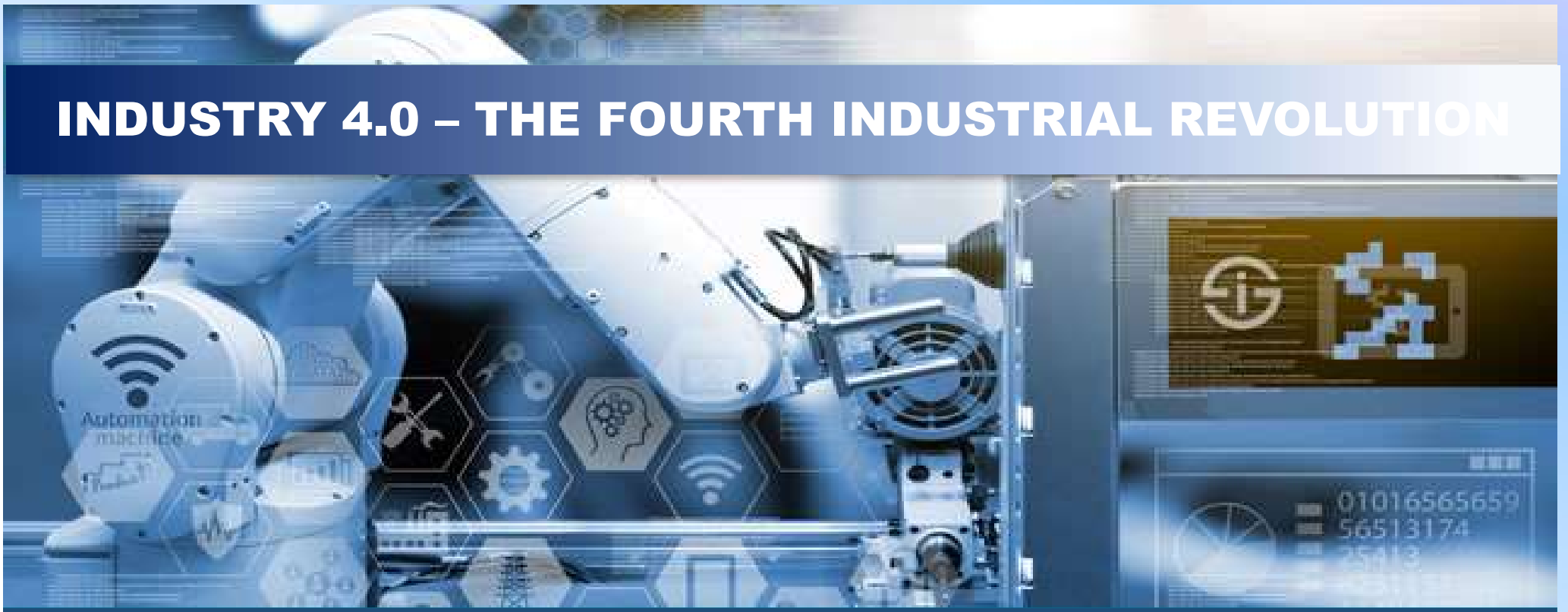
Mr. JONAS JEYARAJ ANTHONY
Dr. NARENDRA KUMAR

The Industrial Internet of Things (IoT): Towards the Future of Digital Manufacturing



Shaping the future of manufacturing

Agenda

1) Sharing on Industry 4.0
2) Why digital manufacturing is important?
3) Panasonic Group Malaysia and Business Direction
4) IND4.0 Project with University of Malaya
5) University-Industry Collaboration Strategy
   (University of Malaya and Panasonic)

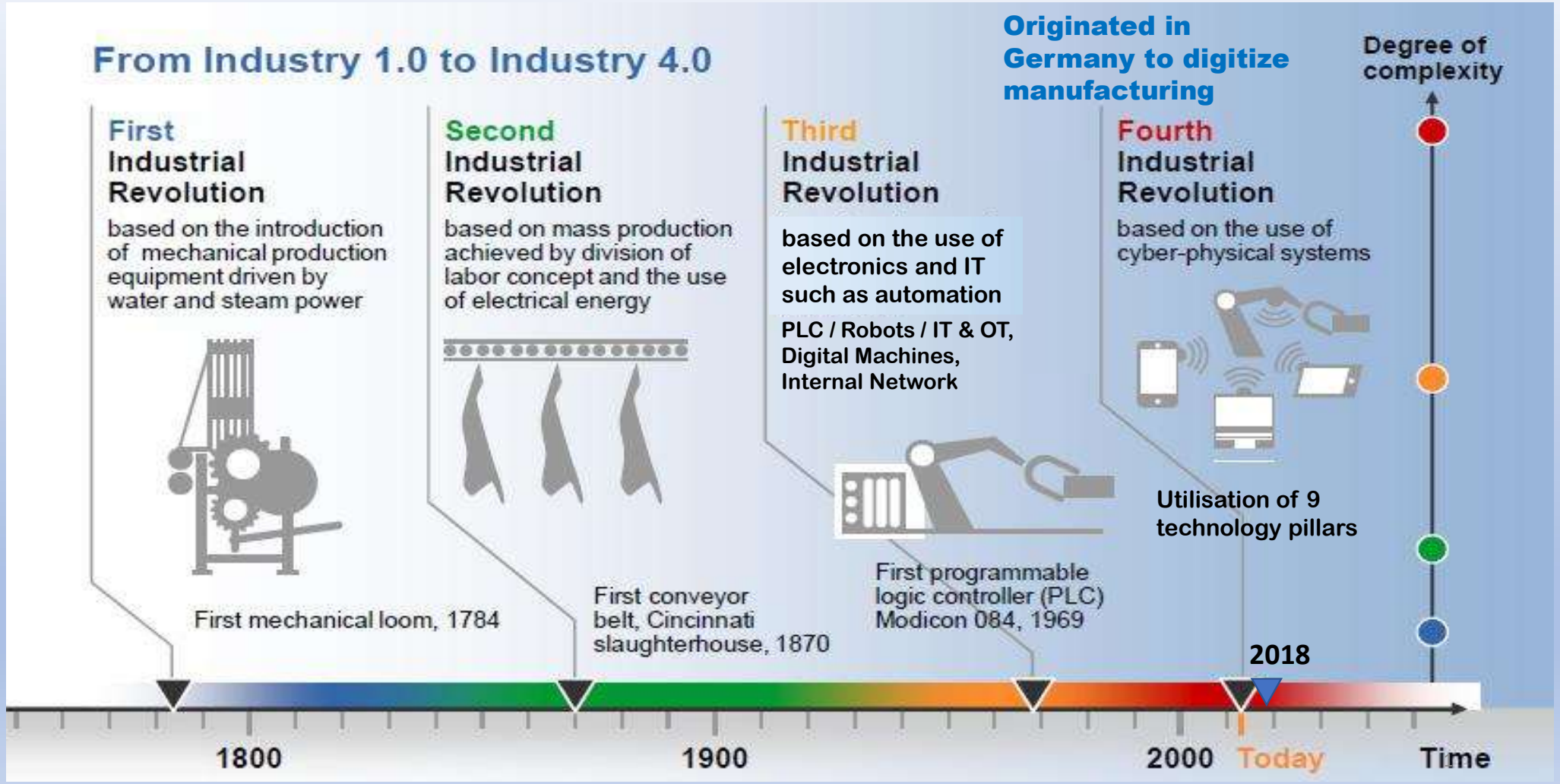
DISRUPTIVE TECHNOLOGIES

- Exponential growth in disruptive technologies
- New technology that will disrupt existing technology rendering it obsolete.
- It will force companies to change or risk losing market share and becoming irrelevant.

