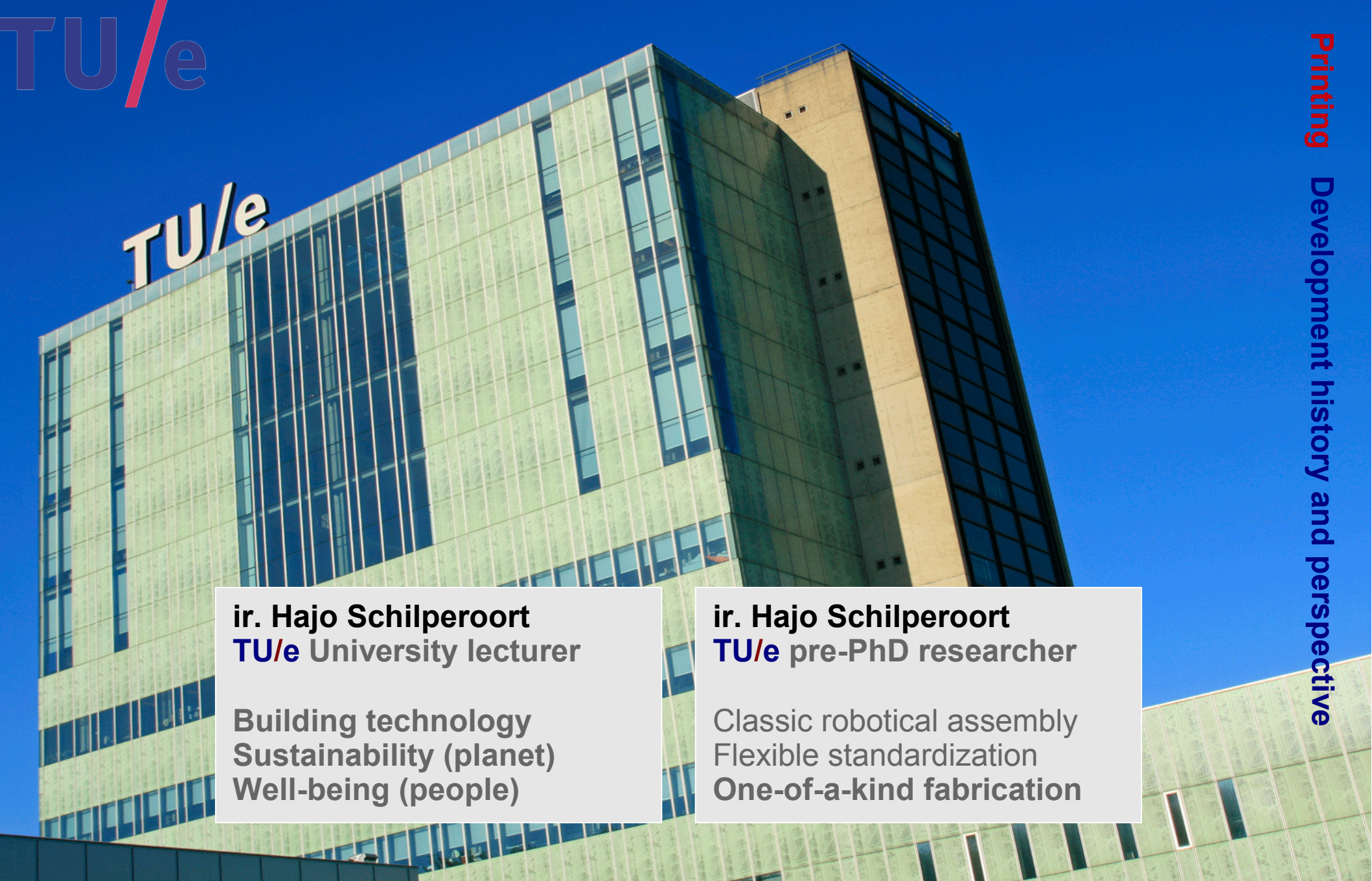
Printing

Development history and perspective



Printing Development history and perspective

ir. Hajo Schilperoort
TU/e University lecturer

Building technology
Sustainability (planet)
Well-being (people)

