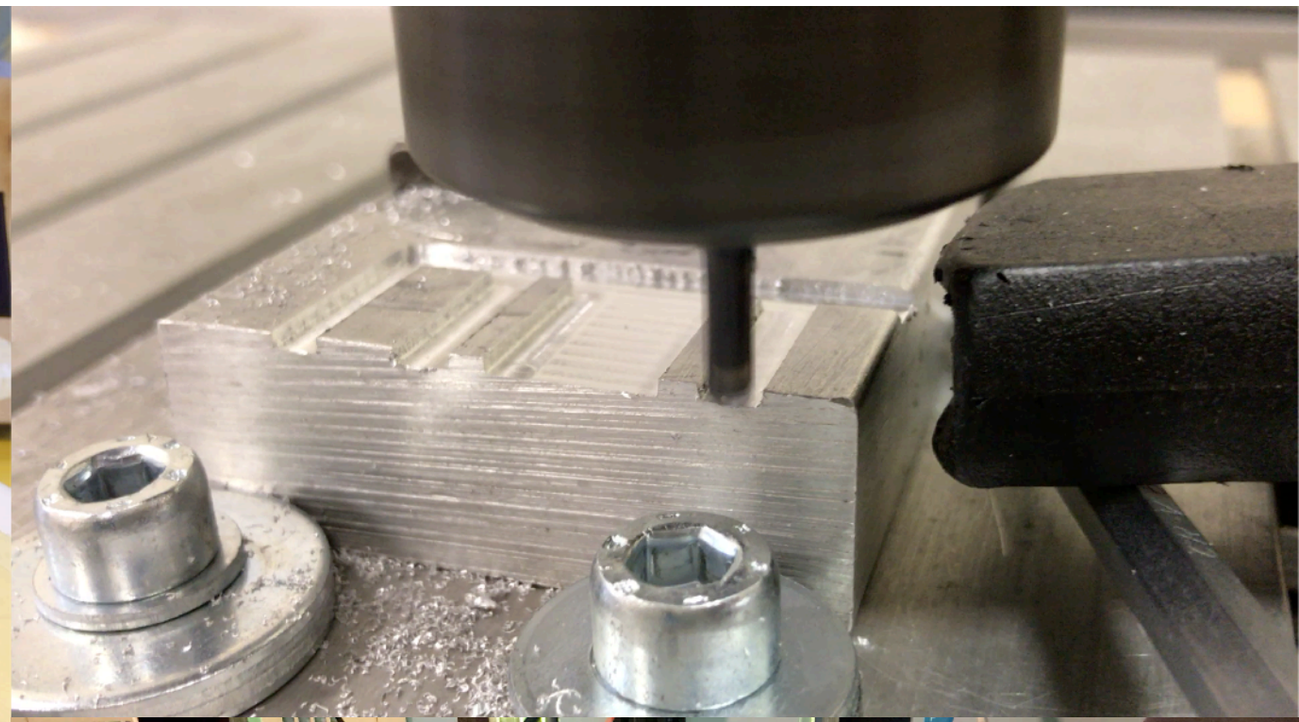
What is a fab lab?
Fab labs are a global network of local labs, enabling invention by providing access to tools for digital fabrication
What's in a fab lab?
Fab labs share an evolving inventory of core capabilities to make (almost) anything, allowing people and projects to be shared
What does the fab lab network provide?
Operational, educational, technical, financial, and logistical assistance beyond what's available within one lab
Who can use a fab lab?
Fab labs are available as a community resource, offering open access for individuals as well as scheduled access for programs
What are your responsibilities?
safety: not hurting people or machines
operations: assisting with cleaning, maintaining, and improving the lab
knowledge: contributing to documentation and instruction
Who owns fab lab inventions?
Designs and processes developed in fab labs can be protected and sold however an inventor chooses, but should remain available for individuals to use and learn from
How can businesses use a fab lab?
Commercial activities can be prototyped and incubated in a fab lab, but they must not conflict with other uses, they should grow beyond rather than within the lab, and they are expected to benefit the inventors, labs, and networks that contribute to their success