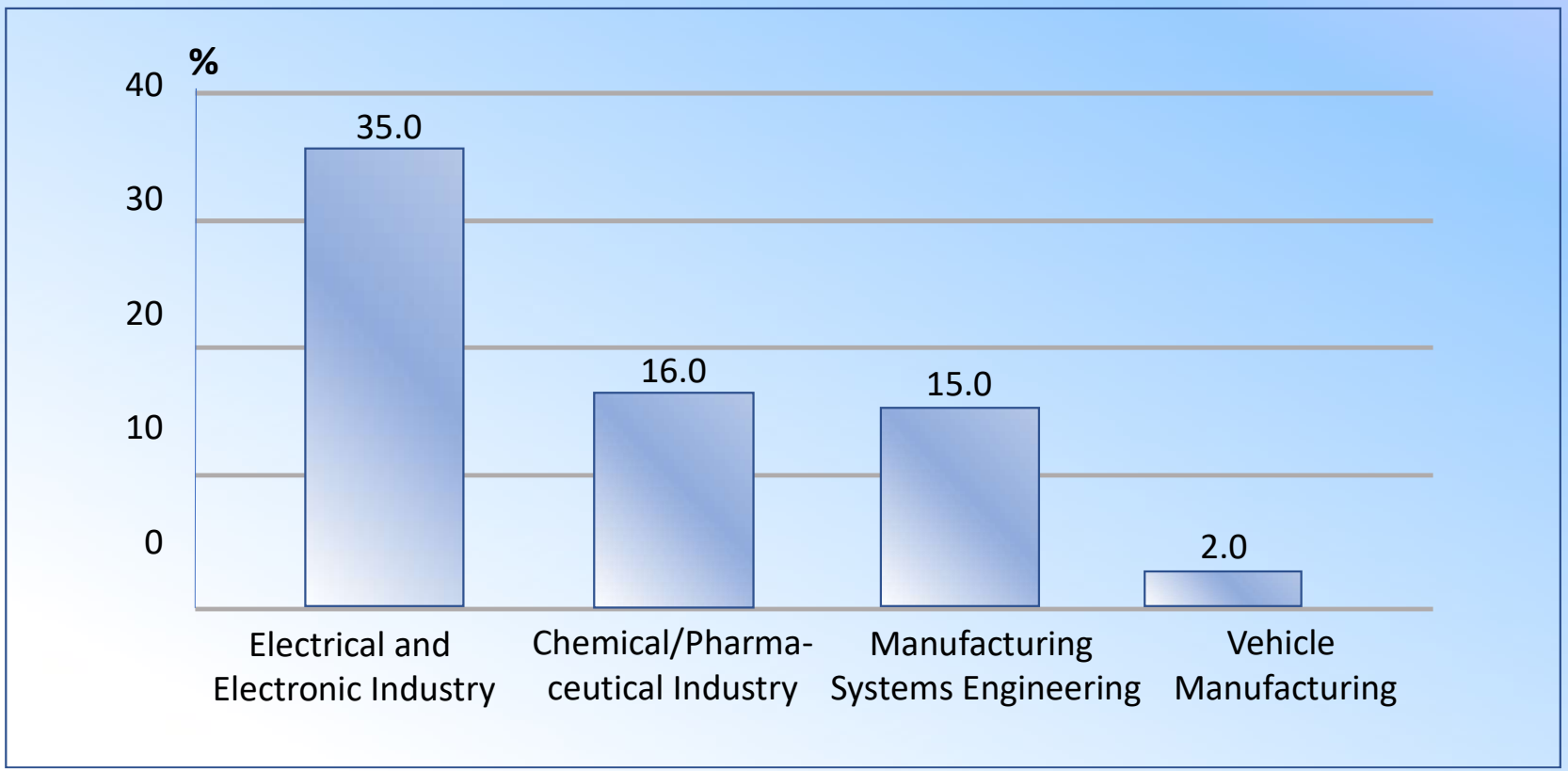
IND 4.0 is A Sure Game Changer

- Drastic change ranging from the design and manufacturing of goods.
- Manufacturing agility is key to meet customer needs and business ability to align delivery of a product virtually on demand.
- Be ready for networked cyber physical systems manufacturing with horizontal and vertical integration.
- It facilitates fundamental KPI improvements factory wide.
- Leveraging on IND 4.0 technologies.

Towards the fourth industrial revolution

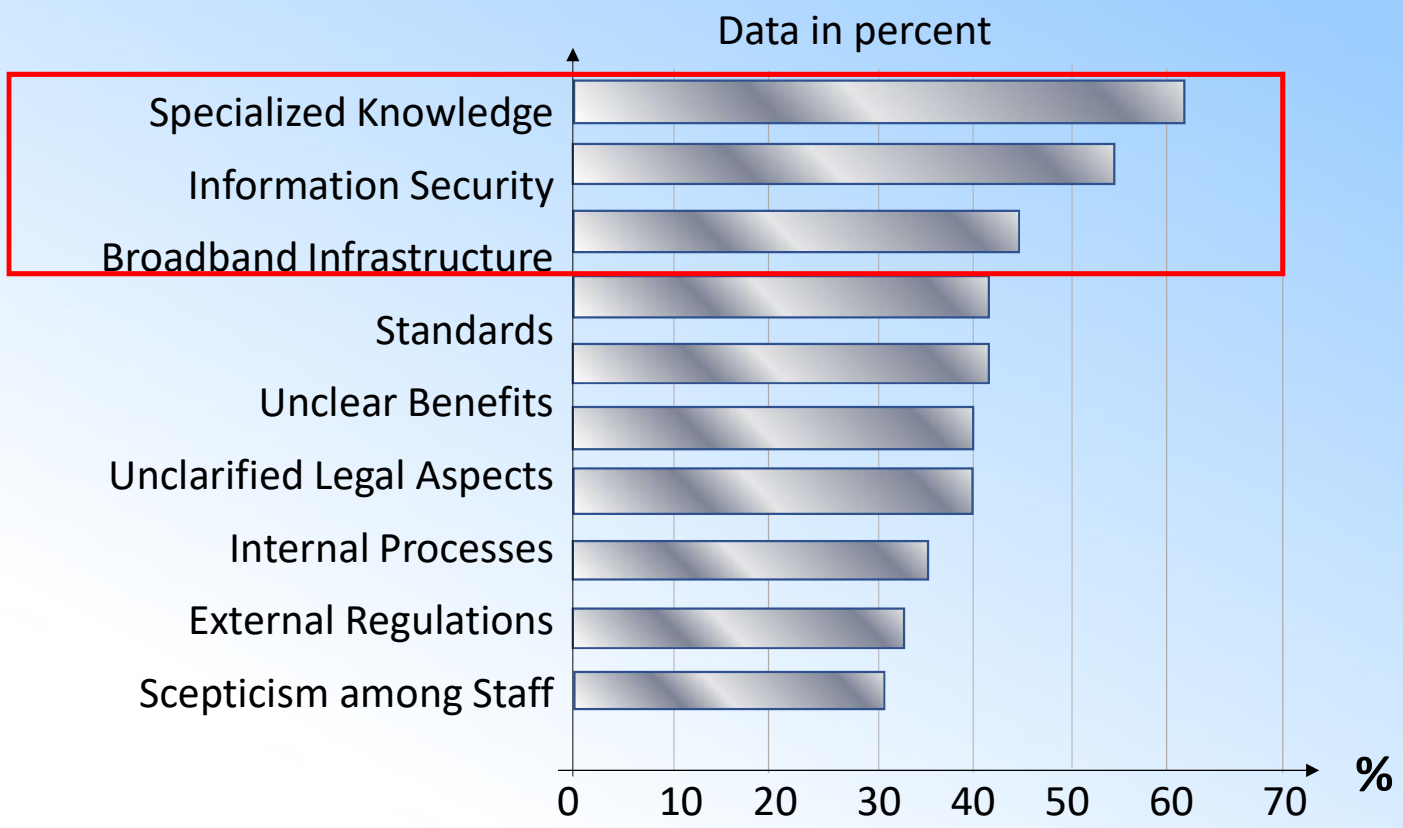


Initiations Towards Industry 4.0 in Germany



Source of ZVEI
(German Electrical and Electronics Manufacturing Association)

