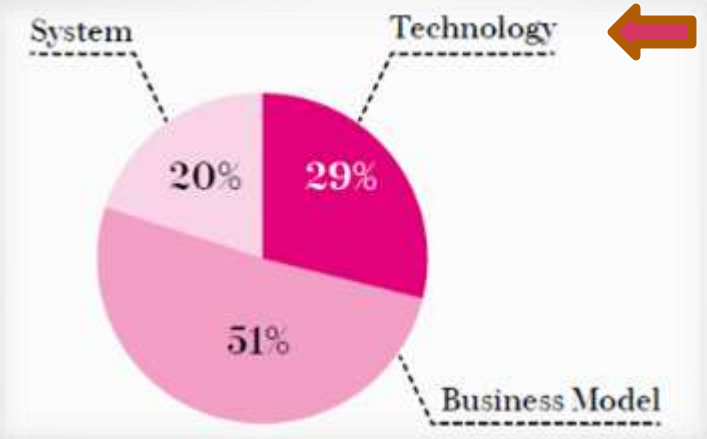
Innovation in the Clothing Value Chain

Technology trends for an agile and sustainable clothing production ecosystem

The Fashion Industry

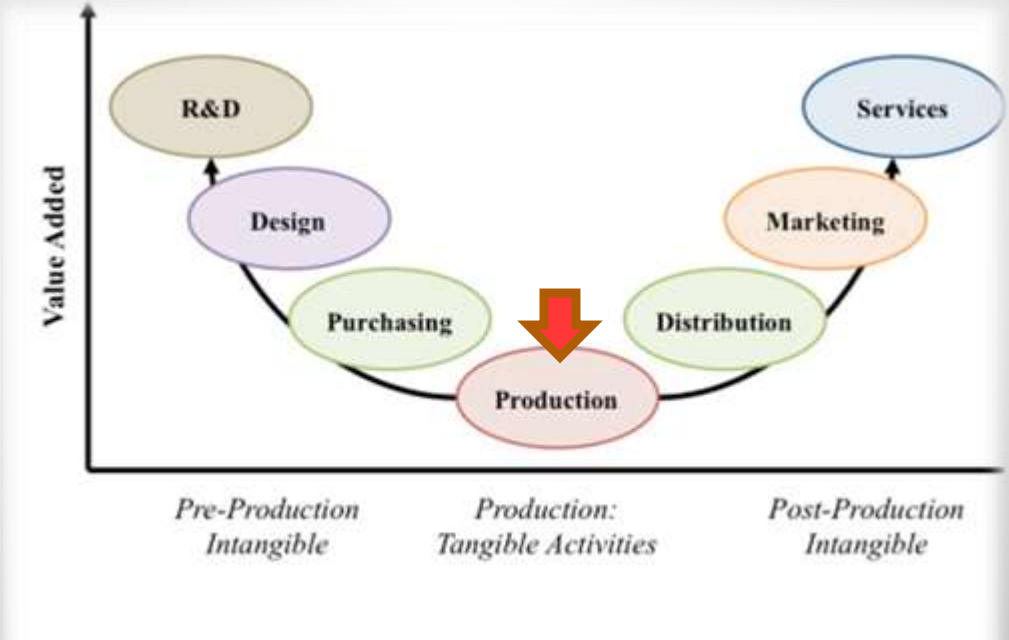
There is an urgent need for both **innovation** and **technology** to enable a transformation of the fashion industry, from linear to more circular business models.



(Circular and Fashion Tech – trend report, 2018) - indicating technology's central role in accelerating the **shift to a circular fashion industry**.

- The fast-moving fashion industry has shown that even a low-tech industry can be disrupted by an **agile approach**, which may be **a paradigm for the future industrial organization.**

Curve of Value-Added Stages in the Apparel Global Value Chain

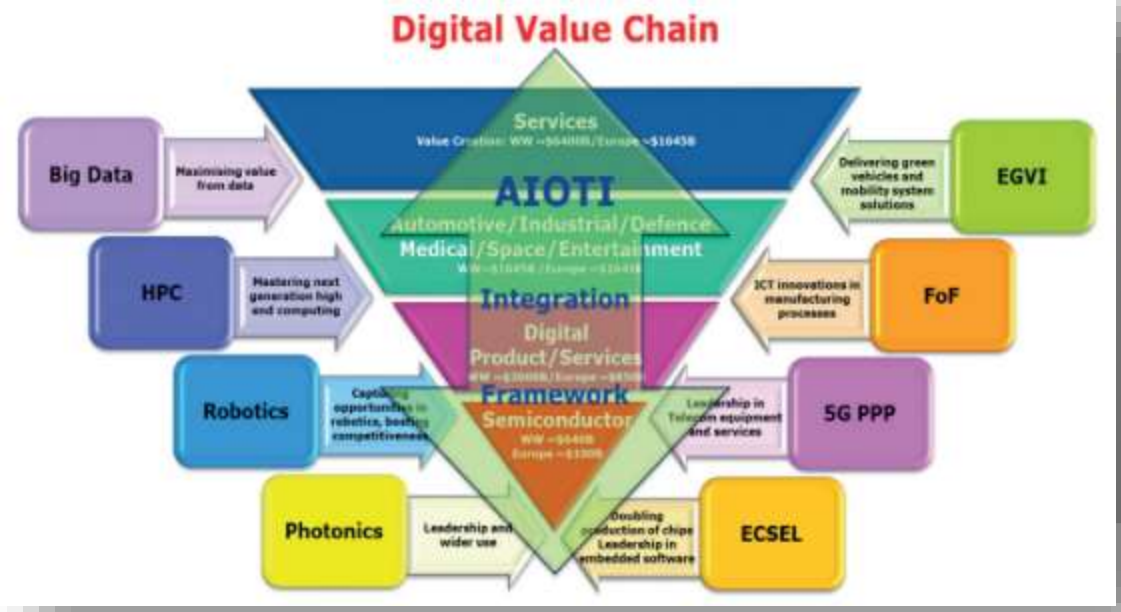


Source: Frederick, 2010.

