

Unit 75: Industry 4.0

Unit code : F/617/3949

Unit level : 4

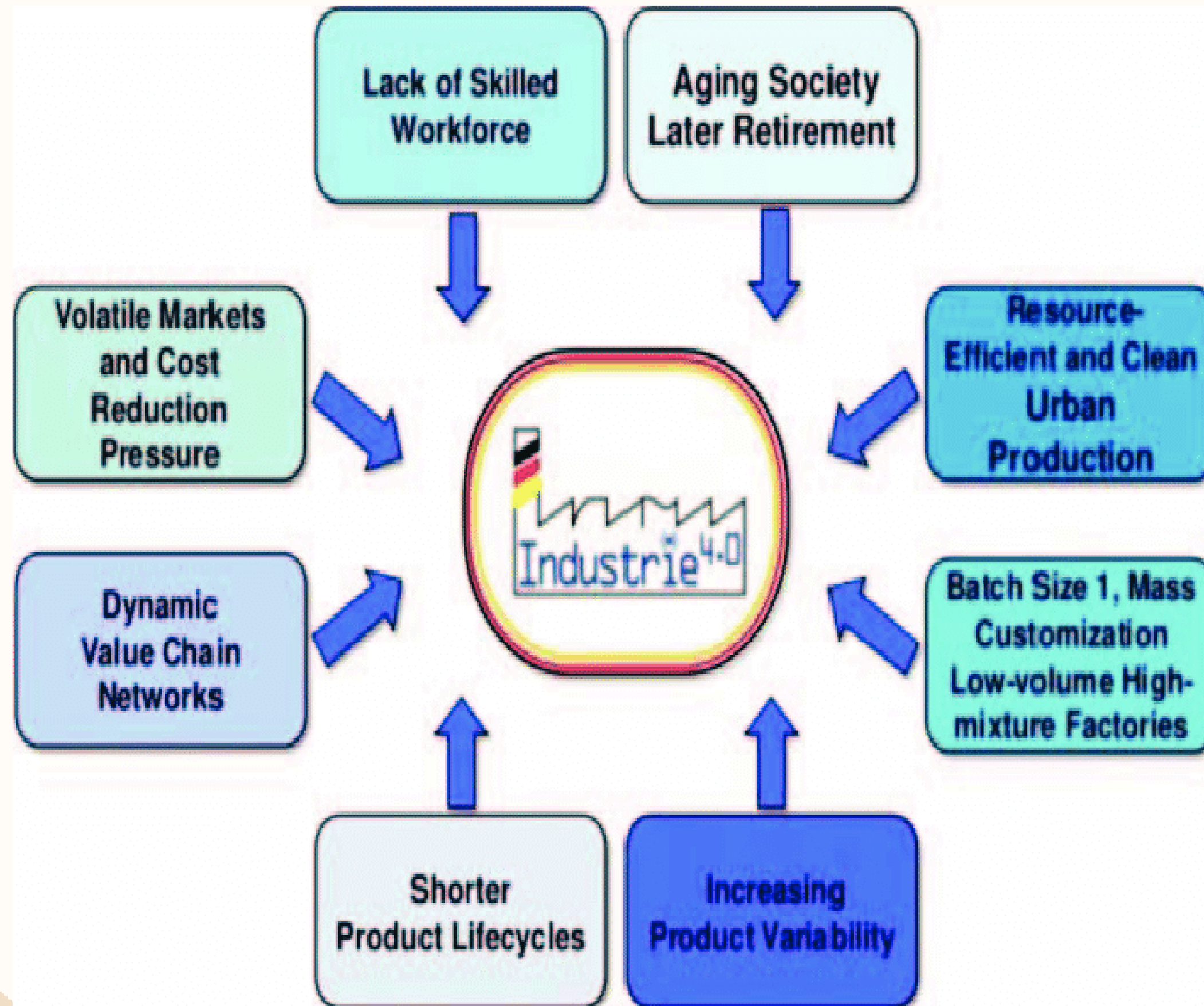
Credit value : 15

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Unit 75: Industry 4.0 Aspects of Industrial Revolutions- Socio-Economics

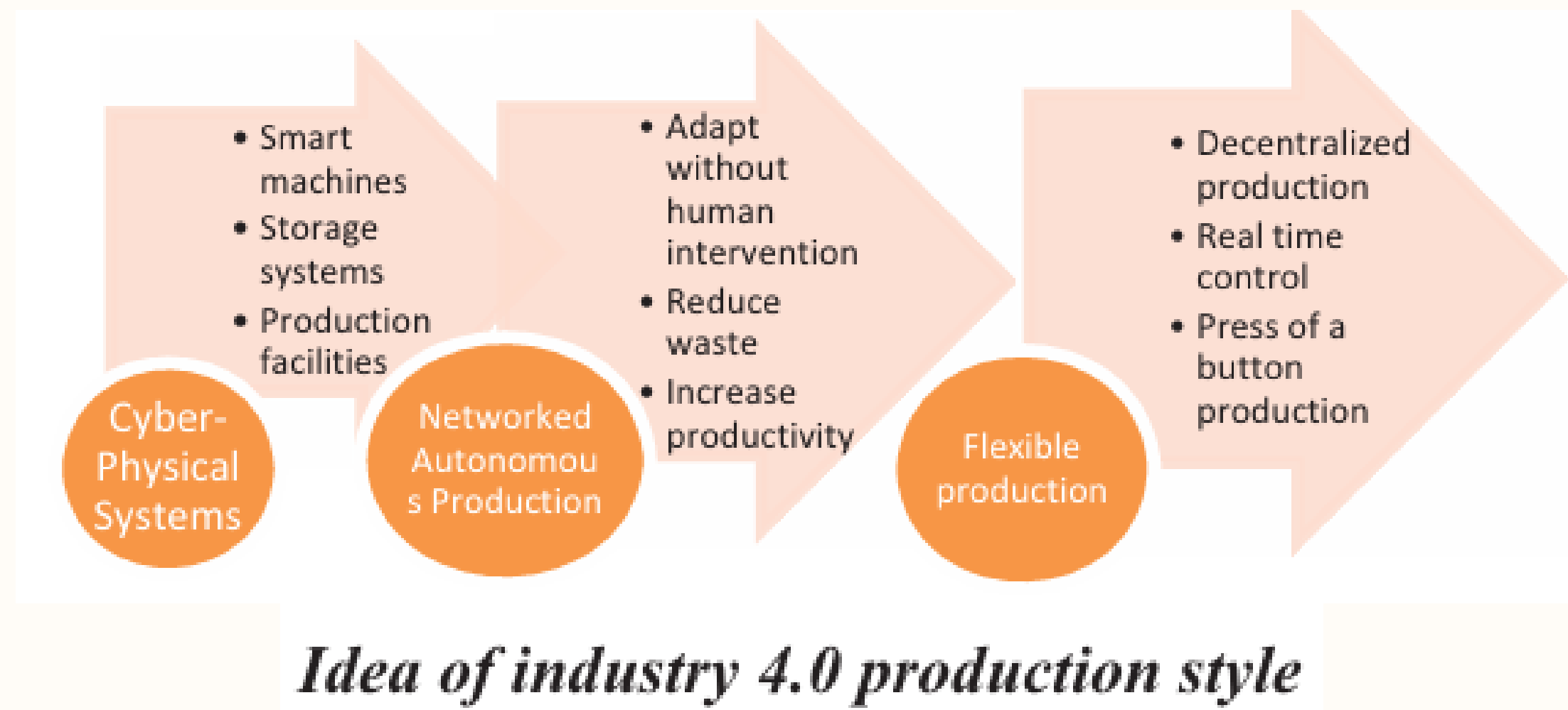
- Lack of skilled workforce
- Aging society
- Resource efficient and clean urban production
- Mass customization
- Increasing product variability
- Shorter product life cycle
- Dynamic value chain
- Volatile markets
- Cost reduction pressure

