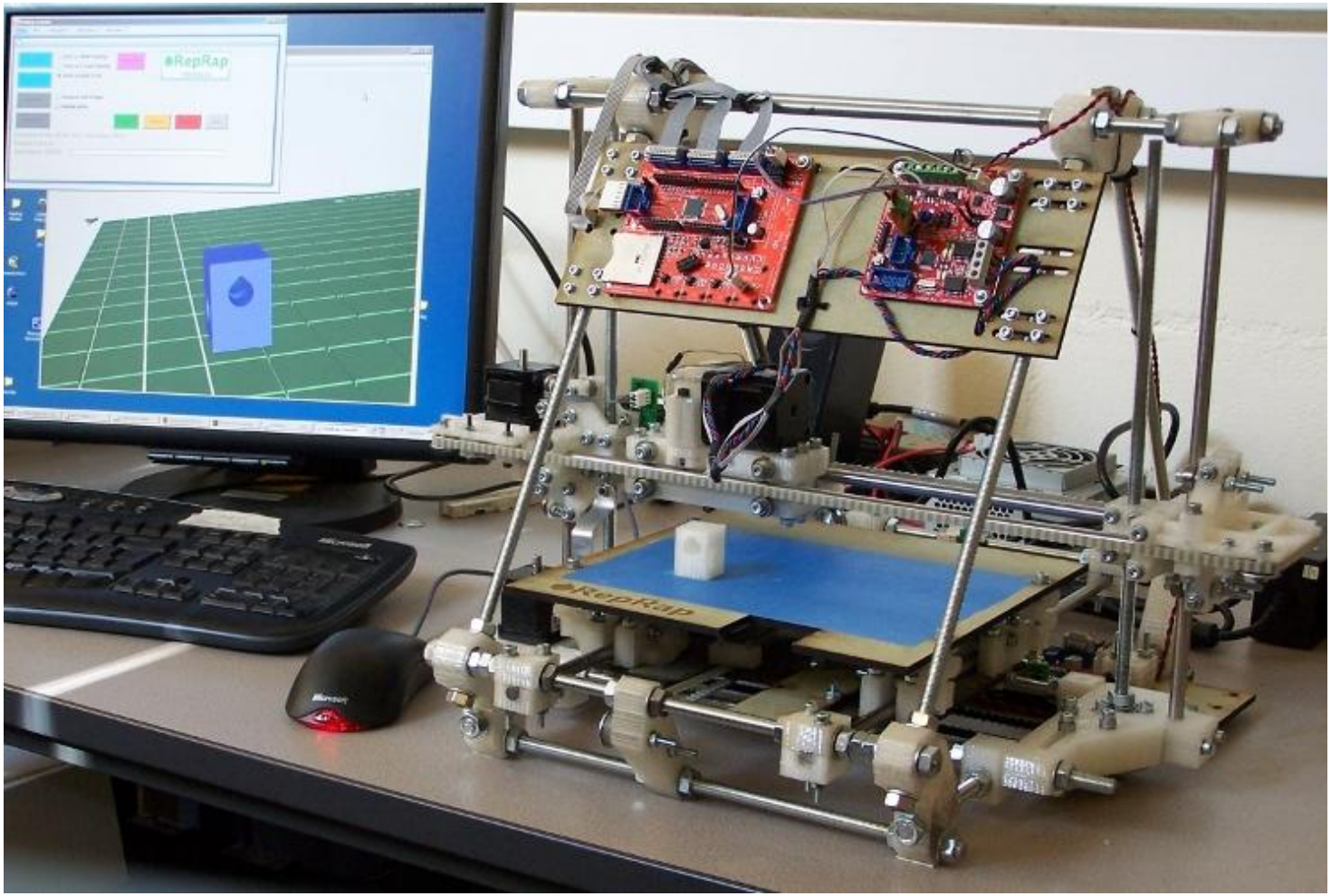
The Law & The Prophets/Profits

Rhys Jones, Adrian Bowyer & Erik de Bruijn

RepRap

RepRap

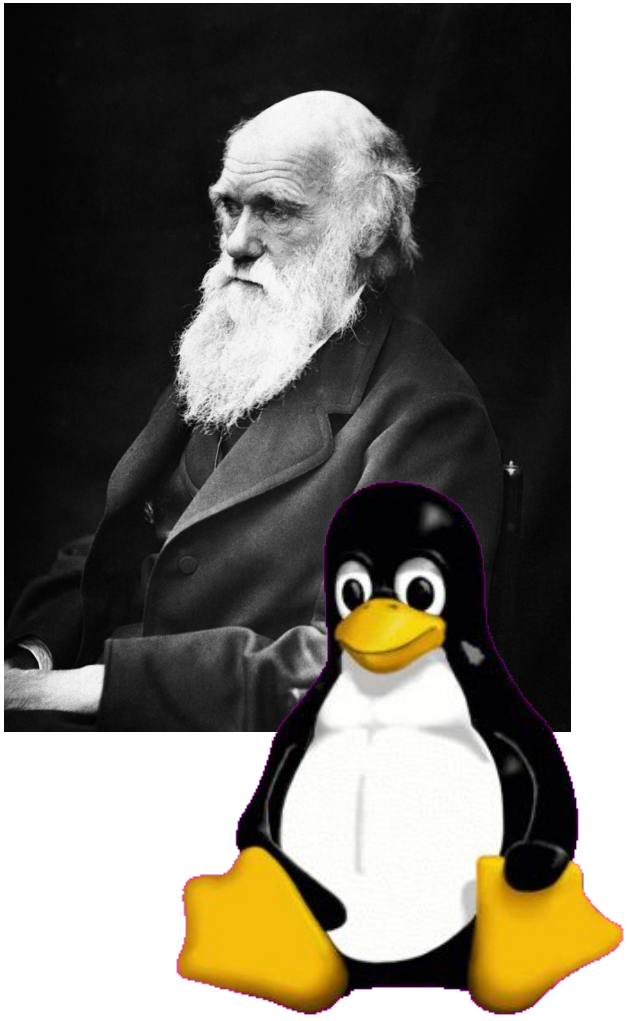
The Replicating Rapid Prototyper



RepRap

Evolution

- Open-Source
- Artificial Selection
- Improvements posted back onto the Web
- Old Machines can produce new designs
- Breeding – Faster, cheaper more reliable, accurate, higher replication rates



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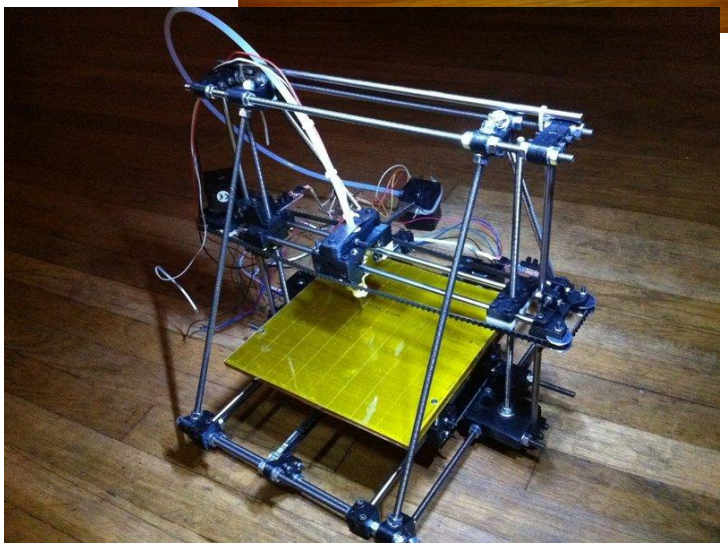
Future Development