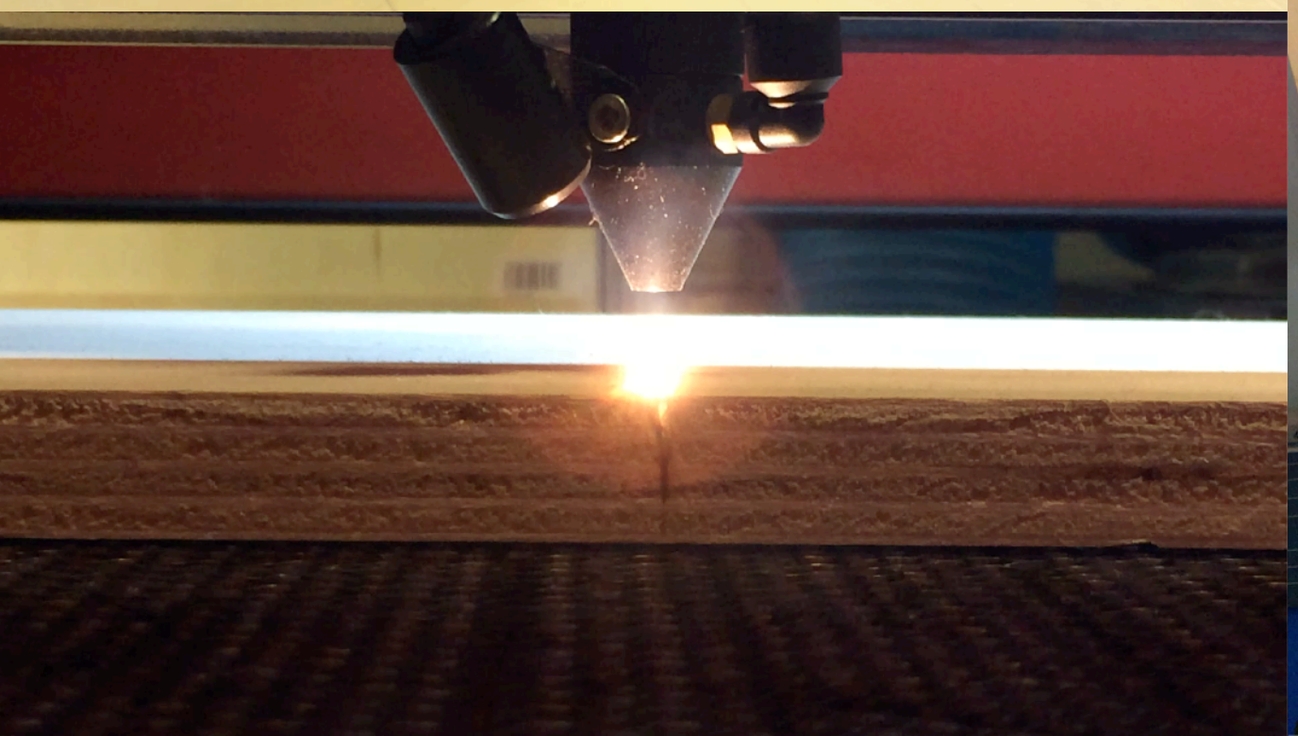
draft: October 20, 2012

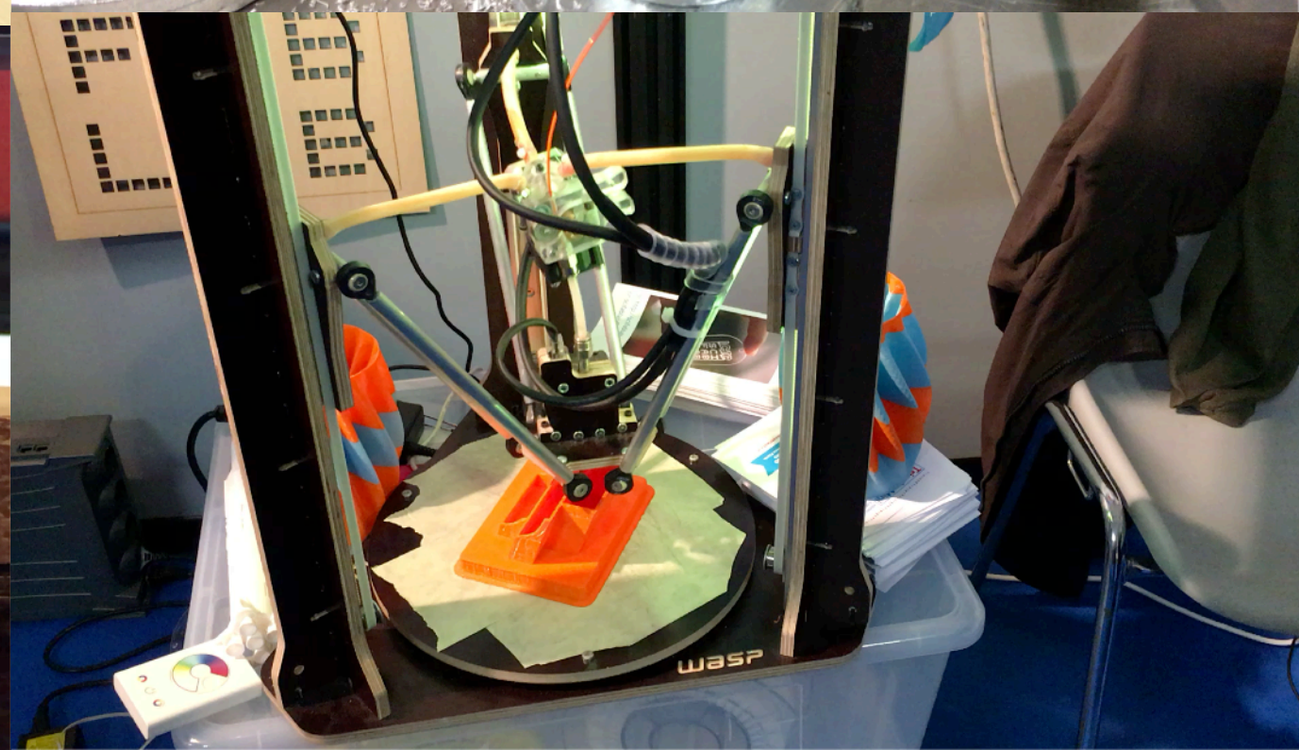
Estratto da: http://fab.cba.mit.edu/about/charter/

TOOLS AND MACHINES









(DIGITAL) TOOLS

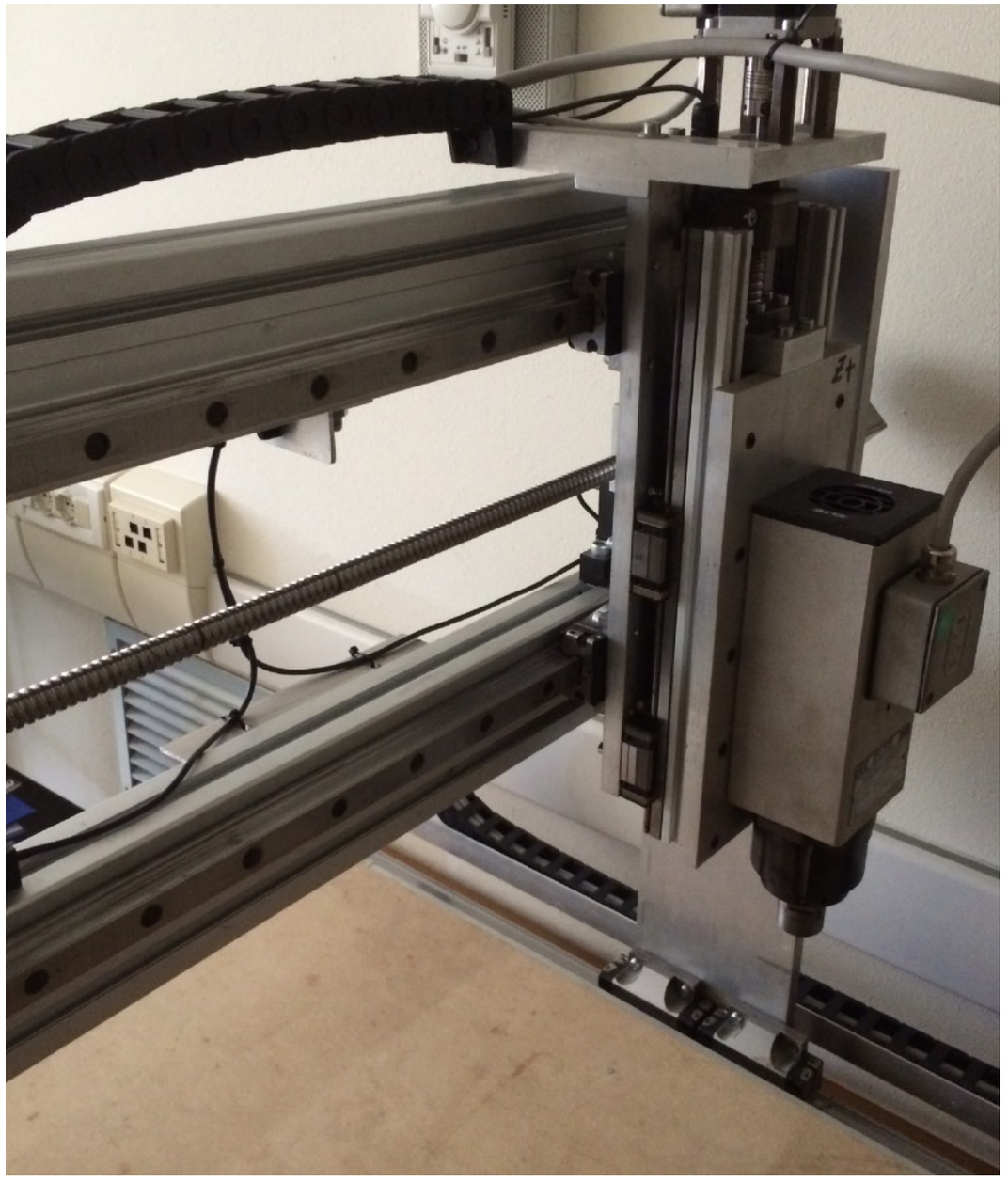
- A computer-controlled lasercutter, for press-fit assembly of 3D structures from 2D parts

- A larger (120x240cm) numerically-controlled milling machine, for making furniture- (and house-) sized parts

- A signcutter, to produce printing masks, flexible circuits, and antennas

- A precision (micron resolution) milling machine to make three-dimensional molds and surface-mount circuit boards