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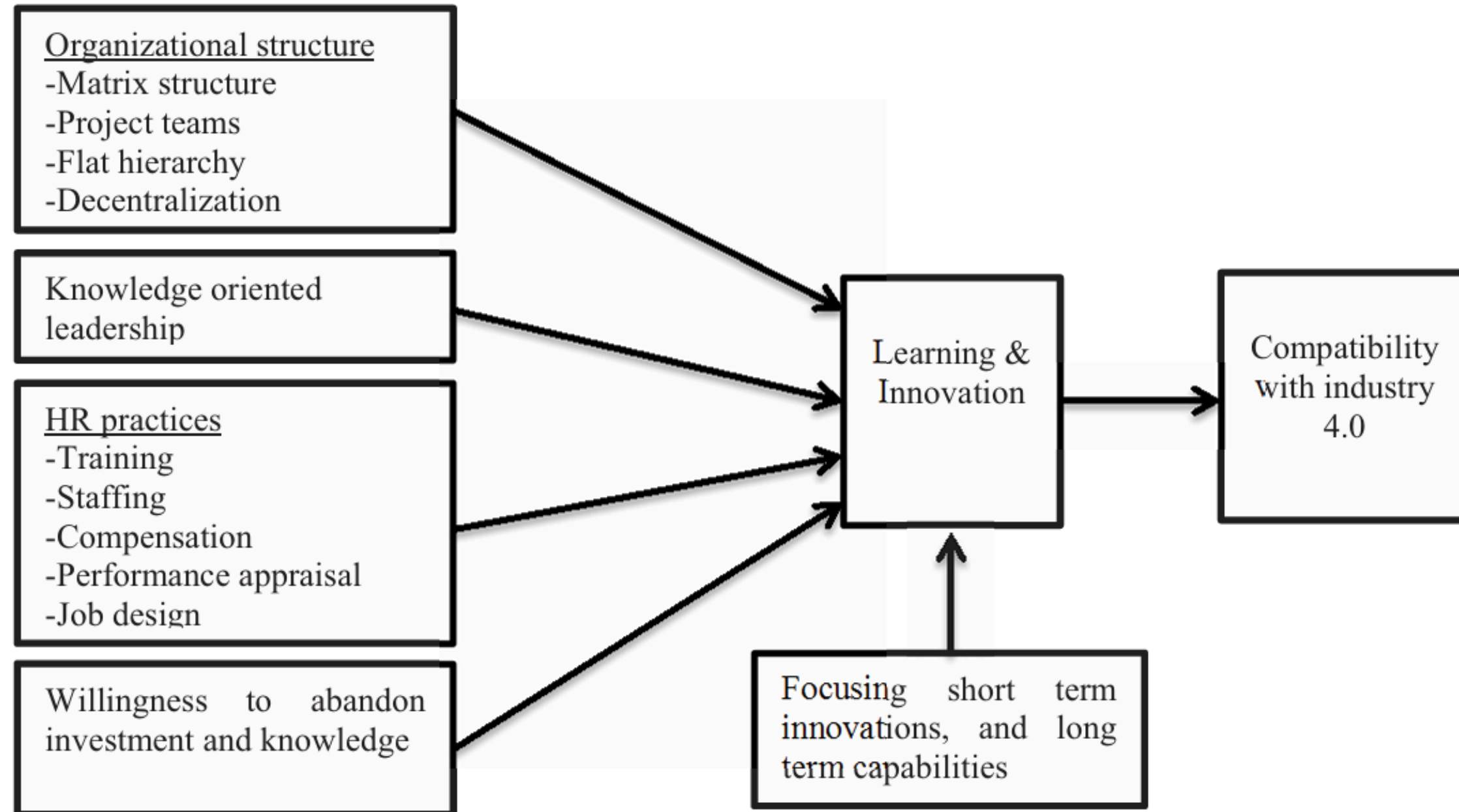
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- China - challenge -clean urban production -high pollution
- aging work force
- customization and cost reduction -conflicting
- short term innovation