- Lack of Control
  - 140 Upgrades since release
  - Mini Mendel, Sarrus Linkage
- Materials -Currently Thermoplastics
  - PLA, ABS, HDPE, LDPE…
  - Limited Material Properties



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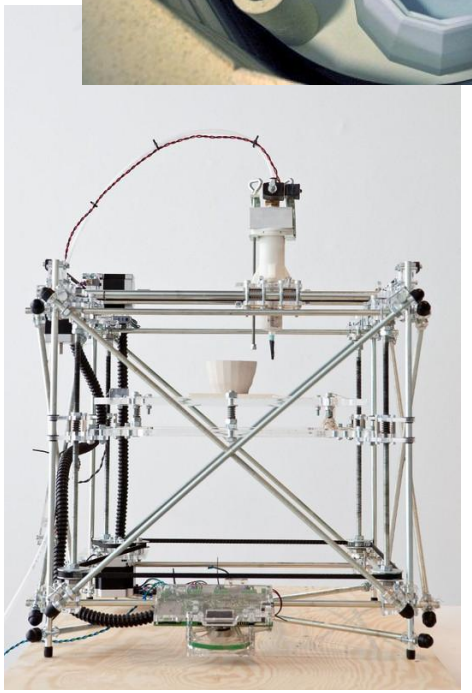
Future Development

- New Materials
  - Increased replication count
  - Manufacture more functional parts
- Pastes
  - Most versatile category of materials
  - Ceramics



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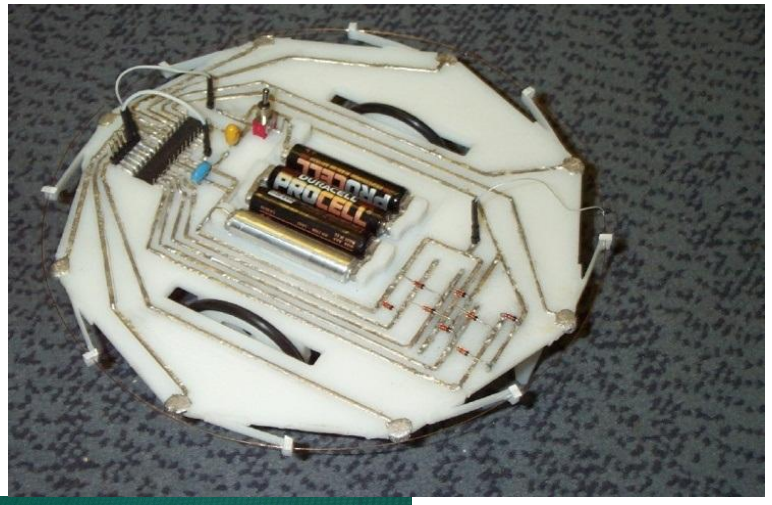
Multi-Materials

- Enables graded, directional or functional properties
- PCB's – Direct extrusion of Solder / Silver Loading of Pastes
- Substantial reductions in part count
- Easier to assemble
- Tweezers



RepRap

I Am The Law

Personal Manufacturing and The Long Arm

(European version...)

RepRap

Relevant Laws

1. Trademarks and passing-off
2. Unregistered and registered design

3. Copyright

4. Patent

RepRap

Trademarks and Passing Off

1. If make something including a trademark, or
2. If you try to pass it off

3. You are a bad person.

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(Un)Registered Design

1. Components only protected if they can be seen
2. No protection for technical function

3. The “must fit” exception

4. The “restore appearance” exception

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Copyright

`..."sculpture" includes a cast or model made for purposes of sculpture...' [s.4 CDPA 1988]

1. Surface images and figurines
2. Excludes industrial prototypes
3. Design documents copyright, but...
4. …*using* them is not an infringement
5. Star Wars knitting patterns
6. 25 year limit after first industrial use

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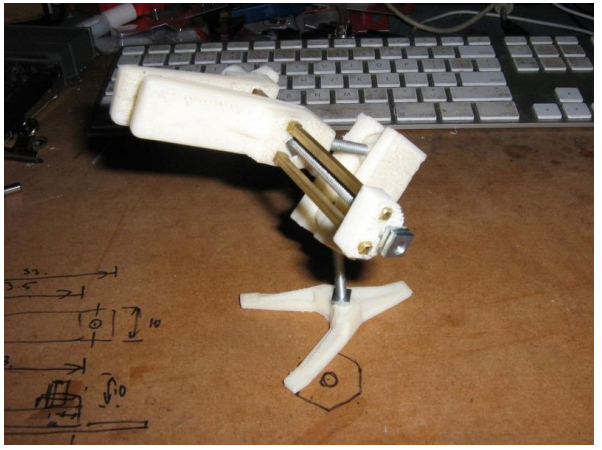
Patent