- Programming tools for low-cost high-speed embedded processors



http://fab.cba.mit.edu/about/faq/

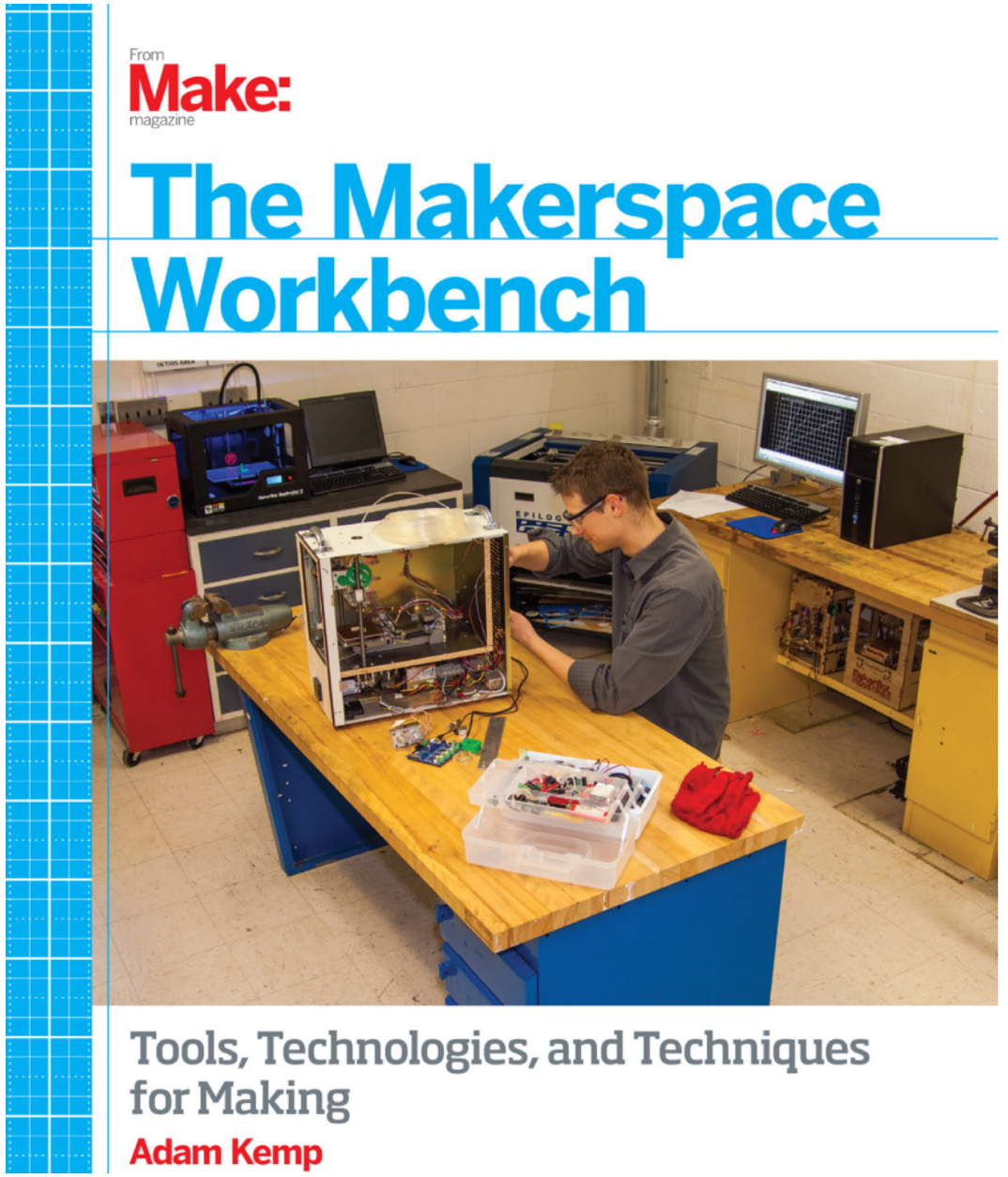
ACTIVITIES

- **Prototyping**: make *often*, make *quickly,* do *iterate*

- **Digital technologies**: digital files with open standards are easy to share on the Internet

- **Sharing**: to allow derivative works, natural evolution of idea, and "cascade effect"

- **Collaboration**: a shared working environment facilitates the exchange of experiences and knowledge



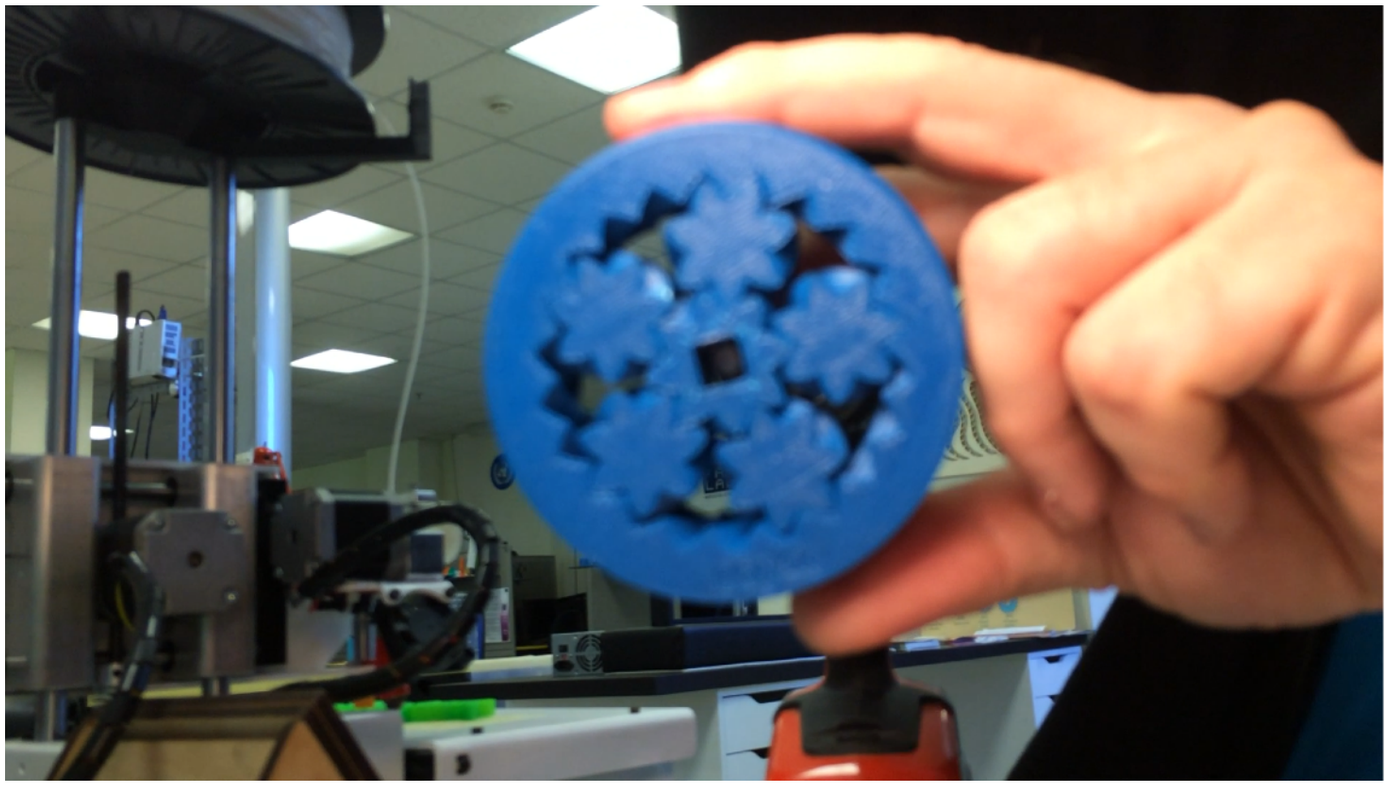
NETWORK

- **Fab Labs have to share a common set of tools and processes. A prototyping facility is not the equivalent of a Fab Lab. A 3D printer is not a Fab Lab.** The idea is that all the labs can share knowledge, designs, and collaborate across international borders. If I make something here in Boston and send you the files and documentation, you should be able to reproduce it there, fairly painlessly. If I walk into a Fab Lab in Russia, I should be able to do the same things that I can do in Nairobi, Cape Town, Delhi, Amsterdam or Boston Fab Labs

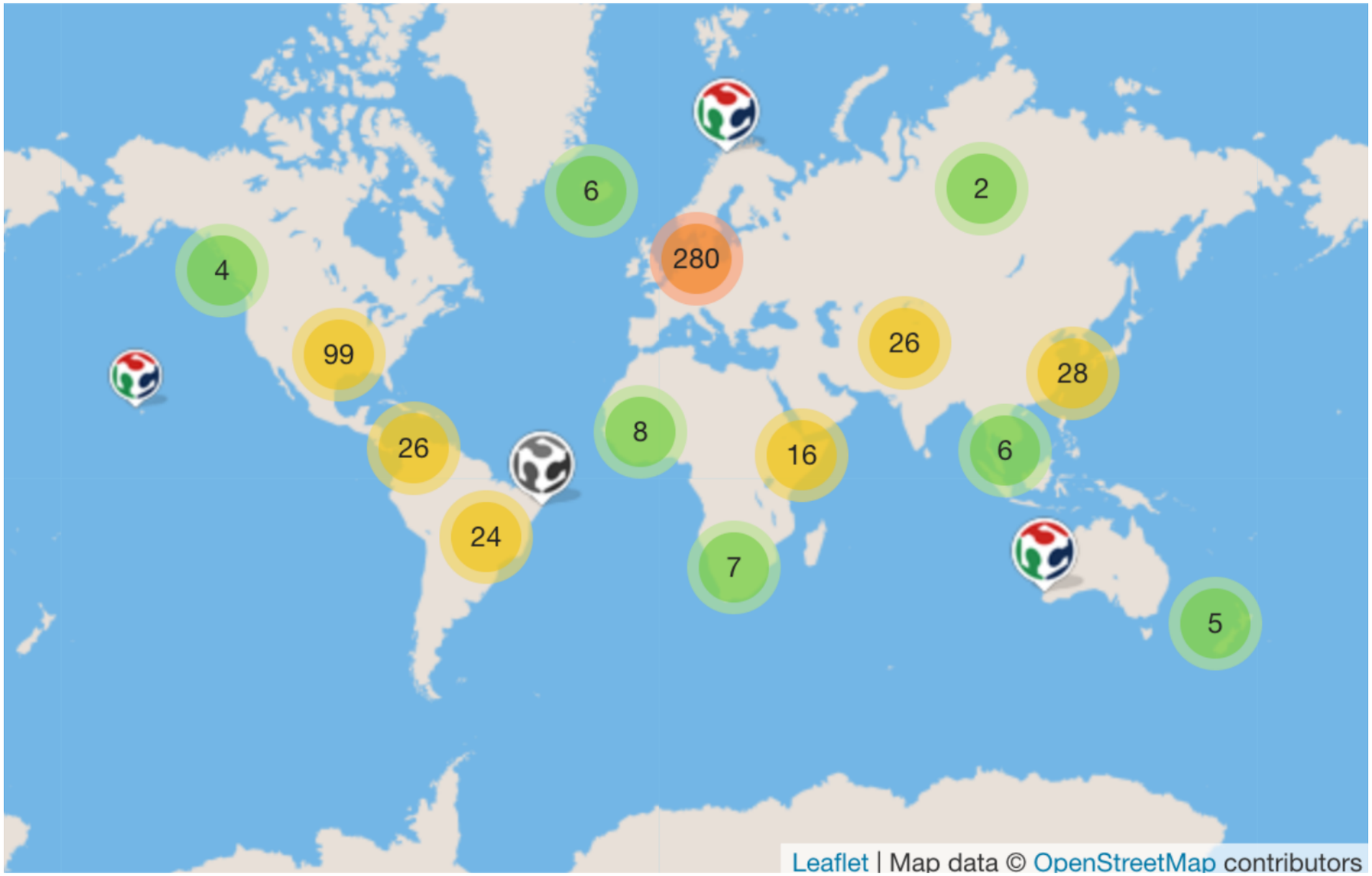
$\mathrm{FabLab} = (\mathbb{D} + \mathbf{p})^{s}$

