Berenschot

Additive Manufacturing and the Business Case

Webinar NAG

Onno Ponfoort, Berenschot

20 JUNI 2024

WEBINAR NAG – 20 JUNI 2024

Agenda

Additive Manufacturing and the Business Case

Introduction Berenschot

AM benefits

Some business cases

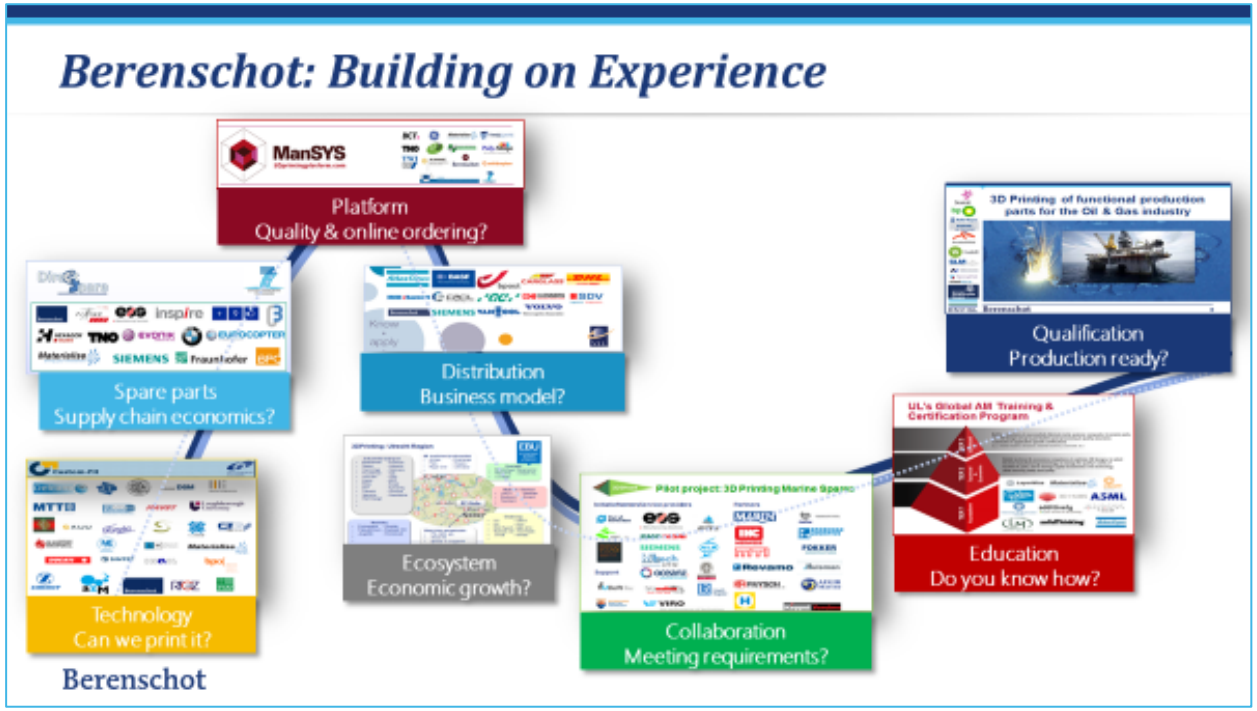
Onno Ponfoort - Berenschot

Berenschot

- General practice
- Founded 1938
- 450 staff
- HQ The Netherlands

Onno Ponfoort

- Practice Leader 3D Printing
- Active in 3D Printing since 2004
- Economic & organisational aspects



3D Printing/Additive manufacturing?

What it is, what you can use it for

- 3D printing/additive manufacturing: making three dimensional solid objects from a digital file.
- The object is created by laying down or hardening successive layers of material until the object is created..
- 3D printing enables you to produce complex shapes using less material than traditional manufacturing methods. It also allows you to print simple parts directly, without of using a mould.
- 3D printing technology is destined to transform almost every major industry.
- Most companies use 3D printing in the design process/prototyping: fast and relatively cheap.
- In many markets 3D Printing is also already used for end products: Automotive, Aviation, Construction, Consumer Products, Healthcare, Food, Oil & Gas.

