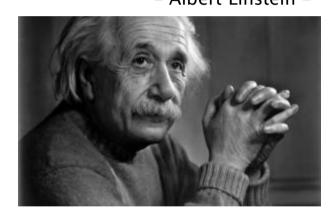


## Agenda

Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning.

- Albert Einstein -



- Introduction
- Drivers
- Examples



#### "Increase the competitiveness of companies of the technological sectors through technological innovations"





















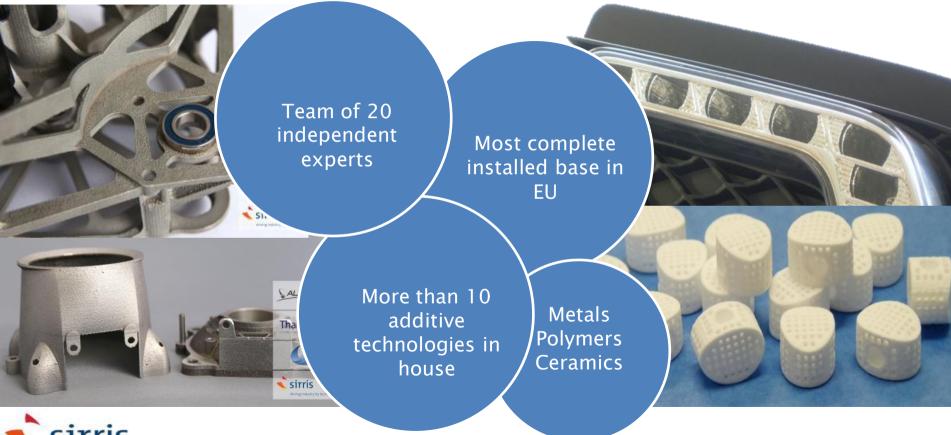




- 140 experts
- 8 locations
- 24 M€ revenue



## Sirris | 25+ years of Additive Manufacturing



#### DEFINITION ADDITIVE MANUFACTURING

- Layer by layer
- Functional end products with excellent mechanical properties
- Starting from a 3D CAD model



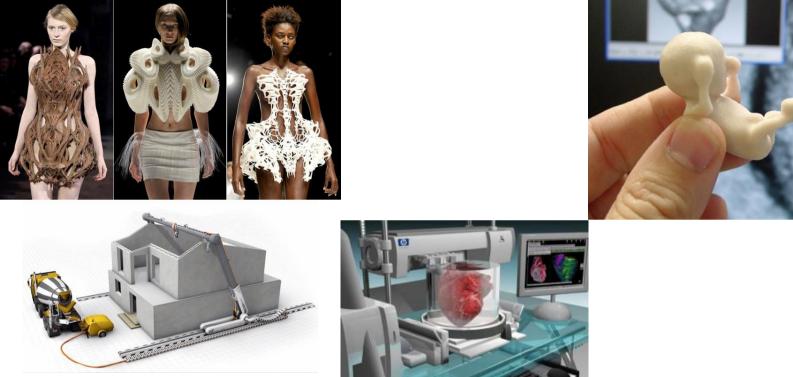
- Freeform complexity for free Few design restrictions
- No moulds, no tooling
   Down to series of 1
- Near net shape Sustainable

- Metals
- Polymers
- Ceramic

© Materialise

- Rapid Prototyping
- Rapid Manufacturing
- Direct Digital Manufacturing
- 3D Printing
- Additive Manufacturing
- AM





