Three components:

- (personal) **digital** fabrication technologies
- aimed to rapid **prototyping**
- all experiences are **shared** on the Internet



FABLABS IN THE WORLD



http://www.fabfoundation.org/fab-labs/ https://www.fablabs.io/labs

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SCIENTIFIC FABRICATION LABORATORY

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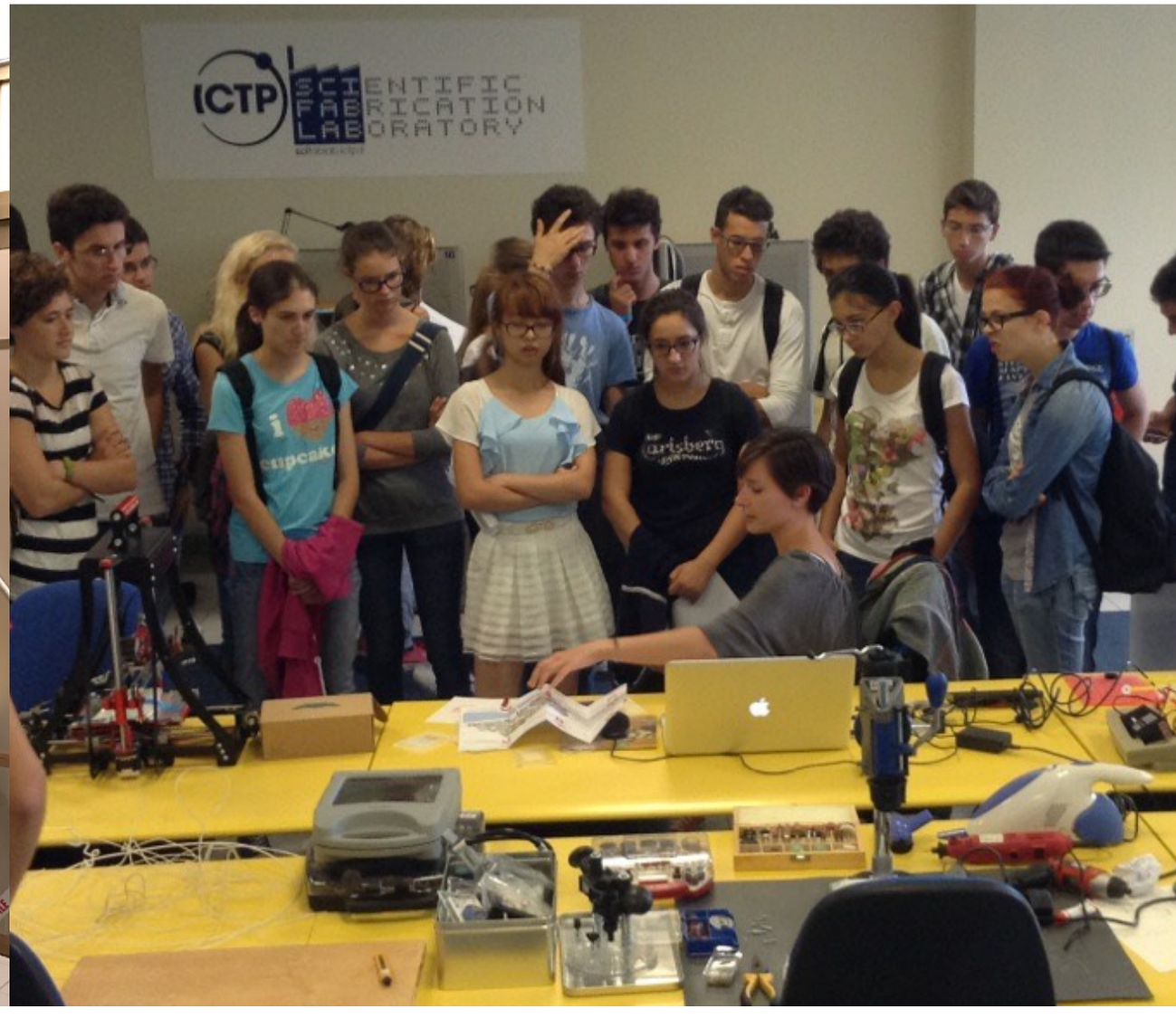
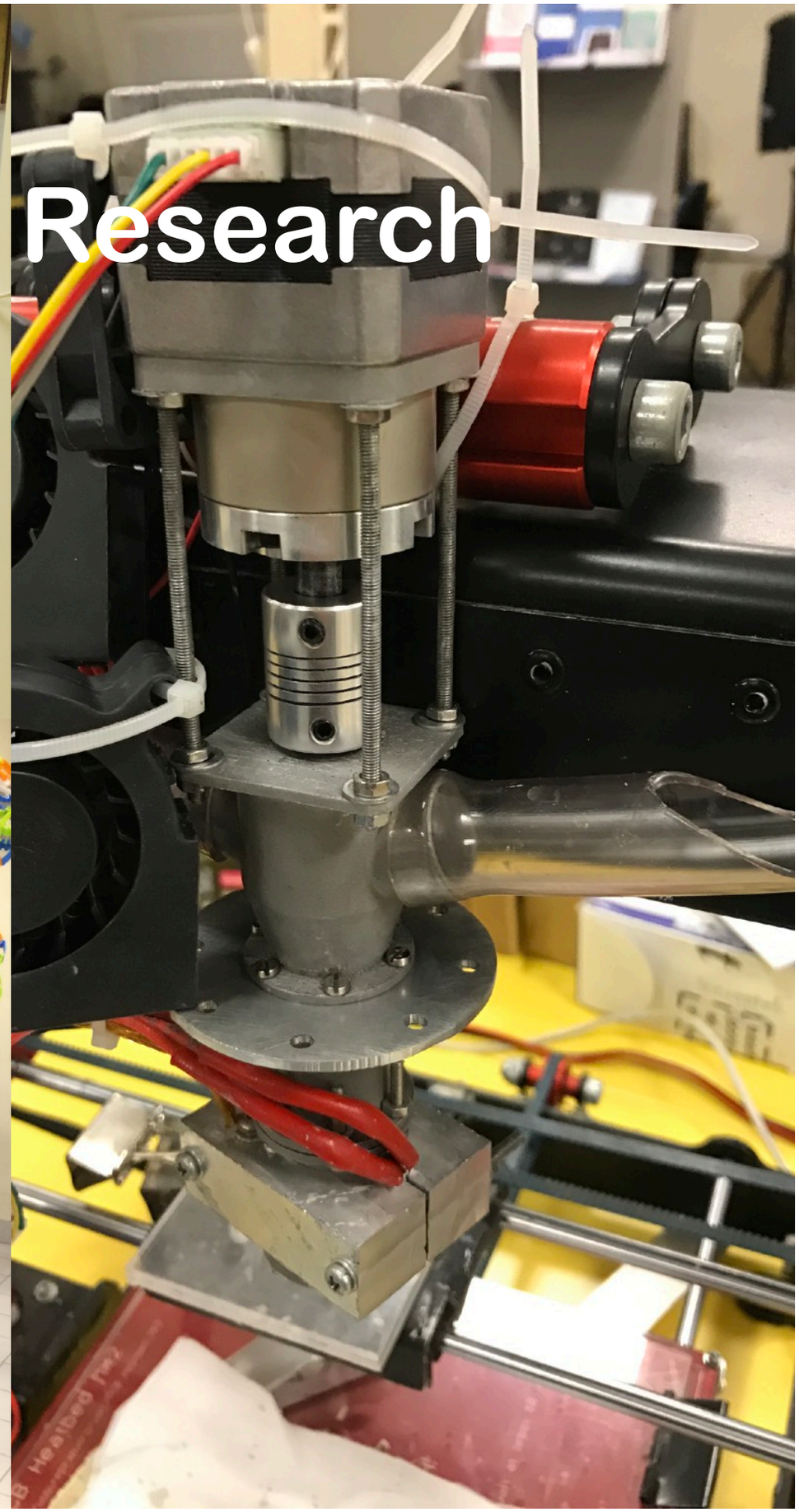


