



AM / 3DP | ONE WAY FOR DIGITAL MANUFACTURING | IMPACT ON WORK & ORGANIZATIONS



AGENDA

1. Used terms: Di, DIY, WORK, ORGANIZATIONS
2. WORK ORGANIZATION. Something is changing
3. Additive Manufacturing Key factor of this change
4. What does AM/3DP provide to Digital Manufacturing?
5. How will AM/3DP impact to Work and Organizations?

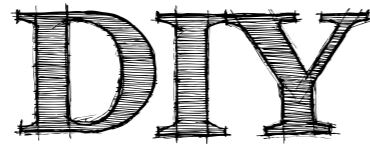


01. Used terms: Di, DIY



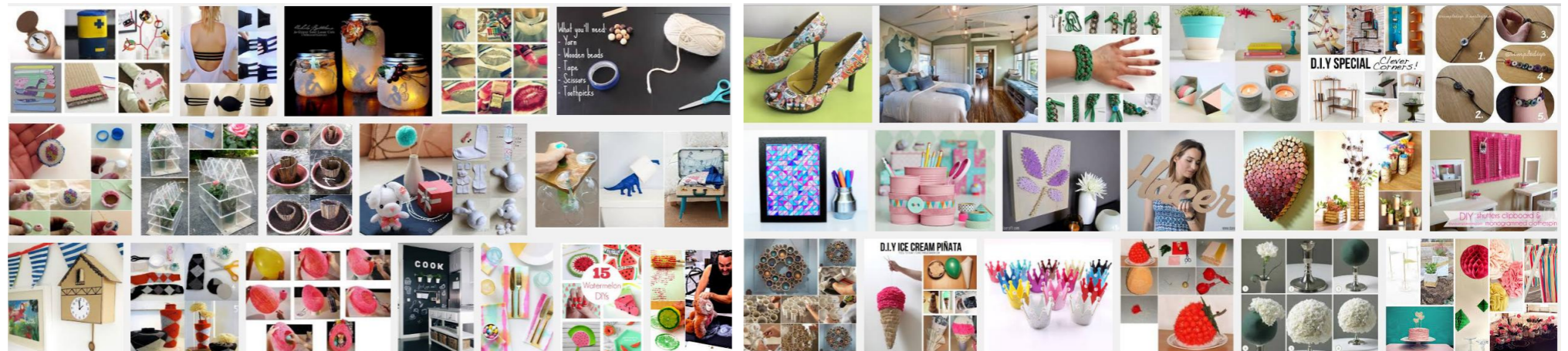
Digitally

From virtual (code, bits...) to tangible (material, atoms...)
From tangible (material, atoms...) to virtual (code, bits...)



Do it yourself

The ability of confronting the manufacturing of a solution, as an individual.



01. Used terms: WORK, ORGANIZATIONS



WORK

Why does work exist?
Unsatisfied needs
How we face it?
By finding solutions

ORGANIZATIONS

Why do they exist *from Technology and Science perspective*?
Because of challenges that we are unable to face as an individual.
E.g.:

- Need for experience.
- Research to create and transfer knowledge.
- Tools for coding and decoding
- Tools for controlling the deposition/positioning of the matter in AM
- Tools for forecasting the interaction between different deposited / positioned materials
- Tools for programming the behavior of the matter.
- ...



02. WORK ORGANIZATION. Something is changing



The division of labour



Adam Smith, Scottish philosopher and recognized as the father of modern economics, wrote in his book "The Wealth of Nations":

“One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving, the head; to make the head requires two or three distinct operations; to put it on is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about *eighteen distinct operations, which, in some manufactories, are all performed by distinct hands, though in others the same man will sometimes perform two or three of them....*

Wealth of Nations, 1776. Book 1, Chapter 1. Of the Division of Labour

02. WORK ORGANIZATION. Something is changing



DIY



Chris Anderson is an author and entrepreneur, and also part scientist, economist and physicist. He is famously known for his vision of business in the digital age

“ We are surrounded by physical goods, most of them products of a manufacturing economy that over the past century has been transformed in all ways but one: unlike the Web, it hasn’t been opened to all. Because of the expertise, equipment, and costs of producing things on a large scale, manufacturing has been mostly the provenance of big companies and trained professionals. That’s about to change.”