ir. Hajo Schilperoort
TU/e pre-PhD researcher

Classic robotical assembly
Flexible standardization
One-of-a-kind fabrication

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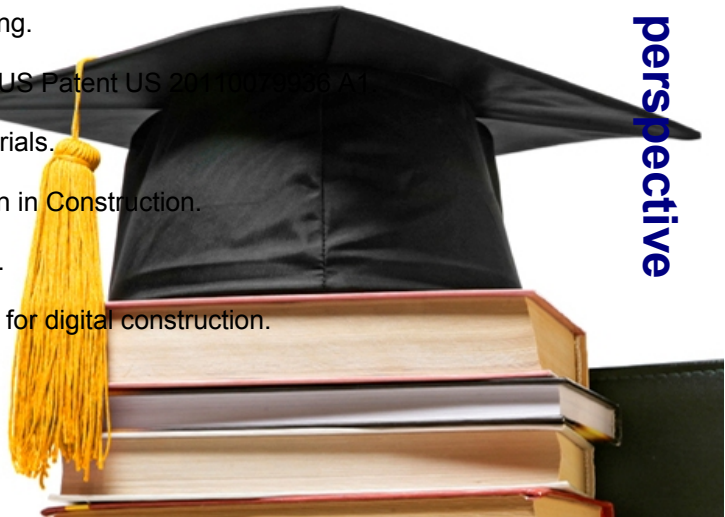


Development history and perspective

First mention of printing in the context of building:

"A thin layer of sand is deposited, followed by the deposition of a patterned layer of cement. Steam is then applied to the layer to obtain rapid curing."

Joseph Pegna, 1997

Pegna, J. (1997). Exploratory Investigation of Solid Freeform Construction. In: Automation in Construction.

Contour Crafting is based on the deposition and smoothening of clay / ceramics in thin layers.

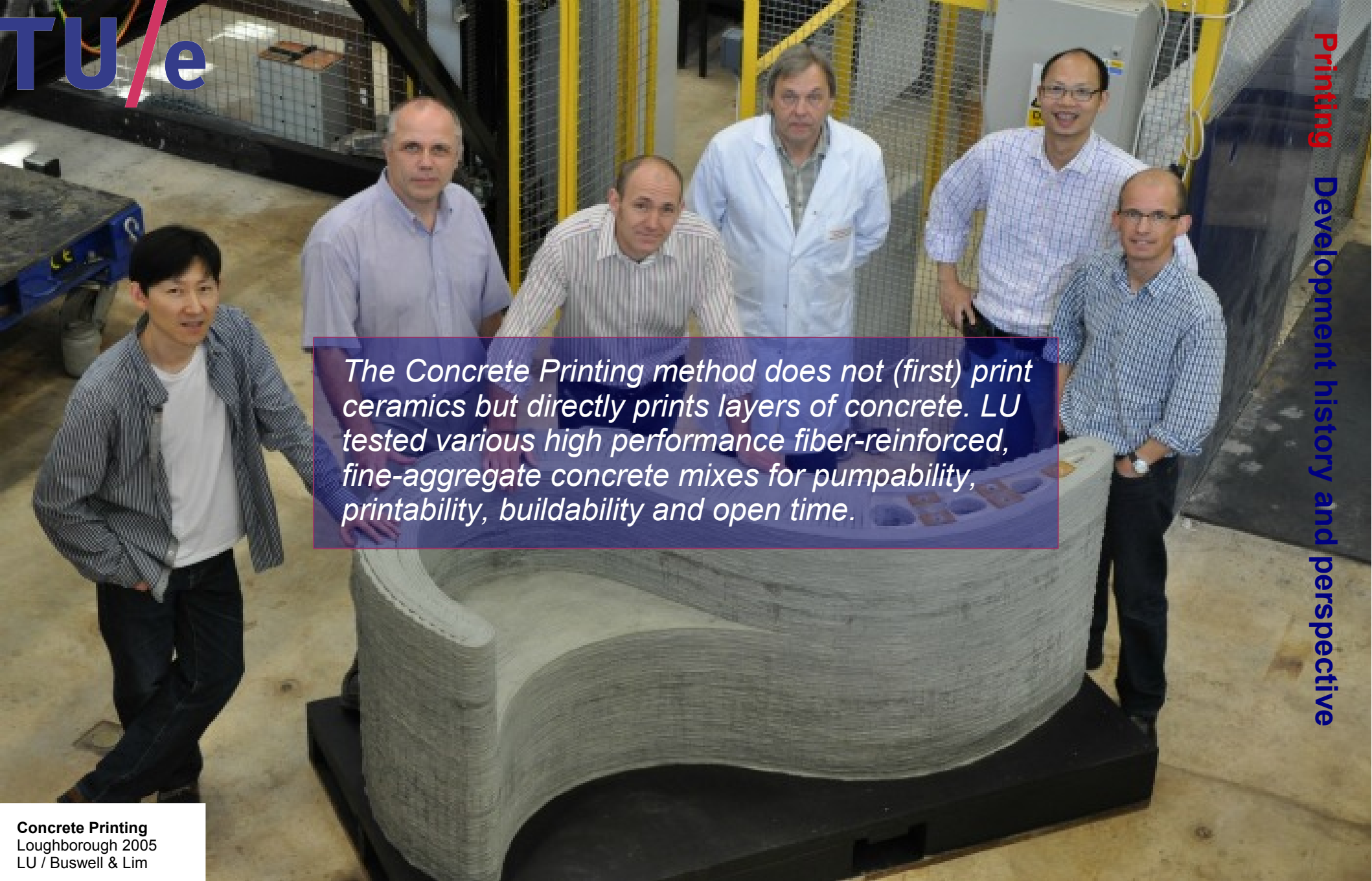
Contour Crafting
Los Angeles 2002
USC / Khoshnevis