http://scifablab.ictp.it

Projects

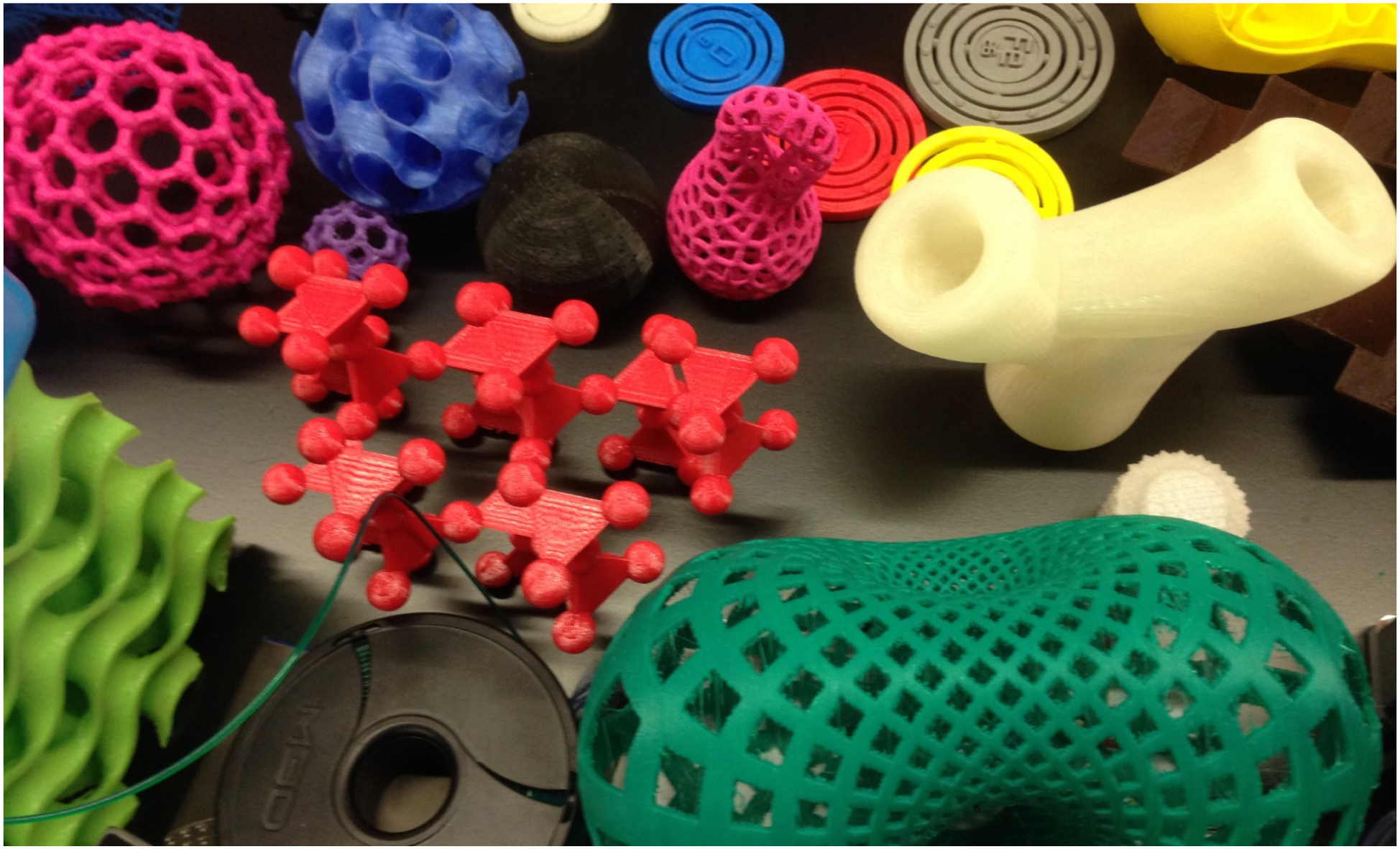
Training



Research

How to create a FabLab

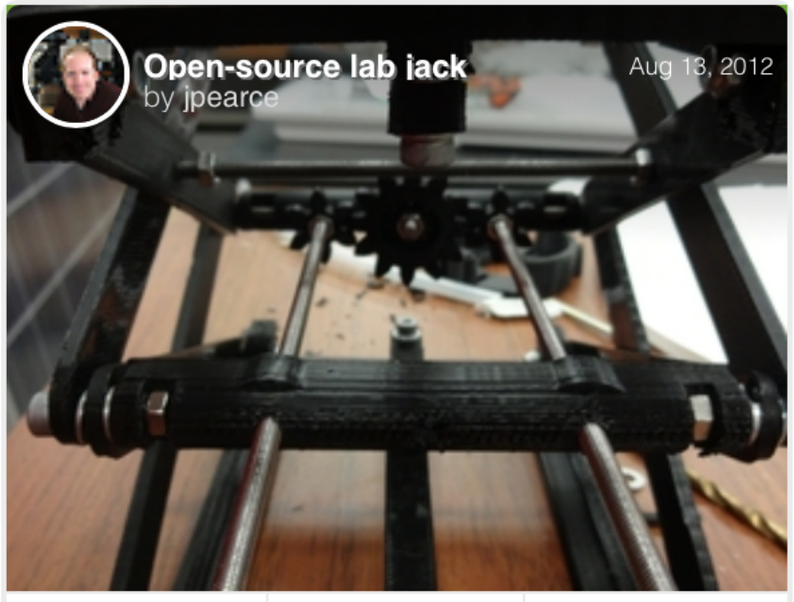
(in a scientific institution)



FabLab + Science = ?

Are FabLabs helping scientific research?
What about education? And development?

Search for "Optics Lab equipment" on Thingiverse



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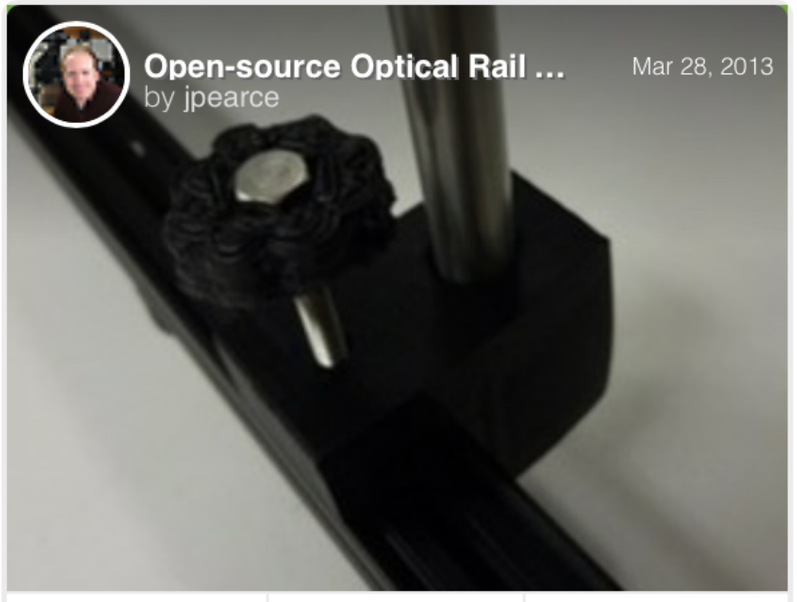