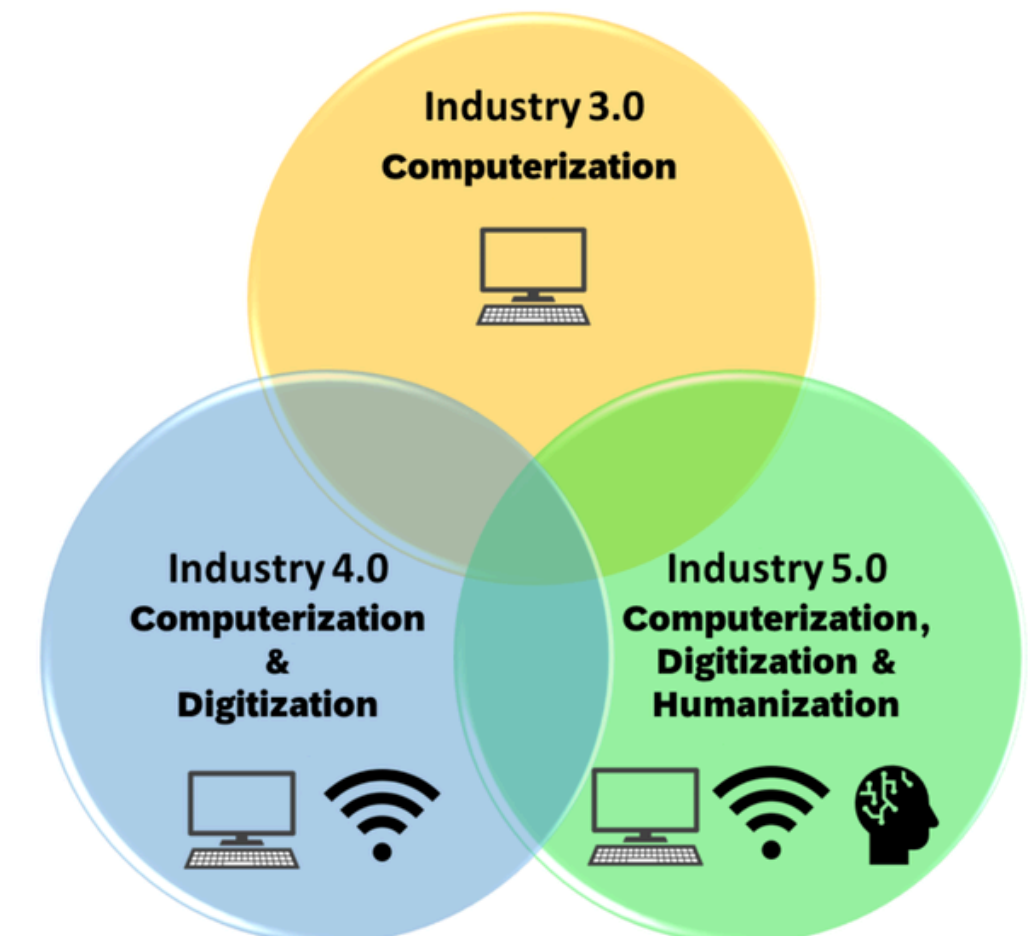
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- organic design
- Unstable environment
- groups people and resources by function and products
- knowledge sourcing
- fewer level of hierarchy, and Wide span of control
- timely decision
- knowledge, learning and innovation- leader
- multitasking for employees
- heterogeneous knowledge
- profit sharing, and additional incentive pay
- MBO
- job rotation, flexible assignments in multiple areas



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- income of the country
- human capital - ability to absorb advanced technology
- human capital development, R&D, income,
- strong financial system , degree of international trade
- transfer of funds
- financial development
- improving the degree of innovation
- incentives and initiatives to invest in new technology
- institutional development, infrastructure, and government policies
- globalization- open trade structure



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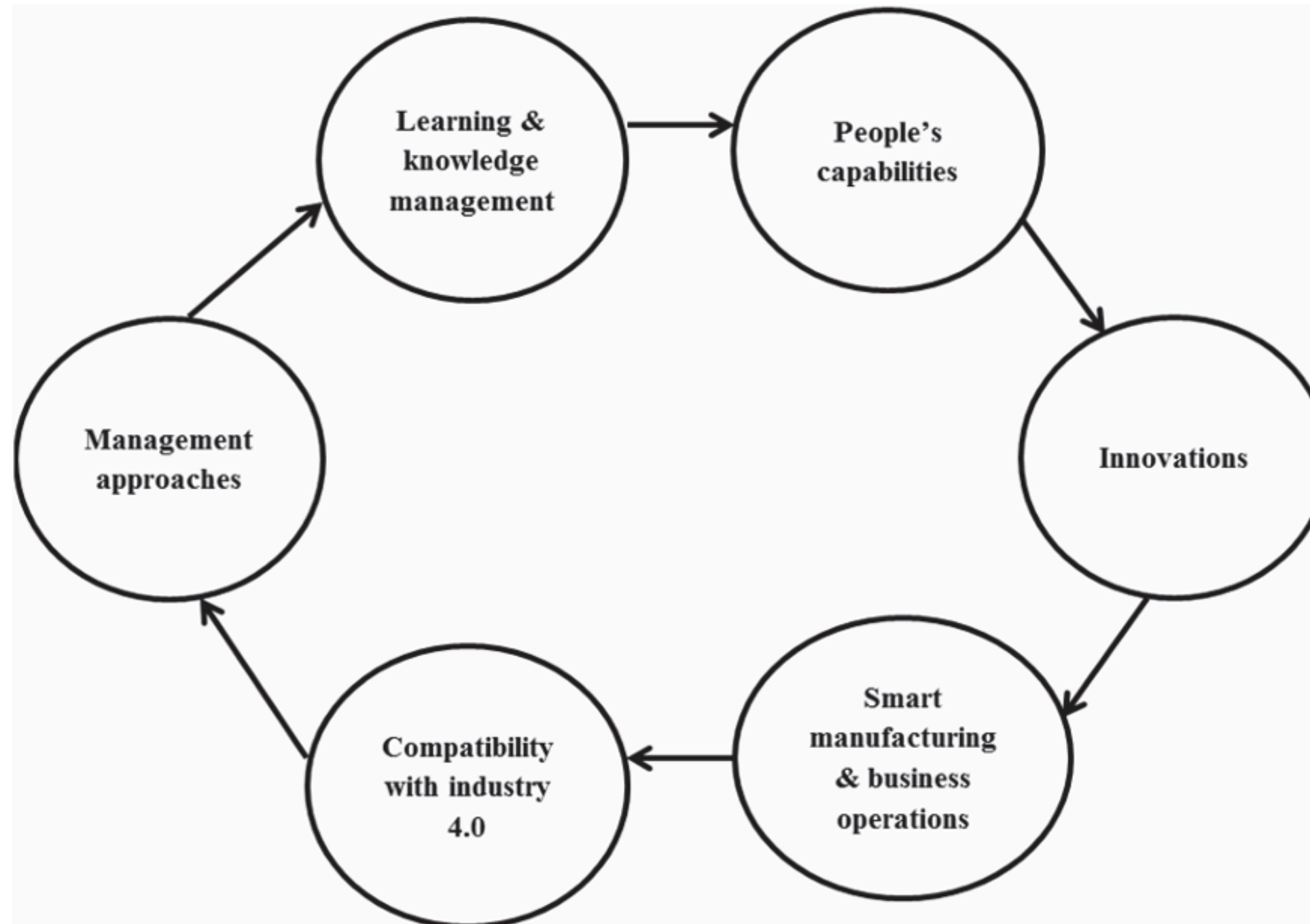


