Inustry 4.0 & advanced costing techniques required! (A curtain raiser)

Dr. V.V.L.N. Sastry

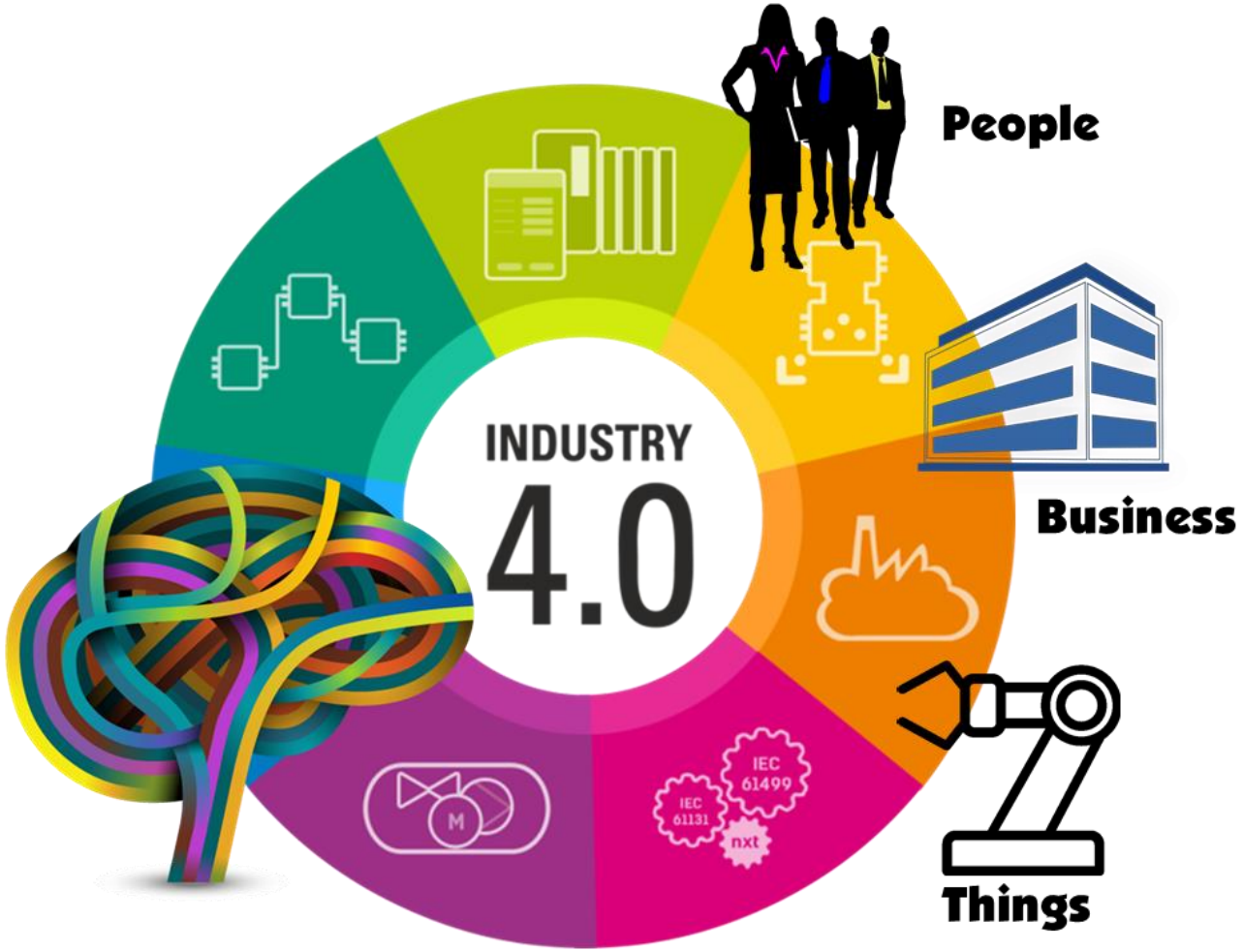
Financial Economist , Jurist, & International Arbitrator

M.E, M.B.A, FCMA (CIMA), CMA, CGMA, CPA, CACA,

MSc (Economic Policy).

LL.B (India), LL.M (U.K), Ph. D (Law, USA).

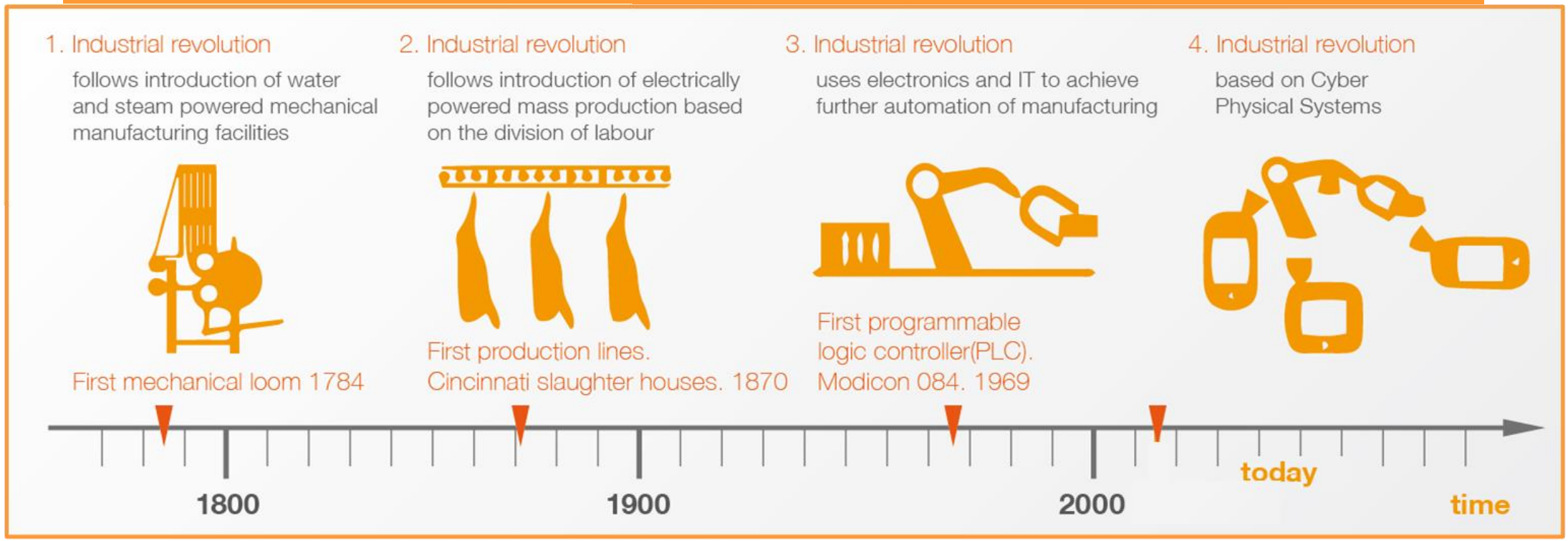
Post Doctorate in Economics



INDUSTRY 4.0

INDUSTRIE 4.0

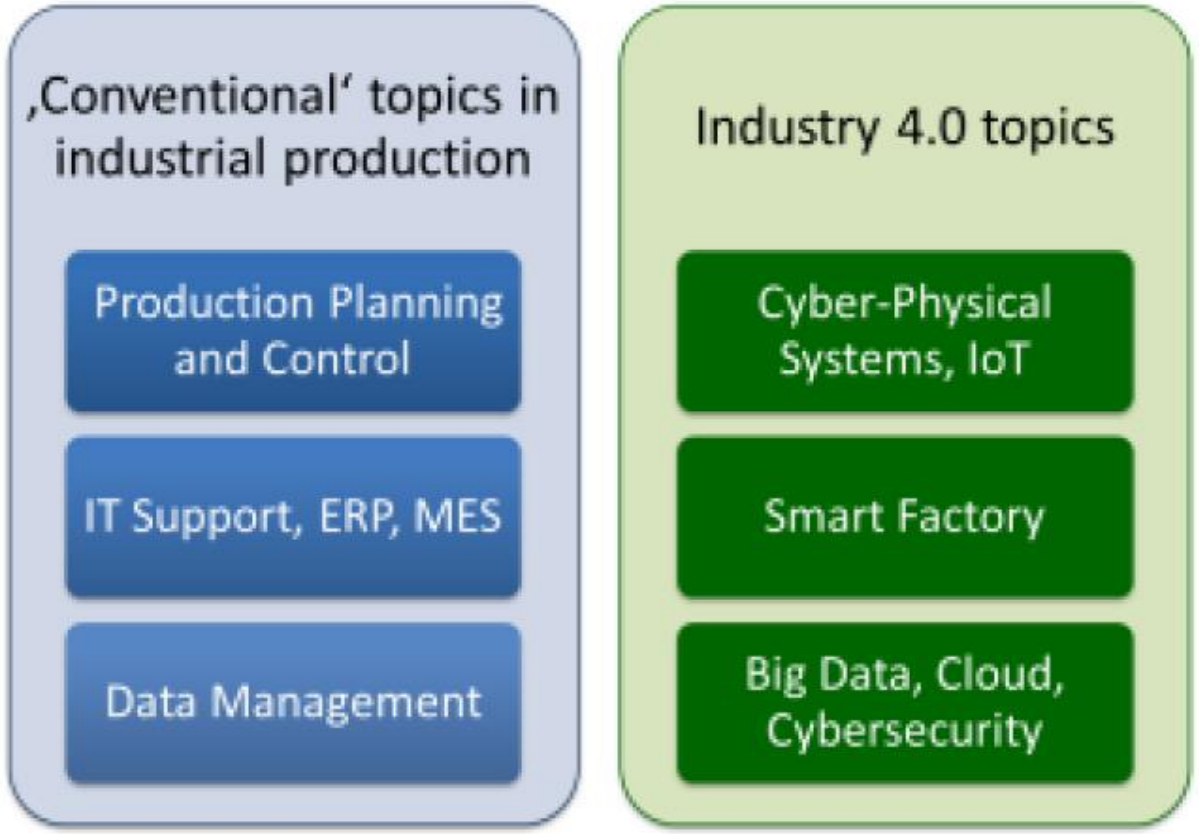
Major trends in industrial evolution



McKinsey & Company

"Industry 4.0 is more than just a flashy catchphrase. A confluence of trends and technologies promises to reshape the way things are made."