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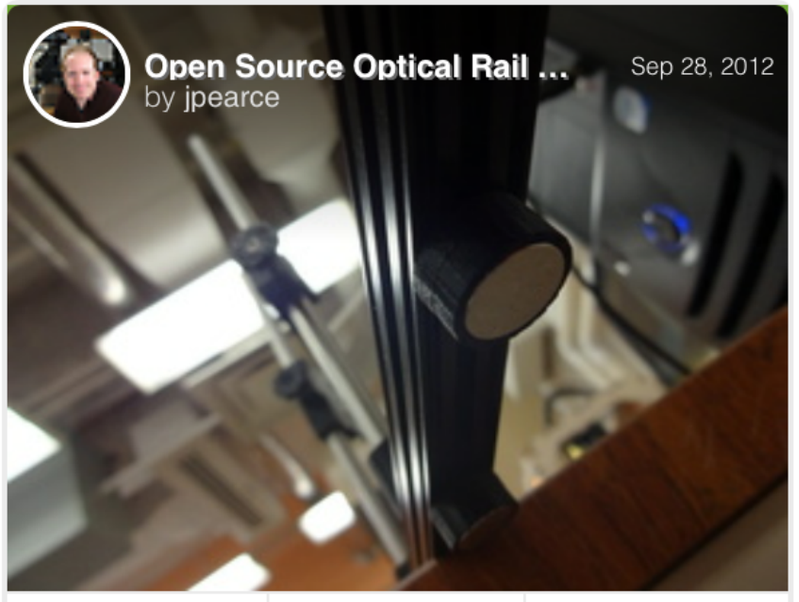

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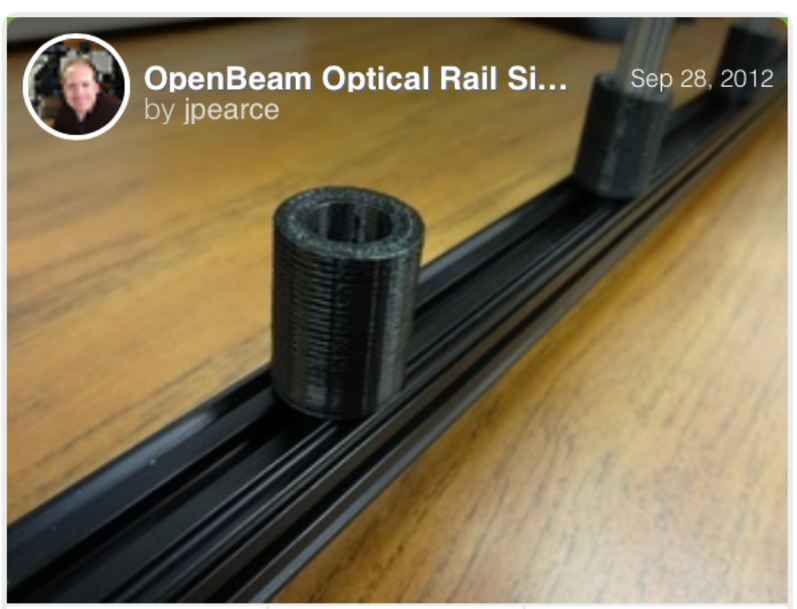

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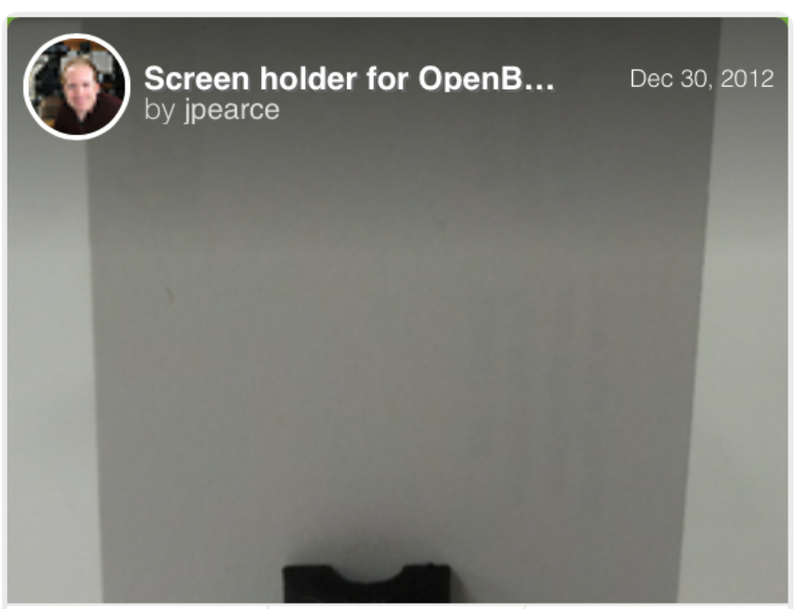

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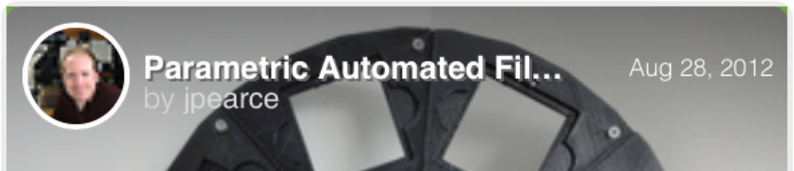
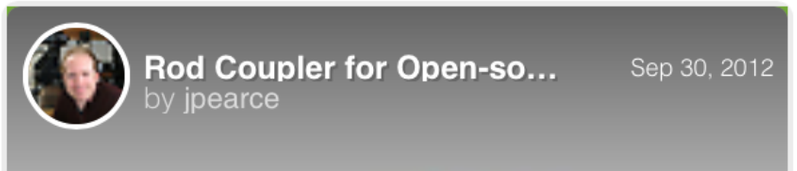
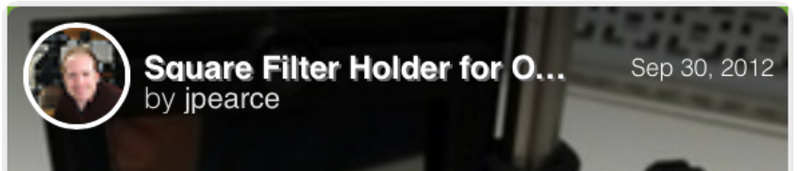


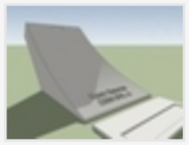


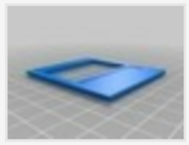
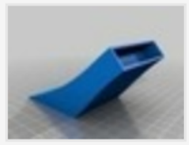
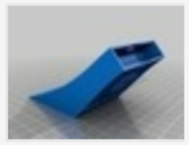


http://www.thingiverse.com/thing:49934

PublicLaboratory Mobile Spectrometer v3.0

by BradDudenhoffer, published Feb 13, 2013



Like 160
Collect 135
Comment 18
I Made One 1
Watch 28
Remix It 3
Share

Download This Thing!

Supporting new Scientific FabLabs in Dev Countries

Open to the public: why?

- Engagement of the **local community** of makers

- Our mandate is to **share and disseminate knowledge**

- We are also working to attract **young** curious people to science

- Our FabLab aims to attract both **scientists** (have problems to solve, and little time/money to learn new skills) and **makers** (passionate people looking for problems to solve, often with valuable technical skills)

A few stats from 1 year

- Since the beginning (August 2014) had more than 30 projects hosted in the SciFabLab (initial space: 200sqm, now has grown to 350sqm)

- On average 5 - 10 users present when the lab is open to the public (48h/month, 100d/year), scientists during all workdays, also on mornings

- A network of >50 external makers are connected with us (15 are women)

- Two ICTP visiting scientists have worked here for 2+ months each (Colombia, Cameroon)