Figure 5, Management practices leading to the compatibility with industry 4.0

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- global income levels
- quality of life for populations
- remote buying
- customer expectations -
- on product enhancement-quality, speed, or price
- on collaborative innovation
- on organizational forms
- growing transparency, consumer engagement, and new patterns of consumer behavior
- lower the barriers for businesses and individuals to create wealth,
- altering the personal and professional environments of workers
- Physical products and services Value enhanced with digital capabilities
- simple digitization to innovation based on combinations of technologies

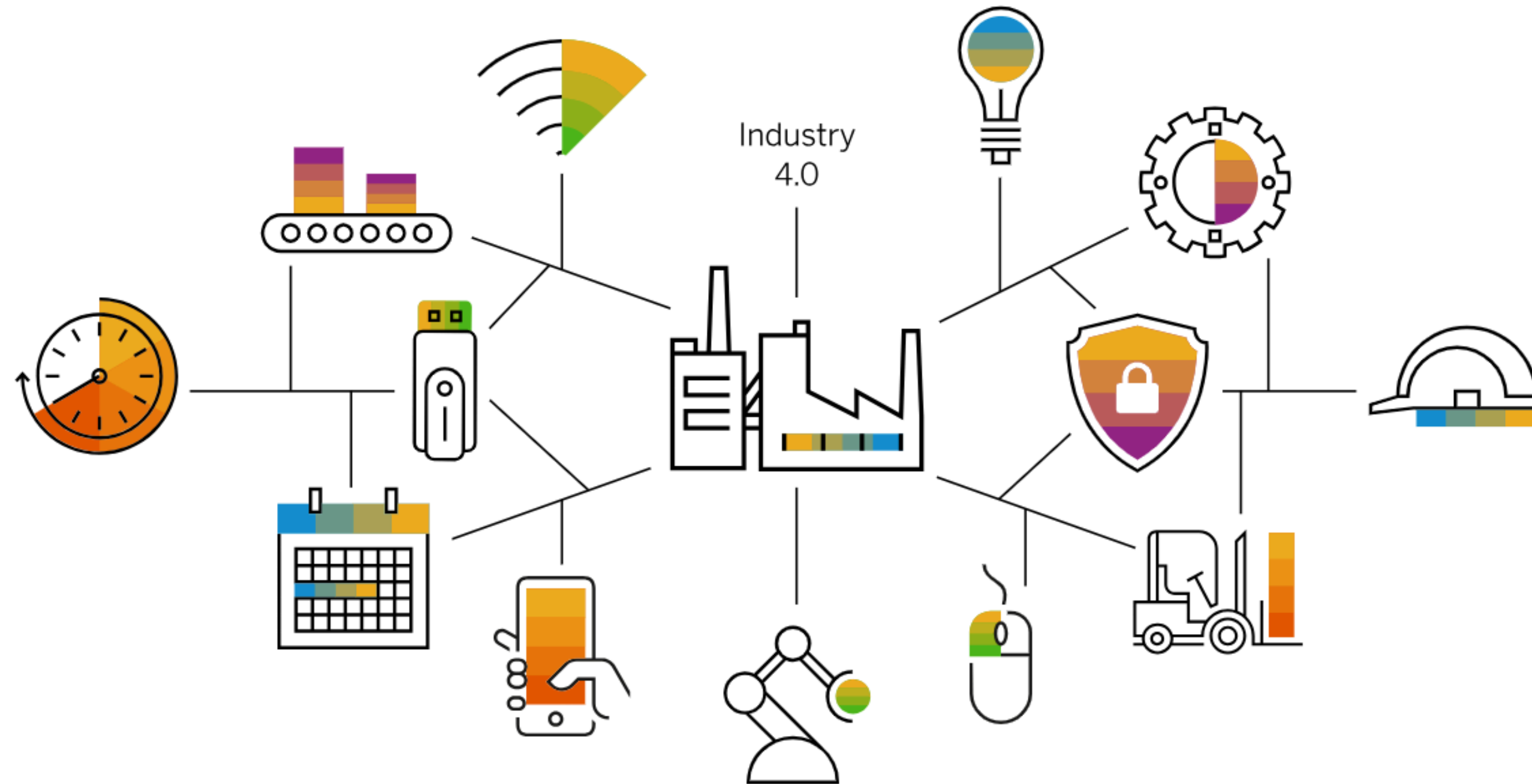
**cognitive horizon -
sum total of all the
knowledge a system
or human .**