Conventional Industrial Production Vs. Industry 4.0



Source: ECPE European Center for Power Electronics e.V., Nuremberg, Germany

Advanced Manufacturing Systems

Sensors
- *Traceability*
- *Predictability*

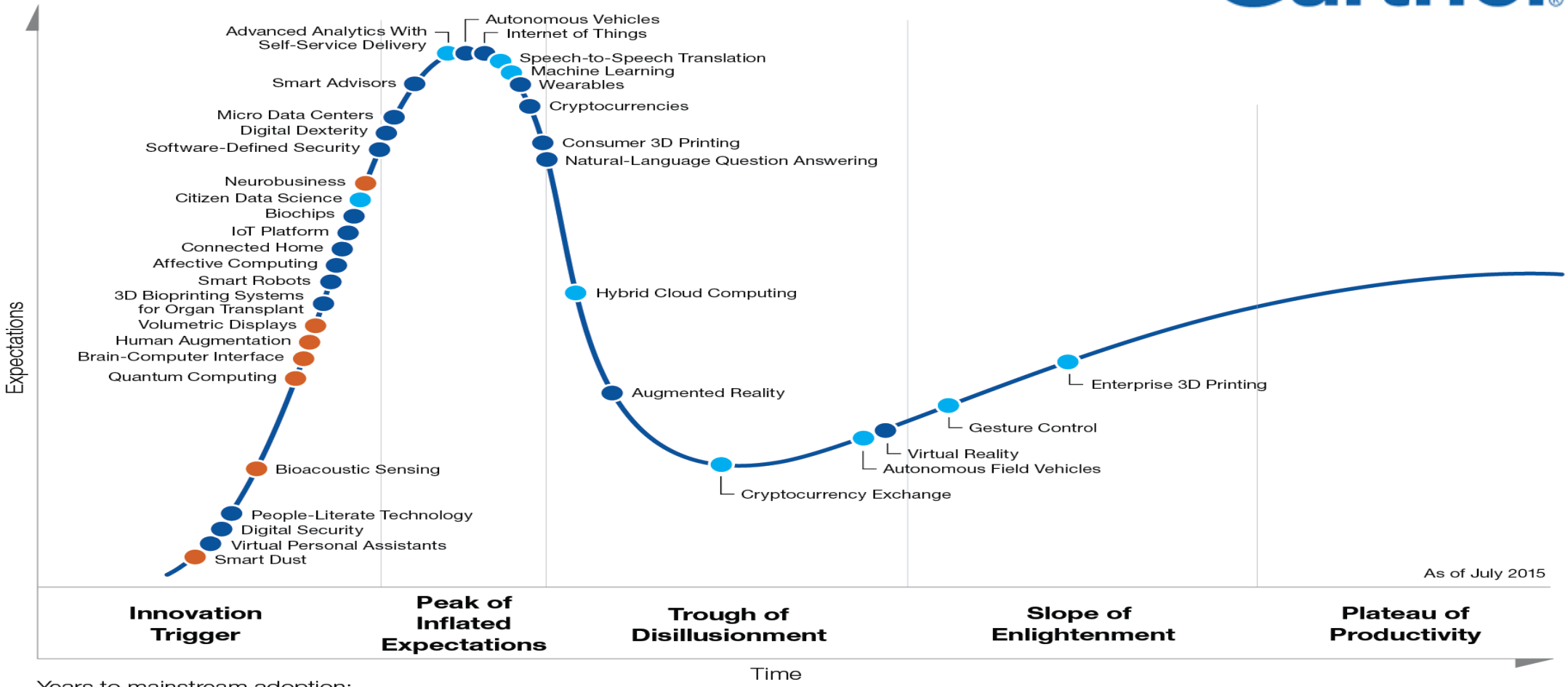
3D Printing
- *Scrap Elimination*
- *Customization*