- We hosted 8 researchers from Developing Countries for 2-4 weeks

- 6 students from University of Trieste and Udine did their thesis/working stage

Sponsorship

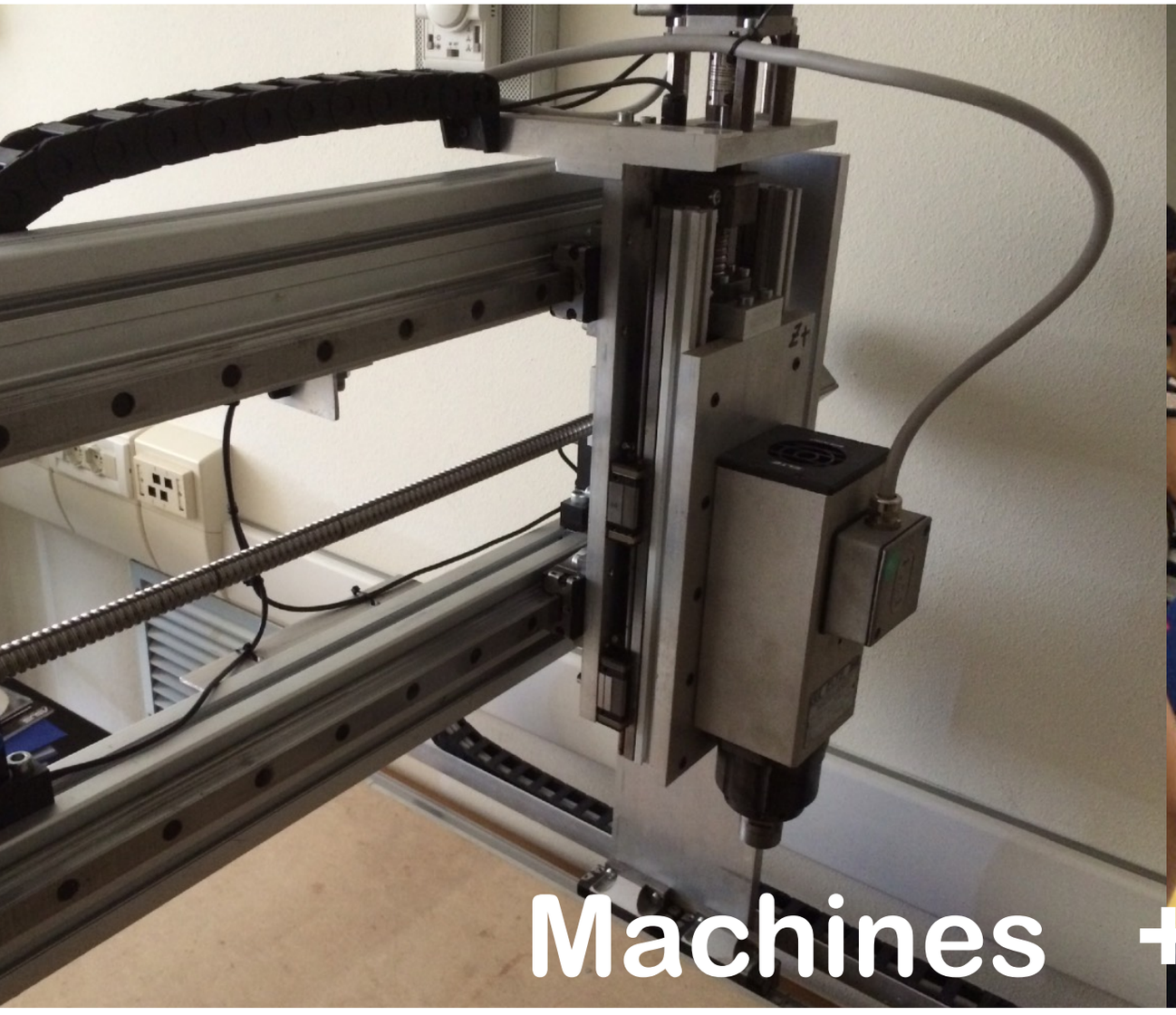
- The ICTP SciFabLab has received a contribution by the **Comune di Trieste** of 20.000€ for the year 2015, in order to offer its facilities to the local community for projects related to Trieste and its area. With half of this sponsorship we have been able to hire two young assistants to keep the lab open on evenings and all Saturdays (22hrs/week). The other half has been used for the TSMMF.

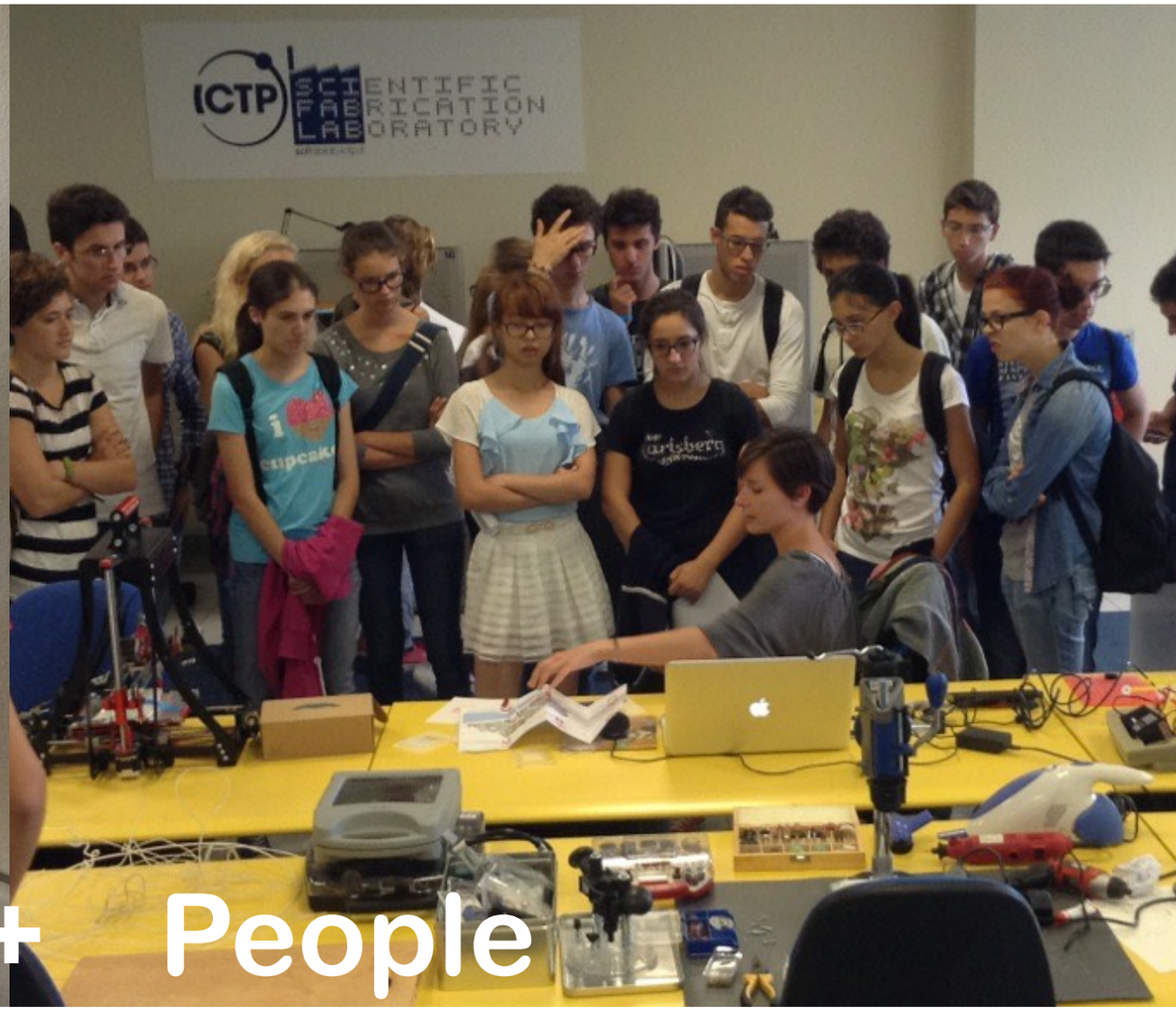
- In 2016 the contribution has been increased to 30.000€, of which 20K have been spent for the Trieste Mini Maker Faire and Science Picnic, and 10K for the SciFabLab.

- The newly elected administration of the Comune di Trieste has just renewed the contribution of 30.000€ for 2017, with the same modality.

ICTP SCI FAB LAB ENTIFIC RICATION ORATORY

scifablab.ictp.it





Machines + People

http://scifablab.ictp.it

3D printers:

- 1x Makerbot Replicator “original” (with dual extruder) link
- 2x Ultimaker “original” (1 with single extruder, 1 with dual extruder) link
- 2x CB-printer “RepRap-Mendel-style” 3D printer link
- 1x Printrbot Jr. link
- 1x Solidoodle 2G link
- 1x PortaBee link
- 1x Makerbot “5th Generation” link

3D scanners:

- Makerbot Digitizer link
- FabScan (DIY kit by Wetterott) link
- Microsoft X-Box Kinect sensor + Skanect software link
- Matter and Form (just arrived, not yet operational) link

Plastic filament production:

- Filastruder link
- automatic spool winder link
- plastic shredder link
- desiccator (drying chamber)

Plastic filament for 3D printing:

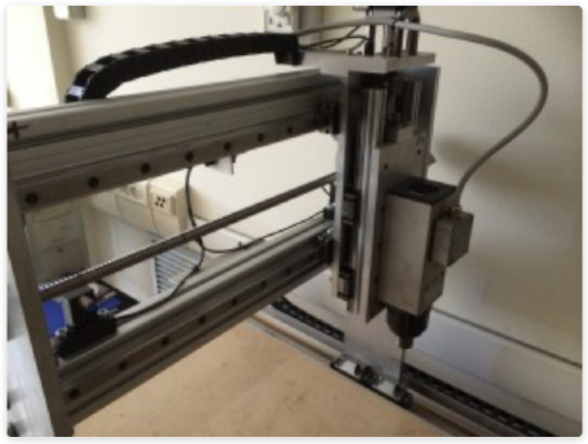
- ABS
- PLA
- Nylon
- PET
- soluble plastic: HIPS, PVA
- special ABS: color-changing, conductive
- special PLA: “ninjaflex”, “laywood”, “rubber-like”, “laybrick”

Laser cutting/engraving:

- Nice-Cut NC-E6090 laser cutter/engraver (60W CO2 laser, cutting bed: 60cm x 90cm) link
  Note: the laser cutter cannot be used before 5pm during working days. User training is required. / *Attenzione: la macchina per taglio laser non può essere utilizzata prima delle 17 durante i giorni lavorativi. È necessaria una formazione per l'uso.*

CNC:

- home-built 3-axis CNC milling machine (470x780mm working area, 1000W, works with aluminum/wood/plastic. Software: Mach3) – will be operational soon
  Note: the milling machine cannot be used before 5pm during working days. User training is required. / *Attenzione: la fresa non può essere utilizzata prima delle 17 durante i giorni lavorativi. È necessaria una formazione per l'uso.*

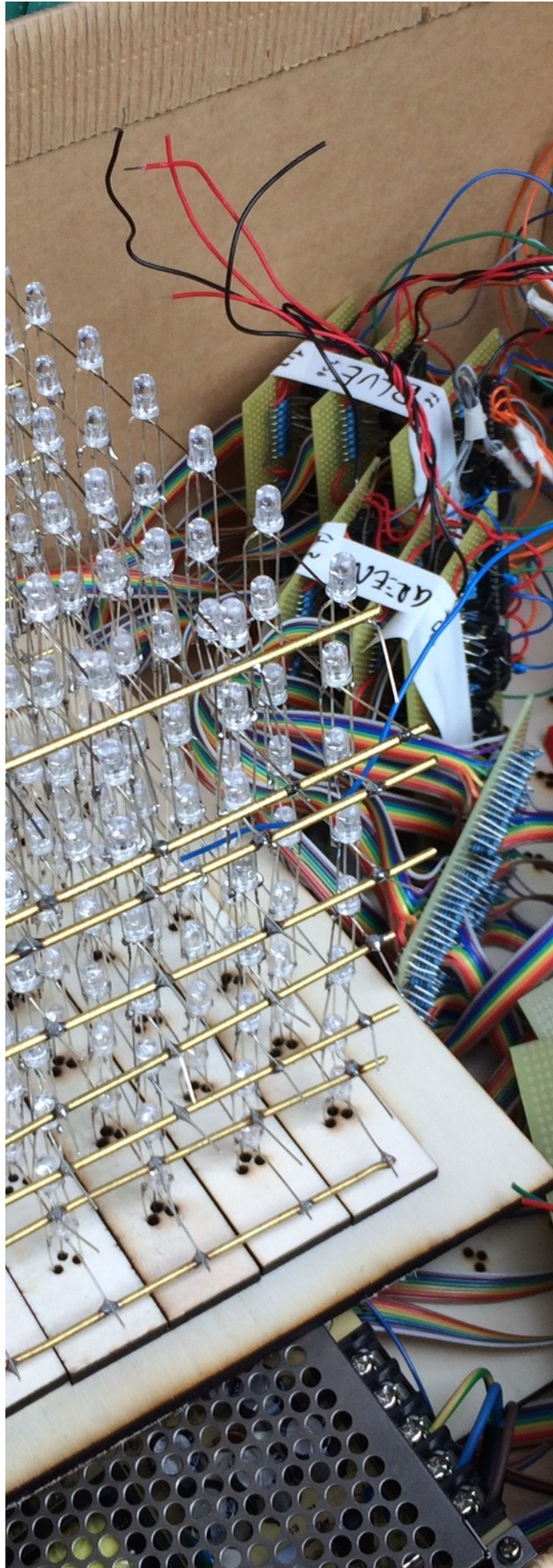


Plotters:

- HP DesignJet 250C inkjet plotter (A1 size, color print, not yet operational) link
- Silhouette Cameo electronic cutting machine (A3 size, vinyl/paper cut) link

Micro-controllers and electronics:

- Arduino (Uno, Mega, Yun) link
- various shield boards, displays, sensors and actuators
- breadboards and wiring
- Raspberry Pi mini computer
- soldering stations and tools
- digital oscilloscope
- multimeters, power supplies

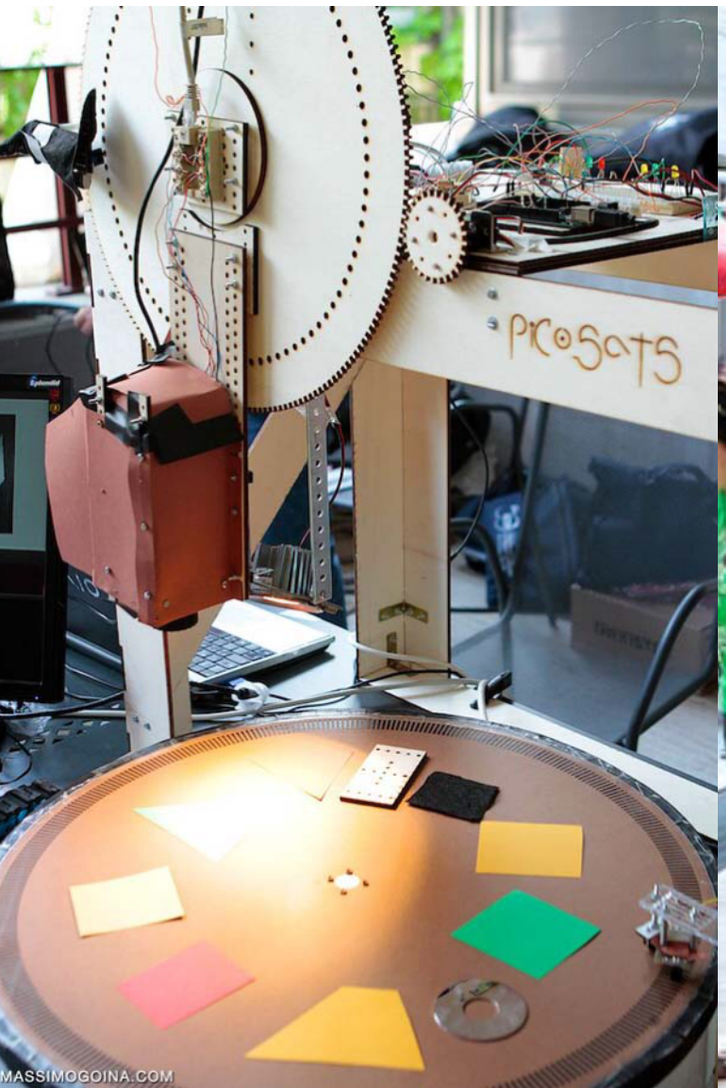


3D Printing Laboratory
ICTP
ABS

Trieste Mini
Maker Faire
GORDAK863
数显组合BGA返修台

Trieste Mini Maker Faire

- A MakerFaire is a unique occasion to exchange ideas between a lot of creative **makers** (with new tools and original solutions) and our **scientists** (they need to use such tools to solve research problems)



16.000 visitors!!!

- In 2014, we organized a 1-day event on Saturday, May 17, and we had 110 projects shown and ~6.000 visitors (cost: 25K€)

- On May 9 and 10 (Saturday and Sunday) 2015 we had more than 16.000 visitors for ~300 makers exhibiting their projects during a free 2-days event (cost: 50K€). Live web streaming: 6.000 viewers.

- We have been helped by ~100 volunteers

2014

Trieste Mini Maker Faire
Trieste Mini Maker Faire
M-7
M-16
#TSM

2015

2016

Trieste Mini
Maker Faire
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CAMPUS ICTP MIRAMARE

SABATO 21 - DOMENICA 22 MAGGIO 2016

SABATO ore 11-21 • DOMENICA ore 10-18

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VIENI IN BUS CON LE CORSE SPECIALI DELLA LINEA 6,
PRENDI UN TRENO (TUTTI I REGIONALI FERMERANNO A MIRAMARE*) O SCEGLI LA BICICLETTA!

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Thank you very much for your attention

by the ICTP SciFabLab team