Innovation Value chain

The main trends that are transforming the fashion value chain:

- **An Automated Supply Chain**
- **Wearable Technology**
- **Artificial Intelligence**
- **An Agile Supply Chain Methodology**
- **Connecting with Millennials Through Your PLM**
- **Enhancing Capabilities with the Cloud**
- **Choosing the Right Procurement Tools**

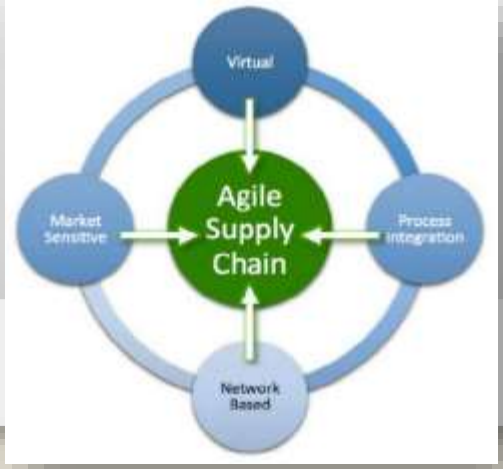


Agile Value Chain as Competitive Advantage

- For a company, **agility means** being able to operate profitably in a competitive environment that is characterized by consistently unpredictable changing customer requirements.

- **Agile customer-oriented organizations** plan their processes, products, and services iteratively instead of waterfall models (Stober & Hansmann, 2010, p. 168; Brechner, 2015, p. IX), reducing the time required for planning and design of products and their manufacturing.

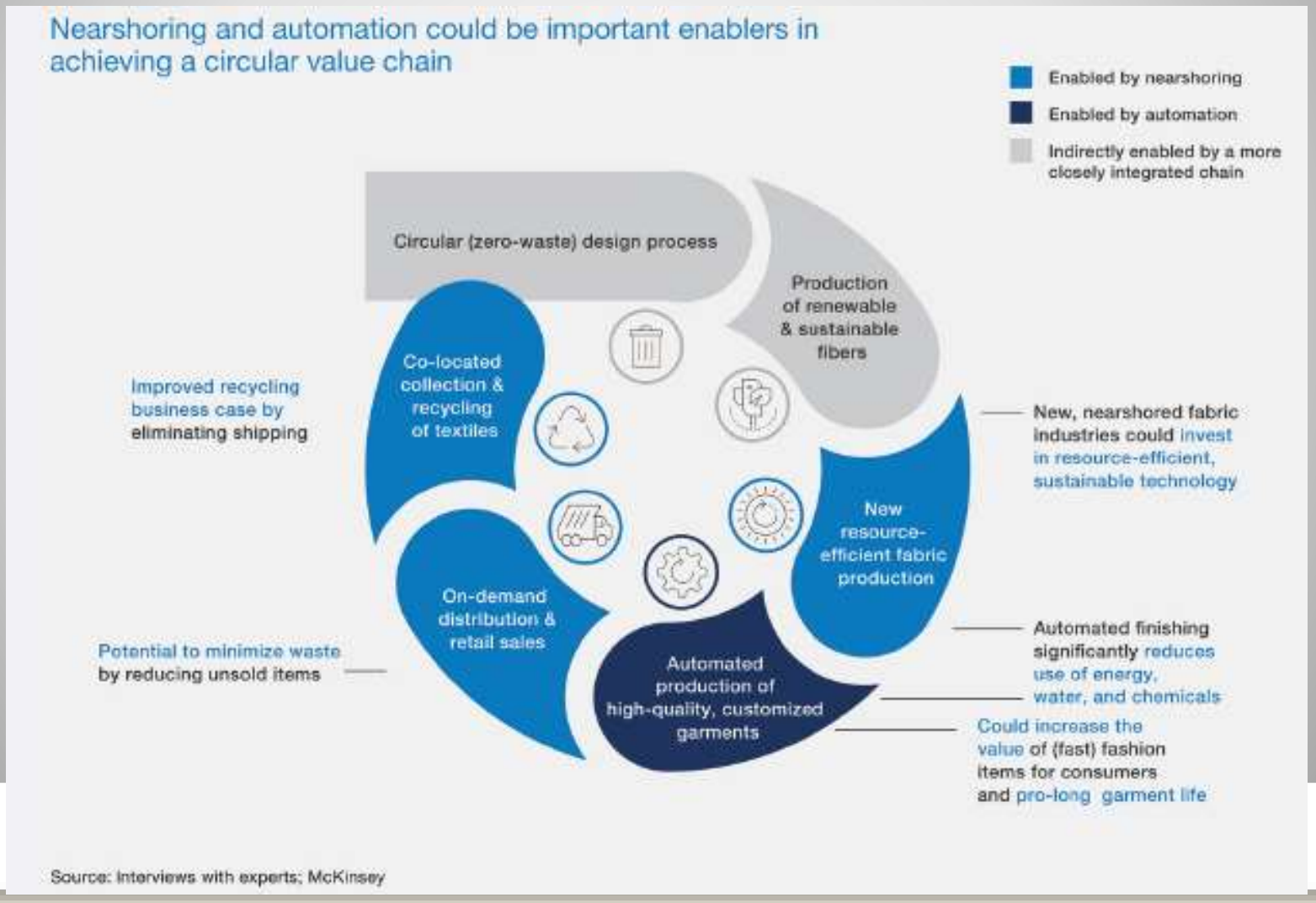
- **Agile companies -** align their strategy with the customer and strive to maximize customer service. Agile, customer oriented organizations are characterized by network structures instead of hierarchies (Hugos, 2009, p. 53).