Study in Germany – Barrier of Industry 4.0



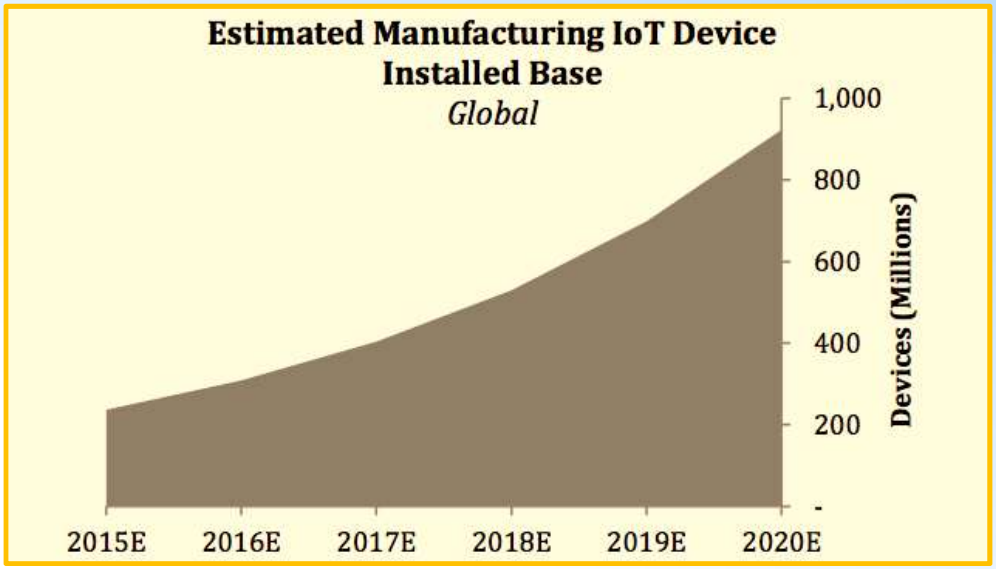
Source of ZVEI

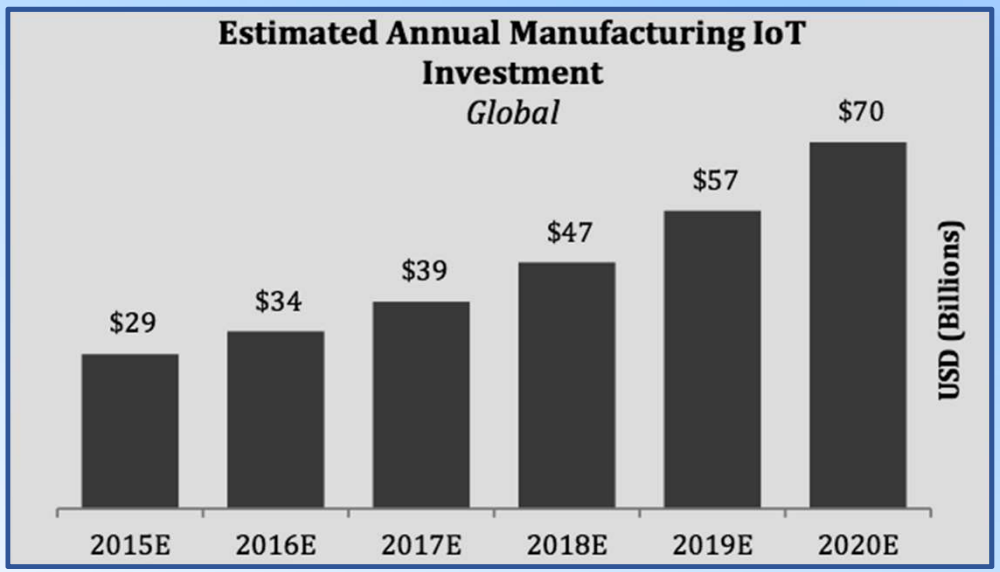
(German Electrical and Electronics Manufacturing Association)

Industry 4.0 Global Key Figures

- IoT device installation
  2020E - $ 1B
  2018E - $ 580M

- Mfg. IoT investment
  2020E - $ 70B
  2018E - $ 47B





Source of General Electric

Why Digital Manufacturing ?

1) Governments and private sectors (MNCs & SMEs) highly motivated towards digital economy.
2) IND 4.0 is powered by (nine industrial technologies) to transform traditional manufacturing to improve critical KPIs.
3) Replace hierarchical structure of shop floor with open, flatter fully interconnected model that links all the functions of a manufacturing operation.
4) Deploy employees to extend personalized and expert support to customers.

Why Digital Manufacturing ?

5) Enables data (internal and external) to be linked to the factory centralized control systems to achieve self healing and self learning (closed loop system).

6) It is a sophisticated technology for predictive manufacturing, proactive action can be taken speedily to mitigate losses and improve process capability.

7) Excellent technology mitigate impact of international business and adapt to ever changing global business landscape (tax/tariffs, economic sanctions, shipping routes, high operation cost and political instability).

Why Digital Manufacturing ?

8) Manufacturers have to be fast and flexible enough to configure and reconfigure shop floor. (Big data sharing across company boundaries and global sites)

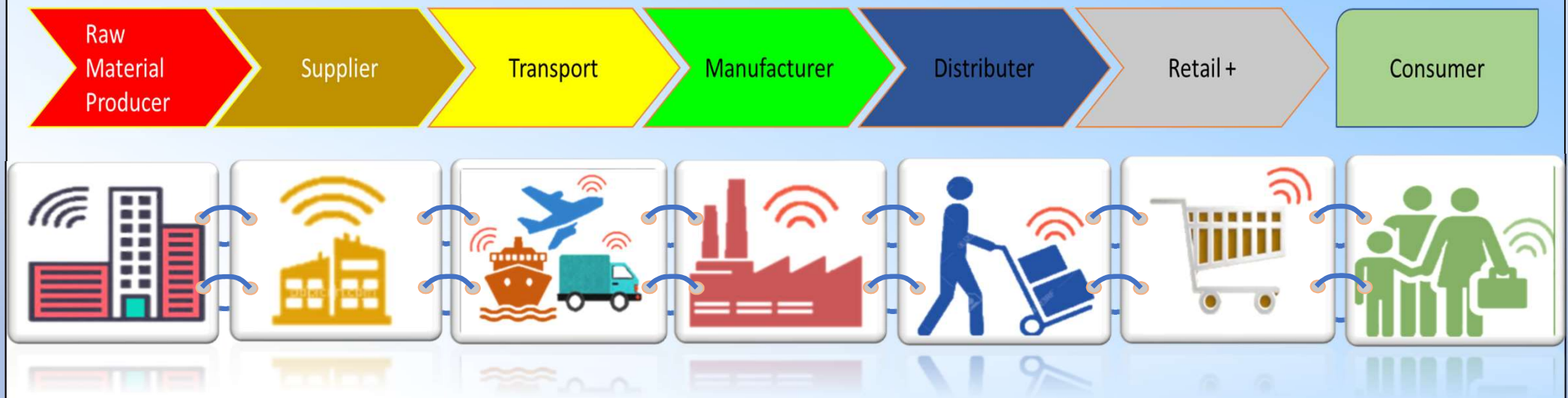
9) The SMEs who partner with Smart manufacturing MNCs will have to be also upgraded to be IND 4.0 capable.

10) IND 4.0 will force skill workers to be scaled up and unskilled workers (foreign workers) to be scaled down. In addition, reform our education system to implement education 4.0 to churn out technology workers for big data analytics, coding, cybersecurity, network design, programmers etc.

Agility is the new business currency

Customer Centric Supply Chain

A **digitally-integrated and intelligent supply chain** enables an unprecedented level of collaboration and real-time visibility across the supply chain to help address rising customer expectations



What should industry players consider as they transform traditional manufacturing to digital manufacturing ?

1) Manufacturers need to partner with Industrial IoT platform vendors and system integrators that provide solution to upgrade or build new systems.
2) Manufacturer should work closely with experience integrators, developers and technology who have already fully implemented and exhibited excellence in security and monetizing smart manufacturing.
3) Manufacturing plant must be designed with cyber security in mind.
4) Consider action for successful software monetization, licensing and IT protection is important.

DRIVING MANUFACTURING PROCESSES OF THE

FUTURE

Brief Concept Industry 4.0

- Industry 4.0 is **digitization of the manufacturing sector**, with embedded sensors virtually in product components and manufacturing equipment, **cyber-physical system** and analysis of all relevant data.
- Need of **data, computational power and connectivity.**
- **Analytics and intelligence,** and **human-machine interaction** are essential.
- **Digital-to-physical conversion** i.e. advanced robotics and 3D printing, augmented reality.

The ingredients for Industry 4.0

- The **impact of Industry 4.0 will not be immediate**, but with its forecast growth on the rise, more companies will be looking to invest in Industry 4.0

Instrumented	Interconnected	Inclusive	Intelligent
Data Devices contain sensors, actuators and software that generate data	**Connectivity** An information network connects devices together; gathers and processes the data either at the edge of the network or centrally - selectively	**Context** Industry knowledge, data external to the network adds context to the data	**Decision making** Machine learning, predictive analytics and cognitive computing makes sense of the data; decentralized decision making, move towards autonomous

Industry 4.0 - The convergence and application of nine digital industrial technologies

1	**Advanced Robotics**	• Autonomous, cooperating industrial robots • Numerous integrated sensors and standardized interfaces
2	**Additive Manufacturing**	• 3D printing for spare parts and prototypes • Decentralized 3D facilities to reduce transport distances and inventory
3	**Augmented Reality**	• Augmented reality for maintenance, logistics and all kinds of SOP • Display of supporting information, e.g through glasses
4	**Simulation**	• Simulation of value networks • Optimization based on real time data from intelligent systems
5	**Horizontal / Vertical Integration**	• Cross company data integration based on data transfer standards • Precondition for a fully automated value chain (supplier to customer)
6	**Industrial Internet**	• Network of machines and products • Multidirectional communication between networked objects
7	**Cloud computing**	• Management of huge data volumes in open systems • Real time communication for production systems
8	**Cyber Security**	• Operation in networks and open systems • High level of networking between intelligent machines, products and systems
9	**Big Data and Analytics**	• Full evaluation of available data (e.g from ERP, SCM, MES, CRM and machine data) • Real time decision making support and optimization

Digitization of Manufacturing Sector

Data, computational power, and connectivity

Big data/open data
Significantly reduced costs of computation, storage, and sensors
Internet of Things/M2M
Reduced cost of small-scale hardware and connectivity (e.g., Through LPWA networks)
Cloud technology
Centralization of data and virtualization of storage

Analytics and intelligence

Digitization and automation of knowledge work
Breakthrough advances in artificial intelligence and machine learning
Advanced analytics
Improved algorithms and largely improved availability of data