direct

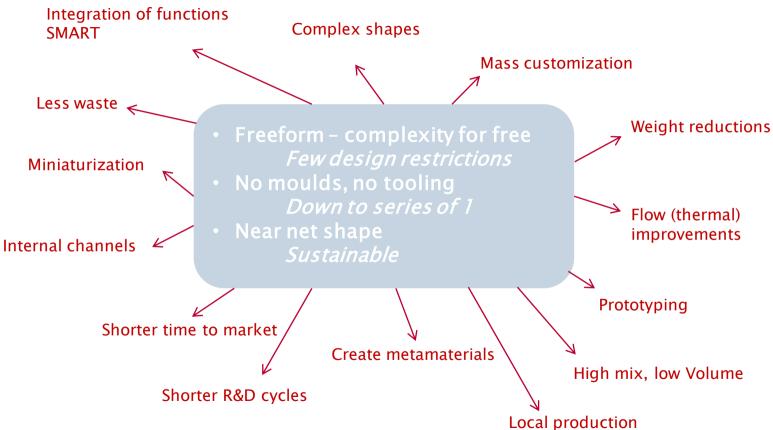
© WITHINLABS<







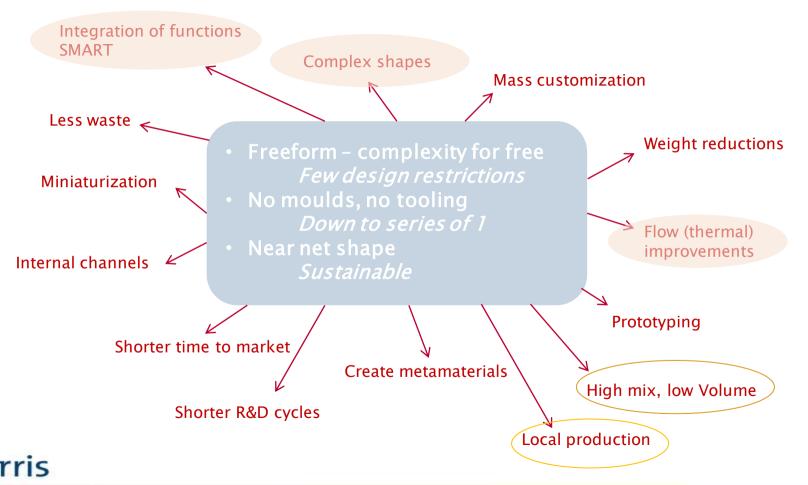
#### **Drivers**





12

#### **Drivers**



#### 3 Product DRIVERS



**Complex shapes** – unique shaped parts



**Thermal** optimalization



integration of **functions** 



#### DRIVERS FOR ADDITIVE MANUFACTURING

# Complex shapes/ unique shaped parts



"What If" we can have more design freedom, to create unique luminaires ...



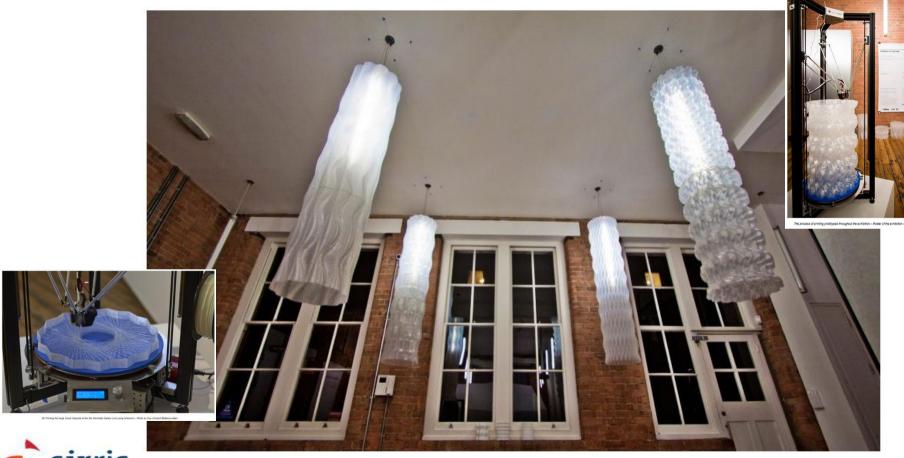
# Cloud capsule by Mamou-Mani





Cloud Capsule by Mamou-Mani - Diagram showing the variations of density from the parametric model - Designing the toolpath not its representation using Silkworm @Mamou-Mani

# Cloud capsule by Mamou-Mani



# Dirk Vander Kooij

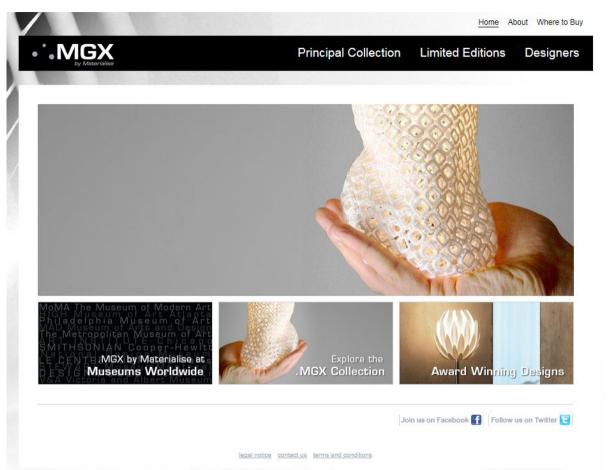






I saw a couple beautiful pieces by Amsterdam designer <u>Dirk Vander Kooii</u> at the design shop of the <u>W Hotel Amsterdam</u>.