Cloud Computing
- *Big Data*
- *Cyber Security*

Robotics
- *Autonomy*
- *Productivity*

Emerging Technology Hype Cycle

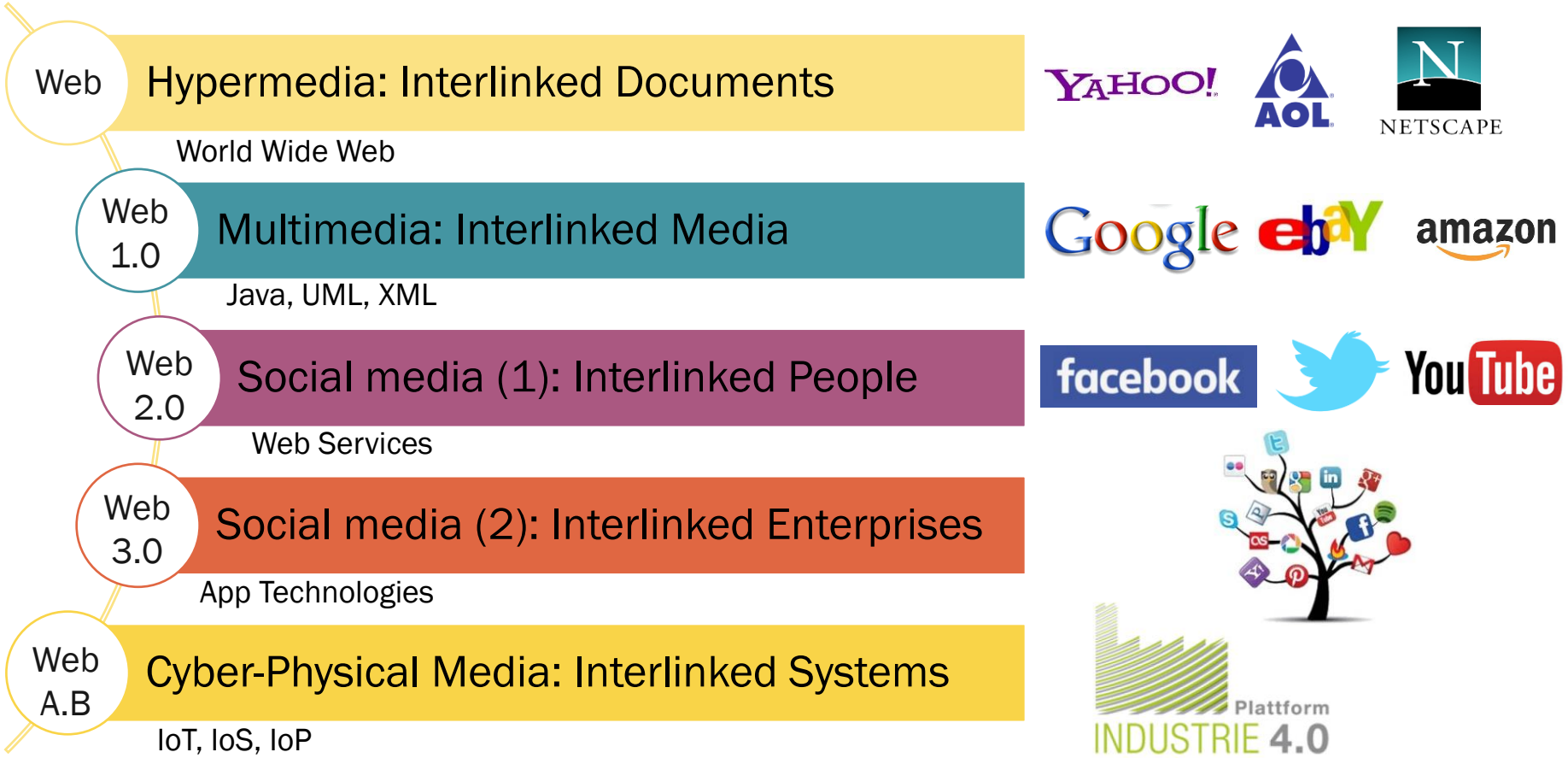
Gartner®

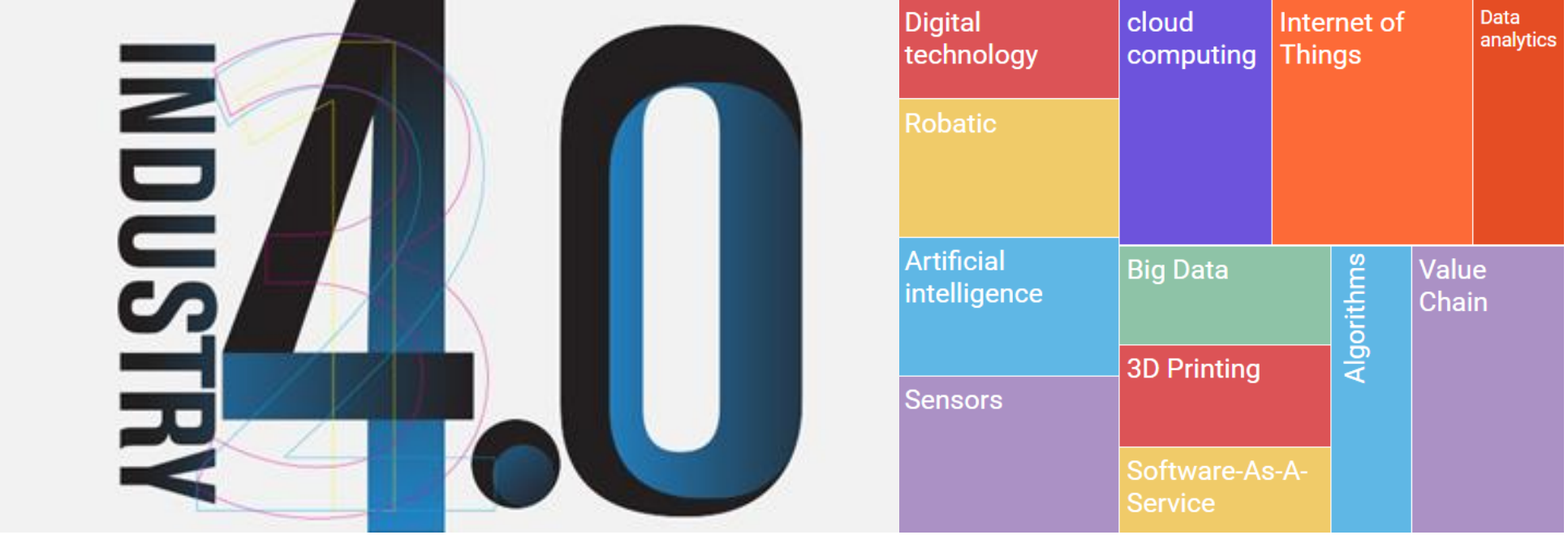


Years to mainstream adoption:

less than 2 years | 2 to 5 years | 5 to 10 years | more than 10 years | obsolete before plateau

The Impact of Information and Communication Technology



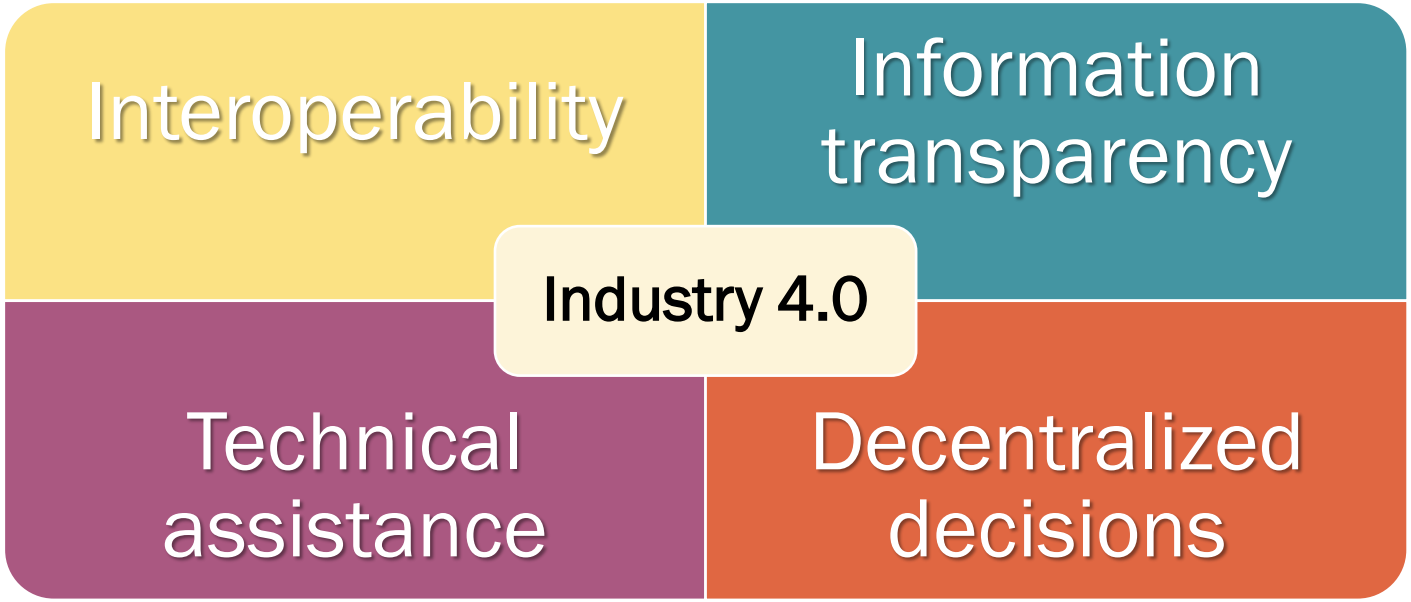


The term Industry 4.0 refers to the combination of several major innovations in digital technology, all coming to maturity right now, all poised to transform the energy and manufacturing sectors. These technologies include advanced robotics and artificial intelligence; sophisticated sensors; cloud computing; the Internet of Things; data capture and analytics; digital fabrication (including 3D printing); software-as-a-service and other new marketing models; smartphones and other mobile devices; platforms that use algorithms to direct motor vehicles (including navigation tools, ride-sharing apps, delivery and ride services, and autonomous vehicles); and the embedding of all these elements in an interoperable global value chain, shared by many companies from many countries.

Design Principles

Internet of Things (IoT)
Internet of People (IoP)

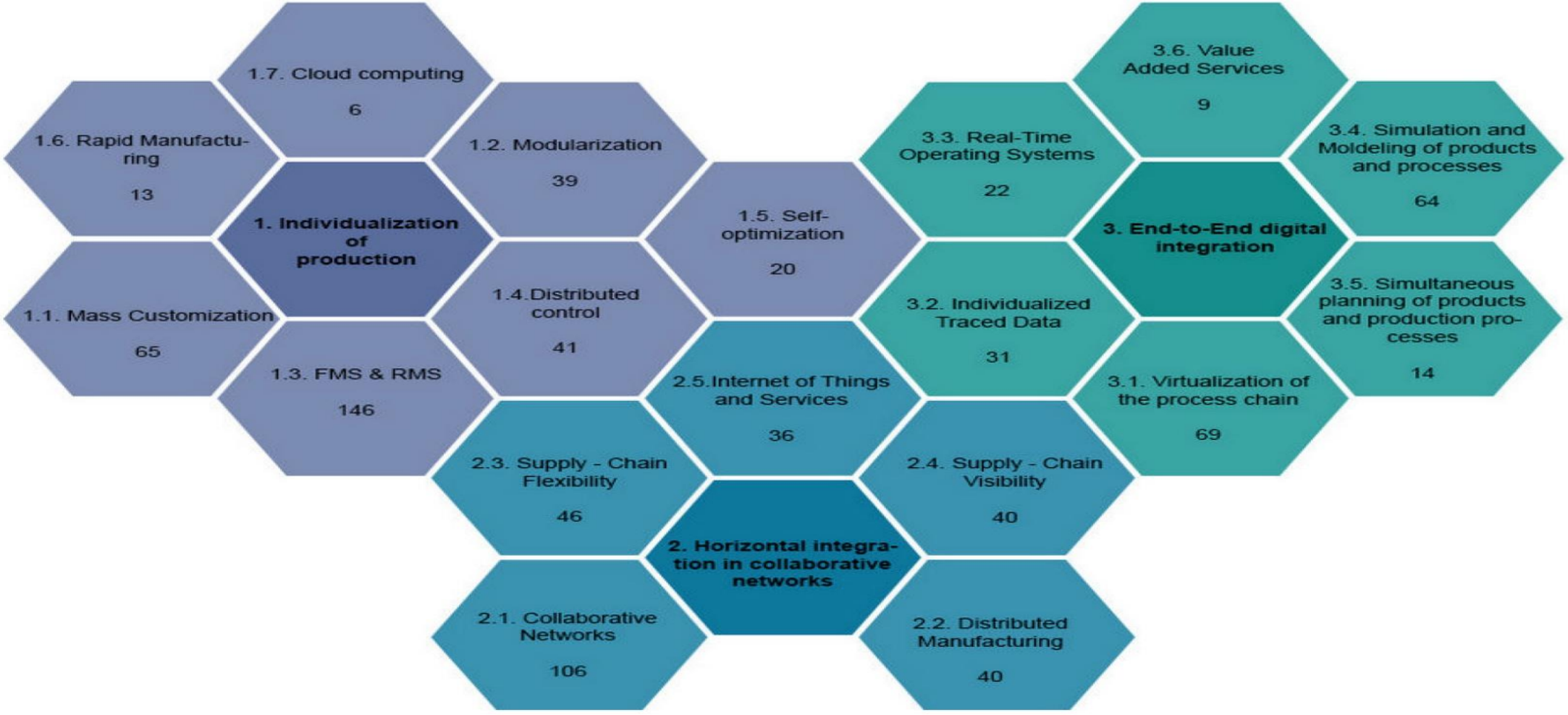
Digital plant models
virtual copy of the physical world



The ability of cyber physical systems to physically support humans by conducting a range of tasks.

The ability of cyber physical systems to make decisions on their own and to perform their tasks as autonomous as possible.

Industry 4.0 related research streams



The numbers underneath the topics illustrate the assigned research articles.

Source: Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An industry 4.0 perspective. International Journal of Mechanical, Industrial Science and Engineering, 8(1), 37-44.