1. 20-year term
2. Private use not-for-gain is exempt

3. Experimental use is exempt

4. Public use (e.g. in a school) infringes

5. *Supplying the means* infringes



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The Law

1 You can't infringe trademarks
2 You can't forge (pass off)

3 You can't make copyright figurines

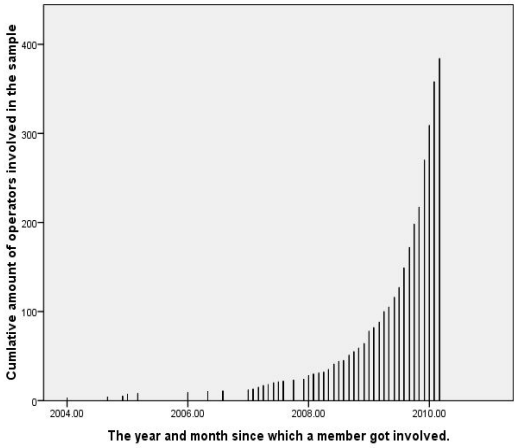
4 You can't include copyright artwork

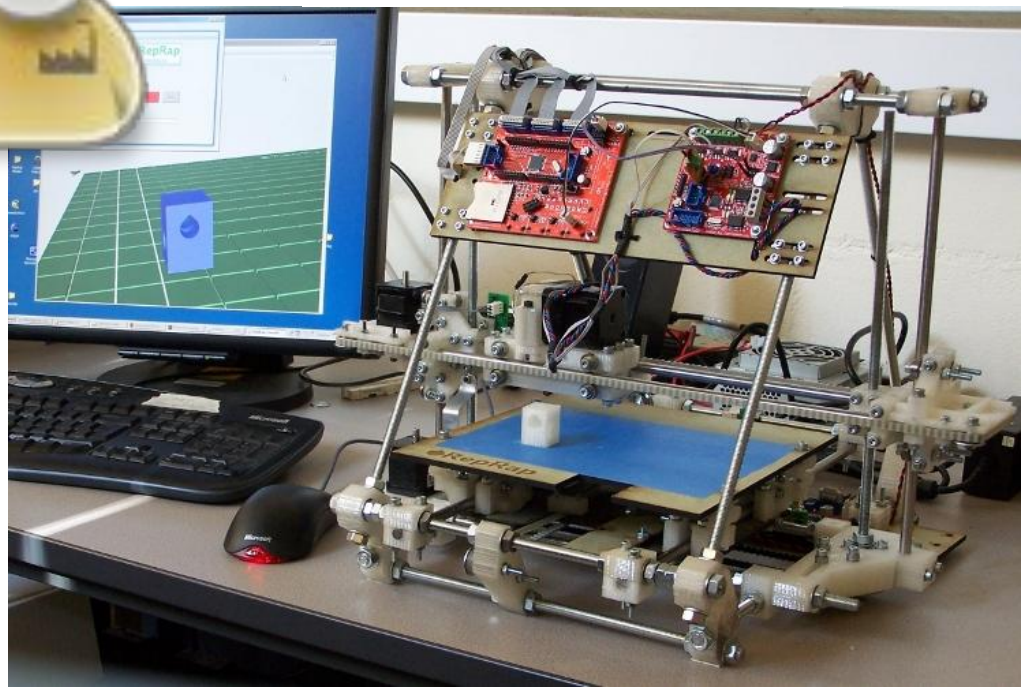
5 You can't *sell* patented items

6 You can pretty much do anything else...

S Bradshaw, A Bowyer and P Haufe, "The Intellectual Property Implications of Low-Cost 3D Printing", (2010) 7:1 SCRIPTed 5, http://www.law.ed.ac.uk/ahrc/script-ed/vol7-1/bradshaw.asp

RepRap



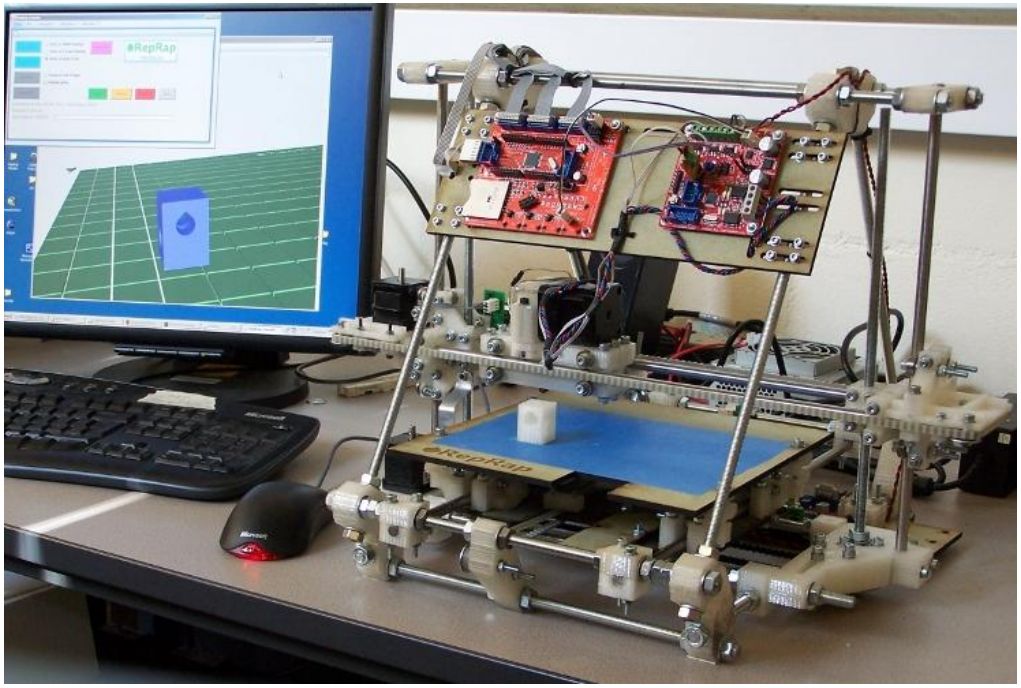


Revolutionizing fabrication together!

RepRap

RepRap's basic elements

- Open Source
- Community
- Personal Fabrication
- “Platform technology”
- Self-replicating



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Impact

Of democratization of personal fabrication through self-replication machines

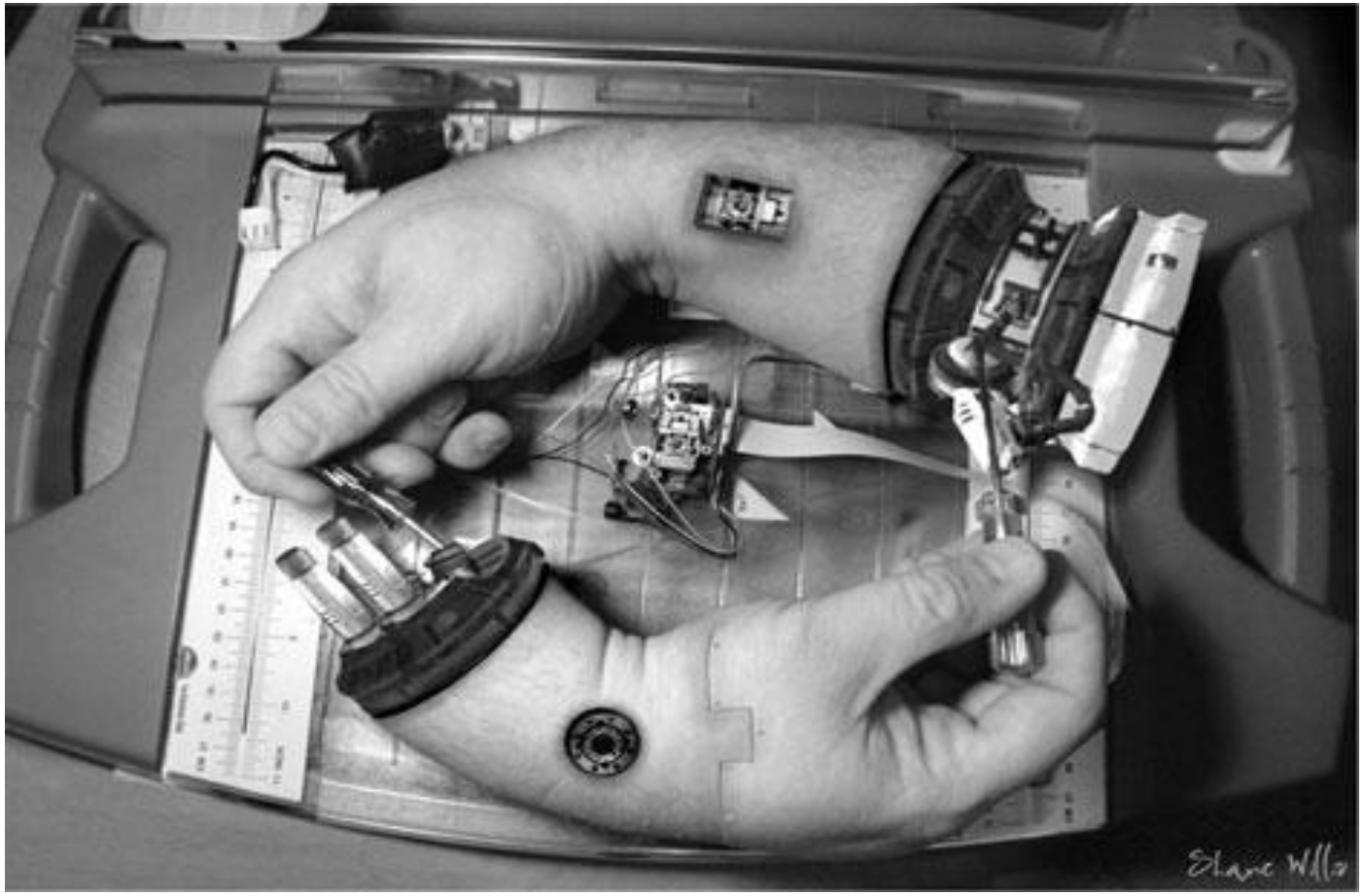

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Image by Shane Willis

Impact

"Freedom to copy software is an important right because it is easy now – any computer can do it.

