

LayerWise

Let *Additive Manufacturing* Inspire You

3D printing

Manufacturing cyclus OMC: Thema 1 - World Class productiemiddelen
Peter Mercelis, PhD - 2013/09/19

- Inleiding en voorstelling LW
- Basisprincipes 3D printing
- 3D printing: nieuwste hype of industriële revolutie?
- Introductie van nieuwe technologie in bestaande markten/producten
- Ontwikkeling van nieuwe markten / producten



- Incorporated in 2008 as spin-off from university of Leuven
 - K.U.Leuven prof. Jean-Pierre Kruth
- Focus on metal AM only
- Unique technological expertise in metal AM since 2001
 - Phd Jonas Van Vaerenbergh
 - Phd Peter Mercelis
 - 12 years experience with AM titanium
- Developing AM technology *and* applications together with our customers

LayerWise markets



Medical



Dental



Aerospace



Industrial



standard implants
customized implants
medical instruments



dental prostheses
implant supported
and cemented



aviation
space



chemical
pharma
pressure & gas
precision mechanics

semicon
tooling
food
electronics
imaging

ISO 9001 and ISO 13485 certified

2001

2008

2009

2010

2011

2012

2013

- 100% prototyping
- 4 materials
- 90 x 90 x 90 mm
- worldwide first 3D printing of Titanium

- 90% serial production
- 17 materials
- 280 x 280 x 440 mm
- largest metal 3D printing company in EU