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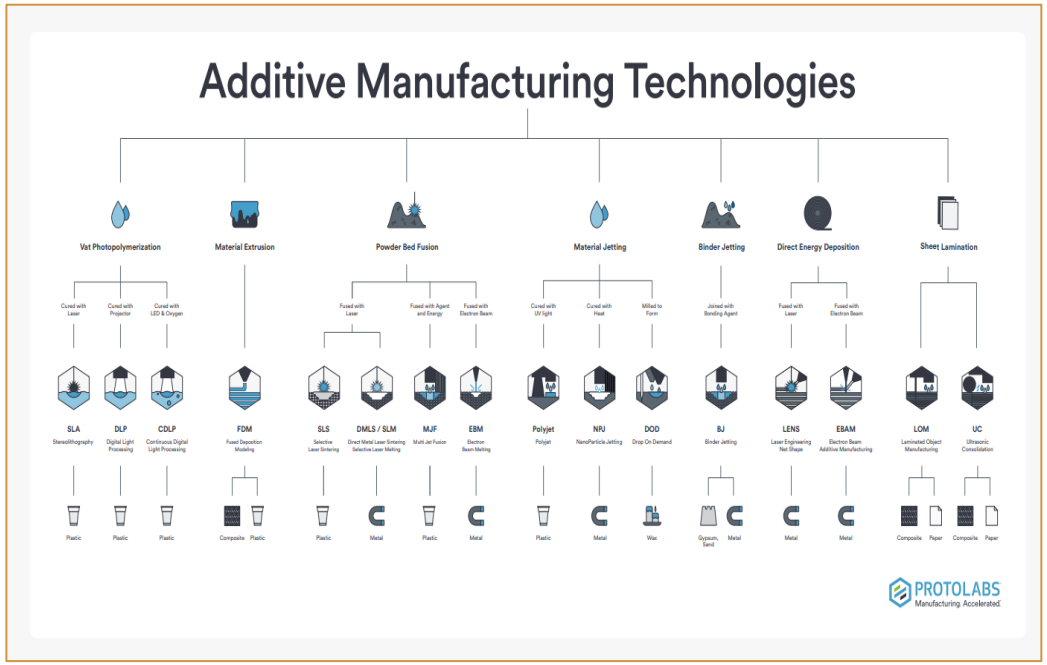
Desk top
€ 2.000

Industrial
€ 1.000.000+

AM/3D Printing Technologies

American Society for Testing and Materials (ASTM) classification

1. **Vat Photopolymerisation**
   Stereolithography (SLA)
   Digital Light Processing (DLP)
   Continuous Liquid Interface Production (CLIP)
2. **Material Jetting**
3. **Binder Jetting**
4. **Material Extrusion**
   Fused Deposition Modeling (FDM)
   Fused Filament Fabrication (FFF)
5. **Powder Bed Fusion**
   Multi Jet Fusion (MJF)
   Selective Laser Sintering (SLS)
   Direct Metal Laser Sintering (DMLS)
6. **Sheet Lamination**
7. **Directed Energy Deposition**
   Wire and Arc Additive manufacturing (WAAM)