Agility

- **Agility** is a conglomerate of a multitude of individual concepts.
- The reorientation to **agile thinking and behaviour** as well as the shaping of agility promoting structures may bring **decisive strategic competitive advantages for companies.**
- **Agile processes -** are **iterative and incremental** and focus on short-term results while enabling quick adaptation to changing conditions (Joslin, 2017, p. 169).
- **Smart and agile manufacturing** is seen as the key concept of companies in the **context of the coming fourth wave of industrialization** (Moller, 2016).

Speed and agility are now on the radar for **winning apparel players** and on-demand replenishment has increasingly become a make-or-break capability**.**



Industry 4.0

- The term **Industry 4.0 -** stands for the fourth industrial revolution**, a new stage in the organization and management of the entire value chain** over the lifecycle of products (Kagermann et al., 2016, p. 5).

- This cycle is geared to the increasingly individualized customer requirements and extends from the design idea, development and **production**, the delivery to the customer, up to recycling, including associated business services (Kagermann et al., 2016, p. 5).

What Industry 4.0 Means for Apparel, Fashion, and Footwear Manufacturers

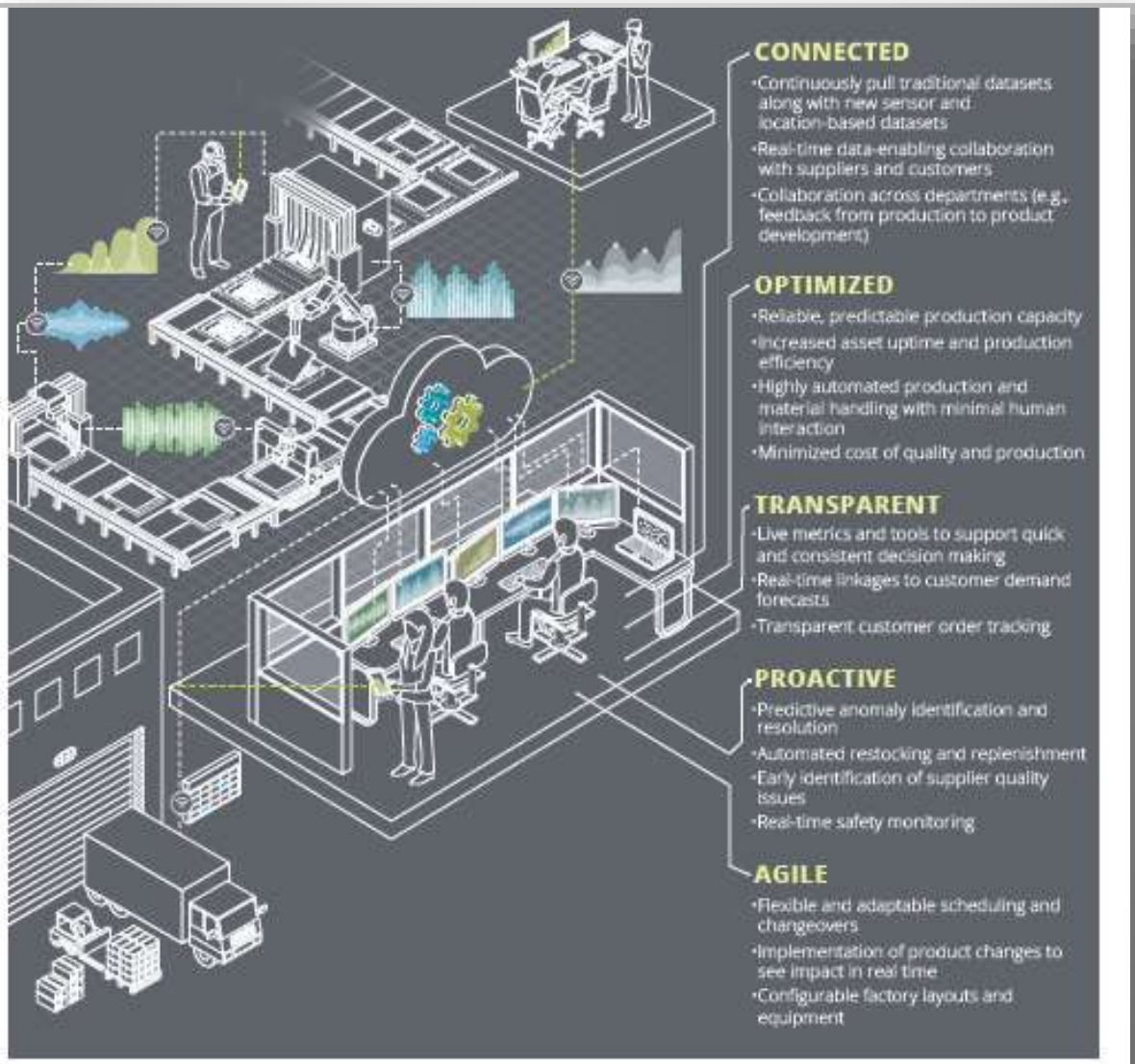
- **The fourth industrial revolution or Industry 4.0,** is the current era when **electronics and information technology** enable complete digital connectivity by bringing together the physical, digital, and organic elements of modern human life.