Adidas - 3D scan

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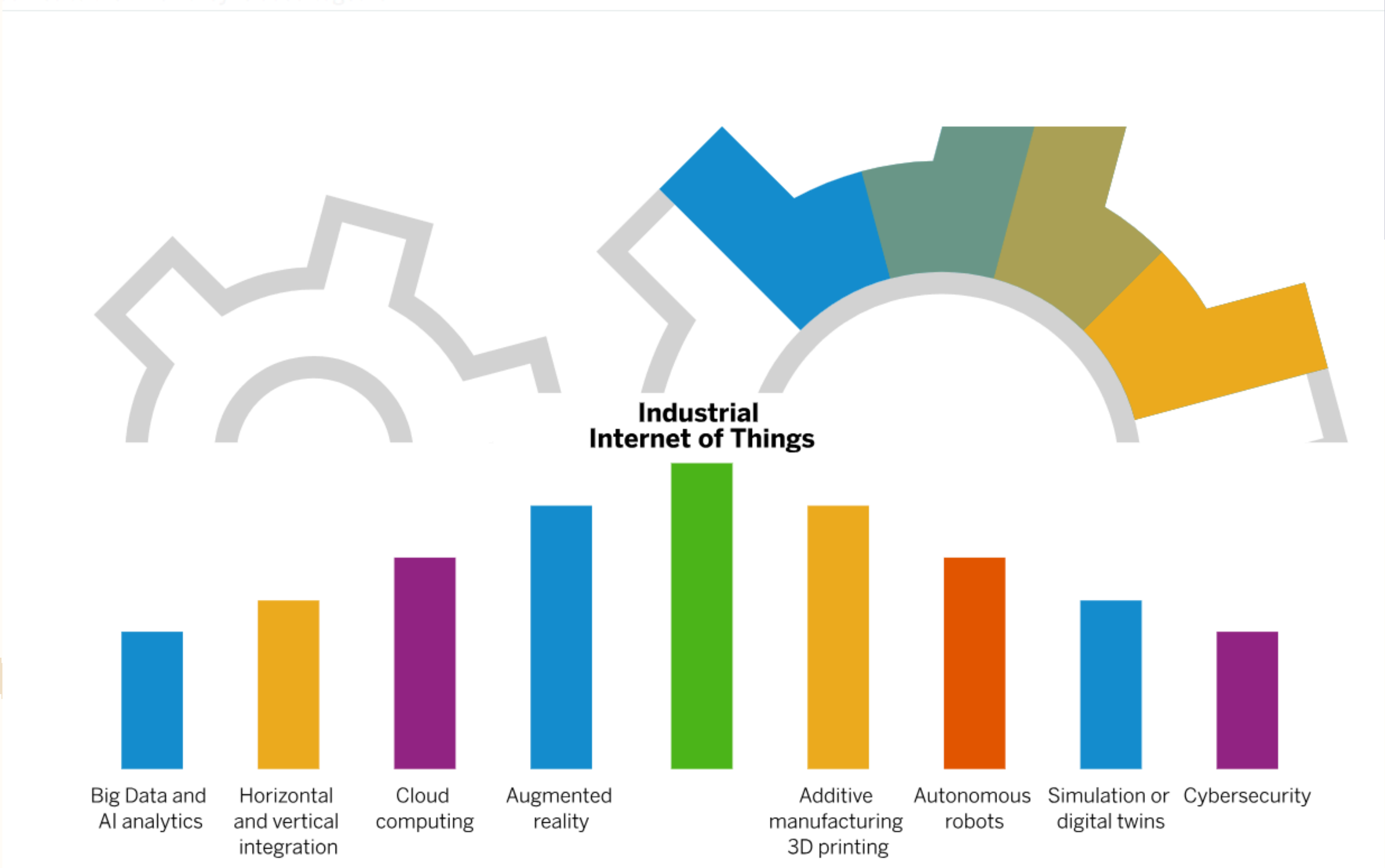
- Cloud Computing - AI, Machine learning, and IOT integration
- Cybersecurity -more devices are connected and exchange information
- **Augmented reality**-increase productivity and working quality, and allow for better use of human resource
- **Additive manufacturing**-product development by allowing for quicker testing and reducing time to market
- **Robotics**- expert systems, autonomous robots, and digital assistants
- **Machine learning** -artificial intelligence that allows systems and algorithms to improve based on experience
- **Computer simulation**- planning and exploratory models
- Cyber physical systems
- Edge computing -Brings communication closer to the source

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“ The general definition of Industry 4.0 is the rise of digital industrial technology ... Industry 4.0 transformations allow us to work alongside machines in new, highly productive ways. ”

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- convergence of digital, biological, and physical innovations
- digital technologies from the Third Industrial Revolution
- transformative technologies
 - artificial intelligence,
 - genome editing,
 - augmented reality,
 - robotics, and 3-D printing
- science provide systemic changes over different sectors
- gene sequencing & modification - building blocks of life
- artificial intelligence enhancing processes across industries
- neurotechnology -understanding and influence over the brain
- automation



Honda's latest version of the Asimo humanoid robot walks up stairs during a presentation in Zaventem near Brussels, July 16, 2014.

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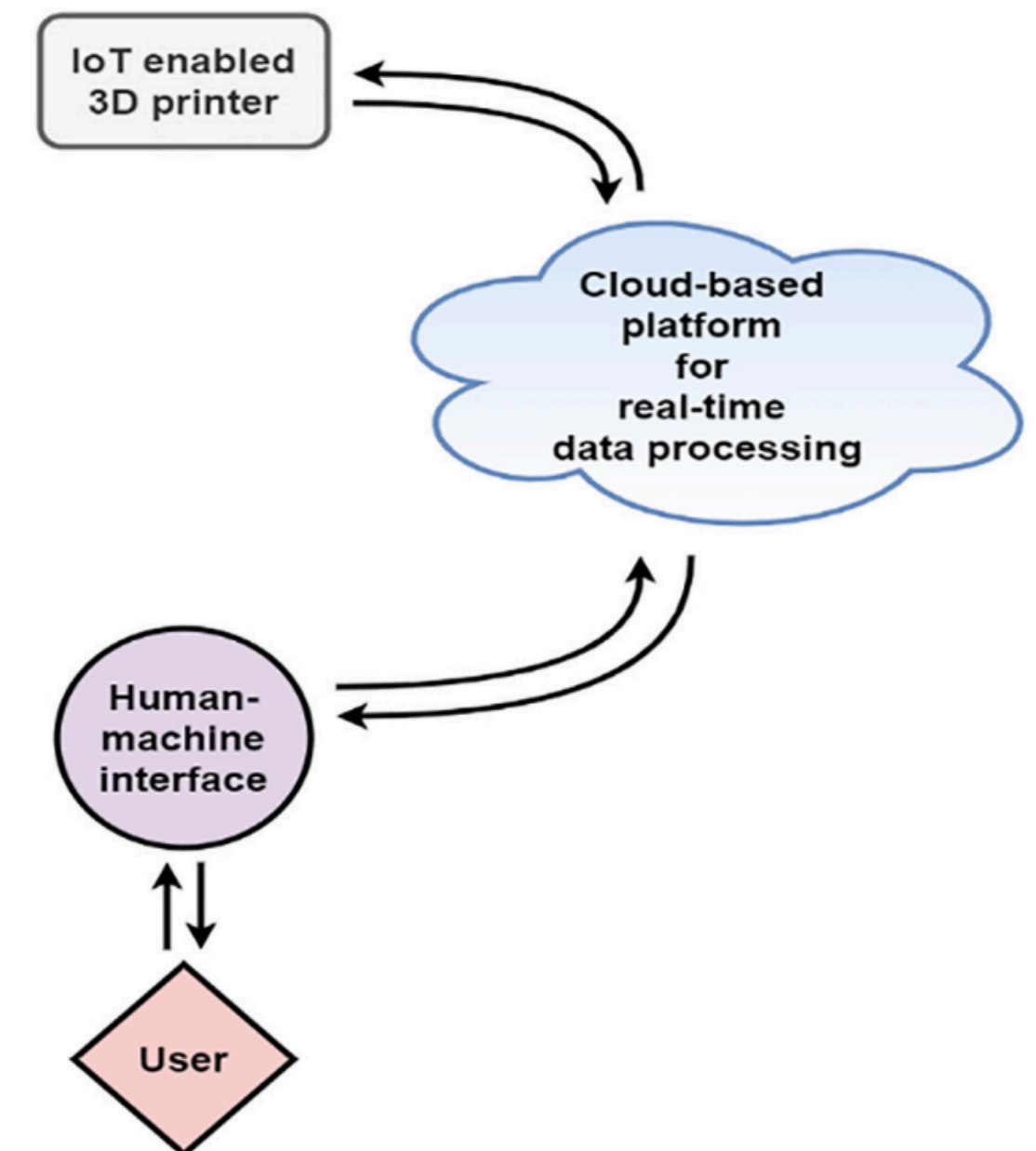
- Manufacturing accounts for more than 16% of global gross domestic output (GDP)
- Make in India - manufacturing skills
- **Smart Materials**
 - reduction of the electronic waste
- **Self-healing materials:**
 - mimic the immune system of biological organisms and repair themselves
 - technologically created, intrinsic ability to mend itself without the need for external diagnostics or human intervention
 - adapt to various environmental circumstances using sensing and actuation.
 - Self-Healing through Structural Adaptation
 - IOT -highly versatile electronics platform , different modular building blocks -easily constructed and changed for various uses. personalised sensors