As per Prof Dr-Ing Dieter Wegener

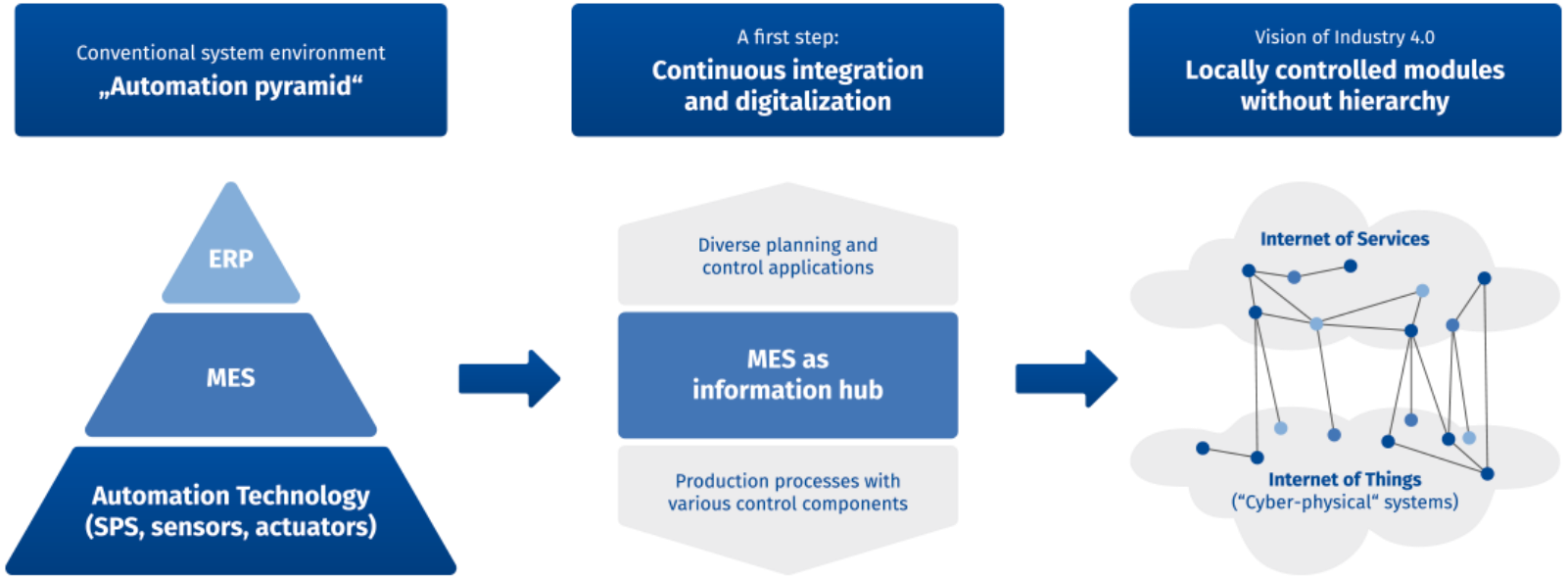
Siemens AG, Digital Factory Division,

“Industry 4.0” Coordinator

- The essence of the Industry 4.0 vision, the “Internet of Things”, is the ubiquitous connection of people, things and machines. This connection is intended to produce a variety of new goods and services.
- Products, means of transport or tools are expected to “negotiate” within a virtual marketplace regarding which production elements could best accomplish the next production step. This would create a seamless link between the virtual world and the physical objects within the real world.
- Examples of factories in which the production processes are digitally supported throughout already exist – however, these processes still have a low level of complexity. A “digital company” with a continuous digital value chain not only digitally integrates the shop floor, but also the development and sales departments from the office floor.

SIEMENS

Today's factory VS. Industry 4.0

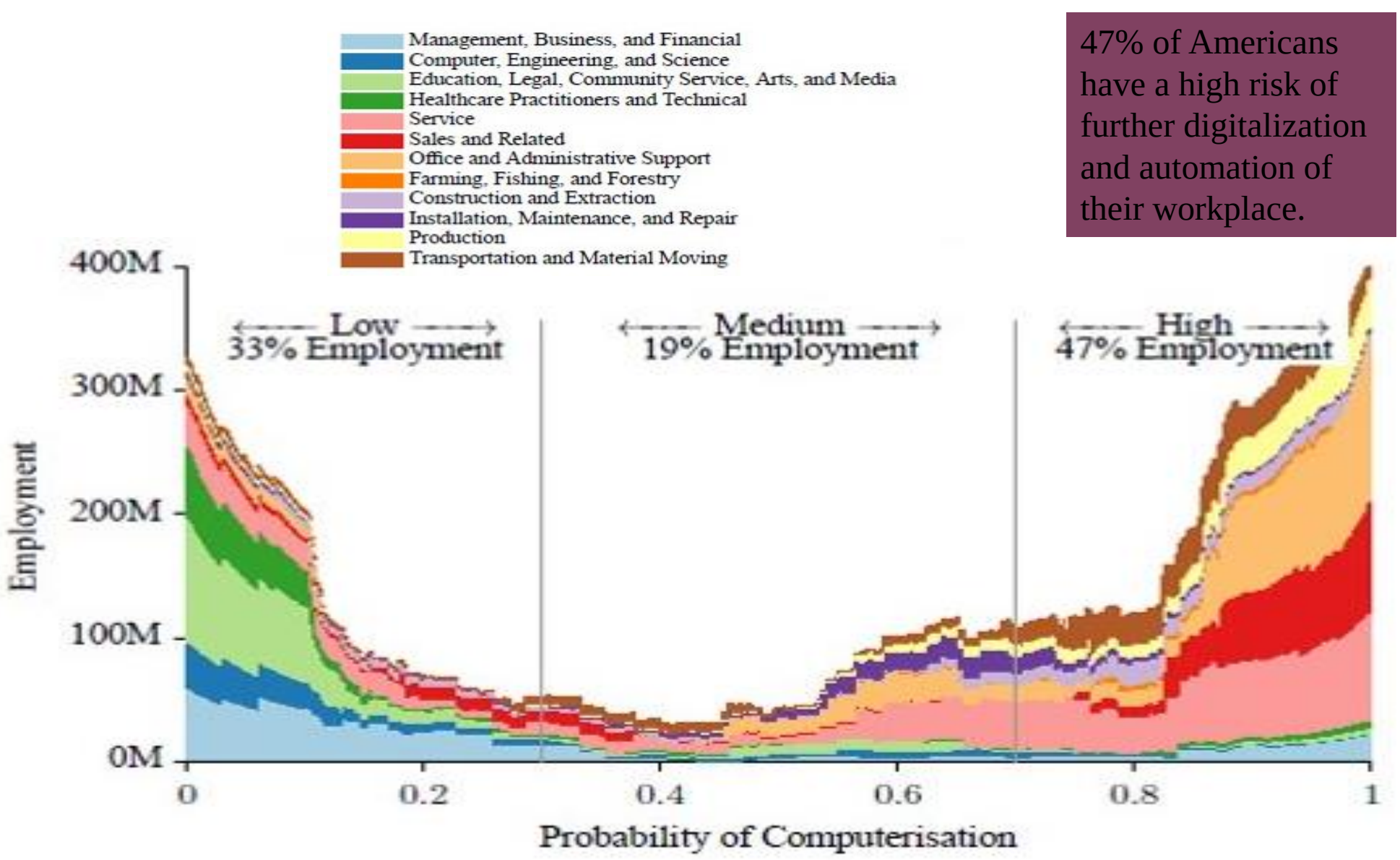


	Data source	Today's factory		Industry 4.0	
		Attributes	Technologies	Attributes	Technologies
Component	Sensor	Precision	Smart sensors and fault detection	Self-aware Self-predict	Degradation monitoring & remaining useful life prediction
Machine	Controller	Producibility & performance	Condition-based monitoring & diagnostics	Self-aware Self-predict Self-compare	Up time with predictive health monitoring
Production system	Networked system	Productivity & OEE	Lean operations: work and waste reduction	Self-configure Self-maintain Self-organize	Worry-free productivity

Source: Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. Manufacturing Letters, 3, 18-23.

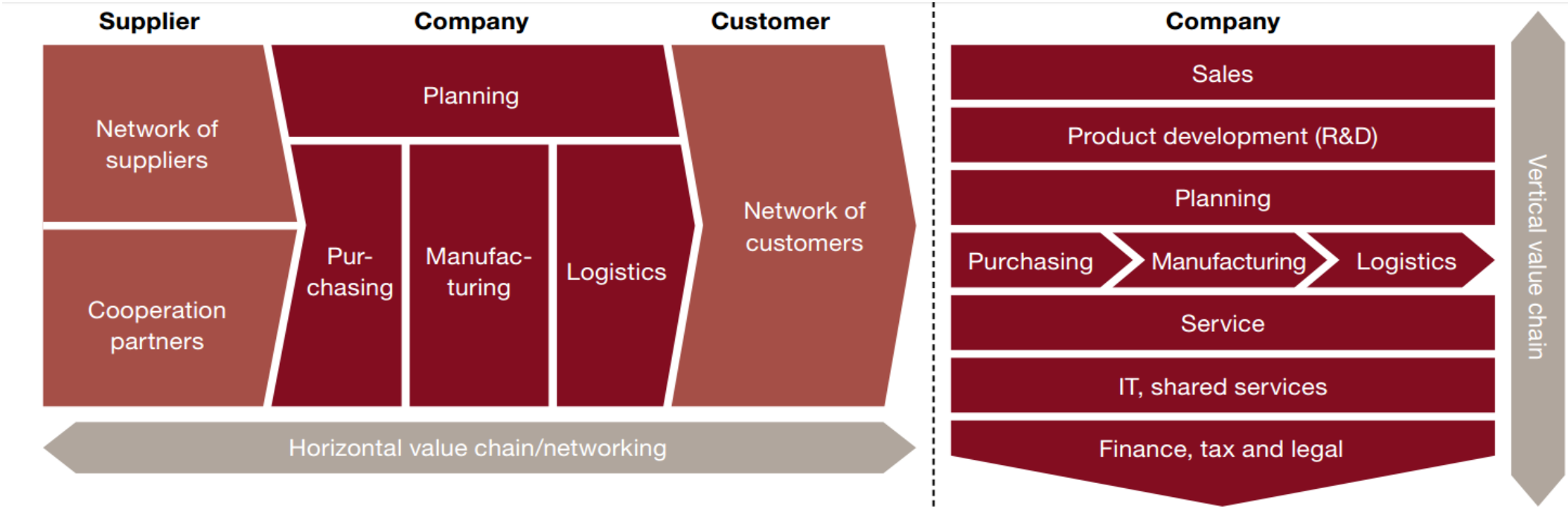
Quantitative repercussions on the number of employees

47% of Americans have a high risk of further digitalization and automation of their workplace.