technology development & production

Benelux

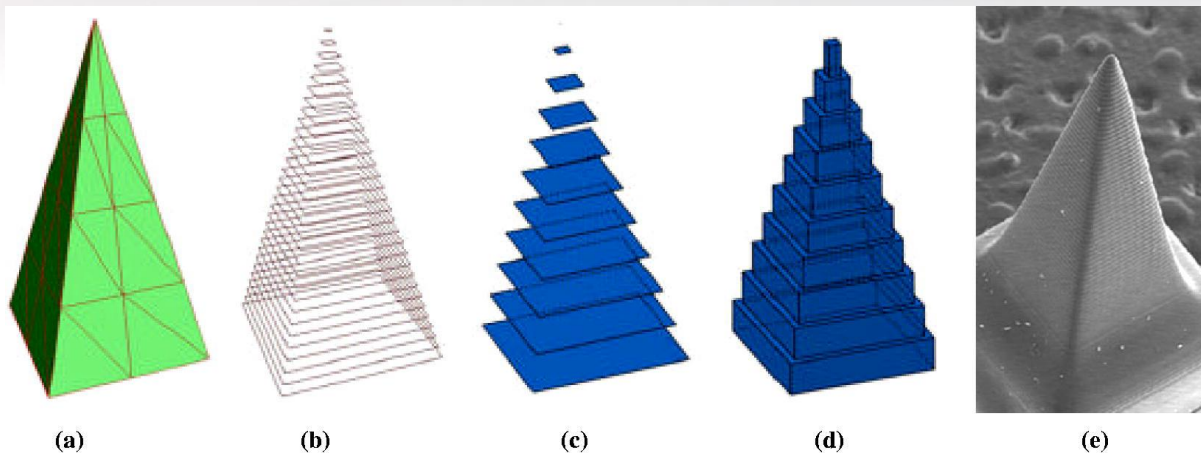
Germany

USA

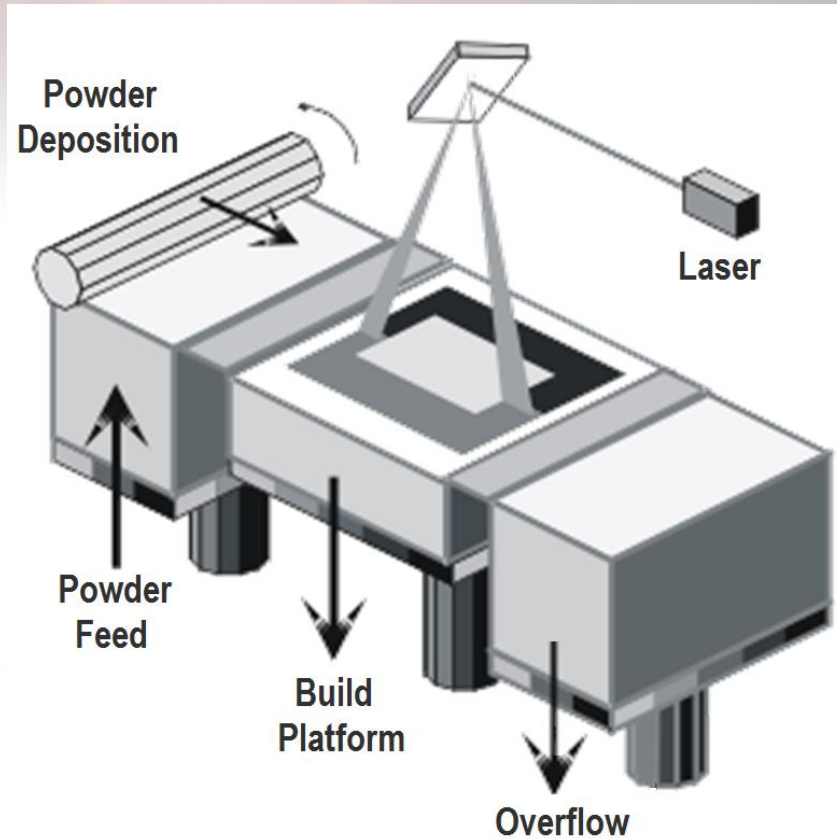
ISO 9001 – ISO 13485 Quality Certified

Technology basics

- Basic principle; 3D object is manufactured as a stack of 2D layers that are interconnected