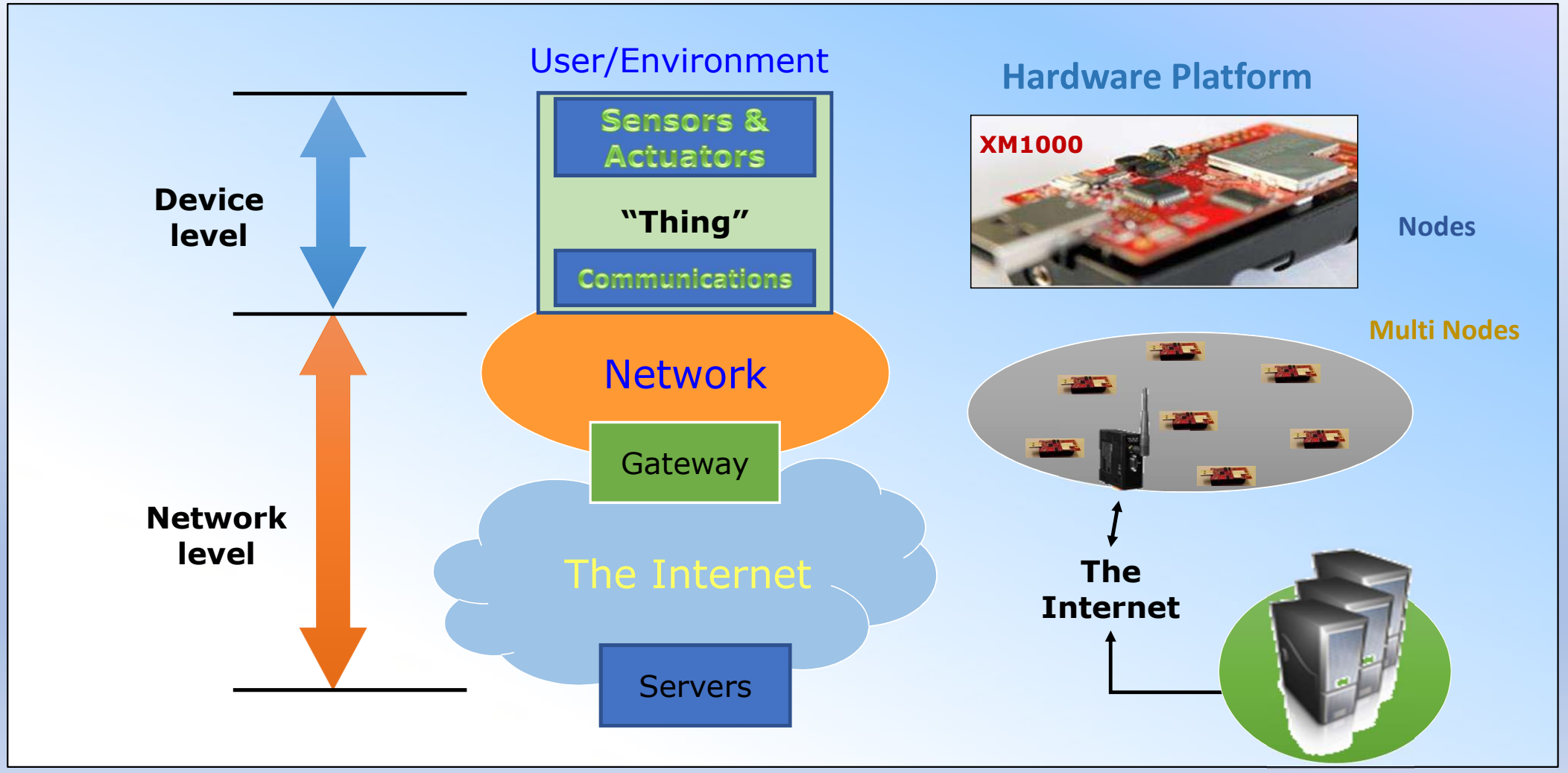
Human-machine interaction

Touch interfaces and next level GUIs
Quick proliferation via consumer devices
Virtual and augmented reality
Breakthrough of optical head-mounted displays (e.g., Google Glass)

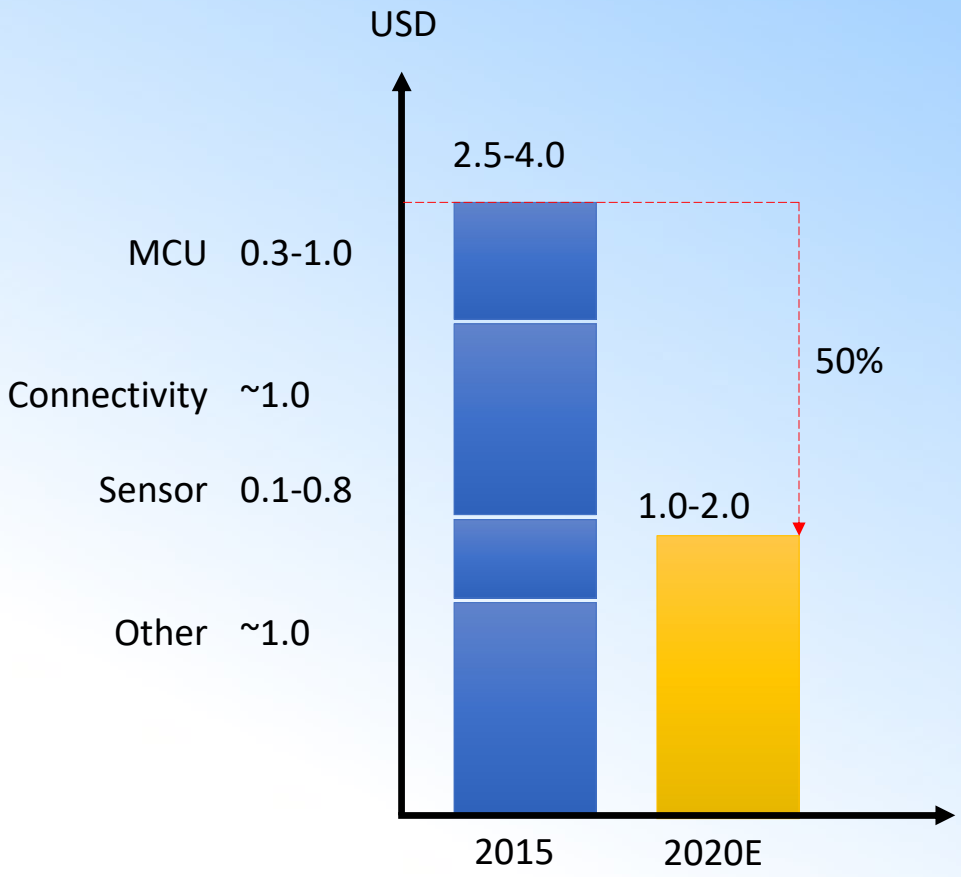
Digital-to-physical conversion

Additive manufacturing (i.e., 3D printing)
Expanding range of materials, rapidly declining prices for printers, increased precision/quality
Advanced robotics (e.g., human-robot collaboration)
Advances in artificial intelligence, machine vision, M2M communication, and cheaper actuators
Energy storage and harvesting
Increasingly cost-effective options for storing energy and innovative ways of harvesting energy

Overview of IoT Hardware Platform



The Cost of IoT Nodes



- **No significant costs** associated with IoT connectivity anymore.
- Prices expected to **continue to fall** over the next few years.
- Additional cost savings potential from **future integrated design solutions.**

Siemens and AliBaba Strategic Partnership

- Siemens is teaming up with Alibaba to utilize the Chinese firm's cloud infrastructure to test its digital operating system MindSphere.
  The Agreement is worth over €20B ($23.5B).

- The two companies will leverage each other's technology and industry resources to build a unique IoT solution to support Industry 4.0.