The impact on employees is not jet quantifiable. Some see the digitalization as part of the future job market, others fear the loss of jobs.

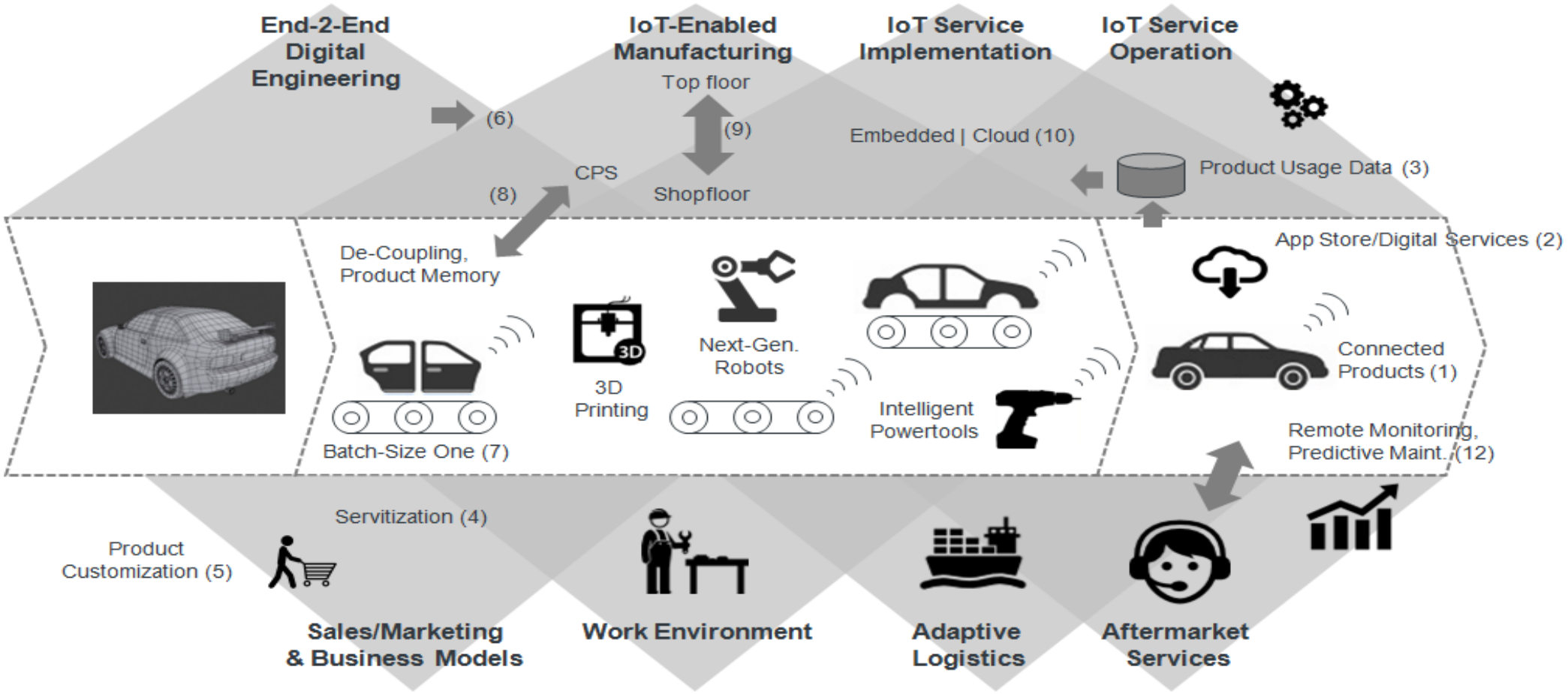
Industry 4.0 requires comprehensive digitization of the horizontal and vertical value chains

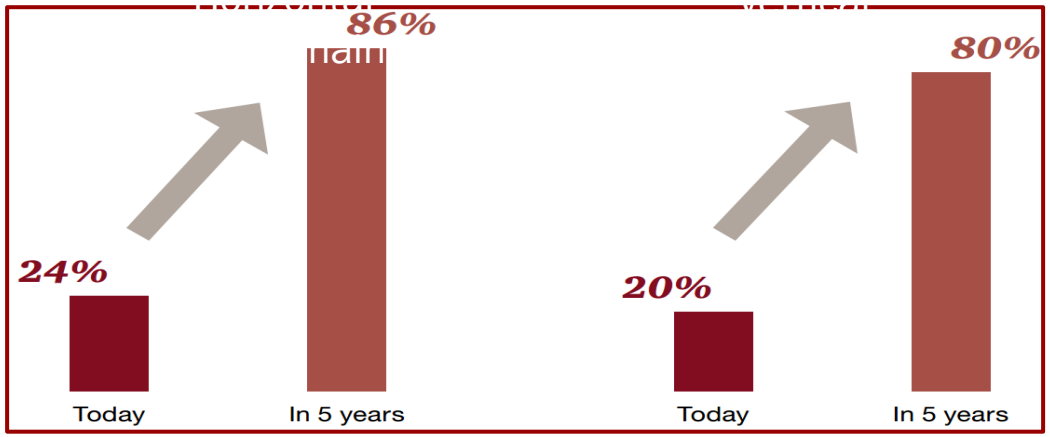


Some of improvements may result from the digitization of processes and value chains:

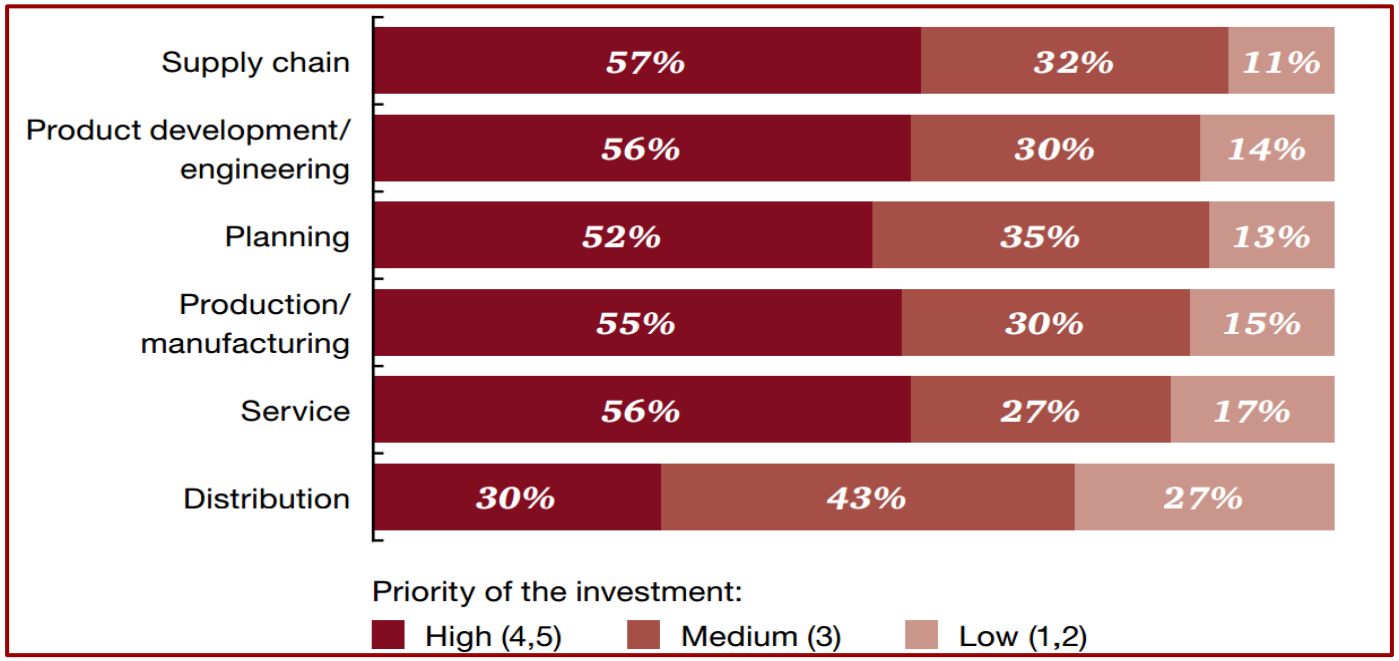
- Focusing on core areas in the individual value chain • Reduction of redundancies in processes
- Minimizing quality losses
- Making processes more flexible and coherent