“The great opportunity in the new Maker Movement is the ability to be both small and global. Both artisanal and innovative. Both high-tech and low cost. Starting small but getting big”

Makers. The new industrial revolution. **2012**

03. Additive Manufacturing / 3D Printing technologies, a key factor of this change



AM /3DP processes can be advantageous for manufacturing :

- Parts can **be manufactured to near-net shape** (i.e. close to the finished shape and size), without further post processing tools, **in a single process step.**
- Degrees of **design freedom** for parts are typically high. Limitations of conventional manufacturing processes do not usually exist, e.g. for tool accessibility, undercuts
- A wide range of **complex geometries** can be produced, such as:
 - free-form geometries, e.g. organic structures
 - topologically optimised structures
 - infill structures, e.g. honeycomb, sandwich and mesh structures.
- The degree of part **complexity is largely unrelated to production costs.**
- Assembly and joining processes can be reduced through **single-body construction.**
- Overall part **characteristics can be selectively configured** by adjusting process parameters locally.



03. Additive Manufacturing / 3D Printing technologies, a key factor of this change



BUT...

Certain disadvantages typically associated with AM processes have to be taken into consideration during product design:

- Shrinkage, residual stress and deformation can occur ...
- The surface quality of AM parts is typically influenced by the layer-wise build-up technique ...
- Consideration must be given to deviations from form, dimensional and positional tolerances ...
- An allowance must therefore be provided for post-production finishing...
- Anisotropic characteristics typically arise...
- Not all materials available for conventional processes are currently suitable for AM processes..
- Material properties can differ from expected values known from other technologies ...
- Material properties can be influenced significantly due to process settings and control...

Not enough reliable?

04. What does AM/3DP provide to Digital Manufacturing?



- Enables the manufacture of **innovative products through design and integration of new materials**: lighter, more resistant, without assemblies.
- Reduction in lead times until part production.
- **A machine, unlimited production lines.**
- **All sizes**: nano, micro, meso and macro parts
- Production of a **unit**, manufacturing **on demand**, true **customization**. **Small productions**, particularly for products with **high added value**.
- Producing with a **lower consumption** of raw **materials** and **energy**.