Source: https://www.hubs.com/get/am-technologies/

3D Printing: Why and When

3D printing

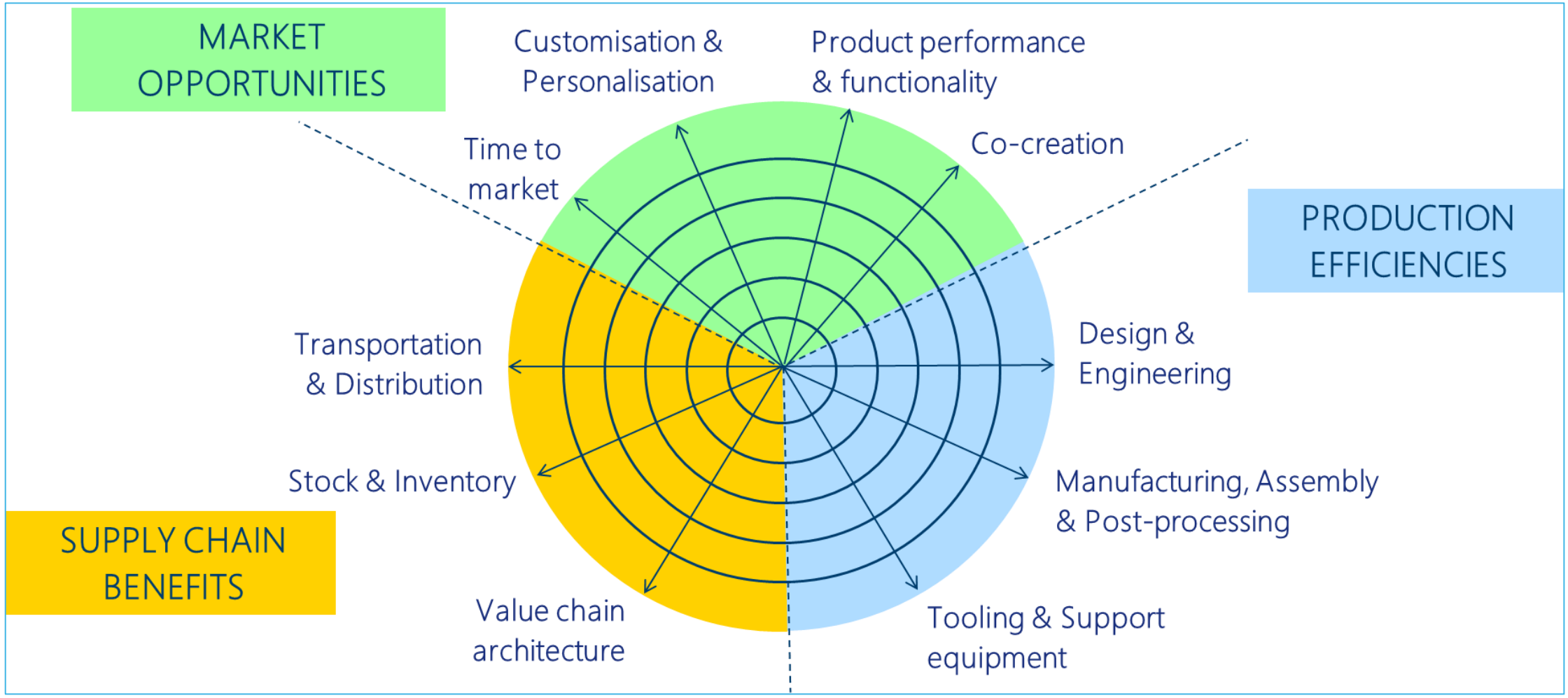
- Because it is available ➔ NO
- ***Because it delivers results***

➢ ***Cheaper***
- To produce (less material, less labor)
- To use (less energy, longevity)
- To distribute (production close to location)
- To store (fewer pieces on stock)

➢ ***More sustainable***
- Less waste after production
- Less energy (production, transport, use)
- Fewer parts to scrap

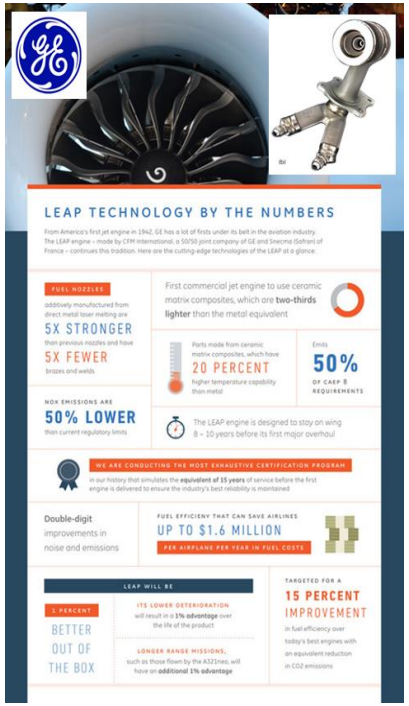
➢ ***Better quality or functionality***
- Functionally better design
- Improved ease of use
- Less maintenance or replacement

Typical benefits of AM



3D Printing business case: Examples (1)

GE: Nozzle for Leap engine



Series of parts

Fuel nozzle:

- 5* stronger
- 5* fewer parts
- 50% less emissions
- $ 1,6 mln lower fuel cost/airplane

Business

- 50+ customers in 20 countries
- 6000+ orders, $ 78 billion
- 25% + market share
- 2500 + jobs

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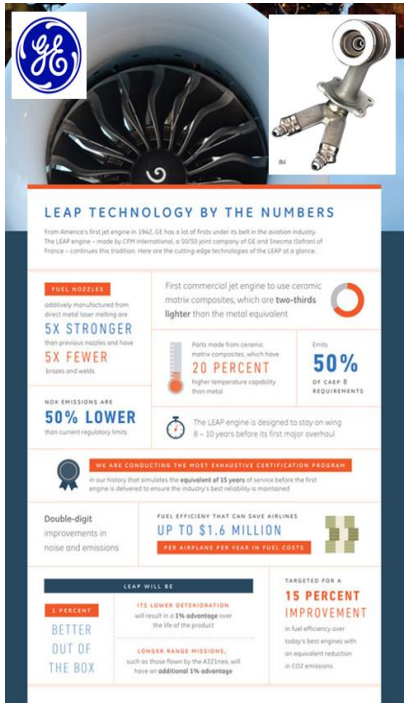