Industry 4.0: Value Chain





Degree of digitization of the value chain

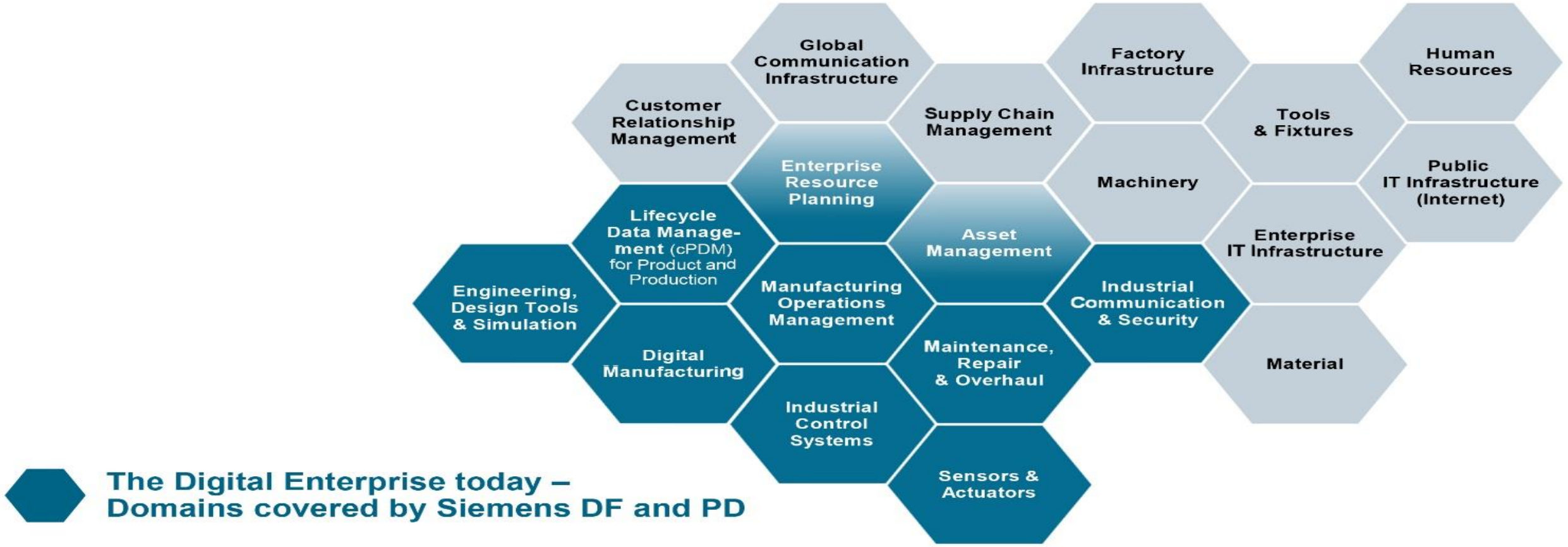


Industry 4.0 investments broken down by steps of the value chain

Results of a study on Industry 4.0 – Opportunities and Challenges of the Industrial Internet, based on a survey of 235 German industrial companies by the market research institution TNS Emnid.

Industrie 4.0 affects all elements of the value chain

Digital Enterprise is the Siemens solutions portfolio



Source: Klaus Helmrich, Member of the Managing Board of Siemens AG, Hannover Messe

An example of use case in combining industry 4.0 with lean production

Industry 4.0	Lean Production	
	Principle: Just-In-Time	**Principle: Jidoka**
	Method: Kanban system	**Method: Andon**
Smart Operator	Employee gets information about remaining cycle time via augmented reality	Wearable computing systems receive failures and display it in real time to the employee
Smart Product	Smart Product contains information of Kanban to realize an order-oriented production	-
Smart Machine	Machines offer a standardized interface for receiving and sending Kanban	Machines send failures directly to Smart Operators and call other systems for fault-repair actions
Smart Planner	IT systems reconfigure production lines and update Kanban according to the new configuration	-

Source: Kolberg, D., & Zühlke, D. (2015). Lean automation enabled by industry 4.0 technologies. IFAC-PapersOnLine, 48(3), 1870-1875.

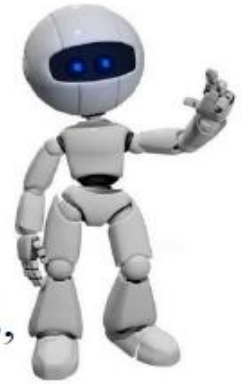
What will come next?

Three clusters merging in cyber physical systems driven by AI and Robots

- Physical, Digital (techno sphere),
- Biological (natural world)

Physical:

- Autonomous technology from DARPA, Google, Tesla, Toyota, 3D printing, Advanced Robotics, New Materials such as polymers, nanomaterials like quantum, new batteries and dot tech



Biological:

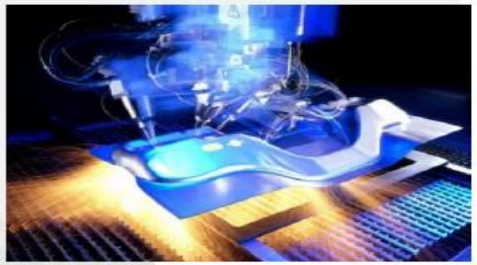
- Genetic analysis.
- Synthetic human genome cell line.
- CRISPR for designer plants, animals, humans, embryo experimentation
- DARPA example: brain implants, Brain interfaces, Mind control of objects, EU Brain project, US Brain initiative

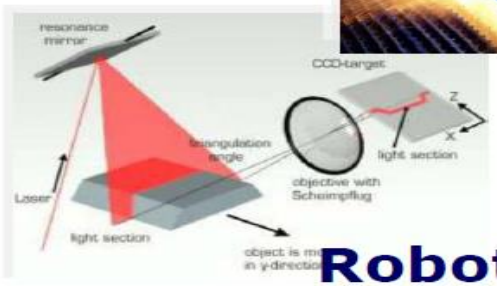
Digital:

Mobile, Smart sensors, Smart devices: heterogeneous computing network, Stochastic network, Arduino, Augmented reality and virtual reality.

Innovative ICT make the difference in Manufacturing

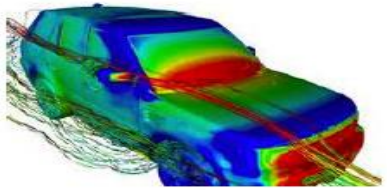
Laser-based manufacturing

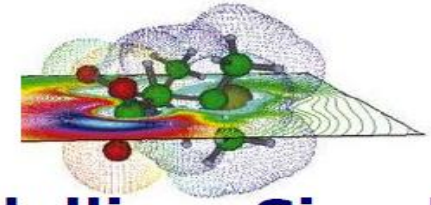




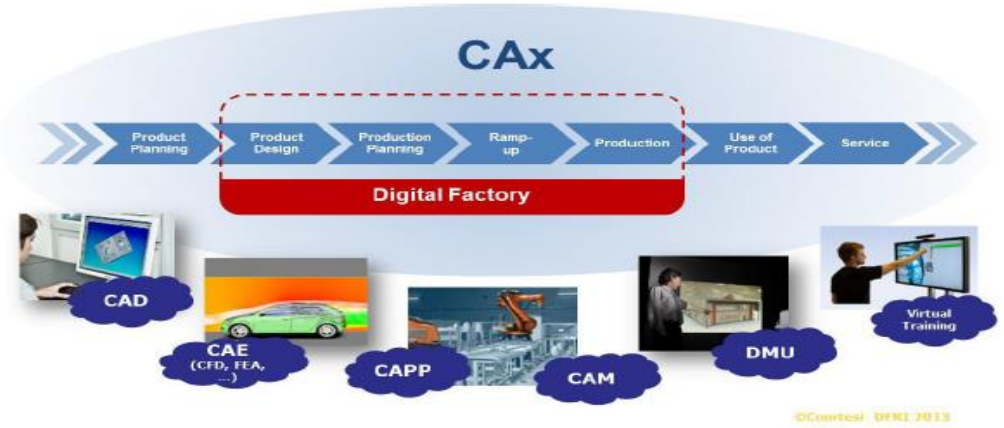
Robotics

Cyber-physical systems for process (chain) optimisation





Modelling, Simulation, Analytics



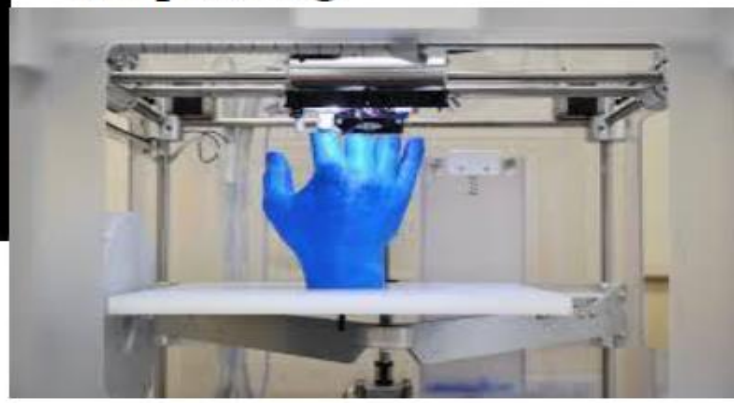
Being Developed

Robotics

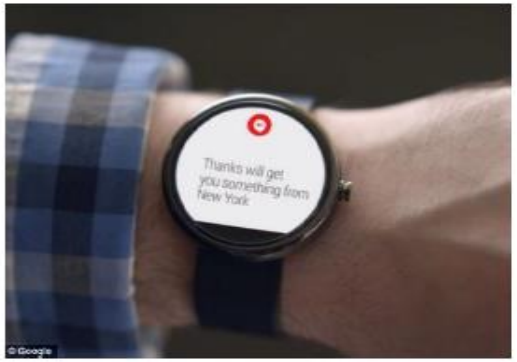
Artificial intelligence

Virtual reality

3D printing



Self driving cars



Google Smart hand watch

AR (augmented reality) and VR (virtual reality) class rooms for training, and manufacturing

AR will soon affect the conventional learning process, and could grant students extra digital information about any subject, and make complex information easier to understand.