- The interactions between **revolutionary technologies** such as AI, ML, automation, IoT, 3D printing, augmented reality, virtual reality, energy storage and generation, quantum computing and robotics, **are changing the very nature of the enterprise value chain.**

- For the **manufacturing sector**, especially in cases of mass-produced goods such as apparel, fashion and footwear, the Industry 4.0 movement is **a revolution in the making.**

Smart Factories – Creating the Factory of the Future

- **The key differentiator of Industry 4.0** lies in its ability to accelerate, expand, and fundamentally alter **critical aspects** of production and manufacturing.
- **Factories of the future** will be completely automated, self-servicing, and self-repairing structures that require minimal human intervention.
- **Production and manufacturing processes** can be replicated on a digital platform within a virtualized environment.
- **The result -** can be a **more efficient and agile system**, **less production downtime**, and a **greater ability to predict and adjust to changes** in the facility or broader network, possibly leading to better positioning in the competitive marketplace.



Five key characteristics of a smart factory

What does the factory of the future look like?

- There will a number of **guiding principles** which will act as the **drivers** of the factories of future:

  - factory's interaction with its ecosystem,

  - optimized value chains and supply networks,

  - agility of manufacturing systems,

  - digitization and cyber security, real-time simulations,

  - worker mobility, etc.

- **Factors of utmost importance**:

  - Flexible manufacturing

  - Agile Processes.

Factories of the future will have to integrate the best foundations of **process and technology** and move to reduce wastage in the system.

Hyperefficient - Characteristics of the hyperefficient and flexible factory of the future

Driving the Sustainability of Production Systems with Fourth Industrial Revolution Innovation

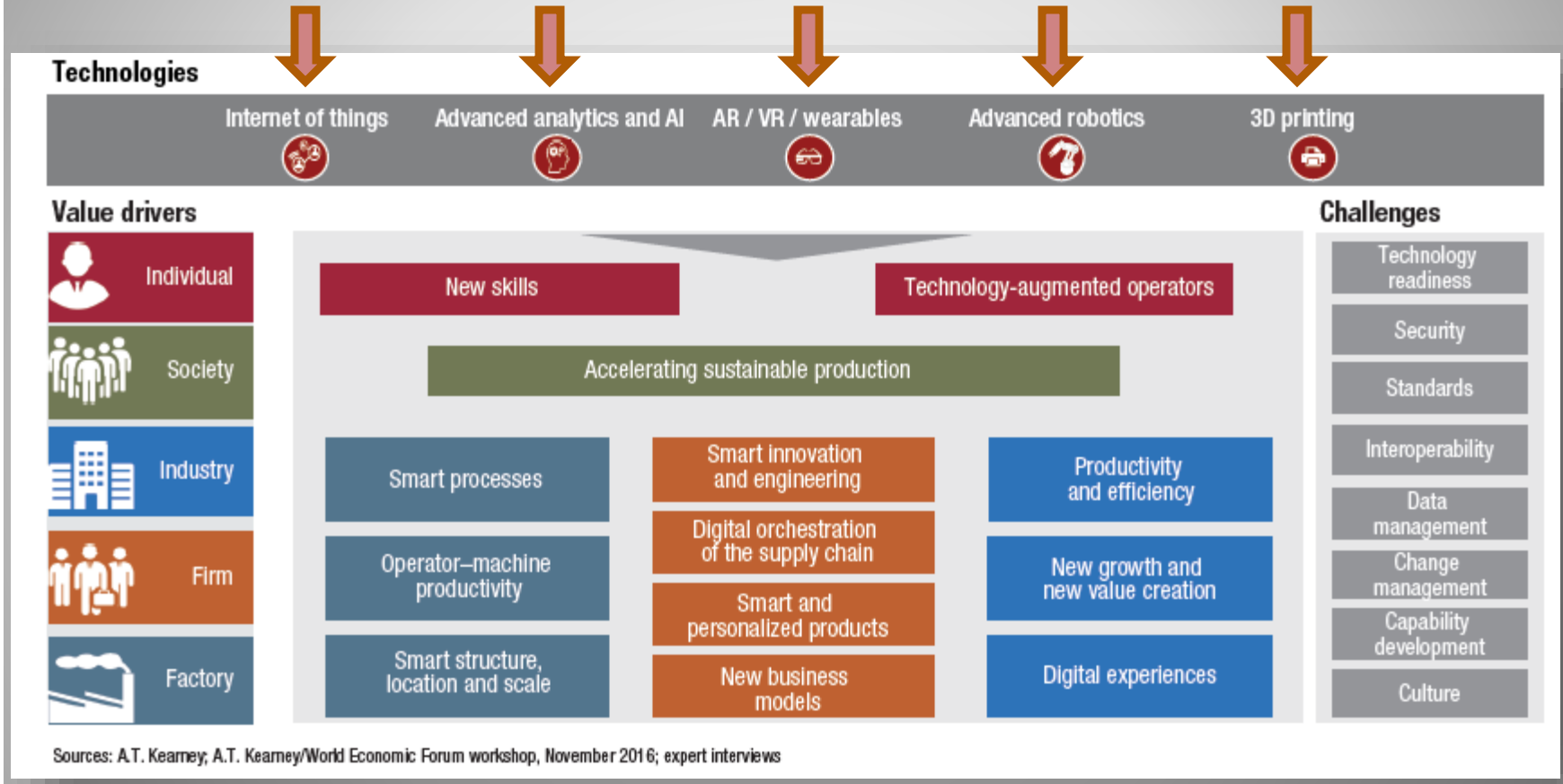
- **Production:** The full spectrum of value-adding activities in the cradle-to-factory-gate part of a given industry value chain.