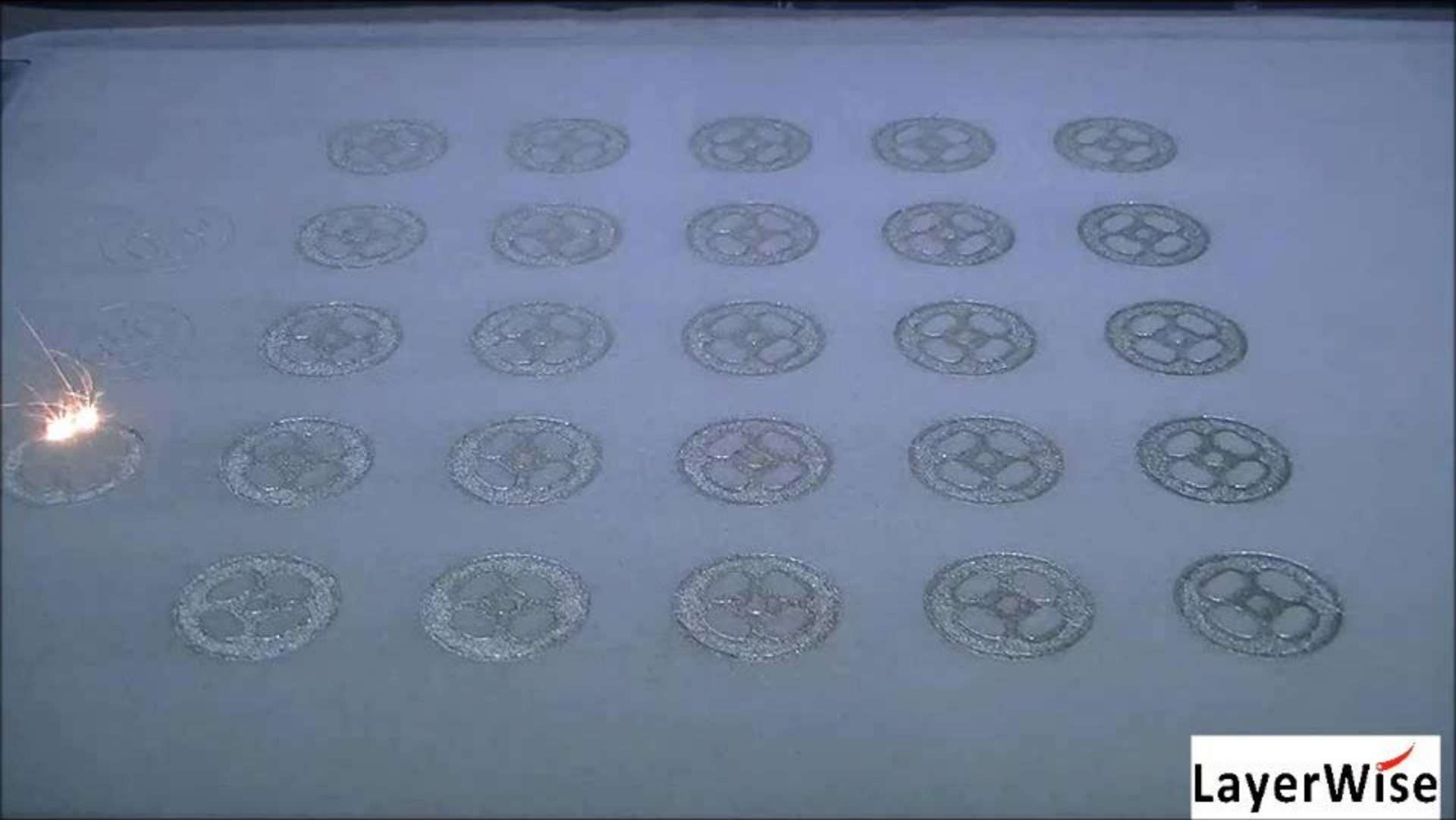
Technology basics



- Directly from 3D CAD
- **Layer-wise** production
- 3D components by successive connection of thin 2D layers







Hype or industrial revolution?

- 3D printing is not new!
 - industrial polymer-based technologies: °1986!
 - Indirect metal technologies: late 90's
 - Direct metal technologies since: since 2000
 - Change in terminology:
 - *Rapid Prototyping*
 - *Rapid Manufacturing / Rapid Tooling*
 - *Additive Manufacturing*
 - *3D Printing*

Hype or industrial revolution?

- Media hype driven by consumer-applications of 3DP
- Home use 3D printers
 - Available for low prices (< 1000 €)
 - Low entry barrier
- Online 3D printing services
 - Shapeways, iMaterialise, etc.



(source: De Bijenkorf)

Consumer applications of 3DP

- Architectural models



- Jewellery



Consumer applications of 3DP

- Design



(source: Materialise NV)



(source: 3D systems)

Consumer applications of 3DP

■ Fashion



(source: Materialise NV)

Consumer applications of 3DP

- Online 3D printing websites give everyone access to 3DP technology

The screenshot shows the i.materialise website interface. At the top, there is a navigation bar with a shopping cart icon, 'Empty cart', 'Login', and 'Sign up'. Below this is the i.materialise logo and a menu with 'Home', 'Creation corner', '3D print lab', 'Materials', 'Gallery', 'About us', 'Blog', and 'Forum'. The main content area is titled '3D print lab' and includes a breadcrumb 'Home > 3D print lab'. The central part of the page features a large blue button that says 'UPLOAD YOUR 3D MODEL' with an upward arrow. Above this button is a question: 'Did you create your 3D model in mm or inch?' with radio buttons for 'mm' (selected) and 'inch'. To the right of the upload area is a 'Material' selection panel with various material thumbnails and icons for 'Price', 'Strength', and 'Detail'. Below the material panel is a 'Polyamide' section with a 'MORE INFO' button and a 'COMPARE MATERIALS' button. At the bottom of the page, there are four columns: 'Color' with a color palette and 'Natural white' text; 'Scale' with a slider and input fields for '0.00 x 0.00 x 0.00 mm'; 'Quantity' with a spinner set to '1'; and 'Price' with '€ --' and an 'ADD TO CART' button.

Risks of the current 3DP hype

- Current media hype on 3DP created unrealistic expectations!
 - Organ printing possible in the near future ...
 - Everyone should have a 3D Printer @ home ...
 - Everything can be 3D printed ...
 - 3D printing is cheap ...