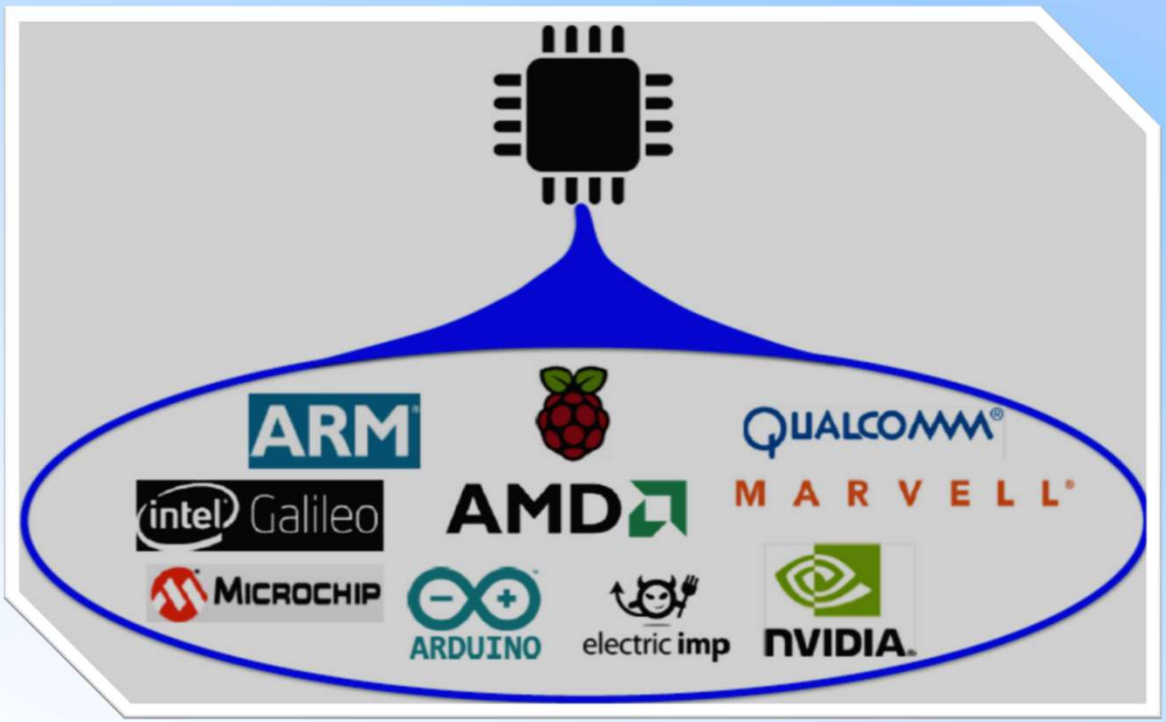
- Siemens chief Executive Joe Kaeser stated : " This cooperation is a landmark deal for bringing Industry solution to China as the world's powerhouse of manufacturing". "Our customers will be able to unlock the potential of the Industrial Internet of Thing with MindSphere now also on the Chinese cloud platform".

- This collaboration will see creation of dozens of IoT products for China manufacturing Industry.

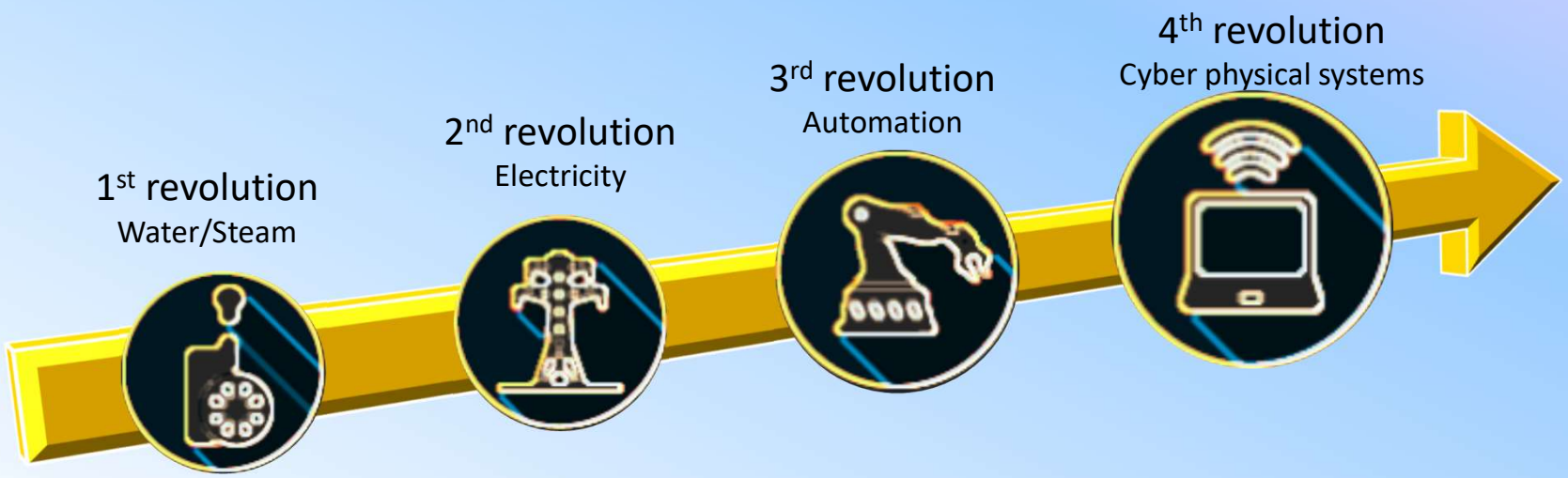
Example of Industrial IoT Platform

- Datonis
- Predix
- Bosch IoT Suite 2.0
- IBM Watson IoT
- The Intel IoT Platform
- AWS IoT

- Many Platforms / chipsets to choose from.
- Integrated SDKs to speed development, testing and optimization.