# MGX by Materialise





19

# MGX by Materialise





CLOSE X



DETAIL.MGX PENDANT SMALL by Dan Yeffet

Image 2 of 2

**CLOSE**X



OMI.MGX PENDANT by Assa Ashuach Image 2 of 2

CLOSE X

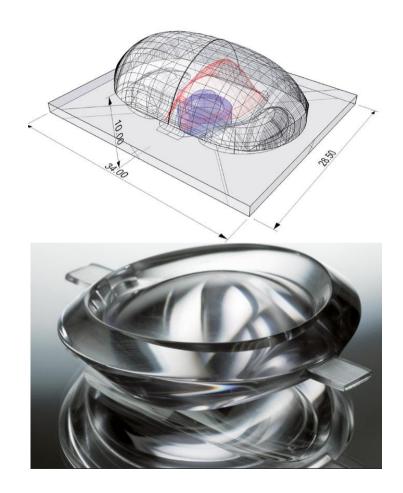


#### **LUXeXceL**

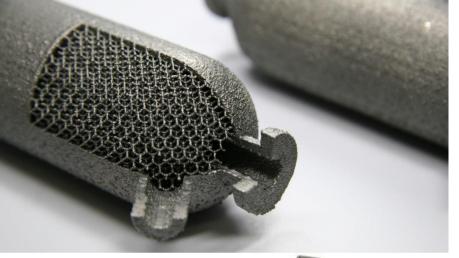


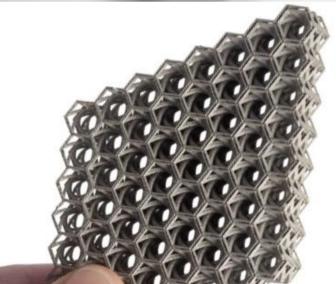
Creating a lighting luminaire for parking garages















## DRIVERS FOR ADDITIVE MANUFACTURING

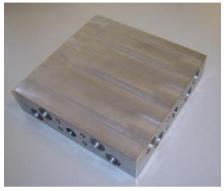
#### Flow (Thermal) optimization

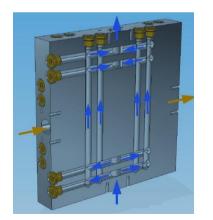


"What If" we can create complex integrated heatsinks inside our products

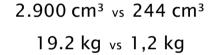


# Example Heat exchanger





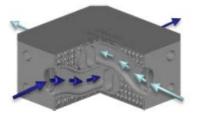




Pressure drop 90% reduced









## Oil cooler



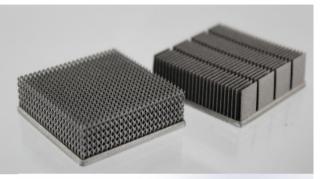


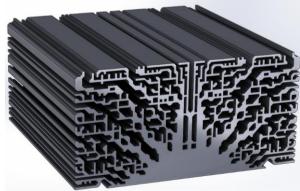
- ➤ Niche automotive application
- ➤ Increased outer surface
- ➤Internal disruptors
- ➤ Modular build up

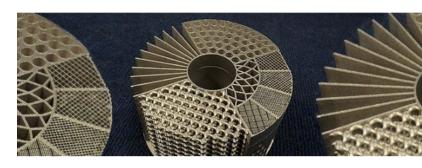


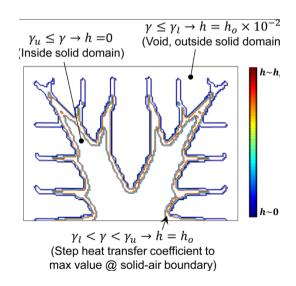


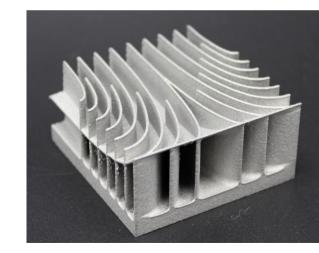
# Thermal topology optimization















## DRIVERS FOR ADDITIVE MANUFACTURING

## Integration of functions



"What If" we can add multiple functionalities in one part

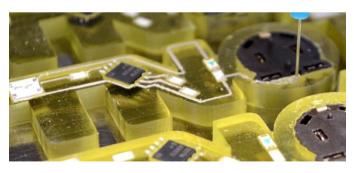




# Embedded / Structural electronics @ TNO EfAM: combining electronics with Additive Manufacturing

#### What?

- Integrated electronics, sensors, lighting
- lightweight structures
- Conductive and isolating materials