Risks of the current 3DP hype

- Importance of realistic expectations!
 - 3DP is NOT a cheap manufacturing technology
 - Traditional manufacturing will not disappear!
 - 3DP often needs to be combined with traditional manufacturing methods
 - Traditional machining techniques generally have higher accuracy than 3DP
 - Limited number of materials possible
 - Size limitations limit the application field
 - Printing of living tissue is still in its infancy!

Hype or industrial revolution?

- The hyped technology has the potential to initiate an industrial revolution though
 - Digital manufacturing without tooling
 - Nearly unlimited shape complexity;
 - Anatomical shapes
 - Weight reduction
 - Cooling/heating channels
 - Transportation channels
 - Eliminating assembly work

New technology for existing market/product

- Essence: the new technology should **add value** to the product/service compared with the traditional technology
- Added value: product/service definition
 - Increased functionality = technical improvement
 - Improved appearance = esthetic improvement
 - Reduced drawbacks!
 - Ergonomics
 - Safety
 - Complexity
 - Reliability
 - Maintenance
 - ...

New technology for existing market/product

- Your technology should increase added value
 - of your **direct** customer
 - of the **end** customer only = more difficult
 - of your **direct** customer **and** the **end** customer = easiest + synergetic

New technology for existing market/product

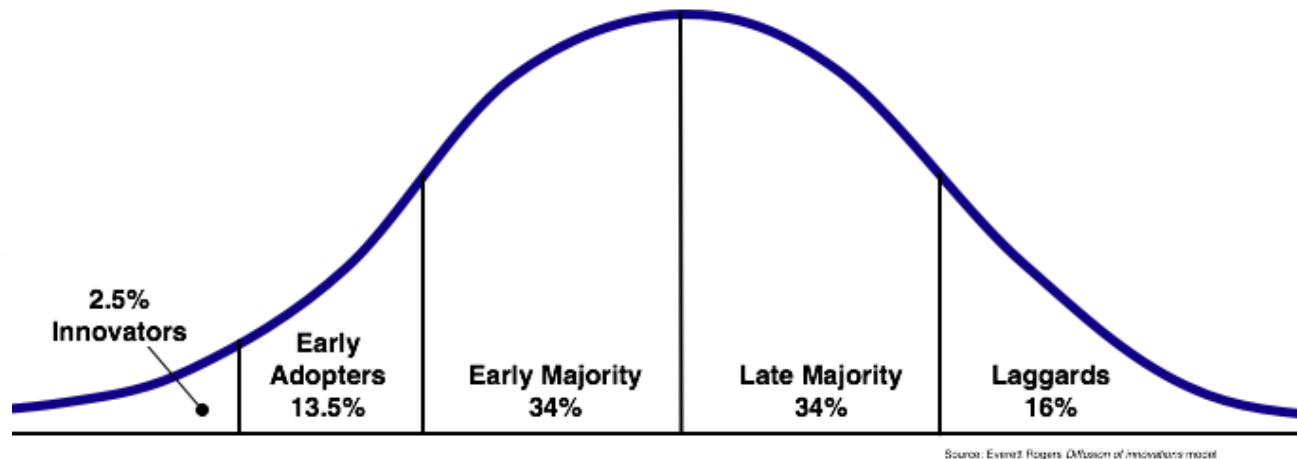
- Regulation;
 - Existing products or markets are often regulated by government or by industry
 - Examples:
 - Medical implants standards (ISO / ASTM / FDA ...)
 - E.g. ASTM F2068 - 09 Standard Specification for Femoral Prostheses—Metallic Implants
 - Quality management systems (Medical / Aerospace ...)
 - E.g. ISO 13485
 - Technology standards;
 - E.g. ASTM F1472 - 08e1 Standard Specification for Wrought Titanium-6Aluminum-4Vanadium Alloy for Surgical Implant Applications (UNS R56400)
 - Often no standards exist yet for a new technology in an existing market/ product category!