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Smart Materials

- AM techniques -printing programmable materials ,
 - change their functional properties in response to changes in the environment
- 4D bioprinting -medicine 4.0. Intelligent materials -
 - shape memory polymers ,customized organs that adjust their shapes accordingly when inserted inside a human body
- Rutgers University -3D printed light-responsive smart gel - changes its physical properties in response.
 - The smart gel contracts in response to light and can be used for developing medical implants



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- Smart materials distinct properties that are developed in controlled factors such as stress, moisture, and temperature control, and electric and magnetic fields control.
- alter thermomechanical, electromagnetic, and optical properties in a regulated environment
- Piezoelectric materials such as bone, crystals, that produce interior electrical charge from applied mechanical stress
- magnetostrictive material is materials that have tiny ferromagnets
- magnetic shape memory -design actuators -element protrudes based on a magnetic field's existence

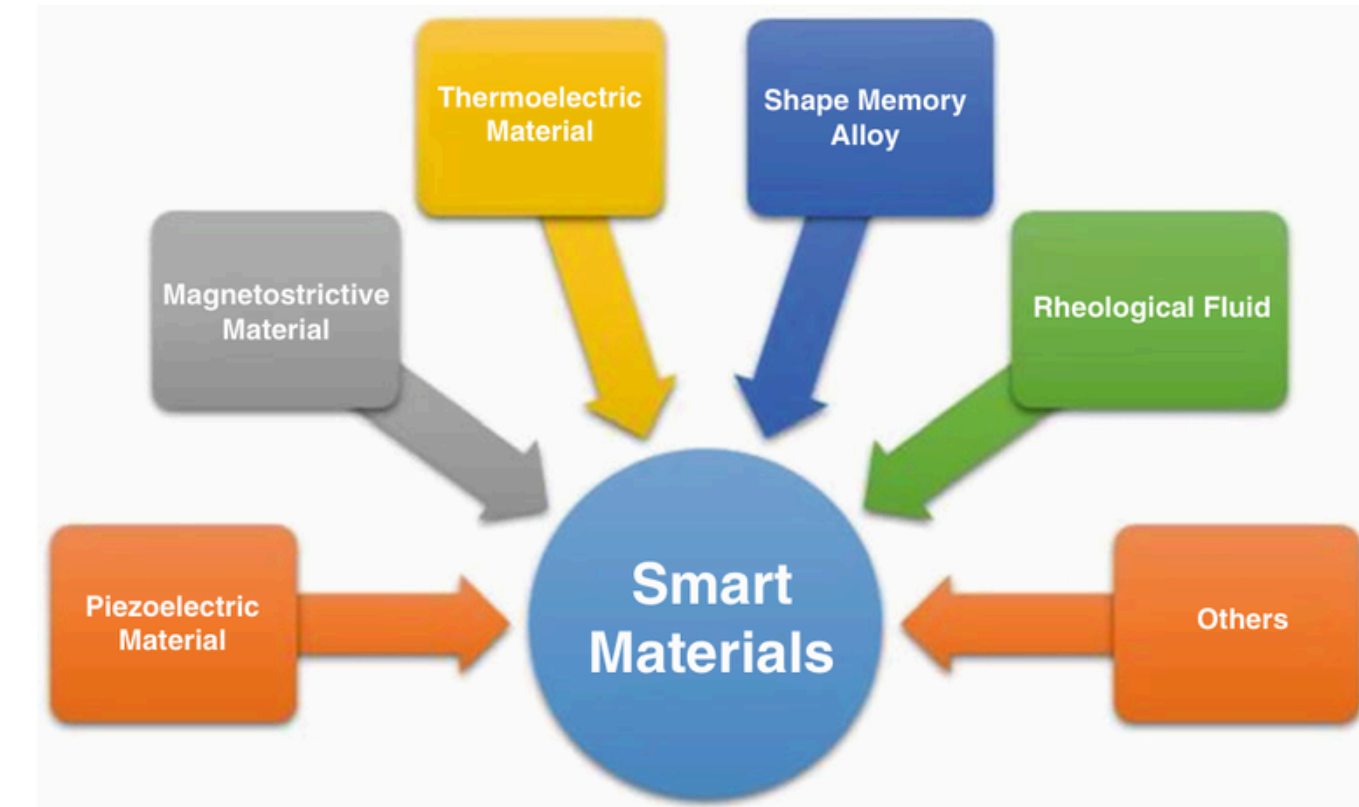


Fig. 1 Different types of smart materials (Applications of Smart Materials 2020)

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- Temperature responsive polymers - change of their physical properties with temperature
- Halochromic material - changes color when pH alteration occurs
- green materials- enhance the environment during processing, consumption, or disposal by conserving resources and minimizing the use of toxic agents, pollution, and waste.
- Active smart materials and passive intelligent materials
- Active materials- modify their material and geometric properties under application of electrical, thermal or magnetic field - transduce energy.
- Piezoelectric materials, shape memory alloys, electro-rheological fluids and magnetostrictive materials- used as sensors and actuators
- Passive smart materials - no capability to transduce energy. Fiber optic materials -for sensing purposes