This contour can be used for (thin layered) casting.

Contour Crafting
Los Angeles 2002
USC / Khoshnevis

The suggested application on site is so far limited to walls. Foundations, floors and spans, insulated facades and roofs, interior, infrastructure are not included. The method is promoted with promises of "speed" and "efficiency" and sustainability, but for all of these benefits there are superior competitors.

Contour Crafting
Los Angeles 2002
USC / Khoshnevis



The Concrete Printing method does not (first) print ceramics but directly prints layers of concrete. LU tested various high performance fiber-reinforced, fine-aggregate concrete mixes for pumpability, printability, buildability and open time.

Concrete Printing
Loughborough 2005
LU / Buswell & Lim

It has similar limitations as Contour Crafting, but CP set different goals: small free form elements.

Concrete Printing
Loughborough 2005
LU / Buswell & Lim

The Chinese print a mix with added waste material, off-site, in the factory, for transportation.

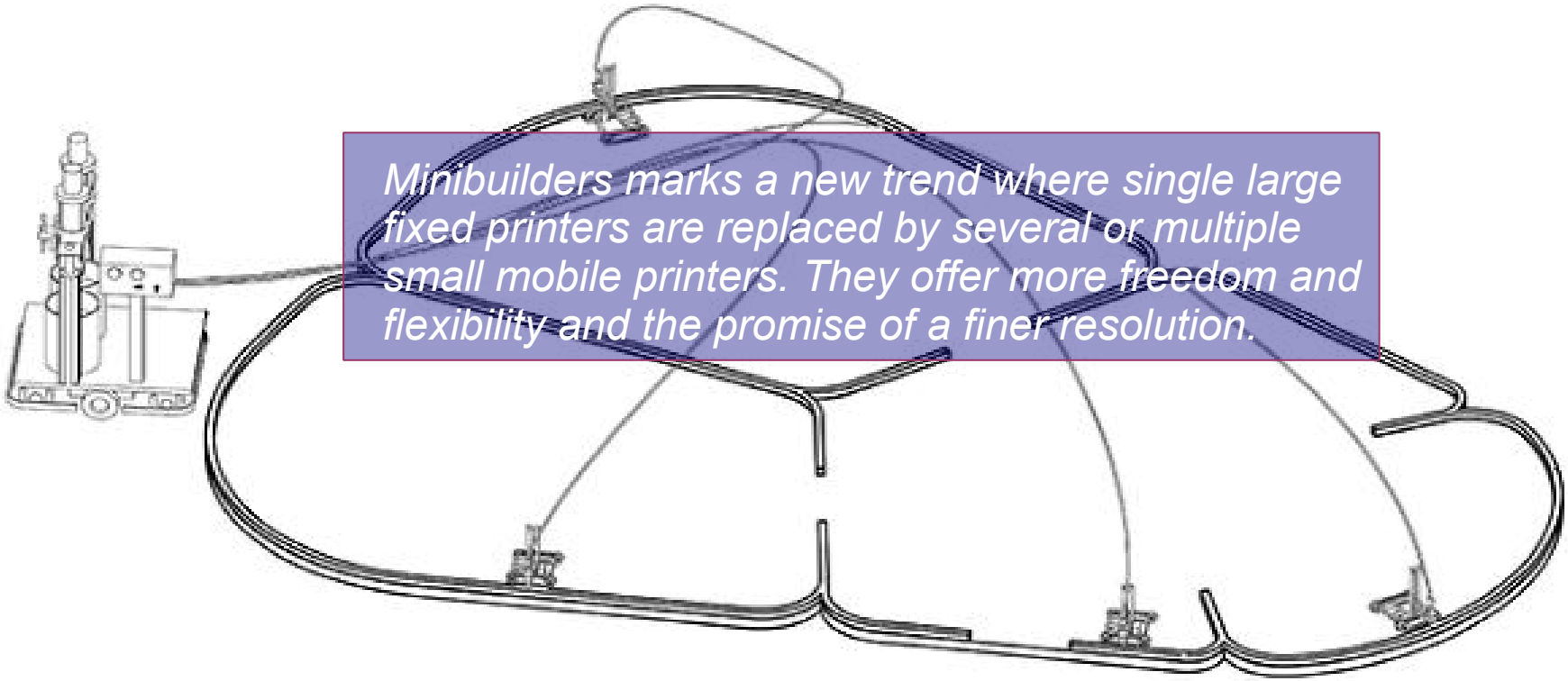
Modular Prefabricated
Shanghai 2014
Winsun DDE