- **Sustainable production**: The manufacturing of products and product inputs, and the creation of related services, which respond to consumer and market needs and bring a better quality of life while minimizing the use of natural resources and toxic materials. In the process, emissions of waste and pollutants are also minimized to avoid jeopardizing the needs of further generations (based on the definition of sustainable consumption and production from the Oslo Symposium in 1994).

- **Fourth Industrial Revolution sustainable production development**: A set of digital, physical and/or biological Fourth Industrial Revolution technologies converging together to change manufacturing inputs, processes and outputs, and enable new business models, with the potential to increase value creation across the triple bottom line (**economic, social and environmental**).

Technology and Innovation for the Future of Production: Accelerating Value Creation

- **Shape a vision** of production that promotes economic growth and innovation in an inclusive and sustainable manner.
- **Some technologies**, in different stages of technical readiness and adoption, also come with varied levels of uncertainty about their future direction.
- **The readiness and adoption** of each technology tells a different story. Some, such as 3D printing and advanced robotics, have a long industrial history. Others, such as artificial intelligence and wearables, are in a more nascent stage, but present promising use cases.
- **Disruptive technologies**, especially robotics, 3D printing and augmented reality, have captured the popular imagination with exciting applications demonstrated already.



Technologies - Creating value from **converging technologies**

The internet of things (IoT)

- **The internet of things (IoT)** – the embedding of physical devices with sensors, network connectivity and other components so they can collect and exchange data – is often presented as a revolution, but it is actually an evolution of technologies developed more than 15 years ago.

- **The immediate opportunities** for producers are in smart enterprise control, asset performance management in real time and smart and connected products and services.

- However, IoT is not just a collection of technologies added on top of current automation systems. It is also a **philosophy** requiring an entire change in mindset, where the potential lies in the ability to link automation systems with enterprise planning, scheduling and product lifecycle systems.

- Internet of Things (IoT) and **Robotics** - Combining robotics and artificial intelligence by sensor technology – implying robotic systems to perform tasks that are learned by means of training (and by which they become self-learning). IoRT is the next level of IoT, integrating sensors into robotic systems.

Artificial intelligence (AI) and **Machine Learning (ML)**

AI and **ML** are hot.

- **AI** refers to the broader concept; the ability of computer systems to perform tasks commonly associated with ‘intelligent (human) beings’.
- **AI** - enables producers to make sense of the overwhelming data that their factories, operations and consumers generate, and to transform that data into meaningful decisions.
- The most promising immediate opportunities for applying AI in production systems are in **quality management, predictive maintenance** and **supply chain optimization.**
- **ML** allows a computer application/program to recognise and learn from patterns in data as well as to improve capabilities without human assistance.

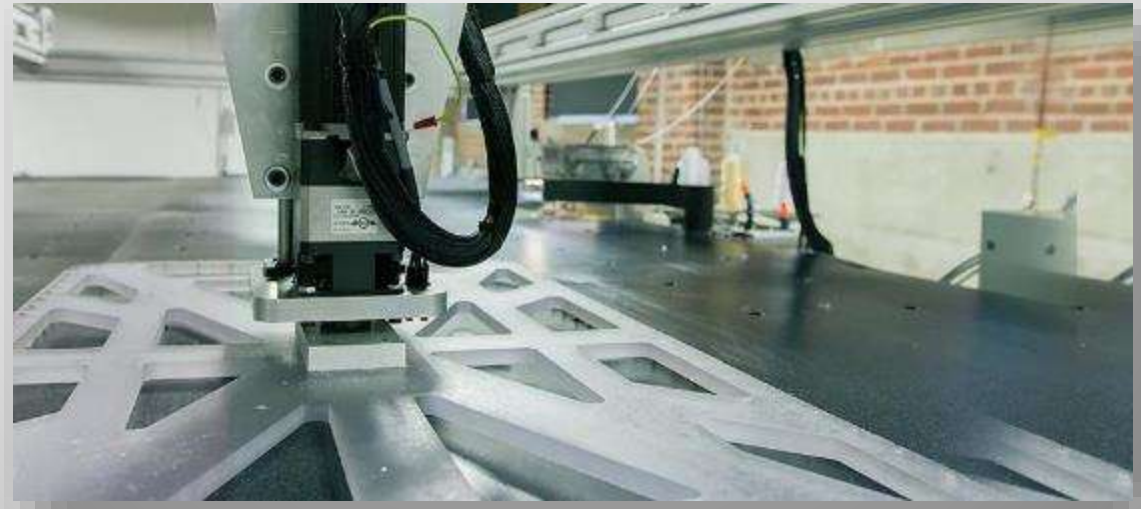
AI and ML will both play a crucial role in delivering personalised content experiences.

Enterprise wearables - including augmented and virtual reality

- Connecting the unconnected with the internet of things
- Technology for **augmented reality (AR) and virtual reality (VR) -** could become the next computing platform.
- **In the specific case of production**, AR and VR could enable people to thrive and harness their capabilities more fully.
- Wearables, AR and VR present **valuable use cases** for quality inspection, work instructions, training, workflow management, operations and safety, logistics and maintenance.

