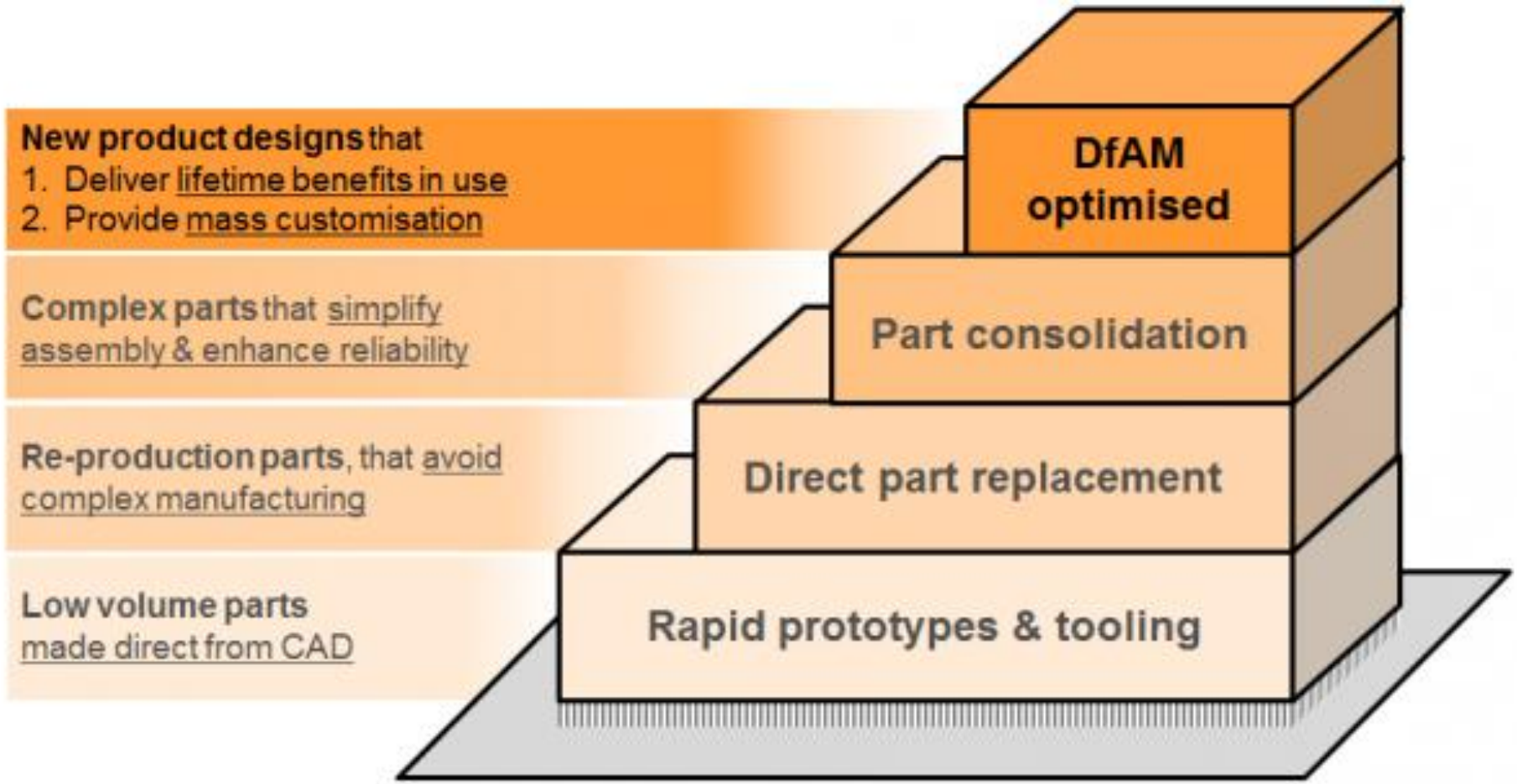
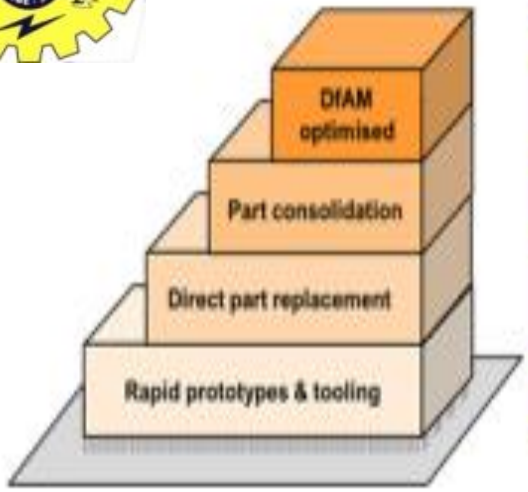
Additive Manufacturing
16ME420