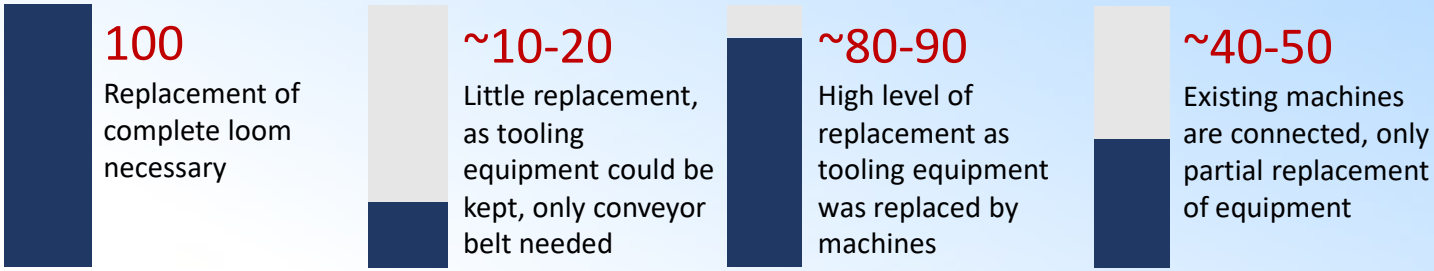


The Replacement of Manufacturing Assets



Replacement of equipment

Percent of installed base



Practical Case Study: Manufacturing Analytics for Cost Productivity

Reduce test time and calibration

- Prediction of test results
- Prediction of calibration parameters

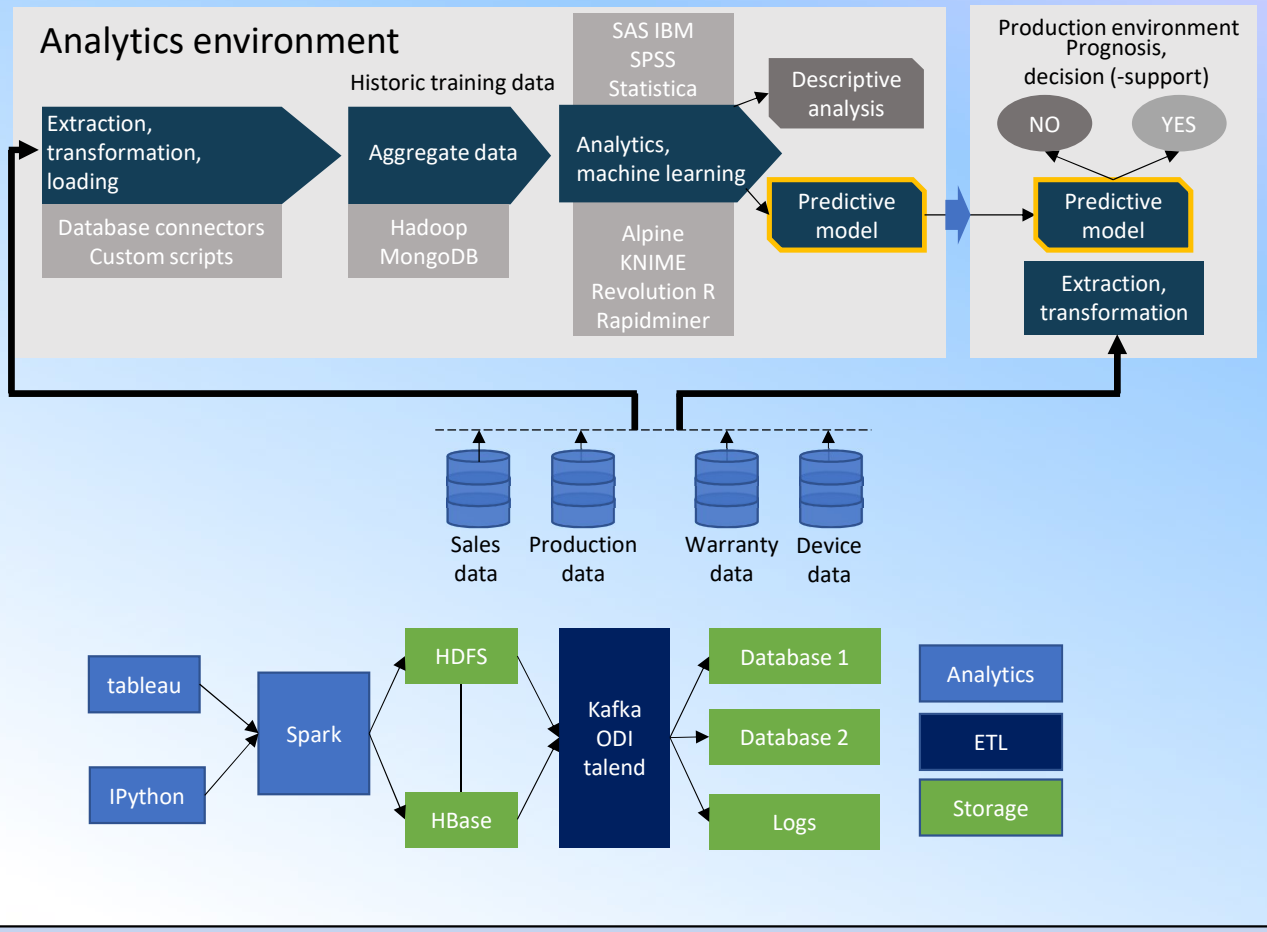
Reduce warranty cost

Prediction of field failures from

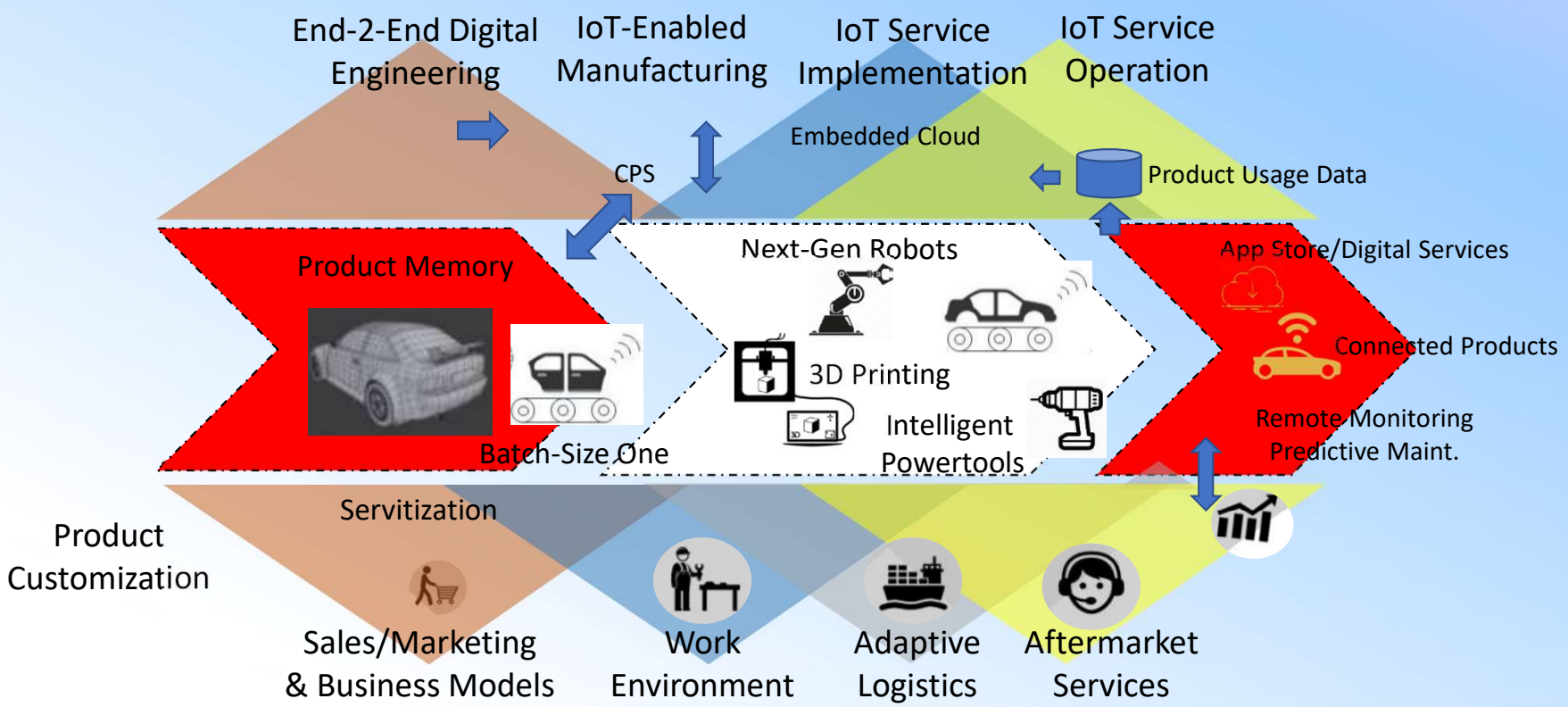
- Test and process data
- Cross-value stream analysis

Perform predictive maintenance

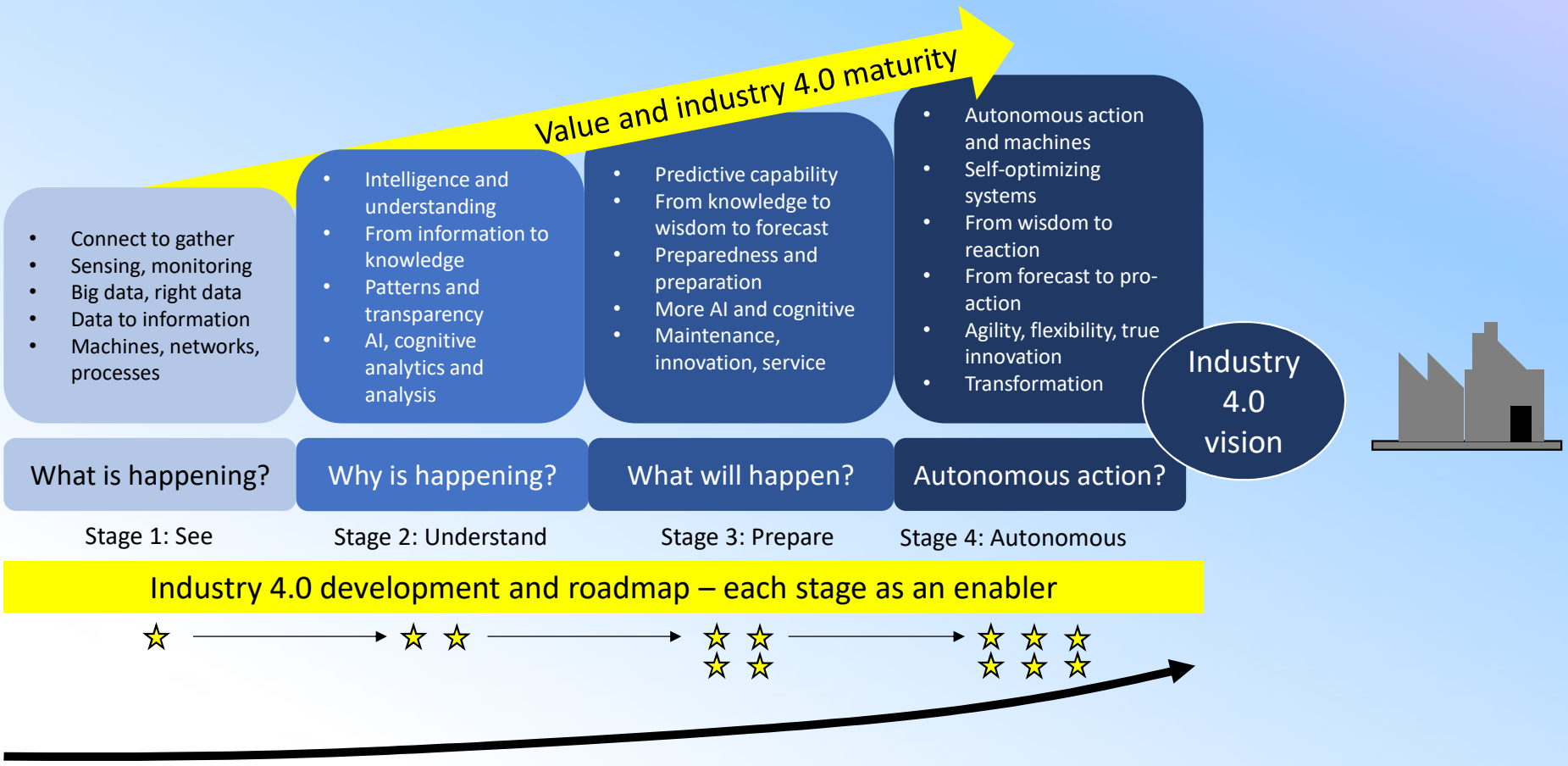
- Identify top failure causes
- Predict component failures to avoid unscheduled machine downtimes
- Data analytical processing with artificial intelligence to reduce time, warranty cost and predictive maintenance
- Data processing, machine learning and visualization platform is developed