Advanced robotics

- Have long handled the “dull, dirty and dangerous” jobs, and currently automates 10% of production tasks.
- Robots were often separated from people for safety reasons, but now, a new generation has “come out of the cage” for 24-hour shifts, working alongside human counterparts.



This T-Shirt Sewing Robot Could Radically Shift The Apparel Industry

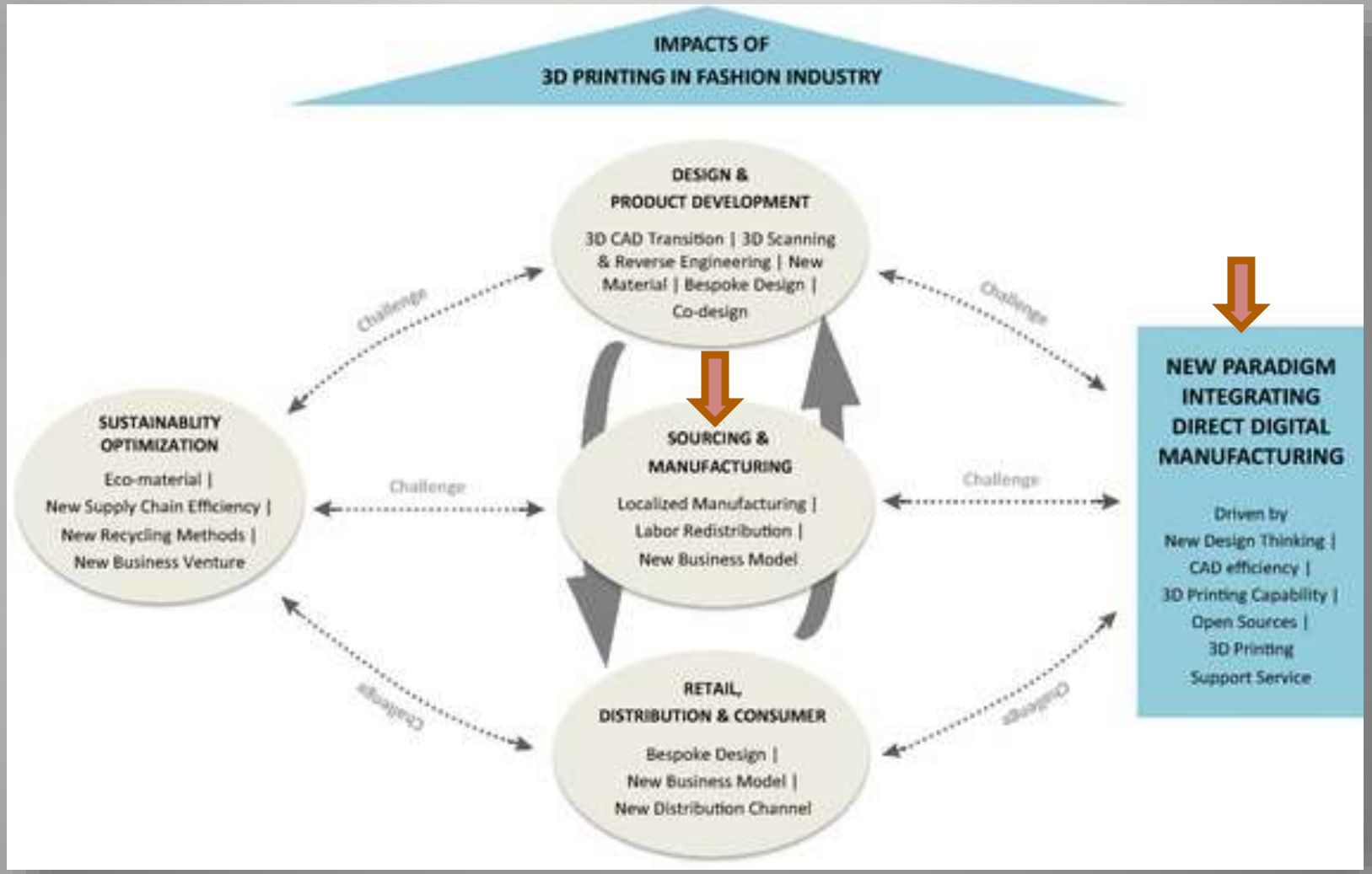
3D printing - shapes the future one layer at a time

- **3D printing is increasingly being adopted for industrial use**, as it helps to deliver better products, and as value chains become ever more connected, simplified, automated and decentralized.

- **3D printing is revolutionary**, but not because it can replace conventional manufacturing, render traditional factories obsolete and localize all production, it is revolutionary due to its ability to complement traditional manufacturing processes, revolutionize product design and create new value.

- **3D printing works best** in industries where customization is critical, typically those with low-volume, high-value parts.