Impact of Additive Manufacturing on Product Chain

Dr. M. Elangovan


New product designs that
1. Deliver lifetime benefits in use
2. Provide mass customisation
Complex parts that simplify assembly & enhance reliability
Re-production parts, that avoid complex manufacturing
Low volume parts made direct from CAD
DfAM optimised
Part consolidation
Direct part replacement
Rapid prototypes & tooling



Financial benefit

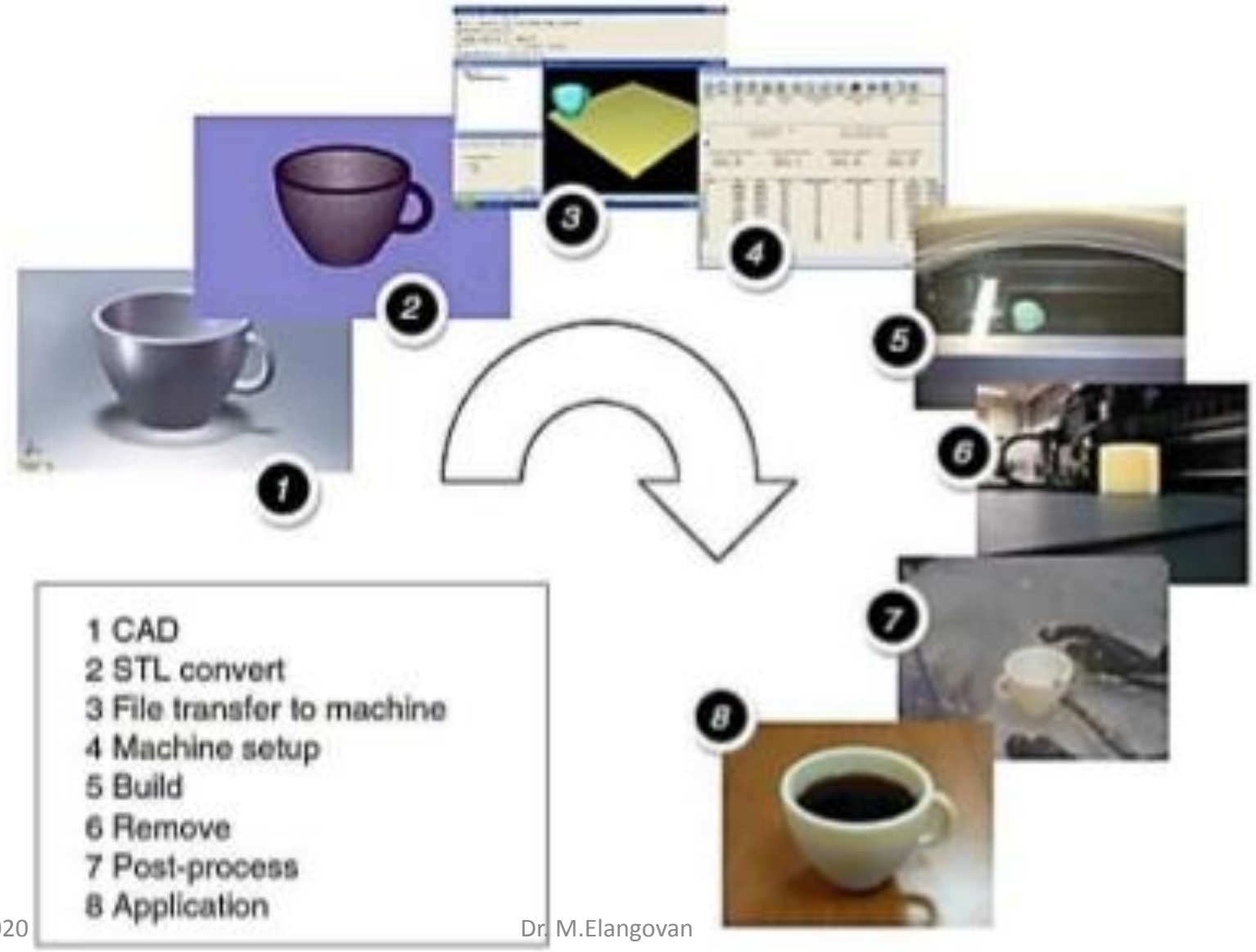
Production benefits

- £ Less materials
- £ Lower tooling costs
- £ Shorter process time
- £ Shorter lead time
- £ Simpler assembly
- £ Automation