"Freedom to copy hardware is not as important, because copying hardware is hard to do."

– Richard Stallman on Linux Today, 1999

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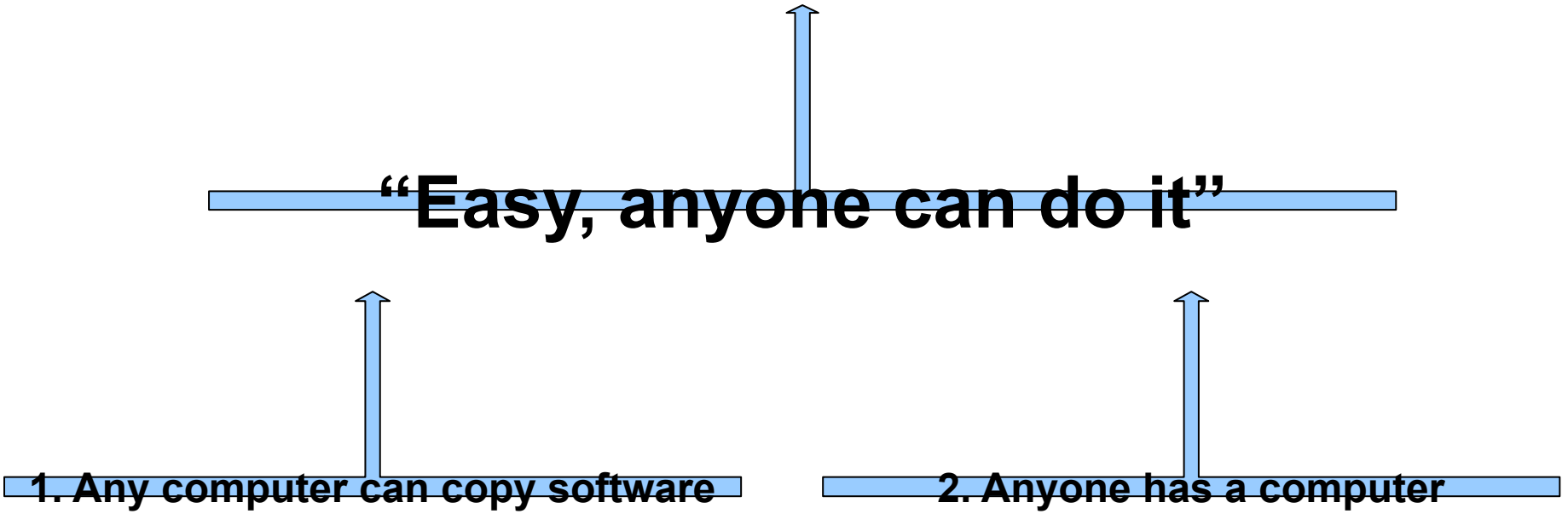
FOR SOFTWARE:

It is important



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FOR HARDWARE:

It is important

"Easy, anyone can do it"

1. Any fabricator can copy hardware

2. Anyone has a fabricator

Driven by:

- Low cost
- Ease of use
- Capabilities
- Discovery of applications
- Word-of-mouth

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Is hardware hard to copy?

- Not inherently, we just need sophisticated tools.
- It is not perceived as hard to copy!
- In the RepRap community, MORE hardware than software innovations are “copied”.

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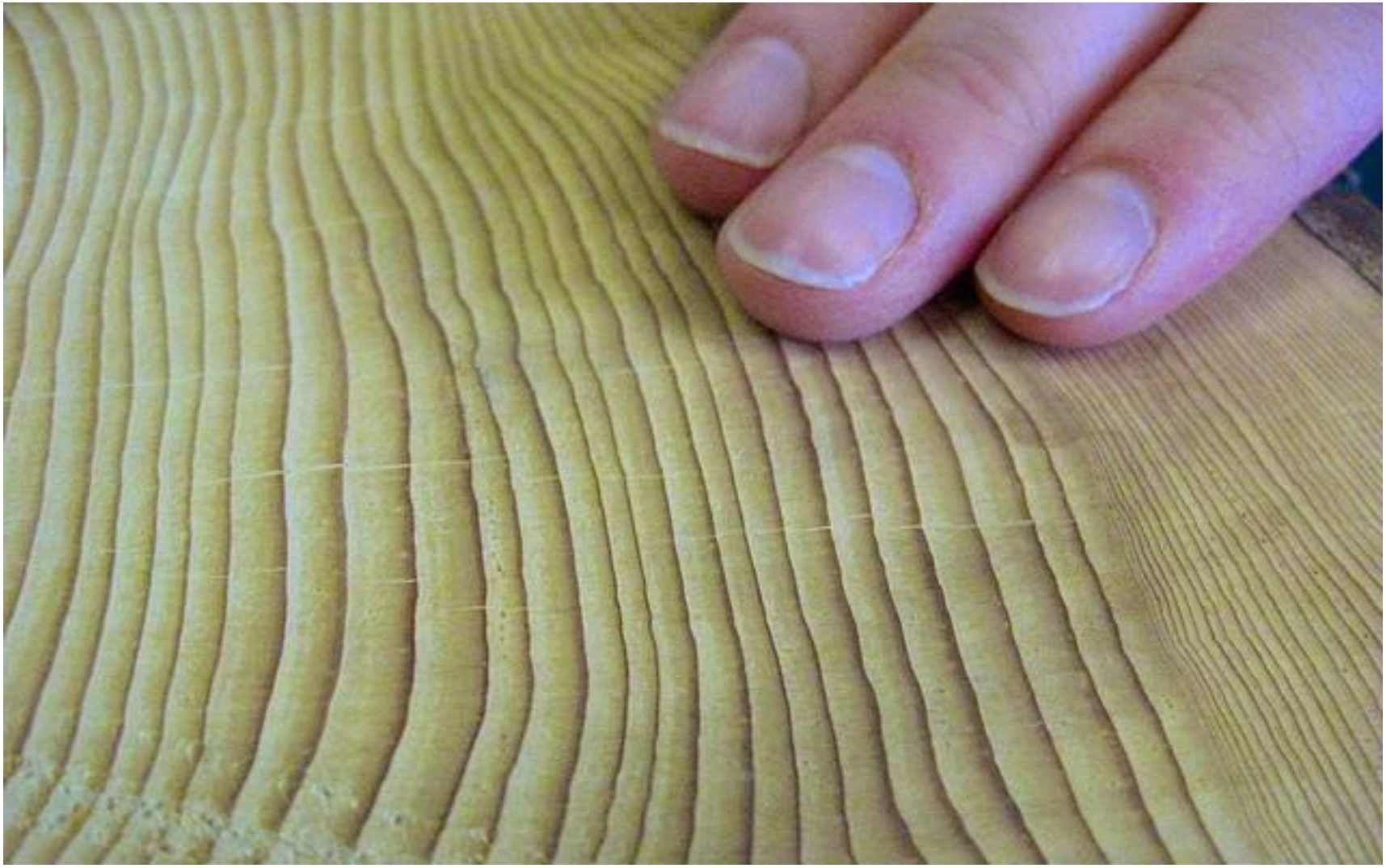
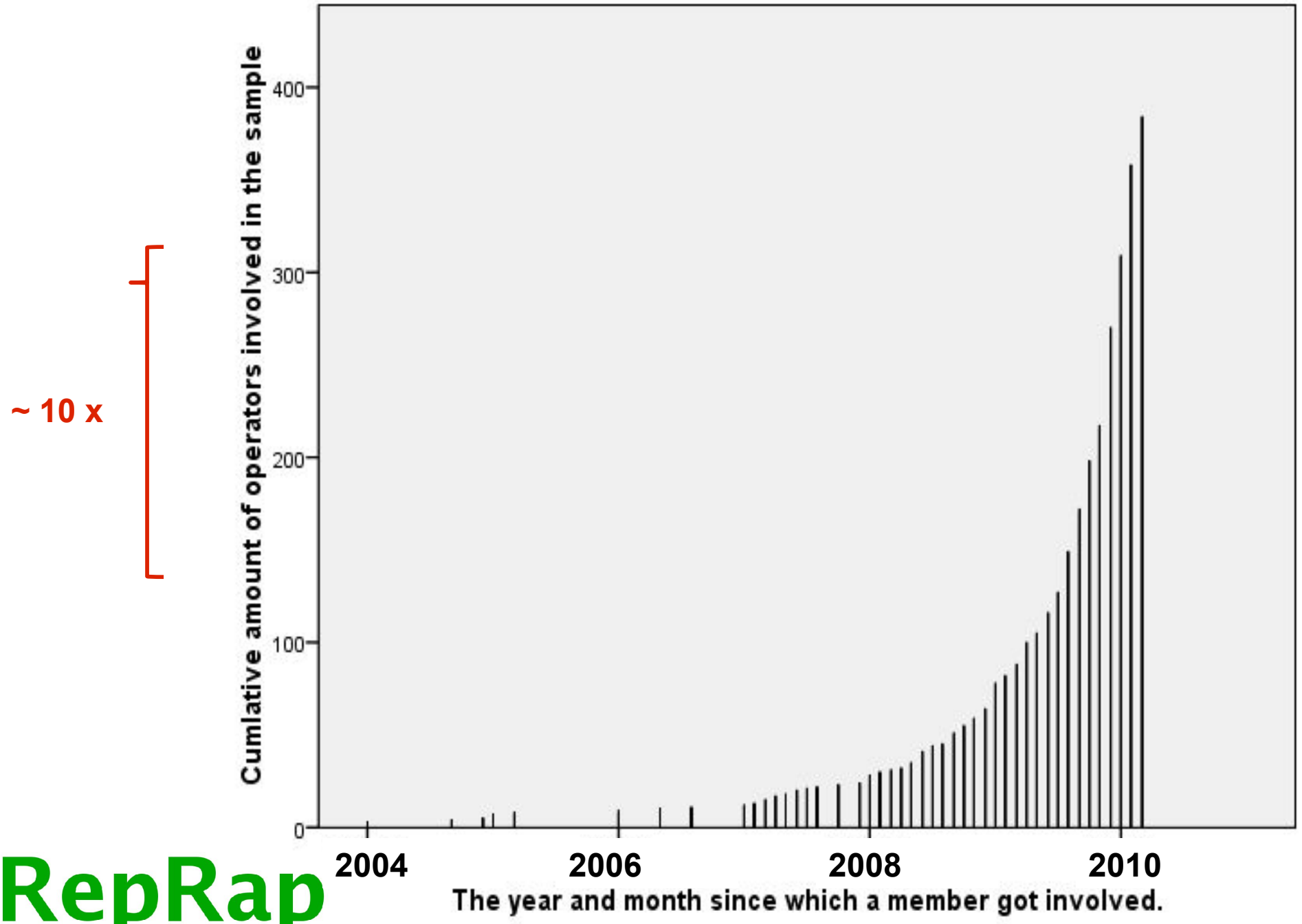
Community growth