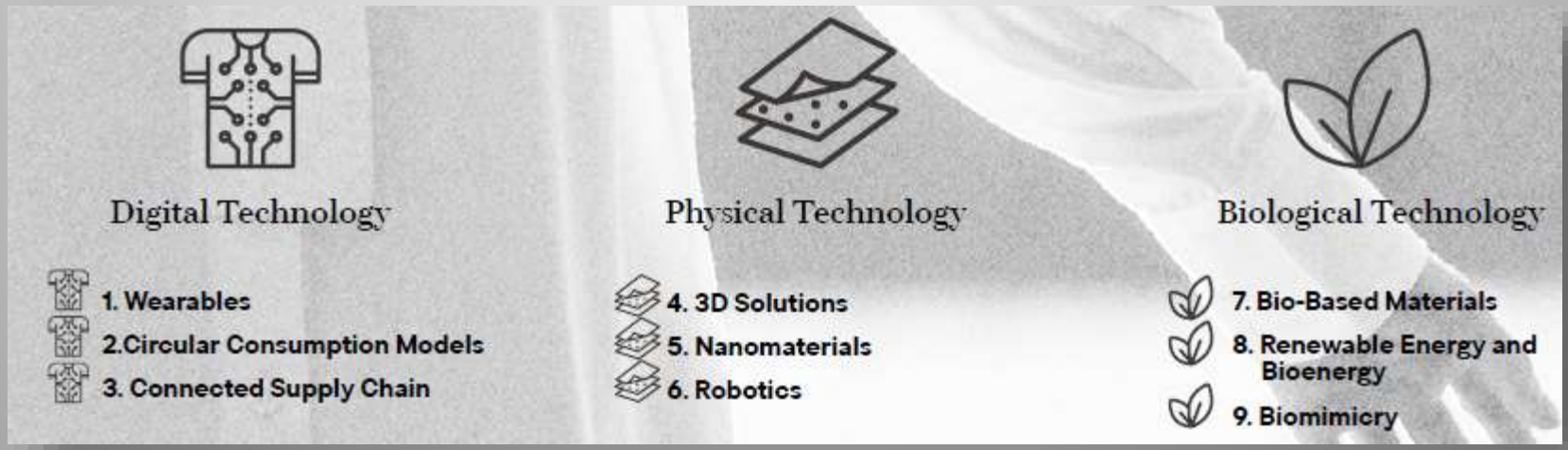
- Use in production. 3D printing has improved and become more versatile to the extent that **it is now transitioning from rapid prototyping to scaled production for select products .**



Impacts of 3D Printing in the Fashion industry

- **Technology innovation - is a must for the development of circular business models**. Emerging technologies allow organizations to create value in a circular economy. Furthermore, technology drives new communication channels, processes and ways of working, and ultimately enables **better use of resources and economic growth.**

  - **Digital, Physical and Biological Technology**



The prospect of automation

- Before being able to fully comprehend **the prospect of automation for apparel manufacturing** and its potential impact, **companies need** to have a detailed understanding of the technology landscape.

- A broad screening throughout the apparel production process - identified the **five key automation technologies** that show the most promising impact on apparel manufacturing overall.

- **Automation of sewing and logistics** offers a step change in the efficiency of existing processes. Additionally, new processes are enabled by innovative technologies in **gluing/bonding, knitting,** and **finishing.**

(Institut für Textiltechnik of the RTWH Aachen University and the DCC Aachen)

Sewing.

- Currently the **most labor-intensive step** in creating a garment, sewing accounts for more than half the total labor time per garment. The potential for labor reduction is highly dependent on product type and design – as much as up to 90 percent of the sewing of simple garments can be automated. While there are a variety of different semi-automation solutions, SoftWear Automation is currently on the forefront of fully automated sewing.

SewBot Is Revolutionizing the Clothing Manufacturing Industry

This fully automated Sewbot is part of the company's initiative to automate the textile industry in the same way that other industries have used robotics for manufacturing.

Intralogistics/ warehousing.

- Next to sewing, this is the most labor-intensive part of the apparel production process and one of the most error prone due to issues in picking.
- **Robotics in intralogistics** throughout the production process as well as warehousing can halve labor intensity, reduce processing time and errors, and improve worker ergonomics.
- **Technologies in the market today** include overhead garment-on-hanger systems, which utilize the previously empty overhead space in a warehouse to store, sort, and pick display-ready garments, and self-driving warehouse vehicles that can transport items as well as load and unload washing machines and dryers.

Gluing/bonding.

- Emerging gluing/bonding technology will allow companies to completely bypass sewing while adding functionality to performance garments.
- Gluing today is also used in the high-end design segment.
- Combined with robotics, gluing and bonding have the potential to significantly reduce labor and increase the production speed.

Bond formation and subsequent testing is affected in a highly coordinated fashion.

Knitting

- Advances in knitting technology, such as computer-controlled or 3-D knitting, enable customization and improvements in design and fit.
- Nike’s Flyknit product line, for instance, uses a computerized knitting process that has reduced material waste by 80 percent.
- Knitting innovation also supports single-item production and new factory-in-store concepts.