Realistic Value Chain

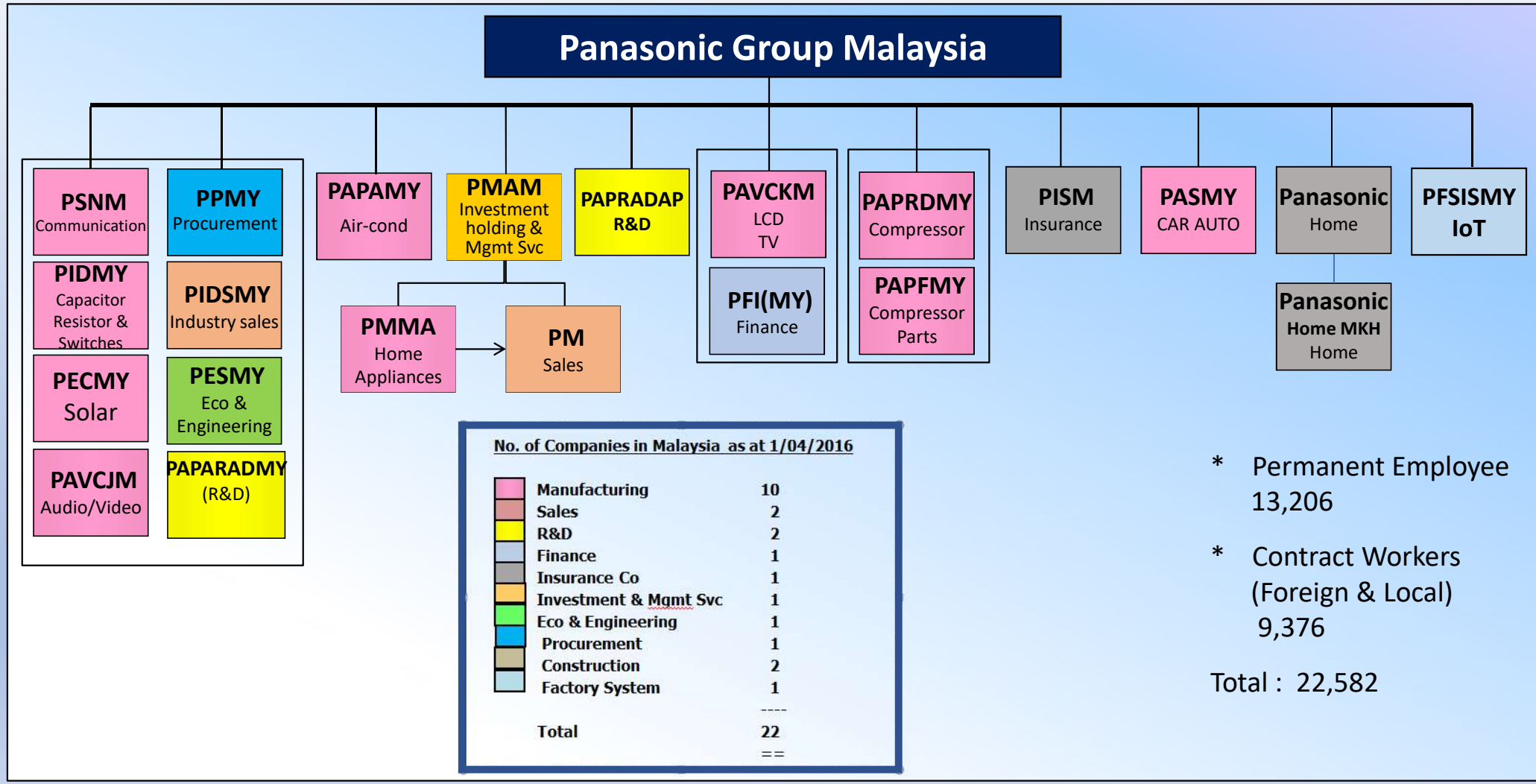


Industry 4.0 Maturity Model




Towards smart manufacturing
3D
DATA
4.0
Ai
VR
IOT

Panasonic Corporate Structure in Malaysia



No. of Companies in Malaysia as at 1/04/2016

Manufacturing	10
Sales	2
R&D	2
Finance	1
Insurance Co	1
Investment & Mgmt Svc	1
Eco & Engineering	1
Procurement	1
Construction	2
Factory System	1
Total	22

* Permanent Employee 13,206

* Contract Workers (Foreign & Local) 9,376

Total : 22,582

Panasonic Malaysia Products

PAVCKM

LED / OLED TV

PAPAMY

Air conditioner

PMMA

Small home appliances

Panasonic Malaysia Products

PAVCJM

Audio system
Camcorder

PASMY

Car audio system & display

PSNM

Communications Product
Office Product
IT Product
Hearing Instrument

Japan
-Telephone

ODM

Network
Camera

IP Phone

Hearing Aid

ITS

DECT

Japan-FAX

A4 B-MFP

PC Configuration

Sensor

Panaboard

Panasonic Malaysia Products

PIDMY

Electronic components

Aluminum Electrolytic Capacitor

Switches

VR, Encoders

PAPRDMY

Compressors For Fridge

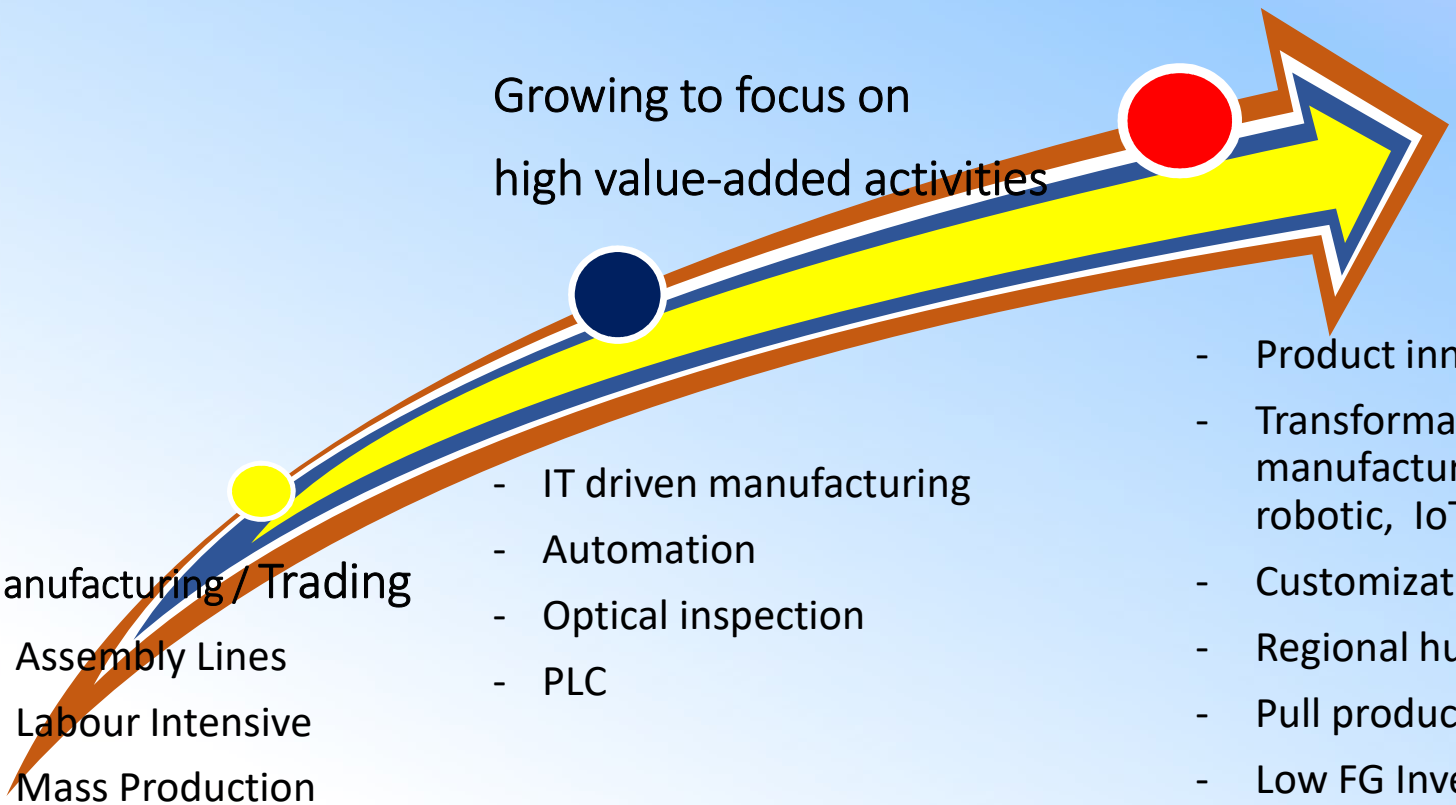
PAPFMY

Foundry Parts for compressors etc

PECMY

Solar Panels

Panasonic Group's Next Phase of Growth in Malaysia
Evolution from manufacturing to high value-added activities