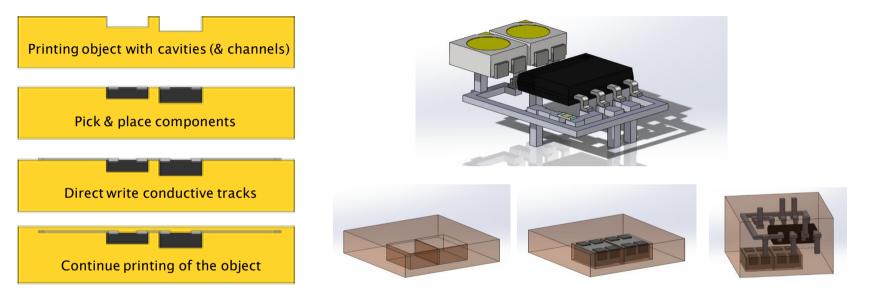
#### WHY?

- Affordable small series, customization
- Increased functionality, smart products, IoT
- Reduced manufacturing complexity
- Fast time to market
- Rugged and waterproof
- Reduced weight, space
- Difficult to reverse-engineer
- Thermal management integration
- ....



#### **PRINCIPLE**





"The fabrication freedom offered by 3D printing techniques, such as stereolithography and fused deposition modeling have recently been explored in the context of 3D electronics integration referred to as **3D structural electronics** or 3D printed electronics"

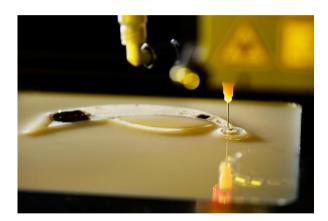
Eric MacDonald et al, "3D printing for the rapid prototyping of structural electronics", IEEE Access, Volume 2, 234-242, March 2014

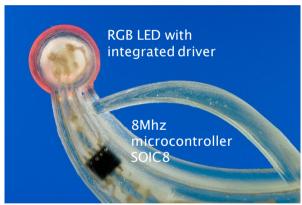


#### Demonstrator: µP controlled LED lamp







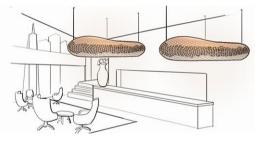




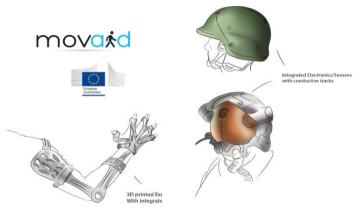
Info: rajesh.mandamparambil@tno.nl

#### **Application areas**

- integrated lighting
- medical patches
- smart connectivity
- exoskeletons
- helmets
- antenna's / waveguides
- microfluidic systems
- personalized shoes/sole
- spare parts
- grippers
- . . . . .











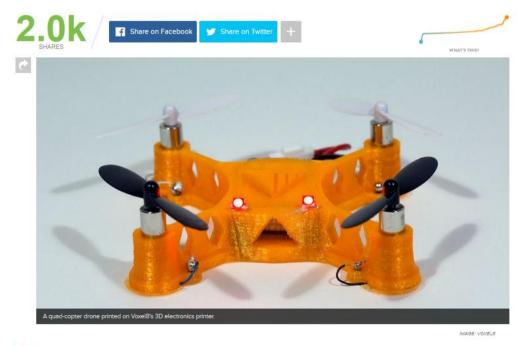
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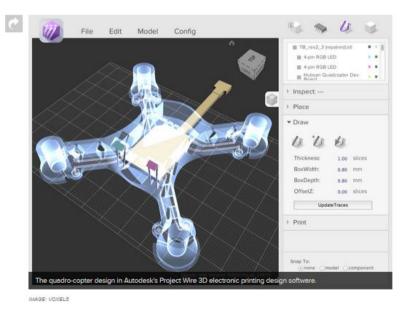