Modular Prefabricated
Shanghai 2014
Winsun DDE

TU/e

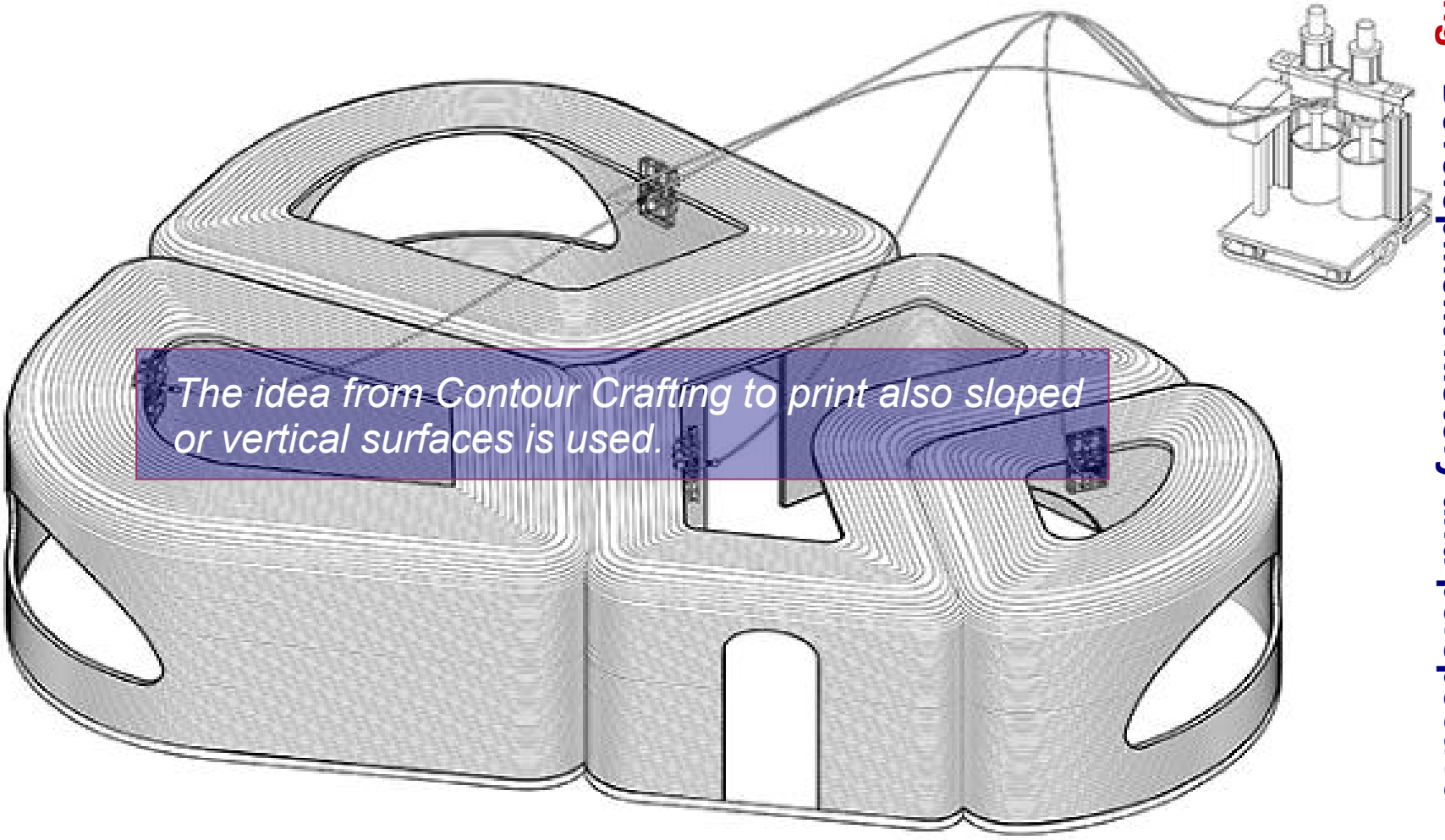
Printing Development history and perspective