Lifetime benefits

- £ Less weight
- £ Faster product launch
- £ Product reliability
- £ Higher performance
- £ Better adaptation
- £ Product attraction
- £ Reduced stocking
- £ Higher responsiveness

Additive Manufacturing Process chain



Impact of value chain

Impact on Product Development & Design

- Form freedom for engineering and design: performance breakthroughs and product solutions
- New design principles, design and analysis tools. Next to rapid prototyping also rapid testing
- Design for function without conventional manufacturing constraints, early design verification
- Integration for fewer parts and less assembly not possible with existing technologies.

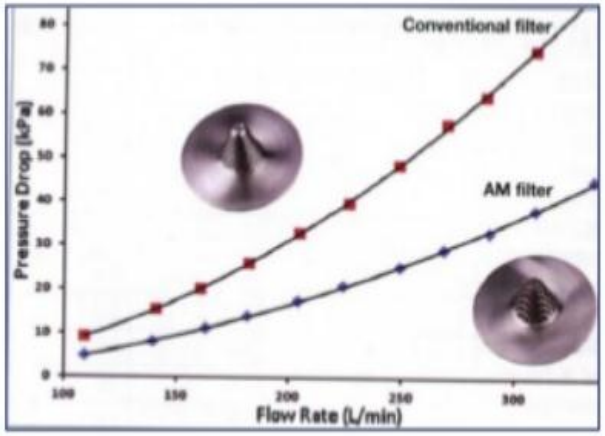
Example: Product Development & Design

- **Traditional** titanium wedge wire filters are difficult and time consuming to manufacture.
- Badly constructed filters impact flow rate and energy consumption
  (Eg. In UK 13% in 2007, being 44.8 million MWh/year, 6% of the UK's carbon footprint).

CROFT Filters

CROFT Additive Manufacturing

- **AM** allows to create filters with aligned and uniform apertures, which leads to a decrease in the pumping energy required.
- This is due to lower pressure drops by higher flow rates.



➔ Up to 30% more energy efficient
➔ Less labour and faster production with AM

Impact on Production efficiency

- Allows for initial or small series parts production (eg. Direct printing or via AM printed moulds)
- In process design iterations or sub-module assembly checks
- Fewer parts to order, less assembly, less risk during build-up
- Time savings, energy savings, process improvements

Drivers:

- ***Lower costs and timing benefits compared to existing production set up***

Example: Production efficiency

- **Traditiona**l production of halogen light bulbs at Havells uses a burner that heats glass to temperatures of about 2000°C.
  The original burner is welded (20 parts)
  It has a working life of about 6 months. Then leakage occurs in one of the welded joints which causes shut downs in production

LayerWise

- The **AM** burner is redesigned and produced in one piece
- Runs for 90 weeks (and counting)
- No production stops during that period

- Break even within 1 year

	Traditional burner assembly	AM burner
Cost per burner	€ 300,-	€ 800,-
Cost for burner quality control	€ 20,-	€ 50,-
Exchange & Maintenance cost	ca. € 500	ca. € 500
Durability	20 weeks	90 weeks
Yearly exchange costs (64 burners)	€ 131.200	€ 43.200
Cost for redesign	-	€ 50.000,-