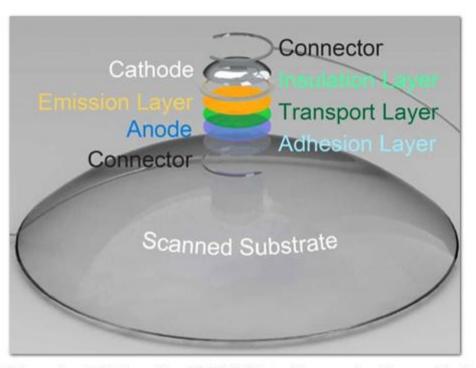
rajesh.mandamparambil@tno.nl

# 3D printing created this drone, complete with circuitry





#### Fully 3D-printed quantum dot LEDs



3D printed quantum dot light-emitting diode (QLED) on a 3D scanned curvilinear substrate. This CAD model shows the QD-LED components and conformal integration onto the curvilinear substrate. (Reprinted with permission by American Chemical Society)



deixine industry by technology

#### Can AM be used for production purposes in the lighting industry?





Integrated electronics (SMART) 🖍

What has been done up to now?





#### The use of AM in Industrial Enterprises (PricewaterhouseCoopers 2016)

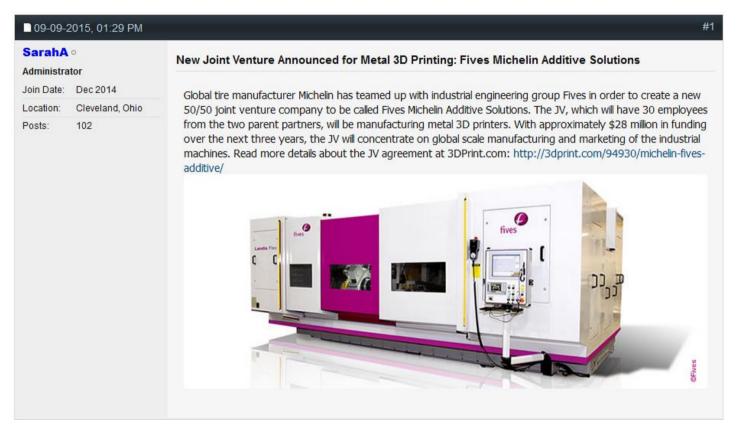
- There are more enterprises who use AM technology to "make" things than (only) for "trails and prototyping" raise up to **51%** compared to 35% in 2014
- Expectations in mass production: **52%** of the industrial enterprises is convinced that mass production will be possible in the coming 3 to 5 years compared to 38% in 2014.
- Main reasons for not using AM in production processes: 42% of the enterprises claims that the cost for the machines is to high and the lack of expertise in this domain. Other brakes are the uncertainty about the quality of the printed parts (33.1%) and the speed of the machines (25.6%).



## Challenges

- Certification/validation → process monitoring
- Adoption of AM in the industry including lighting: demonstrator cases, reference projects (collaboration intention between TNO and Sirris, possible Interreg VL-NL project)
- Cost → industrialization







https://www.youtube.com/watch?v=0V9d3M-qQ7k





#### **Industry News**

Stratasys Partners with Siemens to Integrate 3D Printing into Mass Production

Published on 2016-11-28. Author: SpecialChem

FRANKFURT -- Stratasys Ltd. and Siemens have recently announced a formal partnership to integrate Siemens' Digital Factory solutions with Stratasys' additive manufacturing (3d printing) solutions.

#### Stratasys\Siemens Partnership Objectives:

- Partnership complements recent announcements of new Stratasys and Siemens' solutions for additive manufacturing
- Aims to strengthen and expand the benefits of 3D printing in manufacturing value chain
- Aerospace, automotive and tooling industries expected to benefit first

Stratasys/Seimens Partnership



#### **Industry News**

#### BASF Accelerates 3D Printing Materials Development with HP

Published on 2016-11-09. Author: SpecialChem

BASF has teamed up with HP to offer new 3D printing materials to customers through the HP Multi Jet Fusion Open Platform. The HP Open Platform approach allows customers to select a material supplier, such as BASF, and engage with them directly to develop materials for specific 3D production applications.

#### BASF/HP Collaboration

- Accelerating development of materials for HP Multi Jet Fusion technology
- Based on the unparalleled portfolio BASF develops new materials for the 3D printing market







#### Lessons learned

## 1 RESPONSIBLE for AM

 Task = find out what AM can bring to company. Involves colleagues where needed and gets official support.

## DO IT

- Make a (re)design of a component, together with an experienced party
- Low hanging fruit can be found in your production facility
- Result
  - Get familiar with the technology
  - Get confidence in the technology
  - Get your peers involved



#### **NEED HELP?**

## WANT TO GET STARTED?

## **GET IN TOUCH!**

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