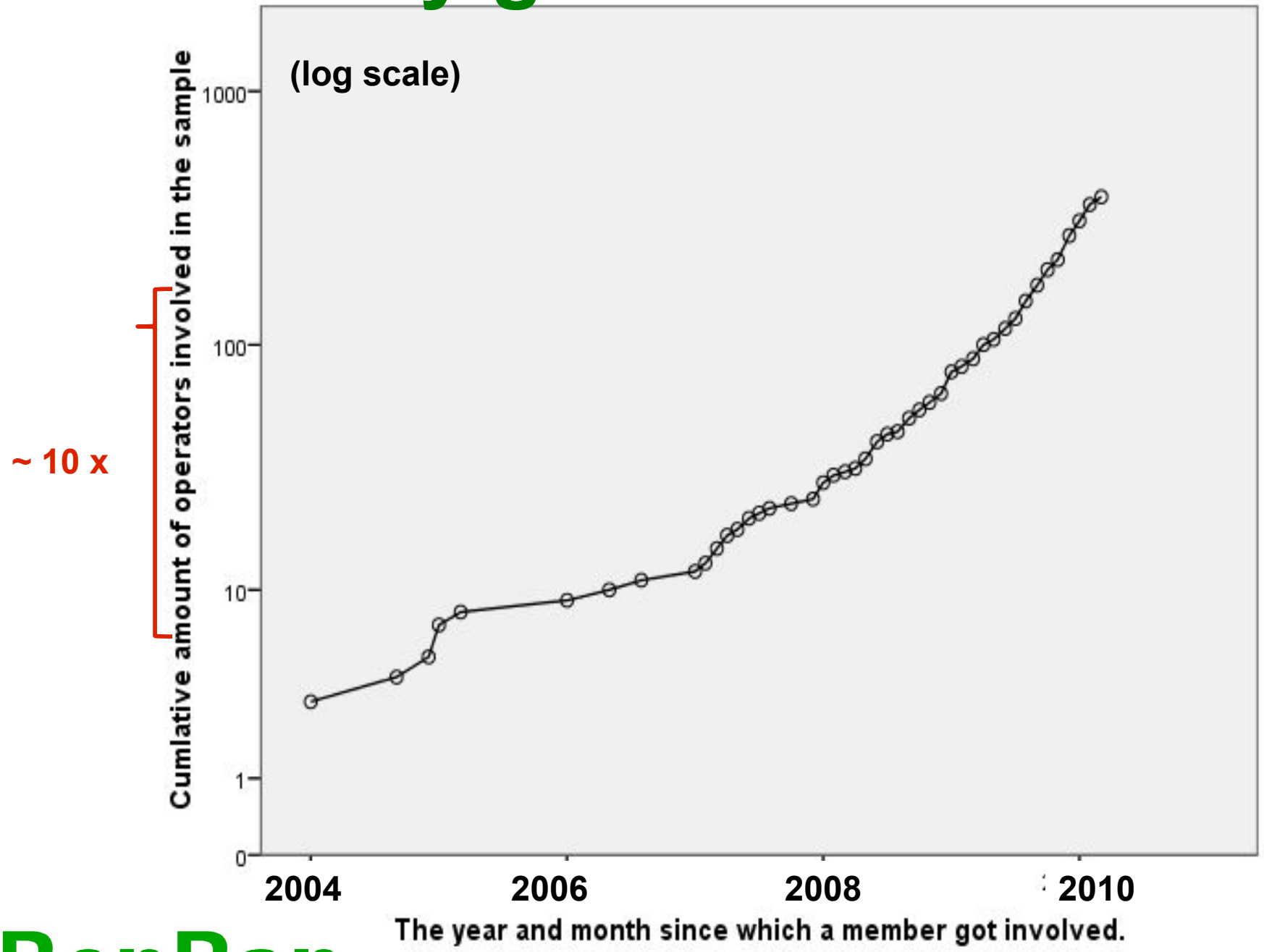
RepRap

Community growth



RepRap

Community growth



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Numbers

- Back of a napkin calculation:

SS * Mpp / FoP * M_{growth} ^ Months = no. of RepRap

	Low estimate	High estimate
Operators in sample* (SS)	386	386
Machines per operator (Mpp)	1.5	2
Machines in sample	579	772
Sampled fraction of pop. (FoP)	0.25	0.1
RepRaps in March	2316	7720
Monthly growth (M**growth**)	1.122	1.122
RepRaps in August 2010	4,127	13,755
RepRaps in Jan 2011	7,353	24,509

* Sampled in March 2010.