Transformation in Manufacturing*

Current State - Mass Production & Centralized Manufacturing

Design for Manufacturing

Economies of Scale

Mass Production

Product Distribution

Emerging State - Mass Complexity & Distributed Manufacturing

Design for Use

Economies of Scope

Mass Customization

Distributed Manufacturing

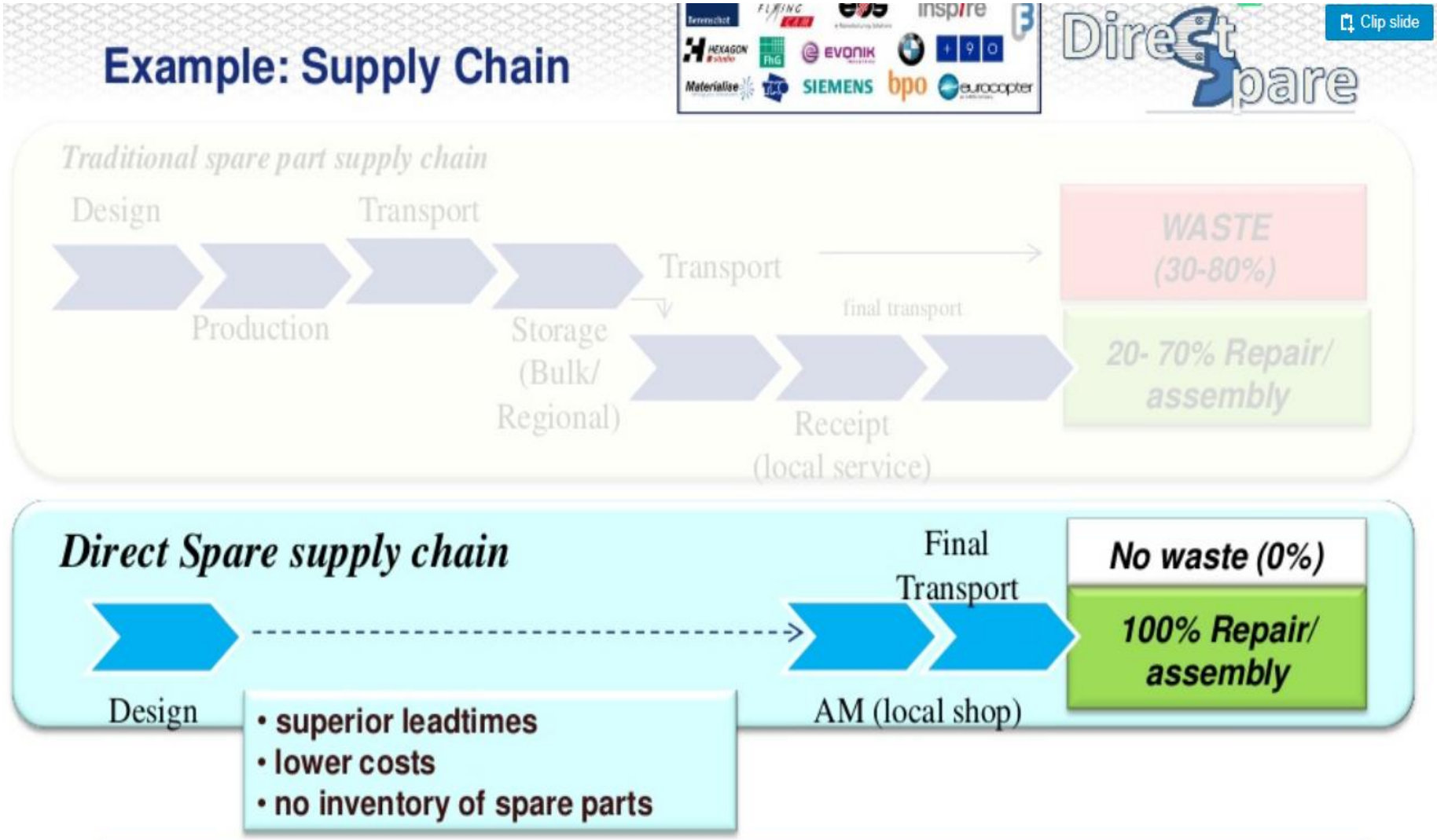
Impact on the Supply chain

- Logistics: fewer stock, print on demand
- Distributed manufacturing: print on location, supply and control of base materials (powders)
- Spare parts: local production, engineering changes, 'Hybrid wholesale', end of life
- Repair and maintenance: fewer scrap, cost saving, faster repair

Drivers:

- ***Lower costs and timing benefits compared to existing production set up***
- ***Less working capital committed***

Example: Supply Chain



Impact on Business Models

- Democratisation of design, allowing end user to impact design and engineering phase
- Custom fit, custom build, requiring more and better interaction with customers/users
- New functions in the value chain (AM file warehouse) and new partnerships
- From B-to-B orC ➔ C-to-B and C-to-C

Drivers:

- ***Customisation and customer benefits***
- ***Added value and higher margins***
- ***Shorter time to market***

Example New Business Model

- **Traditionally**, unique products and own designs were hard or expensive to get manufactured

- **AM** allows for a the rise of a distributed manufacturing network like 3D Hubs.
- Started out as a platform for cheaperhome use printers
- Steadiliy becoming more professional: metal printers, high end plastics, professional designers

3D HUBS

WE'RE CONNECTING YOU TO 17.600+ LOCAL 3D PRINTERS

Started May 2013
€3,4 million investment secured September 2014