Modular Prefabricated
Shanghai 2014
Winsun DDE

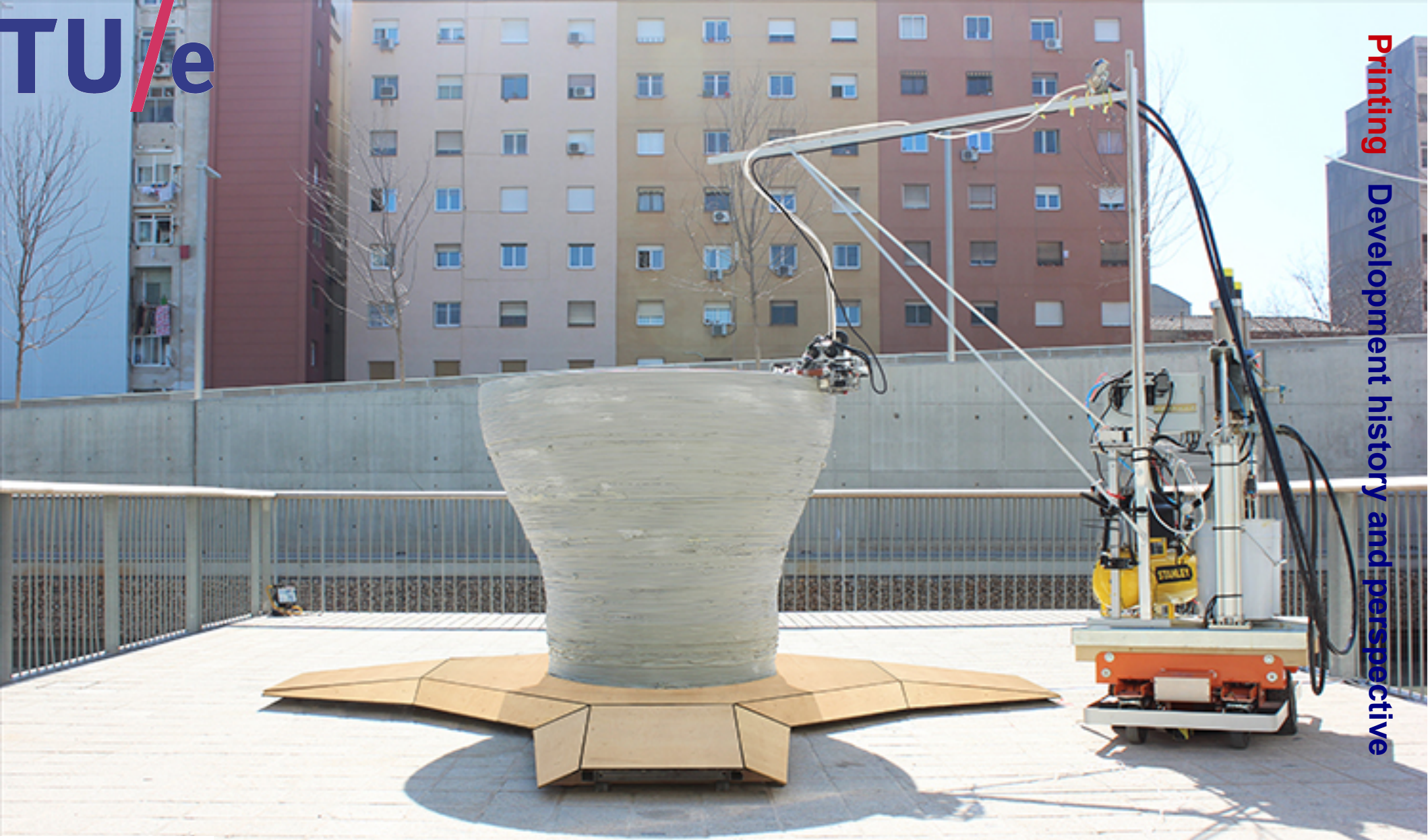


Minibuilders marks a new trend where single large fixed printers are replaced by several or multiple small mobile printers. They offer more freedom and flexibility and the promise of a finer resolution.