Samsung Providing AR in Classroom

AR animated content in classroom lessons could catch students' attention in dynamic day and age

The use of VR is already practiced and highly appreciated in the field of medicine

AR motivate them to study. Adding extra data, short bio of a person, fun facts, historical data about sites or events, visual 3D models, would give students a wider understanding of topics.

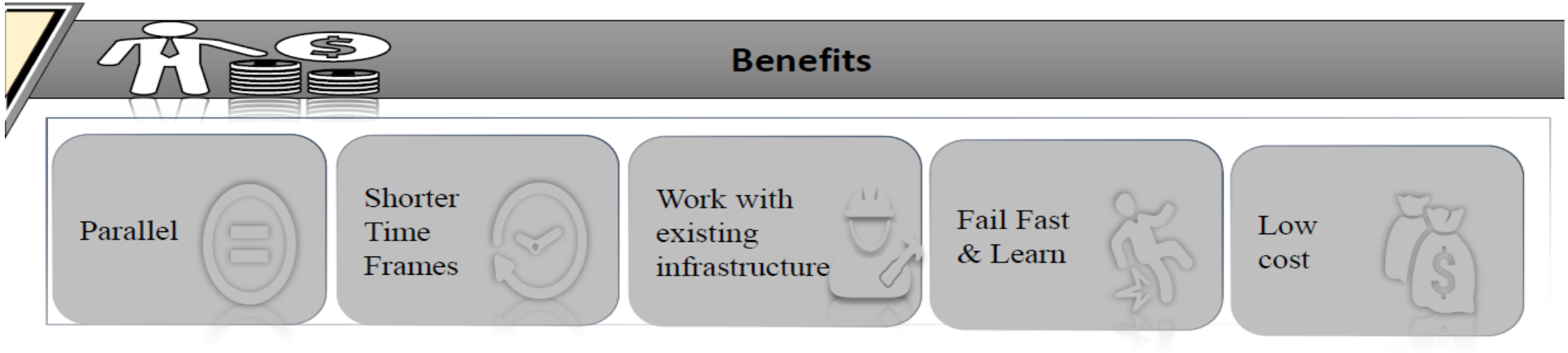
VR in manufactory

Structure and optimise the location.
Flow of production lines.
Position automation lines, robots, production cells
Operate and handle virtual tools and equipment.

Benefits of Industry 4.0

Moving to Industry 4.0 include improved productivity and efficiency, better flexibility and agility, and increased profitability. **Industry 4.0** also improves the customer experience.
This includes technologies that improve automation, machine-to-machine communication, manufacturing oversite, and decision making.

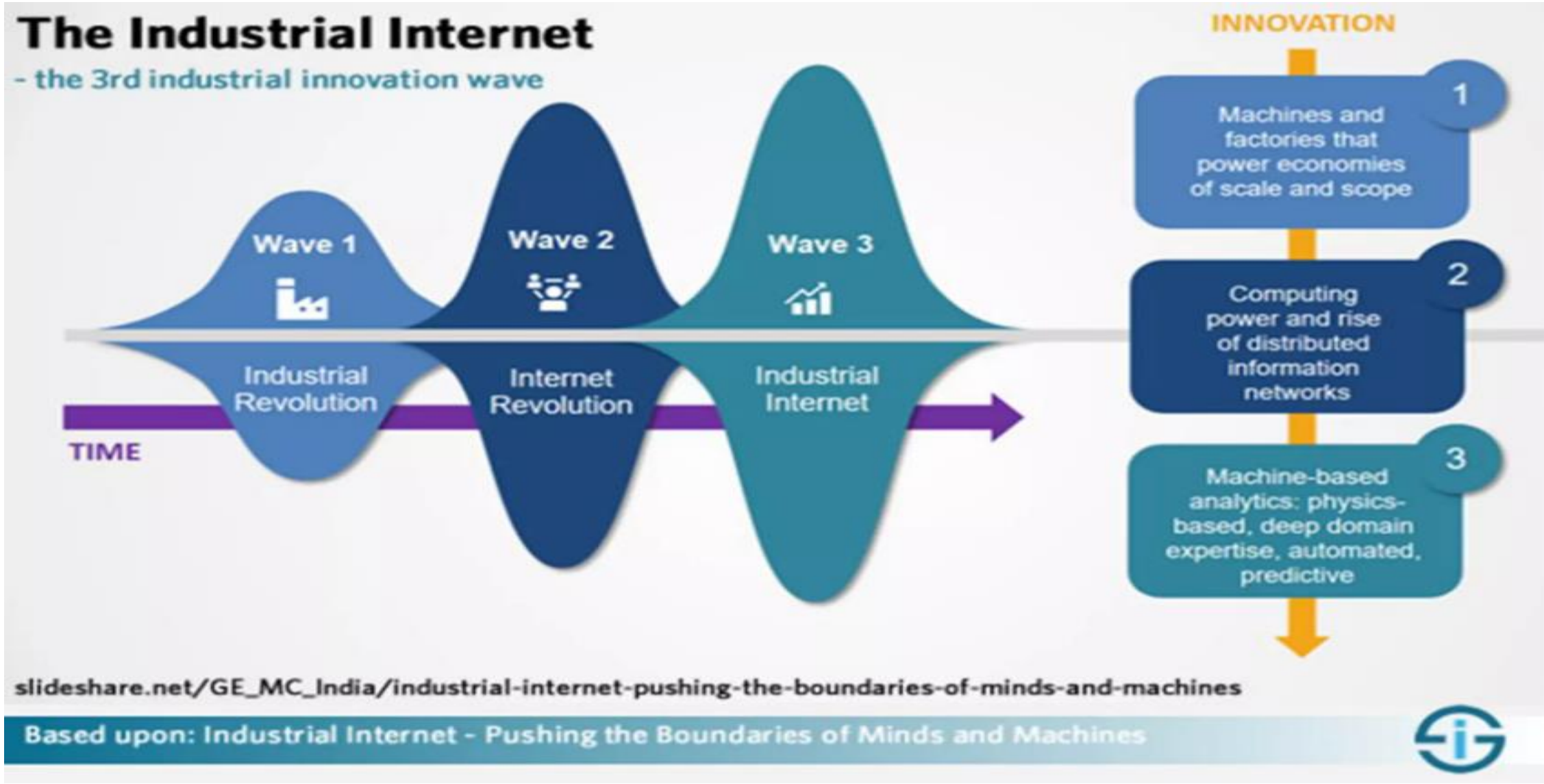
- Increase flexibility
- Productivity
- Efficiency
- Quality
- Reduced time to market
- More R&D and activities
- Development of new skills



Impact of Industry 4.0, Country wise

Country/Region	Continent	Start Year	End Year	Duration
United States (US)	North America	2011	N/A	N/A
Germany	Europe	2012	2020	9
France	Europe	2013	2020	8
United Kingdom (UK)	Europe	2013	2050	38
Europe	Europe	2014	2020	7
South Korea	Asia	2014	2020	7
India	Asia	2014	N/A	N/A
Netherlands	Europe	2014	N/A	N/A
Sweden	Europe	2015	2020	6
China	Asia	2016	2025	10
Spain	Europe	2015	N/A	N/A
Malaysia	Asia	2016	2020	5
Taiwan	Asia	2016	2024	9
Japan	Asia	2016	2020	5
Mexico	North America	2016	2030	15
Canada	North America	2016	2030	15
Singapore	Asia	2016	2020	5
Italy	Europe	2017	2020	4

Industrial Internet – Pushing Machines and Minds



Creative economies – different nomenclatures for Industry 4.0

What is advance costing?

- Advance costing, also known as forward costing, is a method used in manufacturing and service industries to estimate the cost of a product or service before it is actually produced or delivered.

- It involves predicting the various costs involved in the production process, such as labor, materials, overheads, and other expenses, based on historical data, industry trends, and analysis of the production process.

- Advance costing helps businesses in setting prices for their products or services, making informed decisions regarding the feasibility and profitability of a project, and optimizing resource allocation. It allows companies to plan and budget for future production activities, identify cost-saving opportunities, and evaluate the impact of changes in production methods or input costs.

- The accuracy and reliability of advance costing depend on the availability and quality of data, the use of appropriate cost estimation techniques, and the competence of cost accountants or analysts involved in the process.

- It is an important tool used by managers and financial professionals in managing costs, improving efficiency, and driving profitability in organizations.

Advance costing techniques prior to Industry 4.0

Prior to Industry 4.0, some of the advanced costing techniques used included:

1. Activity-Based Costing (ABC): ABC is a method that assigns costs to activities based on their consumption of resources. It provides a more accurate understanding of costs by tracing costs to specific activities, rather than averaging them across products or departments.
2. Target Costing: Target costing is a proactive cost management technique that aims to design products and processes that meet customer requirements at a target cost. It involves setting a cost target and then working backwards to determine the maximum allowable cost for each component or process.
3. Life Cycle Costing (LCC): LCC considers costs over the entire life of a product, including acquisition, production, maintenance, and disposal costs. It enables businesses to evaluate different alternatives and make decisions based on the total cost of ownership rather than just the initial cost.
4. Value-Based Costing: Value-based costing focuses on understanding and capturing the value that customers attach to the features and attributes of a product or service. It involves identifying the value drivers and aligning costs with those drivers to ensure resources are allocated effectively.
5. Lean Costing: Lean costing is a cost management technique that is aligned with lean manufacturing principles. It involves identifying and eliminating waste to reduce costs while maintaining or improving product quality and customer satisfaction.
6. Standard Costing: Standard costing involves setting predetermined costs for resources, activities, and products based on historical data or industry benchmarks. It provides a basis for measuring and controlling costs, as well as evaluating performance against standards.