RepRap

Numbers (cont'd)

- The population is expected to be roughly 10 times bigger than the sample.
  But even if it's 5 or 20 times bigger, we're only off by 6 months!
- Note that: On the left in the log scale graph, results are easily distorted.
- The average operators has 1.5 distinct types of 3D printer.
  Number of RepRaps out there is roughly 3800 (e.g. 1 Mendel and 2 Darwins count as 2 distinct machines)

What is driving this exponential growth?

What does this exponential growth drive?

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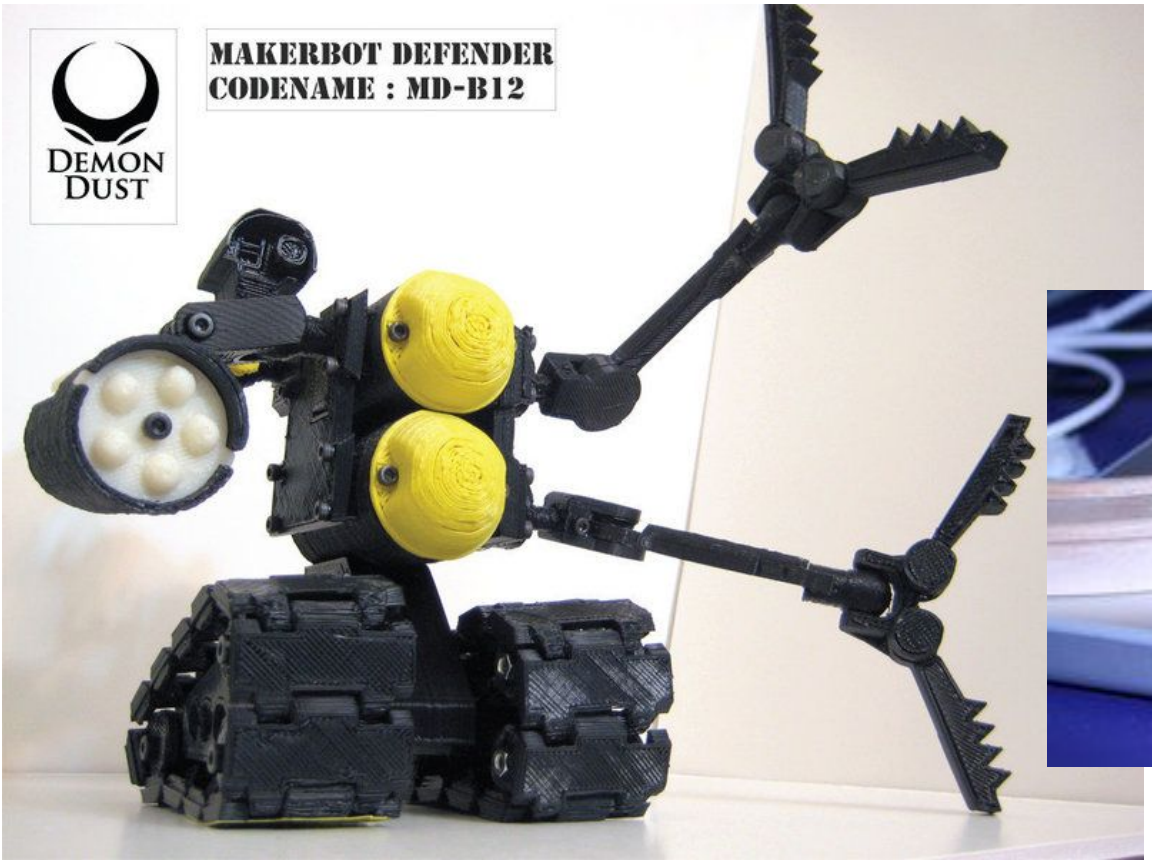
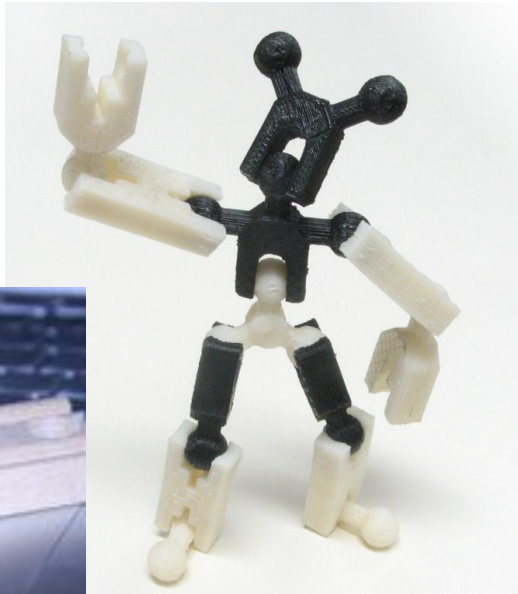
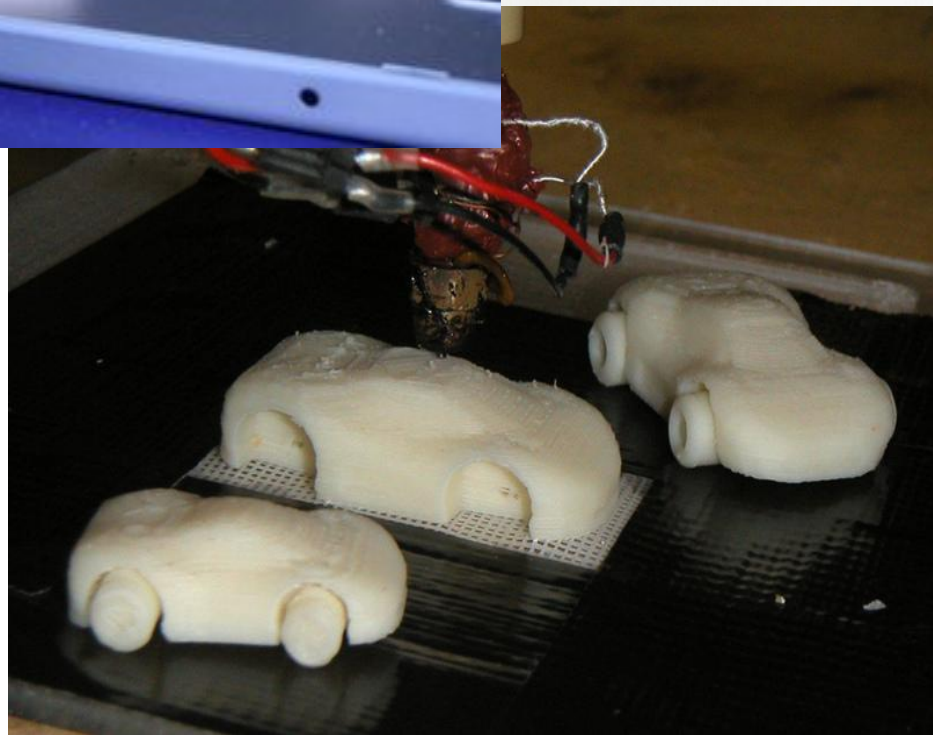
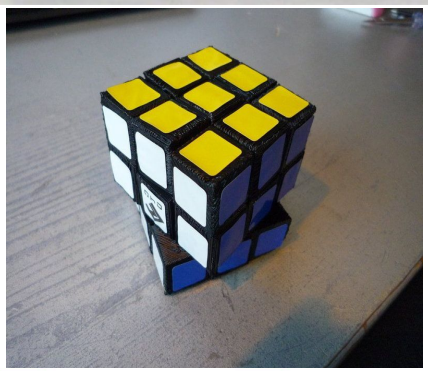
Toys (for all ages)