Minibuilders
Barcelona 2014
IAAC

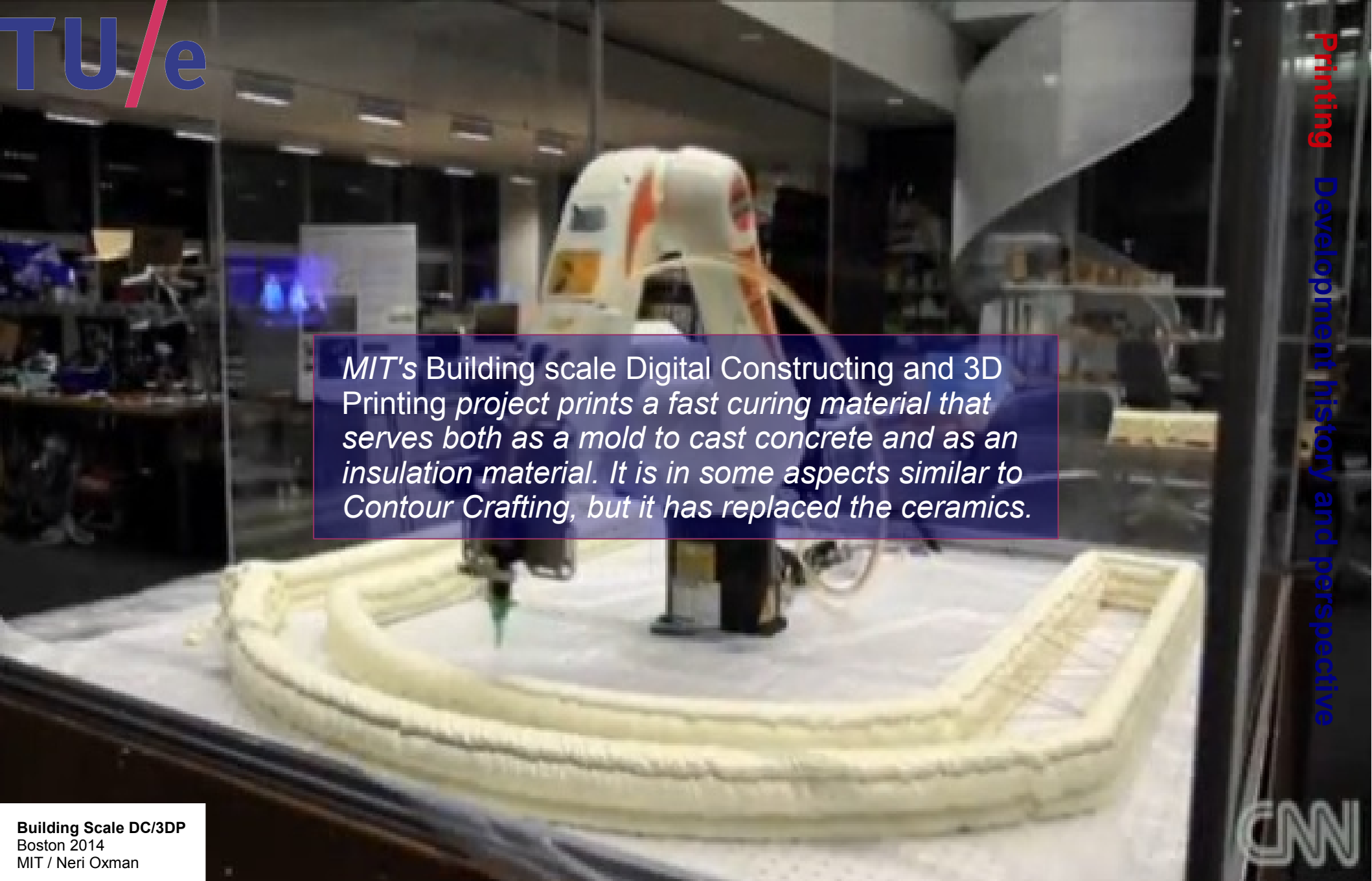


The idea from Contour Crafting to print also sloped or vertical surfaces is used.