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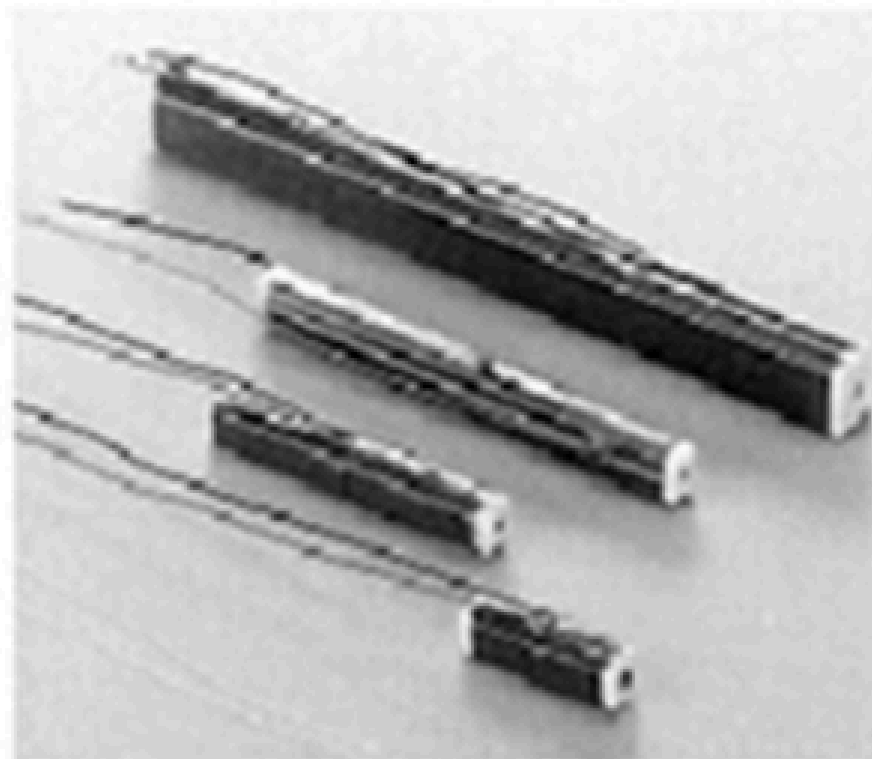
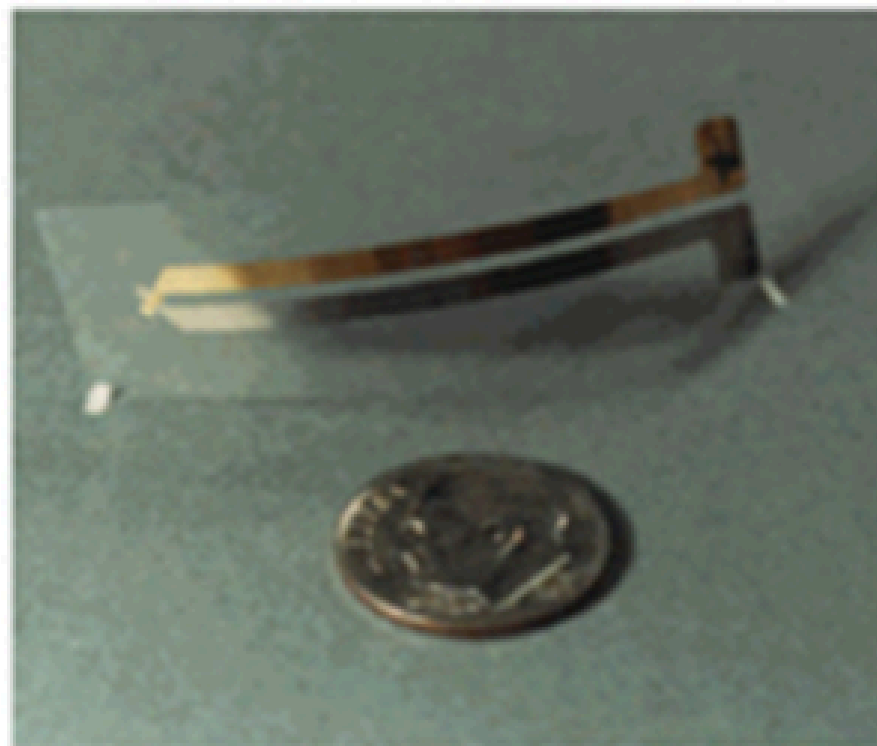


Figure 4.2 Some applications of smart materials: (clockwise) (a) Terfenol-D products (b) SMA Catheter (c) PVDF film and (d) PZT actuator [ETREMA Products Inc. and Sumitomo Metals (SMI) Electronic Devices Inc.]