04. What does AM/3DP provide to Digital Manufacturing?



Software Defined Supply Chain - 2012



Software Defined Supply Chain - 2017



Software Defined Supply Chain - 2022

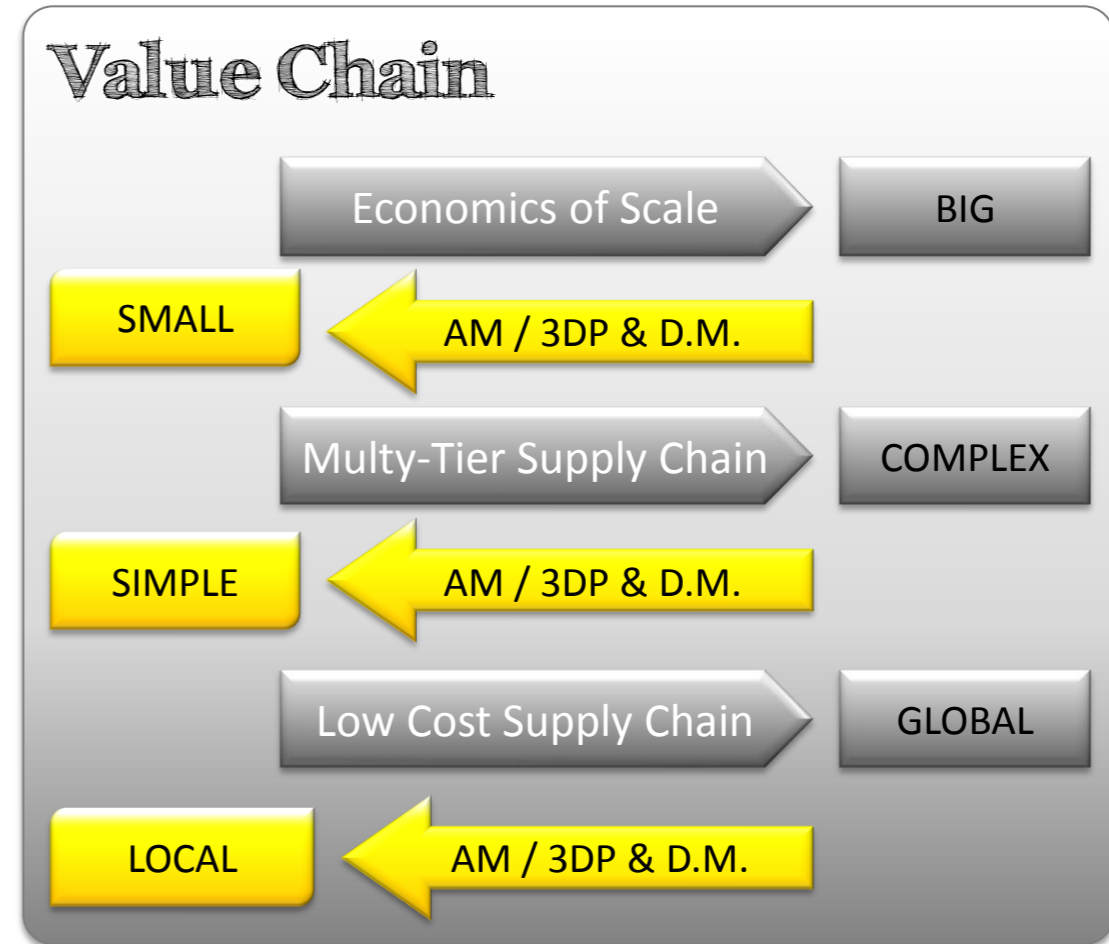
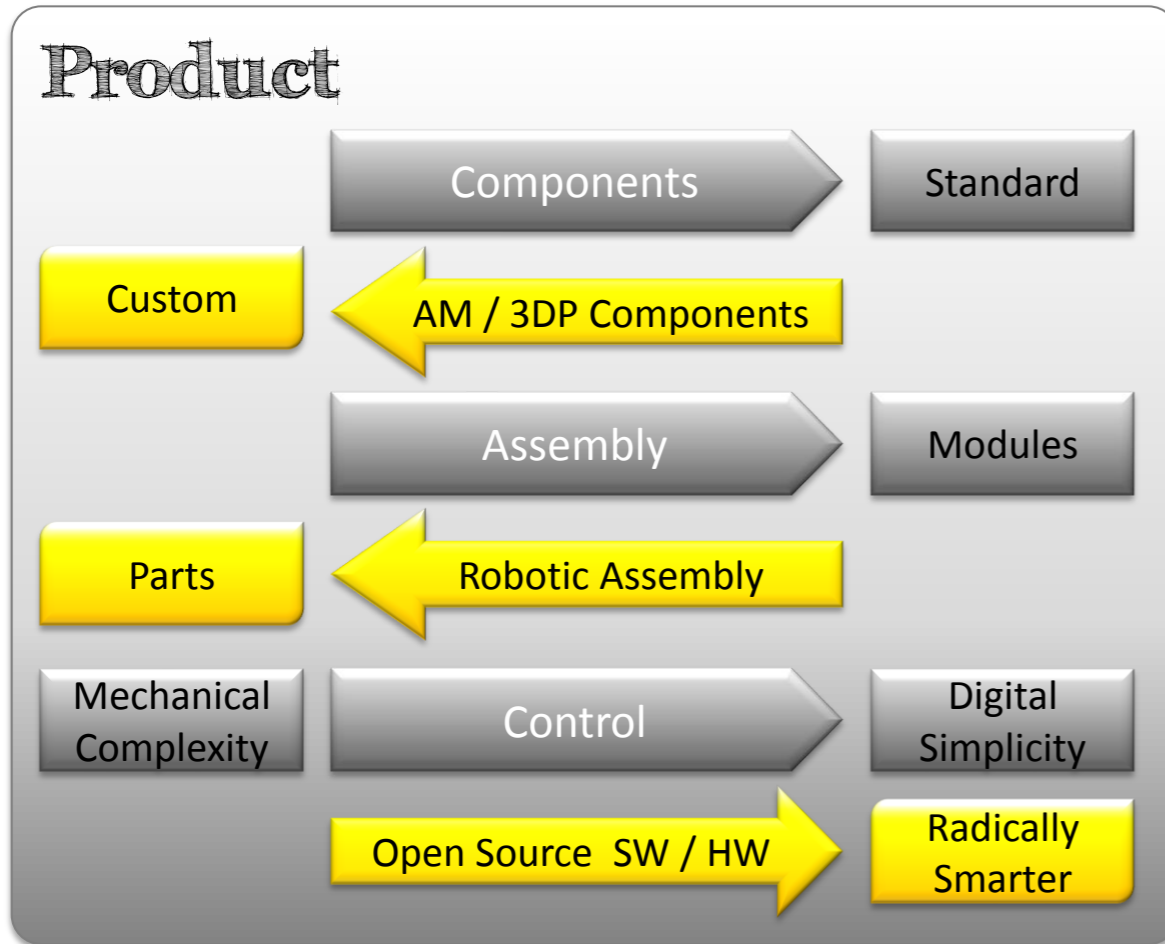