Manufacturing / Trading

- Assembly Lines
- Labour Intensive
- Mass Production
- Push Production
- High FG Inventory

Growing to focus on high value-added activities

- IT driven manufacturing
- Automation
- Optical inspection
- PLC

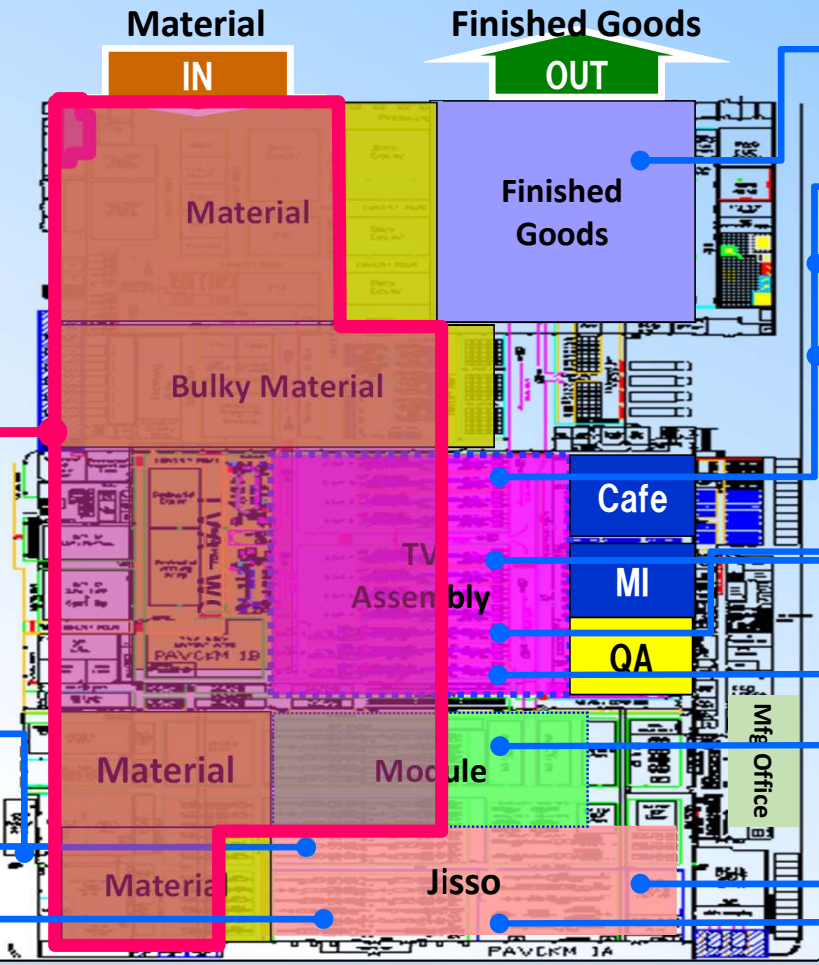
- Product innovation
- Transformation of manufacturing process - robotic, IoT and automation
- Customization
- Regional hub activities
- Pull production
- Low FG Inventory
- Collaboration with University Malaya

Panasonic Factory IT System Map

IT Driven Manufacturing (15 Projects)

Factory Wide Integrated Manufacturing IT System by Intranet

- ❑ Real Time Prod Result visualization
- ❑ Real Time Alert system (e-andon)
- ❑ Material E-Kanban
- ❑ IT Process Poka yoke
- ❑ Process History & Traceability



2018
E Kanban System
End to End centralize Material Mgmt
(receiving → barcoding → storage →kitting by job no → disburse by pull system)

2012
Reflow MMS
Reflow material kitting & disburse

2012
Reflow CVT
Reflow machine parts loading verify

2012
SF Board traceability
Boards function test traceability

2005 2015
FGIS
FGW inventory and shipment system

2013
Sets Traceability
Poka yoke traceability system

2013
Loss Visualization
Smart line loss recording

2012
E-Andon
Factory abnormality alert system

2015
QA Daily Quality Monitoring
Monitory QA Daily Quality

1998
QA AQS system
Action quality system

2016
Workers Traceability
Workers attendance, skills verification.

2015
Module Traceability
Traceability scan + pokayoke

2016
PAPAMY Traceability
Papamy FG scan & Lot traceability

2015
Reflow E-Counter
Reflow machine result visualization

Benefits to Panasonic

Next era of growth

- Moving up the value chain
  Transforming from manufacturing to high value-added services

Growing Malaysian Talent pool

- Upskill local employees
- Transfer of know-how and technology to Malaysia

Reduces foreign workers

- Reduce dependence on foreign labour

Multiplier effect to the economy

- Local sourcing (purchase of assets, installation, repairs & maintenance)
- Close collaboration/ sharing of knowledge & experience with local vendors / SMEs
- Enhancement in human capital investment and job opportunities for technology workers.

Increase sales

- Increase export sales

Biodata

NARENDRA KUMAR

- Asc. Professor of University of Malaya
- Leading innovation Center - Industry 4.0 @ University of Malaya
- Doctorate degree from RWTH Technical University Aachen, Germany
- 15 years of industrial experience as wireless product and testing
- Assigned several IPs (7patents) to US Patent Office
- Visiting Researcher of RWTH Aachen University, Germany
- IEEE Industrial Relation Team of R10 (Asia Pacific)
- Fellow of IET, UK and Senior Member of IEEE, USA
- Published almost 100 journals/conference
- Published 3 technical books published in USA
- Consultant of Steerix GmbH, Germany
- Research Area: Wireless Technology, Sensor and IoT Integration

- EMAIL: narendra.k@um.edu.my TEL: 012 691 8684

Digital Transformation Collaboration Team (UM-Panasonic)

INTERNATIONAL ACADEMY | RWTH AACHEN UNIVERSITY + steerix Steering Innovation For Future + + Panasonic

- One of leading university in Europe
- Leading Industry 4.0 in Germany

- Authorized knowledge transfer partner for ASEAN

- Leading engineering university in Malaysia
- Setup Innovation Center of Industry 4.0 @ UM

Authorized knowledge transfer partner for ASEAN

Dr. Helmut Dinger –
RWTH Aachen University, Germany

Dr.-Ing. Lutz Konstroffer –
Steerix GmbH, Germany

Dr.-Ing. Narendra Kumar –
University of Malaya &
RWTH Aachen University

Mr. Jonas Jeyaraj -
Manufacturing Chief Director,
Panasonic

- Dr.-Ing. Narendra Kumar is leading Innovation Center of Industry 4.0 @University of Malaya
- Mr. Jonas Jeyaraj is leading Industry 4.0 in Panasonic Group
- Industrial-university collaboration model (reference to existing German model)
- To develop platform of digital transformation with actual industrial use case applications

RWTH and Steerix – Technology Partner in Industry 4.0

steerix
Steering Innovation For Future

- **Technology knowledge partner** of RWTH for ASEAN

e.GO

Fraunhofer IPT

IMA ZLW IfU
RWTH AACHEN UNIVERSITY

WZL | RWTH AACHEN UNIVERSITY

INTERNATIONAL ACADEMY | RWTH AACHEN UNIVERSITY

- One of **leading engineering university in Europe**
- **Leading Institute** of Industrie 4.0 in Germany
- Contributions of **10 Professors from 6 Research Institutes** in Industrie 4.0 (WZL, IMA, ZLW, IFU, IFR, etc)
- **Research budget** of ~150 Million Euro (funding from industries)
- More than **200** Researchers/Scientist/Engineers

- **Affordable electric vehicles** developed by RWTH Industry 4.0 Institute for German market (now spin-off company driving the German market **e.GO**)
- The development and manufacturing with Industry 4.0 strategy for cost efficient
- The **knowledge gained from this, professional educational** is developed for German companies
- Steerix is **technology provider to ASEAN**

University-Industrial Collaboration in Germany

RWTH is contributors to IMPULS – Ind4.0 Readiness, Ind4.0 Platform Blueprint and Govt. initiative in Germany

Industry 4.0 related projects – More than 40 projects

- **4 projects** with **Porsche** (Tracking of car components, quality management, advanced analytics and visualization, Machine Learning)
- **3 projects** with **AUDI AG** in terms of data integration, Big Data and Machine Learning
- **2 projects** with **VW** (car tracking and Machine Learning)
- **2 Projects** with **Daimler** (Consulting Change Management, Machine Learning with Manufacturing Data)
- **2 projects** with **Bosch** (Studies and consulting in terms of industrial communication and automation)
- **2 projects** with **Saint Gobain** (Process integration and optimization of information and communication infrastructures)
- **2 projects** with **Siemens** (Machine Learning for Manufacturing Tools)
- **Big project** with **Aixtron** about Data Analytics and ICT
- **Project** with **Opel** and car manufacturing / assembly line optimization
- **Project** with **BMW** (Logistics for Manufacturing)
- **Other projects** are not listed here

...


THANK YOU
INDUSTRY 4.0
Cyber Physical System