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BMW: Thumb protector

- 3D Printing used to reduce strain on employees' hands

- Lower number of working days lost due to illness

B

Joint Industry Projects

Developing standards for 3D printed (spare) parts in Oil, Gas & Maritime

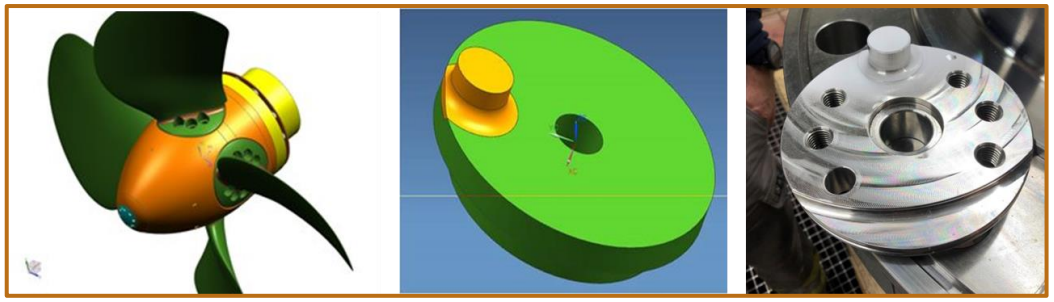
JIP I

JIP II

JIP III

3D Printing business case: Examples (2)

Kongsberg case – Crank pin disc: repair and remanufacturing



Economic benefits

- Less material
- Reduced lead-times
- Less energy & fuel cost
- Lower distribution and Warehousing cost

Savings 20 – 70%

3D Printing business case: Examples (2)

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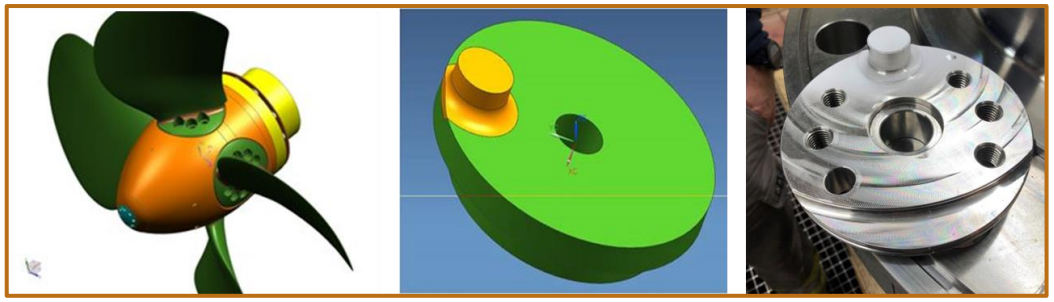

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Sustainability benefits

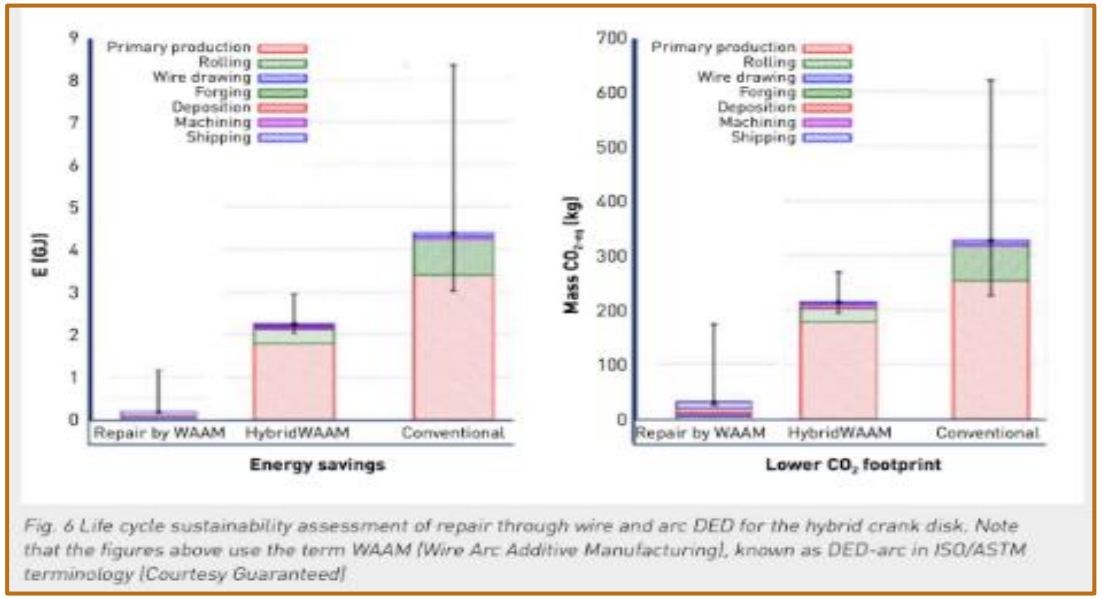

Fig. 6 Life cycle sustainability assessment of repair through wire and arc DED for the hybrid crank disk. Note that the figures above use the term WAAM (Wire Arc Additive Manufacturing), known as DED-arc in ISO/ASTM terminology (Courtesy Guaranteed)