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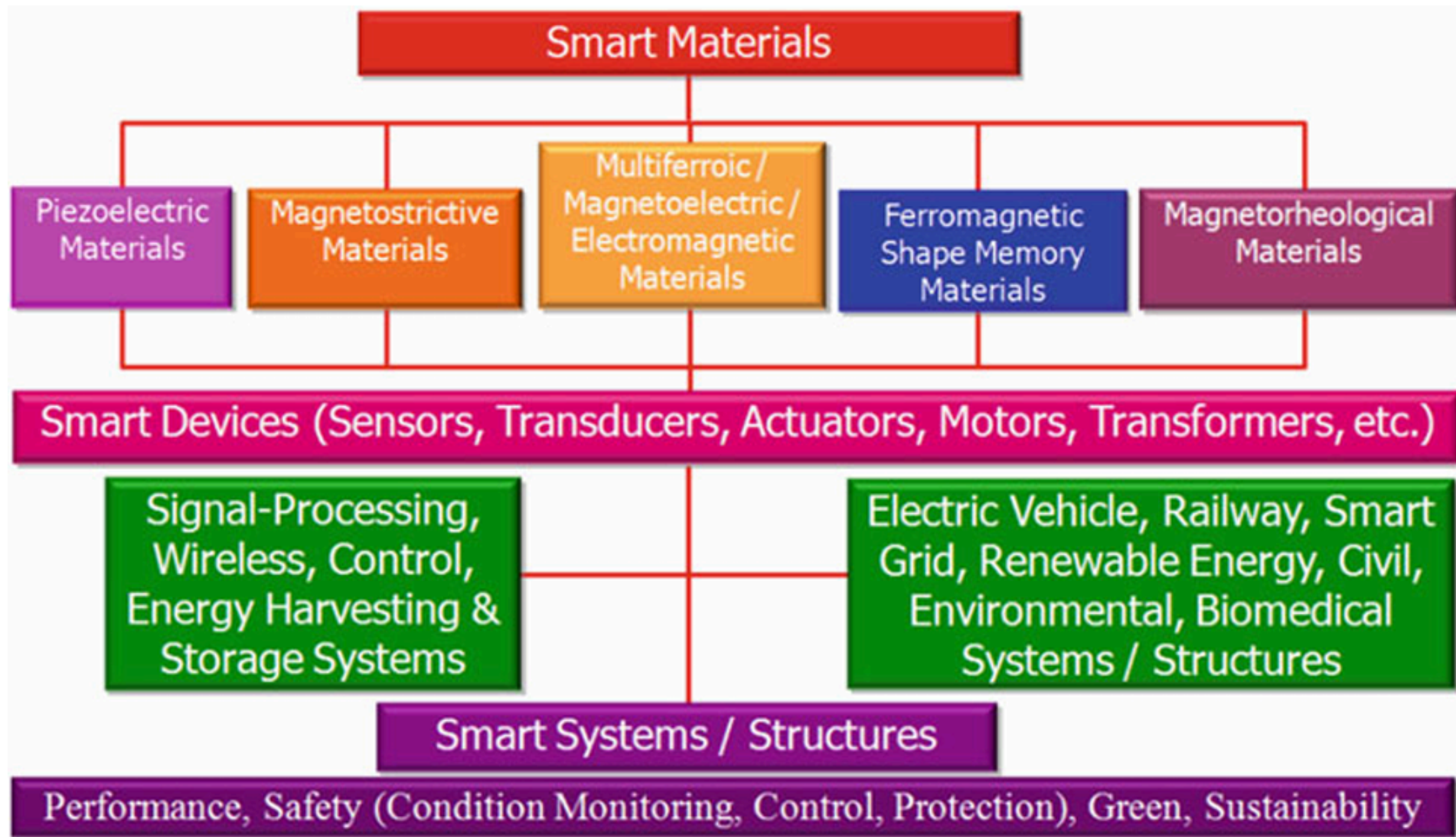


Fig. 2 Smart material and application in transport industry (Applications of Smart Materials 2020)

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- homogeneous materials supplied by nature
- composite materials -properties adapted to specific users
- Boeing's 7E7 Dream liner -50%
- Structural health monitoring (SHM) systems
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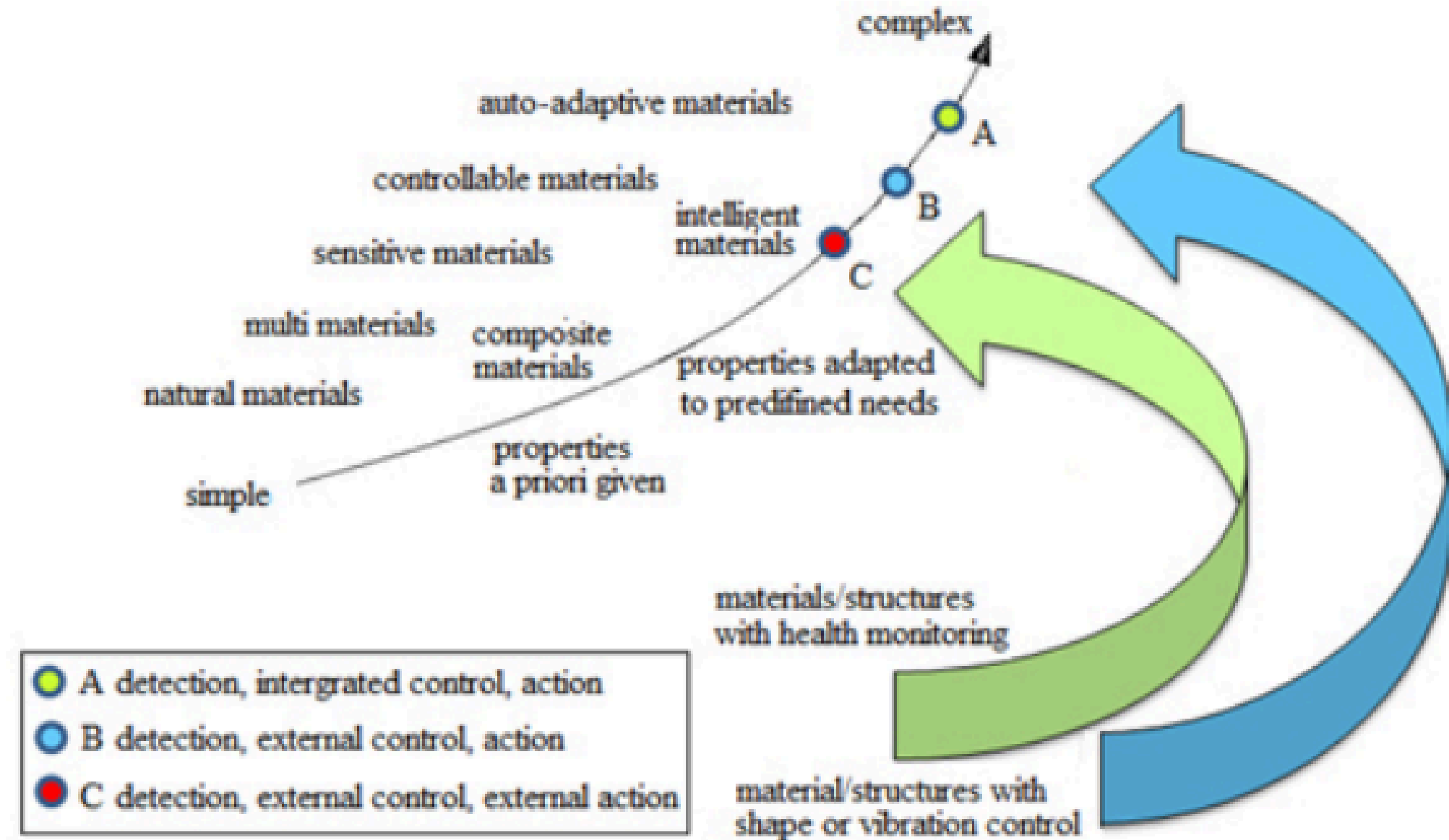


Figure 4.3: General evolutions of materials/structures

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Thanks