Printing Development history and perspective

Minibuilders
Barcelona 2014
IAAC



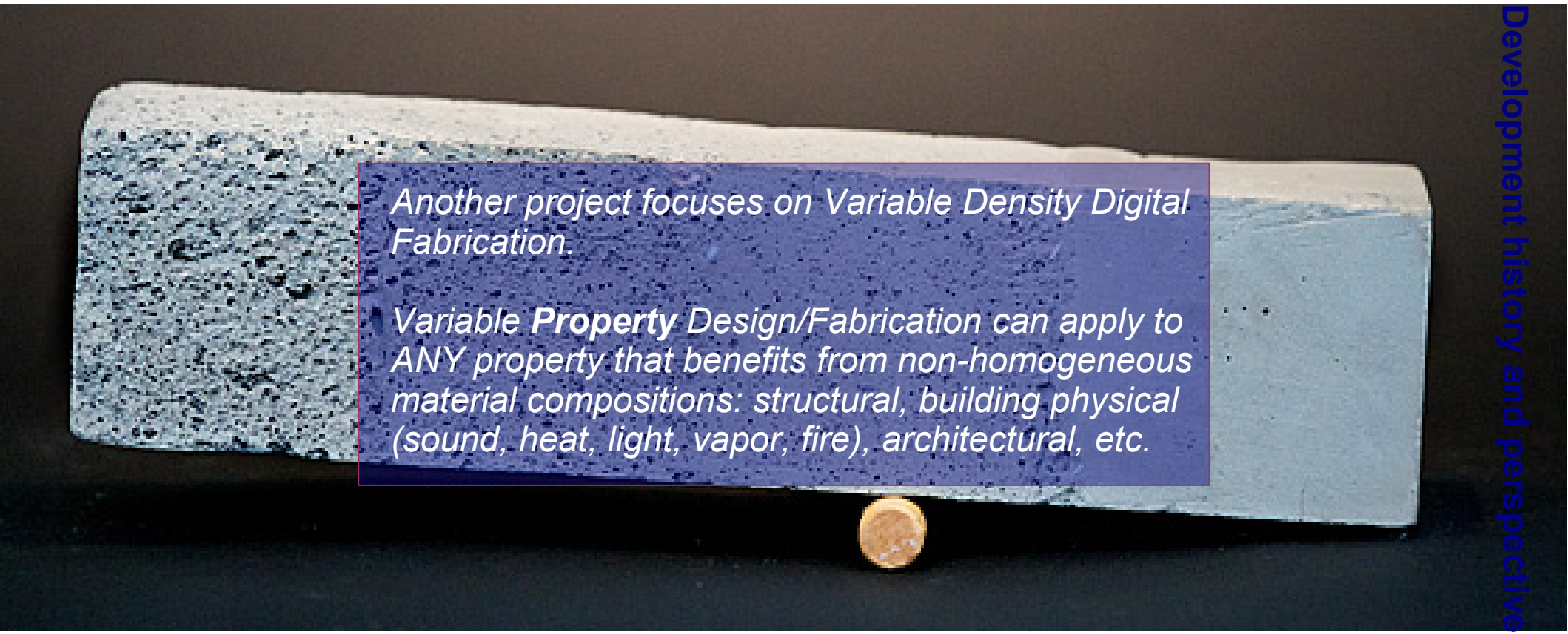
MIT's Building scale Digital Constructing and 3D Printing *project prints a fast curing material that serves both as a mold to cast concrete and as an insulation material. It is in some aspects similar to Contour Crafting, but it has replaced the ceramics.*

Building Scale DC/3DP
Boston 2014
MIT / Neri Oxman

MIT works on materials that are dynamically mixed from components in a fully continuous process of printing. The local mix ratio determines their local properties. The "Monocoque" object on the photo is printed from polymers that are more or less rigid or elastic (Variable Elasticity Digital Fabrication). The polymer shell is tessellated based on FES (Finite Element Synthesis).

Variable Elasticity
Boston 2013
MIT / Neri Oxman

Variable Elasticity
Boston 2013
MIT / Neri Oxman

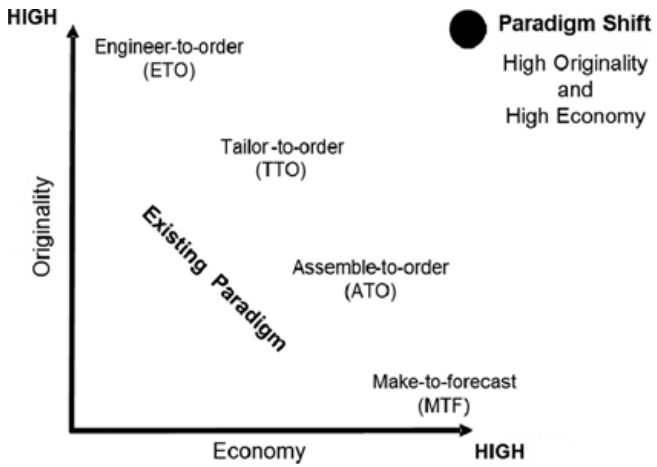


Variable Density
Boston 2013
MIT / Neri Oxman

And then we can also print (at variable resolutions) with multiple materials. These could be:
→ structural materials (with mineral compounds).
→ a temporary support material.
→ thermal and acoustic insulating materials.
→ transparent materials (similar to glass).
→ window/door framing materials.
→ aesthetic and technical finishing materials.
→ conductive and insulating electrical materials.

Various materials
PolyJet
stratasys.com

A printer makes a thousand unique one-of-a-kind products for the same price (money, time, material, energy, effort) as a 1000 copies (Fox, 2012).