- Hybrid DED: - 50% energy, - 33% CO2
- Repair DED: - 95% energy, - 90% CO2

AM = Sustainability? Not always!

Findings during JIP Phase III

Parameters	Material extraction	Material production		Production			Packaging	Storage	Transpor-tation	Use	End-of-life
		New	Recy-cled	Pre	AM	Post					
Material Waste											
Energy use											
Emissions											
Water use											
Pollution											

Complete “Cradle-to-Grave” assessment of the sustainability impact of additive manufacturing versus conventional manufacturing of part s

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Findings during JIP Phase III

- 'On demand/on location' is more easily realized with AM ➔
  AM likely to support production in countries with cleaner energy mix, close to the point of use to reduce logistic emissions.

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Findings during JIP Phase III

- 'On demand/on location' is more easily realized with AM ➔ AM likely to support production in countries with cleaner energy mix, close to the point of use to reduce logistic emissions.
- Powder-bed fusion for 'like-for-like' AM of casted parts, increases emissions during production ➔ To be analyzed if the design (e.g. light-weighting) offers energy benefits during the use phase
- WAAM likely to reduce CO2 emissions up to 40% vs. milling. because of less material use

Production

Parameters	Material extraction	Material production		Production			Packaging	Storage	Transport-tation	Use	End-of-life
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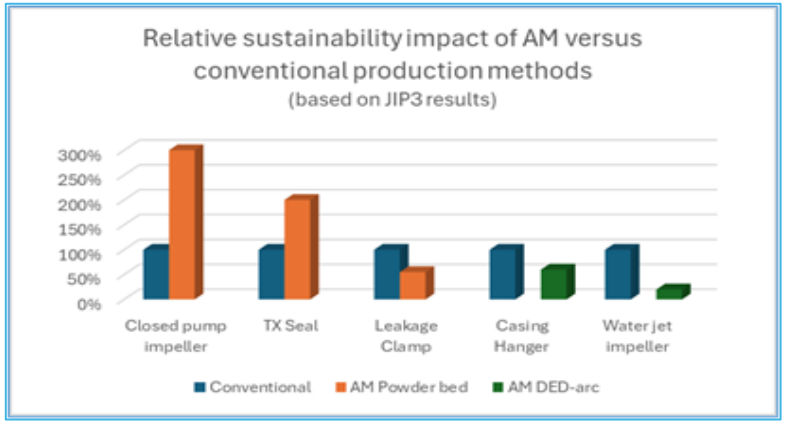

Drivers for adoption of metal AM

Adopters Main reasons to adopt
Relative advantage
Organisational image
Pressure from competition
Supplier marketing activities

Visionary leaders

with room to manoeuvre are willing to step in, convince partners/stakeholders with

- The economics and benefits in operations
- Real life examples presented by end-users

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Drivers for adoption of metal AM

Adopters Main reasons to adopt
Relative advantage
Organisational image
Pressure from competition
Supplier marketing activities

Non-adopters Main reasons not to adopt
Complexity
Financing costs
Business case
Reluctance at business partners

Visionary leaders

with room to manoeuvre are willing to step in, convince partners/stakeholders with

- The economics and benefits in operations
- Real life examples presented by end-users

Cautious managers

with investment guidelines and risk-assessments, can be convinced via:

- Real life examples including a business case
- Involving supply chain partners to share costs

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3D Printing

A valid technology to produce fully functional parts in many materials

From Lab
- Prototype
- R&D, makerspace
- Manual
- Slow

To Fab
- **Validated end part**
- **Industrial setting**
- **Automated**
- **Quick**

- 3D Printing: increased functionality, certified (spare) parts, cost effective tooling
- Not only plastics: Large size metal printing is possible, composites, alloys, ceramics, etc.

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- 3D printing is a means, not a goal:
  - Determine the benefits you want to achieve
  - For companies of all sizes, in every supply chain role
  - Be your visionary self and create the future for your company

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Any Questions?

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