Advance costing after Industry 4.0

In Industry 4.0, advanced costing techniques are enhanced and enriched by the plethora of digital technologies and data-driven approaches.

Some of the advanced costing techniques used in Industry 4.0 include:

1. Real-Time Costing: With the availability of real-time data captured through sensors, Internet of Things (IoT) devices, and other digital systems, costs can be monitored and analyzed in real-time. This provides up-to-date insights on cost drivers and enables proactive cost management.

2. Predictive Costing: Machine learning algorithms and predictive analytics can be applied to historical and real-time data to forecast future costs. This helps in anticipating and mitigating cost overruns or identifying cost-saving opportunities.

3. Digital Twin Costing: Digital twins, which are digital replicas of physical assets or processes, enable simulation and analysis of costs in a virtual environment. This allows for experimentation and optimization of cost factors before implementing them in the physical world.

4. Blockchain Costing: Blockchain technology can be used to track and verify costs throughout the supply chain. It provides transparency and traceability, reducing the risk of cost manipulation or discrepancies. improved profitability and competitiveness.

Advance costing after Industry 4.0

5. Artificial Intelligence (AI)-based Costing: AI algorithms can analyze large volumes of data to identify patterns, optimize cost allocation, and suggest cost reduction strategies. AI-powered cost estimation models can also provide more accurate and reliable cost projections.

6. Cost Optimization through the Internet of Things (IoT): IoT devices and sensors connected to production equipment can collect real-time data on energy consumption, machine utilization, maintenance needs, and other cost-relevant parameters. This data can be used to identify opportunities for cost optimization and efficiency improvements.

7. Advanced Cost Analytics: Data visualization tools, data mining techniques, and advanced analytics allow for deeper analysis and interpretation of cost data. This enables organizations to identify cost drivers, optimize resource allocation, and improve efficiency.

8. Integrated Cost Management Systems: Industry 4.0 technologies facilitate the integration of various cost management systems, such as Enterprise Resource Planning (ERP), Product Lifecycle Management (PLM), and Manufacturing Execution Systems (MES). This integration improves data accuracy, visibility, and accessibility, leading to more effective cost management.

Overall, Industry 4.0 enables organizations to leverage advanced costing techniques with the help of digital technologies and data analytics. These techniques enable accurate cost estimation, efficient cost control, and strategic decision-making for

Advanced costing in Industry 4.0

Objective of Advanced costing in Industry 4.0 is to reduce costs in manufacturing goods, and services!

1. There are two basic elements of superiority in competition between countries. These are cost and technological differences (Bashimov, 2017).

2. The reason for the differentiation in the price of the product at the end of the process in the enterprises with the same raw material inputs is the efficient operation of the enterprise and the ability to use scarce resources in the best way.

3. Hence, it is important to note that all these resources are accurately reflected on the product when pricing.

4. In addition, new technologies used in the machinery, workflow, and production process will reduce the costs to the extent that it minimizes the use of time and energy.

How to reduce costs in manufacturing with Industry 4.0?

- Industry 4.0 technology combined with operational expertise can map a company's main cost drivers to show exactly where digital technology can provide value.
- This data-driven approach can reveal overlooked opportunities in areas ranging from waste reduction to the use of robotics, such as automated mobile robots (AMRs).
- However, it can be overwhelming to figure out what technologies will actually deliver results for your business. So, how can companies leverage Industry 4.0 to reduce costs in manufacturing and R&D?
- Use information technology (IT) to solve operational technology (OT) problems
- Reduce CapEx by embracing the Cloud
- Improve asset utilization through increased performance visibility
- Develop a data strategy and get insights from your data

Cost Analysis in Industry 4.0

- The costing practices in industrial enterprises are not yet achieved at the desired levels.

- It is known that some certain factors incur the expenses of all processes that are effective in the emergence of a product and that these expenses have effects on the parts that form the product in different rates. In other words, the statements of cost and profit planned by the manager does not coincide with the figures occurred at the end of the period.

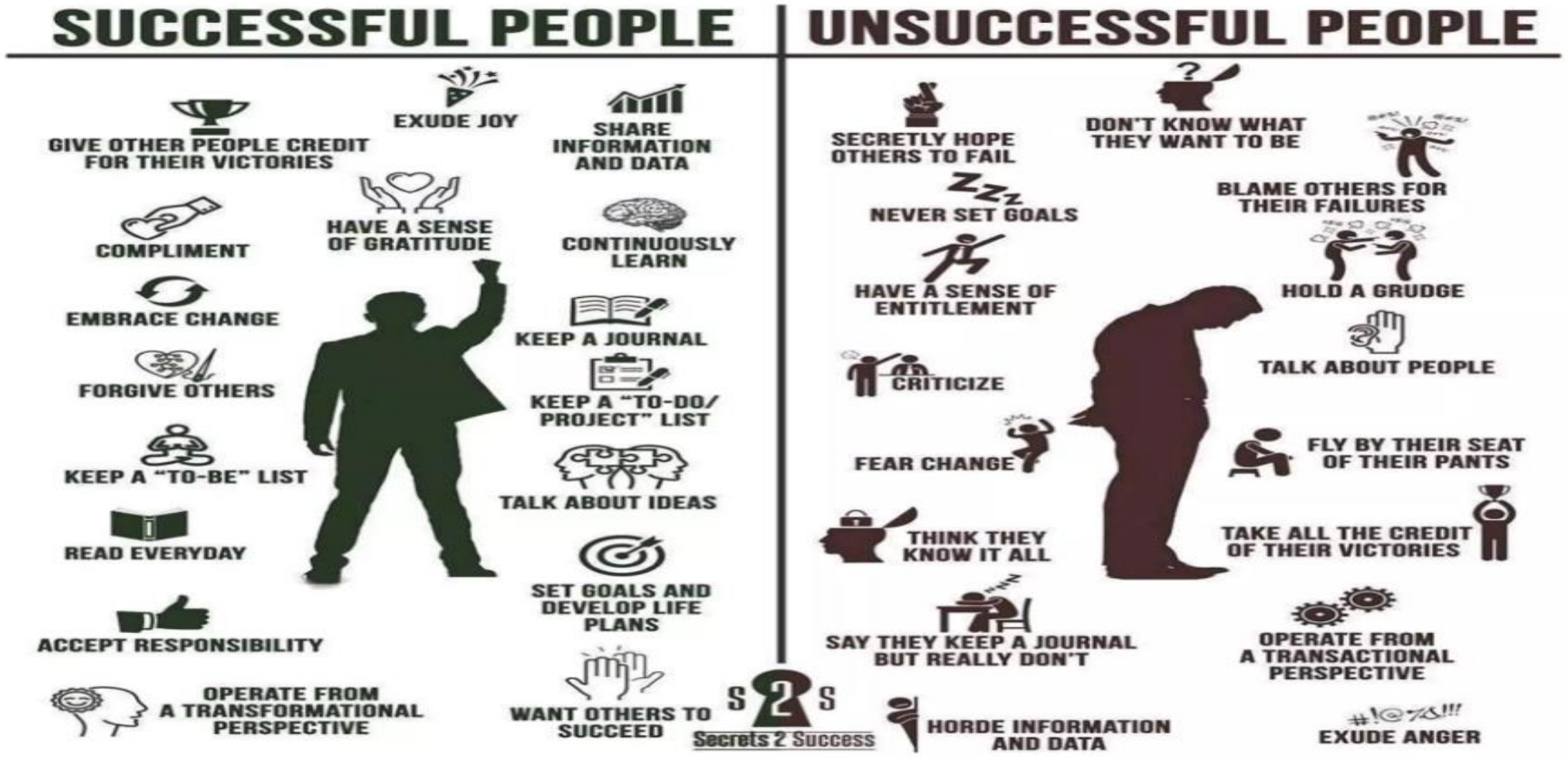
- Businesses generally defines the difference between the planned and actual statements as an invisible expense.

- In fact, this creates an unavoidable situation for businesses which is expressed as the forced acceptance of these uncertainties. One of the biggest financial error that arises as a result of this is that the cost of a product does not reflect its real value and accordingly the profitability ratios cannot be estimated correctly.

- The prevention of the financial losses resulting from the inability to calculate unforeseen expenses goes through the accurate reflection of all the factors that affect the cost of a product. The key factor underlying this is the requirement of quickly gathering and processing the clear data from all the variables in the production areas and external factors under a single source (big data). In order this to happen, a smart costing system must be established.

- The "Industry 4.0" concept, which has been widely spoken recently and is referred to as the 4th Industrial Revolution, has put the smart factories on the agenda. In this way, Industry 4.0 and smart factories will allow businesses to eliminate all the disadvantages mentioned above.

Profession – Success in Industry 4.0



Skill set in Industry 4.0

TOP 5 Behavioral Skills hirers look for in Fresh Graduates

1. Willingness to learn
2. Initiative
3. Honesty & Integrity
4. Self-motivated/self-starter
5. Self-confidence

TOP 5 Functional Skills hirers look for in Fresh Graduates

1. Communication skills
2. Trainability
3. Competence
4. Problem solving and analytical skills
5. Tech know-how

Thank you

Thanks to your commitment and great interest to listen to this presentation.

We look forward to working together.

Dr.V.V.L.N.Sastry. Sastry

drsastry12@gmail.com