New technology for existing market/product

- LW's approach;
 - Fulfill existing regulations that lie close to your new technology field and that your customers are familiar with
 - LW uses 'conventional' material compositions
 - LW's titanium material performance fulfills the requirements of E.g. ASTM F1472 - 08e1 Standard Specification for Wrought Titanium-6Aluminum-4Vanadium Alloy for Surgical Implant Applications (UNS R56400)
 - Proactively follow and cooperate in standard development (ISO / ATSM)

New technology for existing market/product

- Innovative technology can be a trigger to convince innovators!
 - But; this is a short term effect, in the end the it is the added value that counts to convince the early adopters and the majority



New technology for existing market/product

- Strategy; try to become a chameleon after convincing the innovators
 - Most customers are not interested in technology, but simply want added value in their products or services
 - Risk aversion of most (large) companies demands full compliance to their existing technologies, habits, existing standards and personal opinions ...



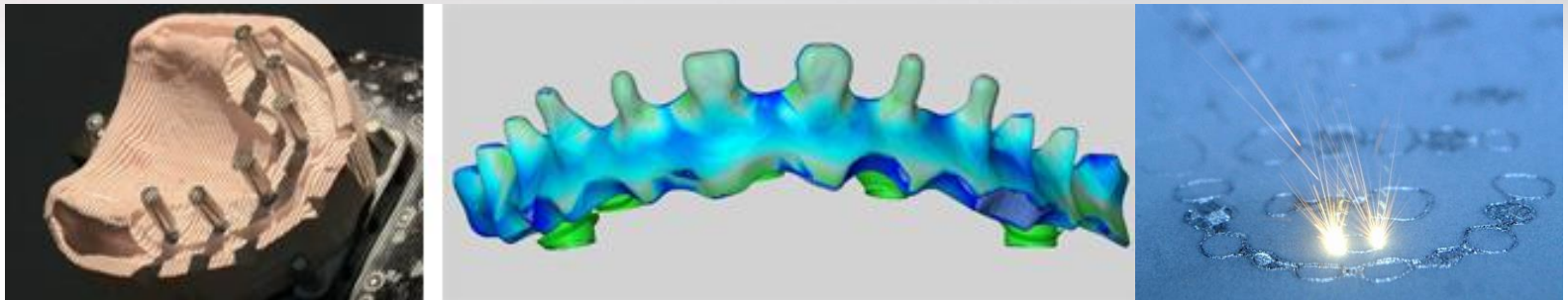
New technology for existing market/product

- Illustration; dental prosthetics
 - Traditional technology:
 - Analog imprints
 - Wax modeling
 - Casting technique
 - Labor intensive
 - Inaccurate
 - Recent technologies:
 - Digital prosthesis design
 - Digital prosthesis manufacturing;
 - CNC milling
 - **3D printing / Additive Manufacturing**



New technology for existing market/product

- Dental prostheses @ DentWise
 - Digitalisation of the design and manufacturing process



Patented technology by LayerWise

- Digital scanning at dentist practise is the logical next step



Medical applications of AM

- Illustrations of dental applications of 3DP



New technology for existing market/product

- Added value; higher strength improved fixation, improved esthetics in final prosthesis, short lead time