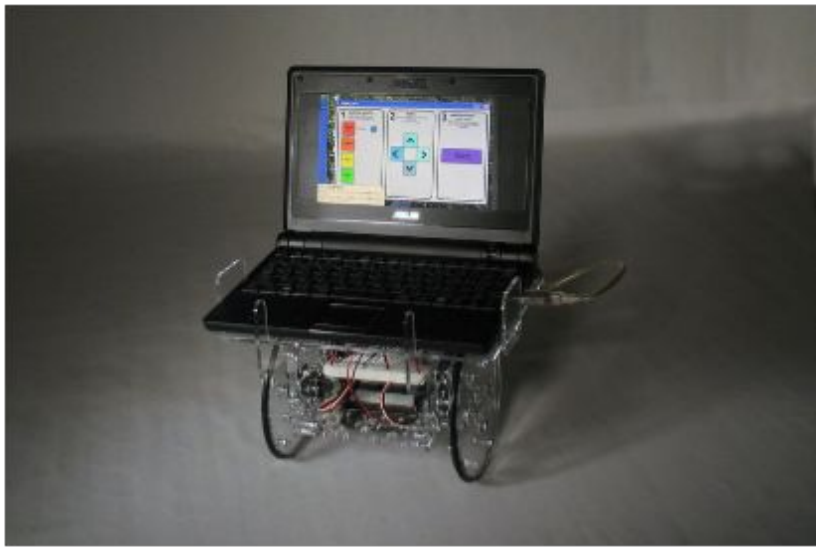


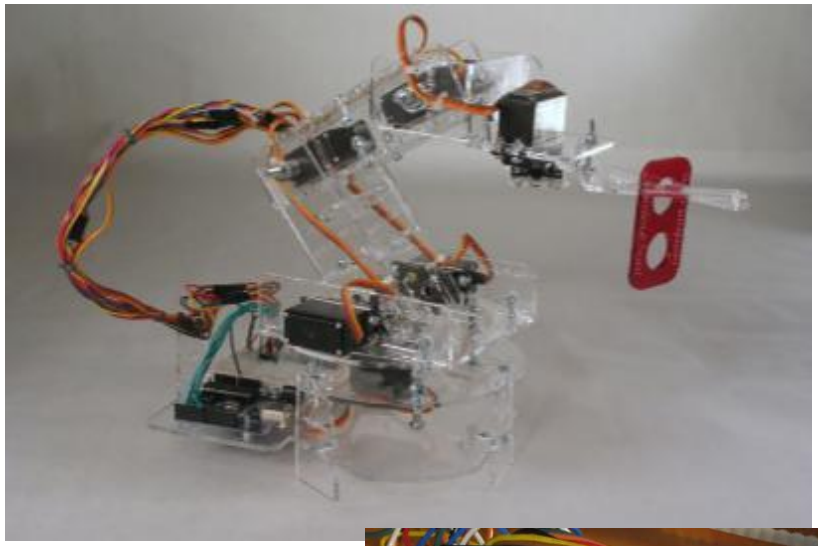


RepRap

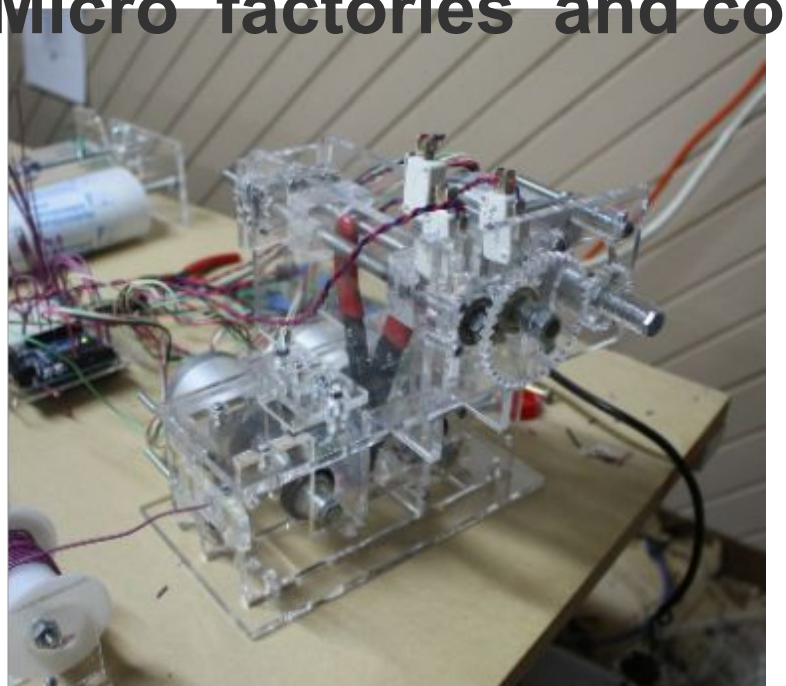
Content or innovations?