- **Distributed** production, **without tools**. Simultaneously production in several places near the point of consumption.
- It allows **consumers to participate in manufacturing** from online purchased or shared digital data. Manufacturing accessible to everyone.
- **Auto manufacturing** of parts and small components, avoiding much of the industry and the traditional value chain.
- It also **changes how to design**, develop, market and distribute a product.
- **Alternative business models** and new approaches to the supply chain by compressing and shortening it.
- It **defies** control over **IPR** and **standards** on product safety.

Paul Brody et al. The New Software Defined Supply Chain. *Preparing for the disruptive transformation of Electronics design and manufacturing*. The IBM Institute for Business Value . Proceedings of AMI Conference, 2013. Nottingham

05. How will AM/3DP impact to Work and Organizations?

Paul Brody et al. The New Software Defined Supply Chain.



Current Paradigms: Standardization, Modularity and Digital Control

Future Paradigms: Customization, Detailed parts, Radically Smarter

05. How will AM/3DP impact to Work and Organizations?

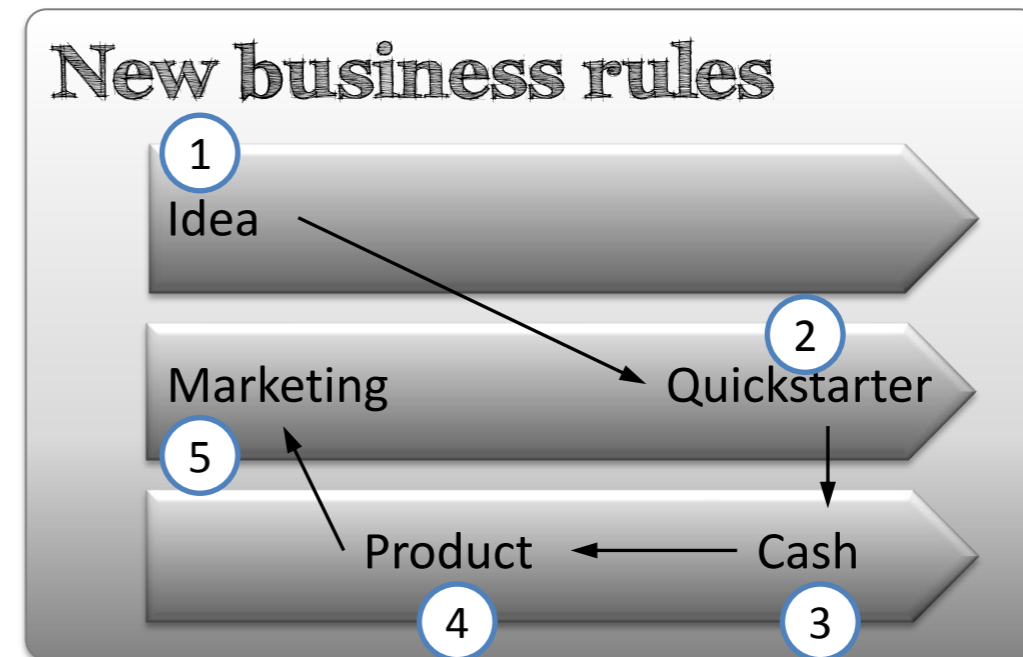
Paul Brody et al. The New Software Defined Supply Chain.



Rewriting the Rules. Changing business model.

These trends not only interact one to each other but with the whole social and digital design ecosystem that is maturing very quickly: Crowd Sourcing Design, Public Cloud Based Design, Apps everywhere ...

The integration of these new technologies and the creation of agile companies will be able to rewrite the sequence of traditional processes "end-to-end" that large companies take for granted.





“REAL world is COMPLEX and we cannot fight the complexity from “black & white” “

Magí Galindo Anguera
magigalindo@leitat.org



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