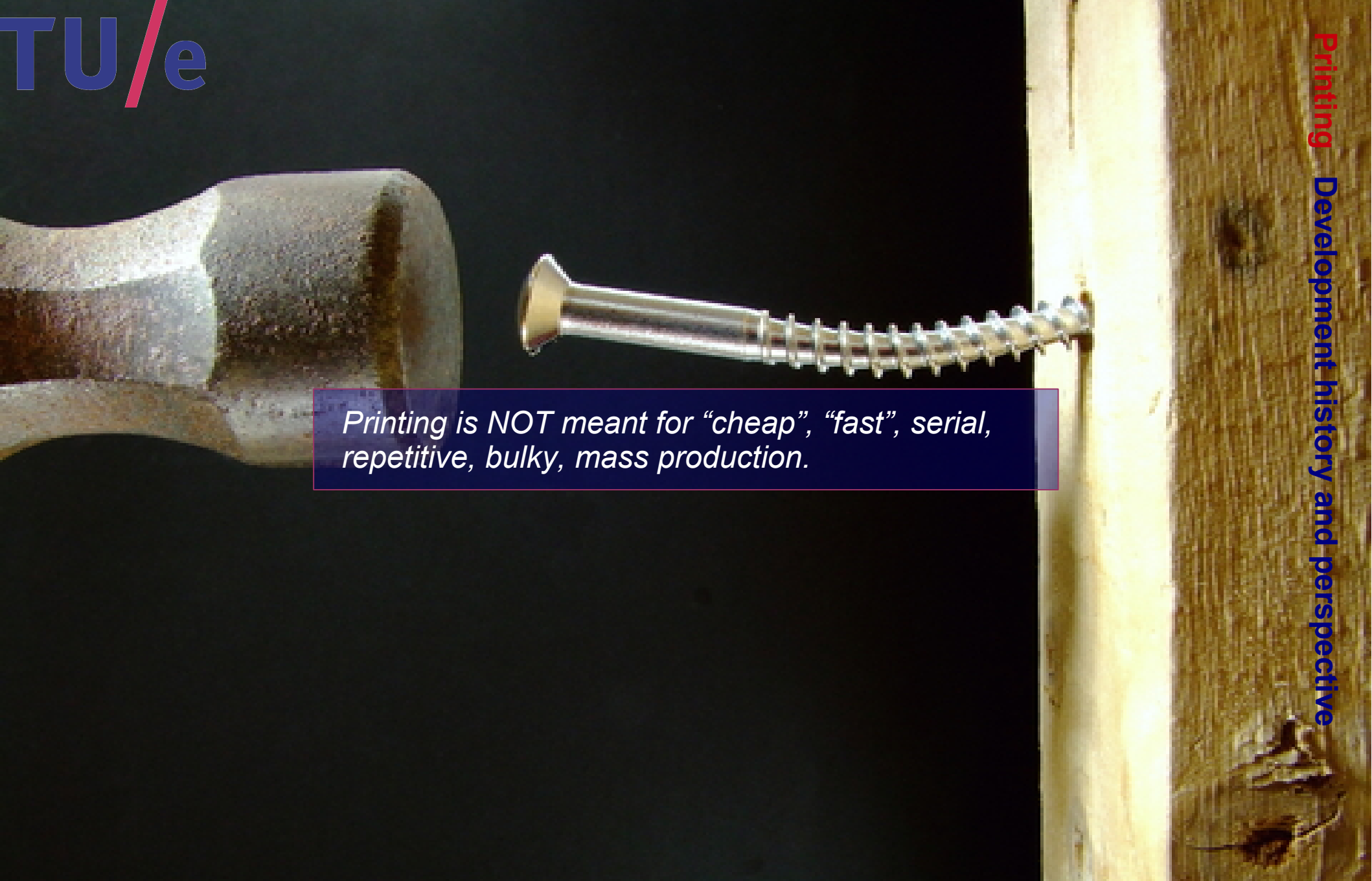


So, the next generation of 3d printing will offer:
→ Several/multiple small, mobile, flexible printers.
→ Variable resolution printing (fast, or fine).
→ Multiple materials (in parallel printing sessions).
→ Mixed materials with variable local properties.
→ Support materials (either as external or internal form-work for casting).

It should be applied to create the unique, the one of a kind, the fully optimized or fully personalized.

It should be used to create the complex, the poetic, the sensual and refined.

It will probably some day be suitable for complex, integral load bearing structures, but it can also be used for assembled facades and interior elements.



Printing is NOT meant for “cheap”, “fast”, serial, repetitive, bulky, mass production.