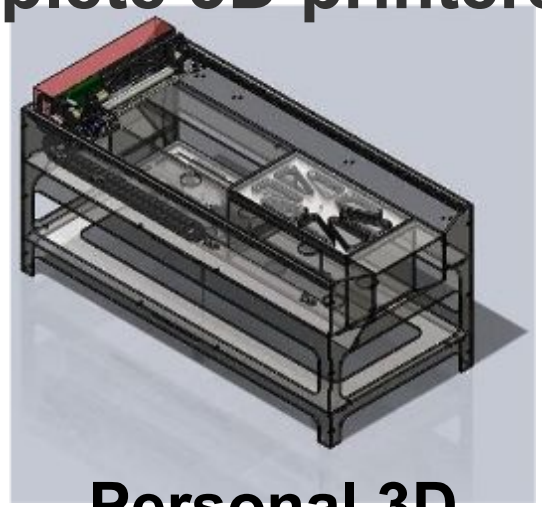
Robot modules or even complete robots





Micro 'factories' and complete 3D printers

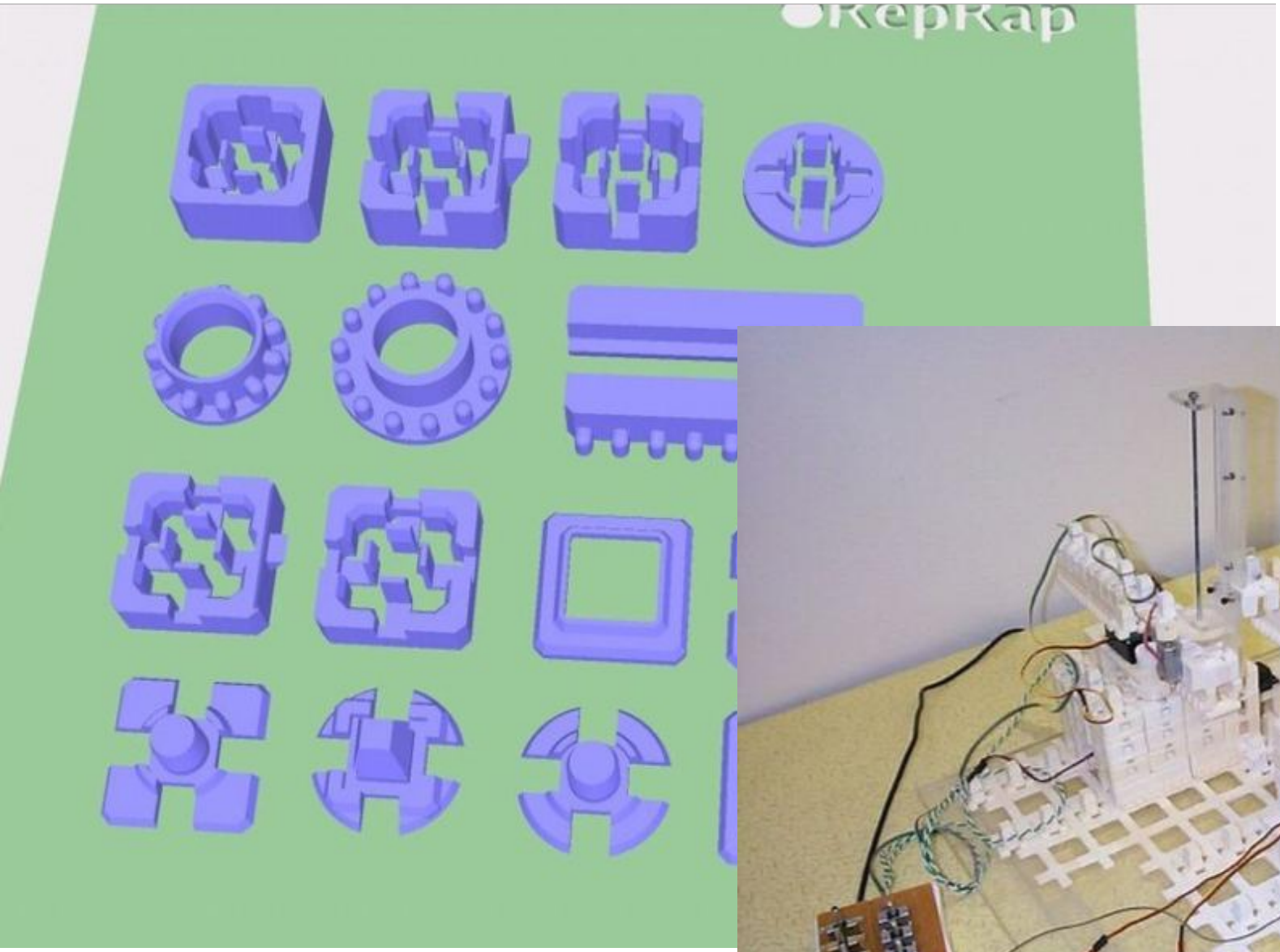


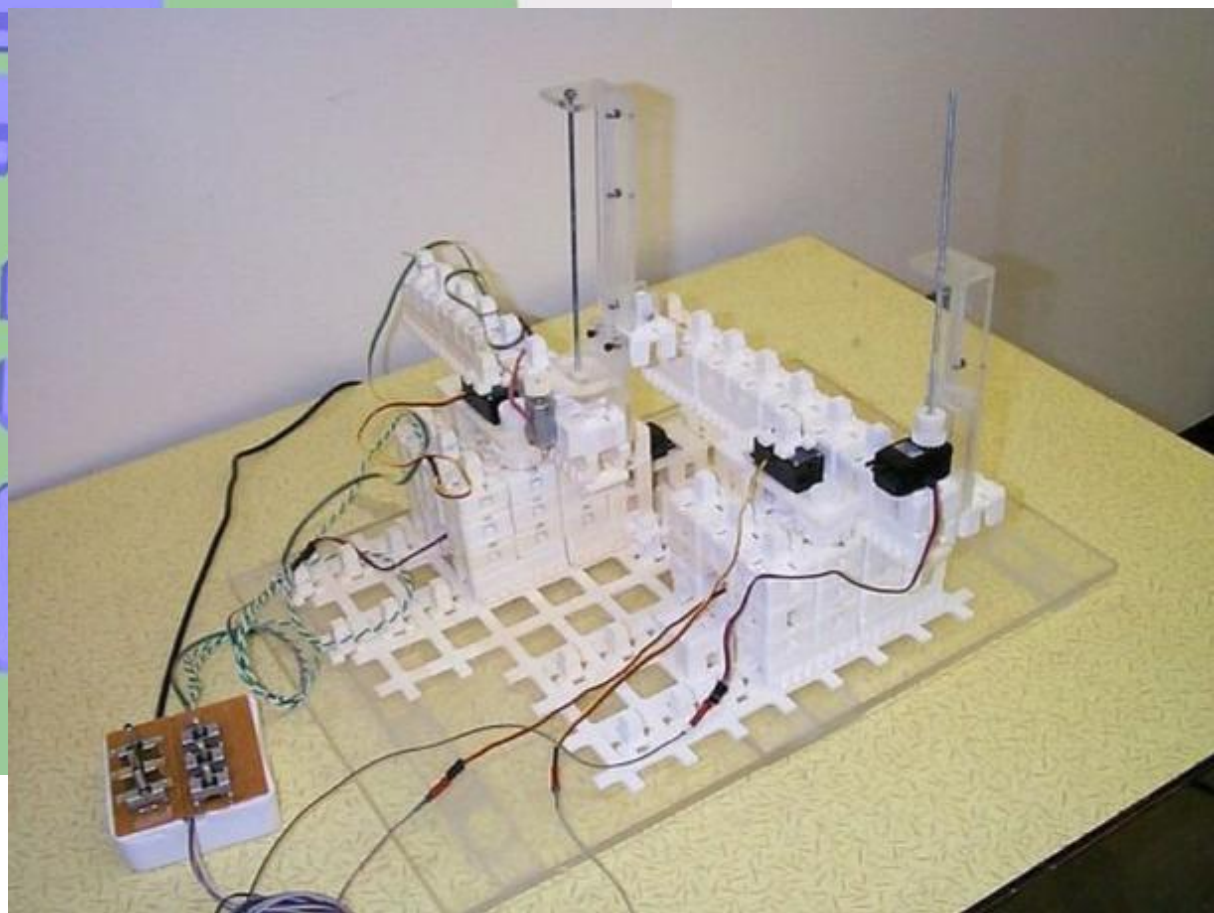


Personal 3D Printer

Content or innovations?

Parts for self assembling systems that can be 3D printed






Open Source Fusion
powered by
3D printed parts
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Conclusions

- PF is a critical collaboration platform for open hardware
- We will have PF in our homes
- More and more, WE will be the CREATORS of our futures
- The economics of physical goods will change very radically

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http://www.RepRap.org

Erik's survey and quantitative study done in conjunction with:

RepRap

Eric von Hippel, MIT Sloan School of Management