Stoll presents innovative knitting solutions

Nike’s Flyknit

Techtextil & Texprocess 25th April 2019, Reutlingen

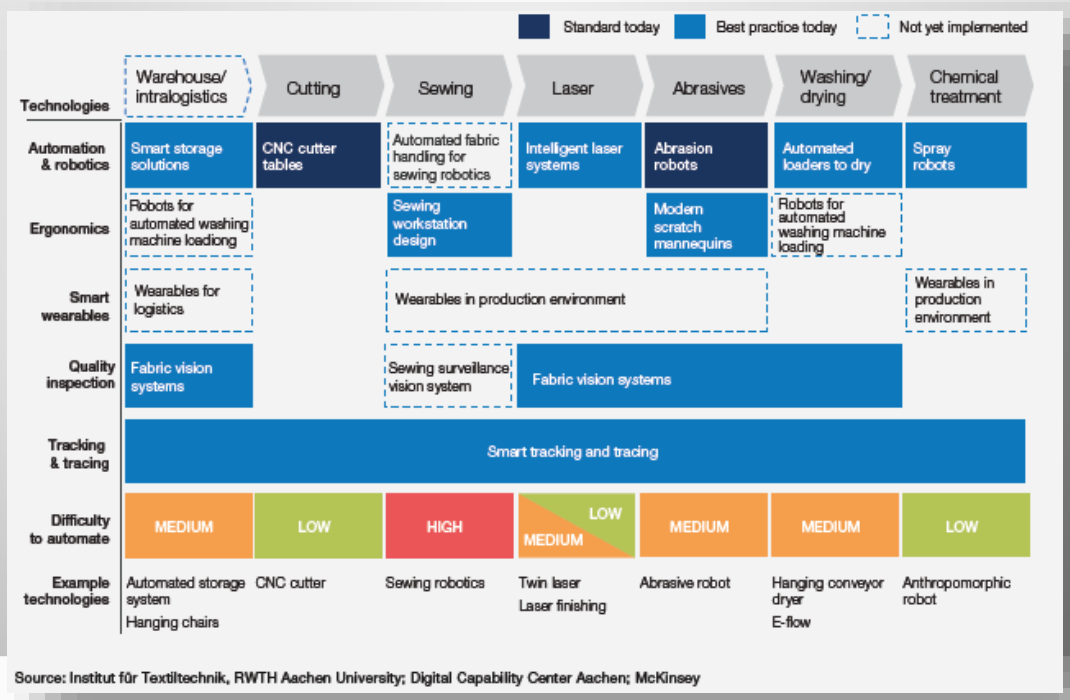
Finishing

- **Automated finishing** (e.g., digital printing, abrasives, lasers) – which is fast, low cost, and requires little labor.
- Digital printing can reduce labor by up to 70 percent and abrasives by up to 90 percent.
- Levi's laser technology drastically cuts finishing time for a pair of jeans (from 20 minutes to 90 seconds").

Digital printing

Economic viability of automation

- Assessment of automation technologies across the cut-make-trim (CMT) and finishing processes shows just how much the difficulty of automation varies throughout the CMT process.
- In several of the production steps, innovative technologies have not yet been broadly implemented.
- These provide an indication of the automation potential in the years to come, e.g., ***support from smart wearables in the production process,*** or ***automated fabric handling for sewing robotics***.



Sewing is the most complex step to automate in the CMT process – Jeans example

- **Technological advancements** (e.g., in gripping technology, robotic vision, cobots) - have pushed automation in apparel manufacturing to the brink of a breakthrough. Apparel companies that are active in driving the development should expect to see great returns on their investments.

- Technological advancements **will define the future of production systems.**
  Such advances **could create green, clean, equitable and sustainable systems.**

Building skills and changing mindsets will be critical for a successful transformation

- The technological opportunities from automation and digitization and the need for speed on **rethinking the entire apparel value chain** requires a very different, much more consumer focused and agile approaches.

- As players will not be able to go it alone in the future, it will be important to shift mindsets when it comes **to building an ecosystem of partnerships.**

Building a new ecosystem of partnerships

- **Partnerships** - will be key in building a sustainable competitive advantage in the context of uncertainty regarding winning technologies and the high speed of innovation.

- To be able to stay at the forefront, brands will also need to **collaborate with technology companies** to develop innovative automation solutions since, currently, neither apparel brands nor (most) manufacturers are likely best positioned to develop disruptive technologies.

Open ecosystems

- There is a shift from using closed technical infrastructures to open platforms that enable a **complete (digital) ecosystem** available to everyone.
- **Ecosystems will continue to evolve**. With more and more devices connected, the amount of data available is endless and with the first 5G devices, the availability and speed of data is rising.
- Moreover, businesses with different profiles but operating in common markets with common customer profiles will seek to strike **mutually beneficial partnerships**.

The global economy is built on unsustainable foundations

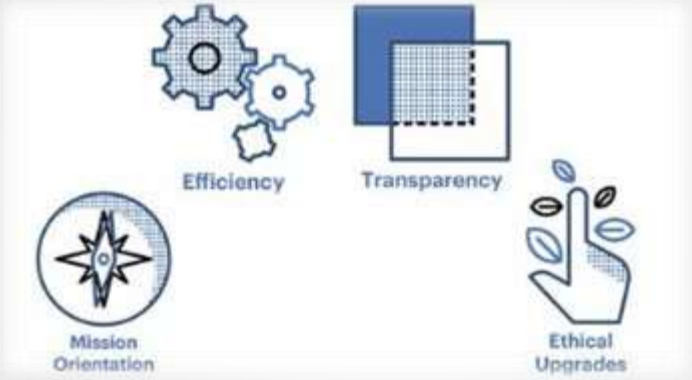
- However, technological advancements also come at a significant environmental cost. Industry must act to tackle the rapidly increasing environmental impact of new technologies.

- Disruptive technologies could potentially transform traditional materials-reliant production systems and accelerate a new form of sustainable production. (For example, 3D printing could reduce manufacturing costs by $170 billion to $593 billion, cut energy use by 2.54–9.30 exajoules and reduce CO_2 emissions by between 130.5 and 525.5 metric tons by 2025.)

- However, technologies are not a universal panacea for sustainability and their impact needs to be assessed on a holistic level to ensure net positive gains of “shared value”. With such value, economic profits are anchored to social benefits for people and the planet.

- **Sustainable production aims to “do more and better with less”.**

Thank you very much for your attention



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