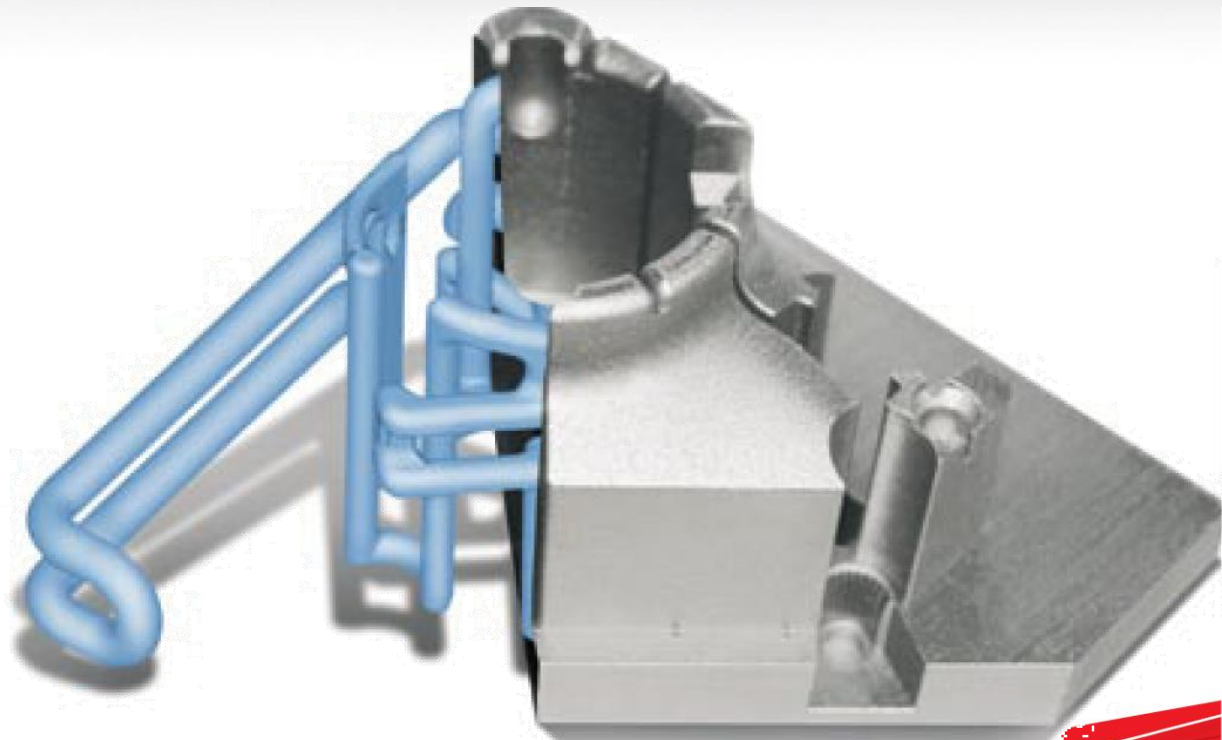
Patented technology by LayerWise

New technology for existing market/product

- Added value for dental lab
 - Reduced cost of prosthetic framework
 - Easier finishing of dental prosthesis
 - Removal of 'dirty' casting area from the lab!
- Added value for end client (dentist / patient)
 - Faster throughput
 - Higher strength of prosthesis
 - Improved esthetics of prosthesis
 - Reduced cost of prosthesis

New technology for existing market/product

- Use of internal cooling channels in tooling applications



New technology for existing market/product

- Added value:
 - Shorter cycle times
 - Improved quality of injection molded products at these cycle times
- However; LW is not successful in the tooling market
- Main reason; added value does not lie with our direct customer, the toolmaker! Added value lies with his customer, the injection molding company

New product development

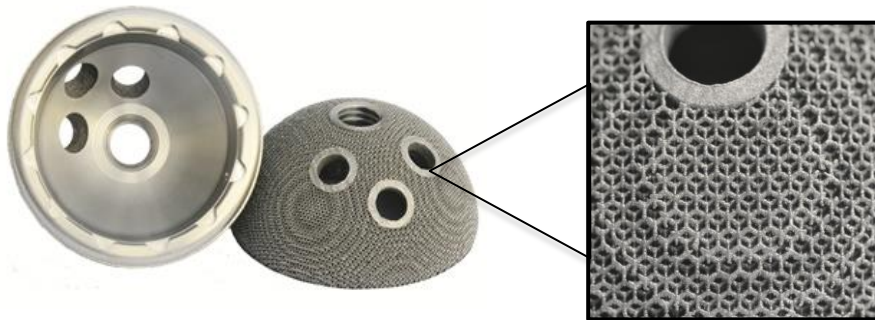
- Advantages;
 - Few competitors
 - More possibilities for IP protection
- Disadvantages;
 - Unknown market potential
 - Market not yet aware of the application; missionary work even more difficult
 - Higher investment costs

New product development

- Importance of **time to market** for products with short life cycles
- Typical for medical markets:
 - Scientific evidence is crucial
 - Support of Key Opinion Leaders is important to convince majority
- LW strategy;
 - Partner with existing companies to develop new products in a shared risk setup
 - Products that offer incremental improvements towards existing products are;
 - Easier to develop
 - Cheaper to develop
 - Many times easier to sell
 - Radical new products only developed if IP protection is possible

New product development

- Illustration of new product development



*Porous hip cup implant
allowing full integration
with human bone*



*Patient specific hip implant
(courtesy of Mobelife NV)*



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