<u>**Industry 4.0 Awareness Seminars Reports Template**</u>

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1.	Date of the Seminar	27 February 2019
2.	Organizers	CII and FSM
3.	Title of the seminar	Awareness Workshop on Industry 4.0 *The Indian Perspective*
4.	Programme	Annexure 1
5.	Report: suggested contents (1) Main takeaways / good suggestions, (2) Clusters covered – **Gurgaon, Haryana** (3) Nos attended - **46** (4) Success stories that need to be compiled / shared – **FSM case study**	(1) <u>Main takeaways / good suggestions</u> • Overview of Industry 4.0 concepts • Exposure to explore the possibilities of 'Digitalization' - its benefits as well as key challenges • Understanding of a basic framework of readiness for Industry 4.0 • Additive manufacturing – its relevance, challenges and applications • Case-study of Pilot cyber-physical line through remote demonstration • Levels of Smart Manufacturing and applications, key ingredients and survey on Industrial IoT • Understanding of the digital journey of a company with Augmented Reality and Machine

		Learning
6.	List of Speakers with contact details	Annexure 2
7.	Presentations	Annexure 3
8.	Resource persons for providing consultancy, skilling, guidance etc.	Dr Sunil Jha, Mr Anup Wadhwa and Mr Saroop Chand
9.	Photographs	Annexure 4
10.	Leanings from the seminar	- Industry has a basic understanding of the concepts of Industry 4.0 at a broader level (as understood from the participants who attended the workshops). They are keen on understanding in detail about the applications of how to benefit from implementing Industry 4.0 through specific case. -studies by companies who have deployed Industry 4.0. -Working models and demonstrations of Industry 4.0 Applications were very well received by the participants. It was also quite engaging and insightful. -Participants attending the workshops have shown great interest on interacting with DHI officials to understand about the various initiatives taken by Government in creating an enabling ecosystem for Industry 4.0 adoption.

Confederation of Indian Industry

Department of Heavy Industry
Government of India

FSM Smart Manufacturing Simplified

Program Outline

Awareness Workshop on Industry 4.0

The Indian Perspective

Date: 27th February 2019
Time: 10:30 AM – 4:00 PM
Venue: CII Office, Plot No. - 249F, Phase IV, Udyog Vihar, Sector 18, Gurugram, Haryana

PROGRAM SCHEDULE	
10:00 – 10:30	Registration
10:30 – 10:40	**Welcome Address** *Mr Satendra Singh, Member – CII Smart Manufacturing Council and Head- Manufacturing & Strategy, Nokia Solutions and Networks India Pvt. Ltd.*
10:40 – 10:50	**Special Address** *Ms Sukriti Likhi, Joint Secretary, Department of Heavy Industry (DHI)**
10:50 – 11:10	**Business Disruptions and Opportunities for Smart Manufacturing in India** *Mr Ravi Agarwal, MD, Pepperl+Fuchs Factory Automation & President, Automation Industry Association*
11:10 – 11:20	Tea Break
11:20 – 12:25	**Getting started with Smart Automation and IIoT Layers – Case Study of Pilot Cyber Physical Line** *Dr Sunil Jha: Director, FSM & Lead Facilitator FSM Technology Team*
12:25 – 12:50	**Challenges in Automated Tracking, Tracing and Remote Supervision** *Mr Sandeep Singh, Director, Reckers Mechatronics Pvt Ltd*
12:50 – 13:10	**Relevance of Additive Manufacturing beyond Prototyping** *Mr Saroop Chand, MD, Adroitec Information Systems*
13:10 – 13:15	Q&A
13:15 – 14:00	Lunch Break
14:00 – 15:05	**Preparing for the next level of Digital Journey with Augmented Reality and Machine Learning** *Dr Sunil Jha, Director, FSM & Lead Facilitator FSM Technology Team*
15:05 – 15:35	**Business Value Creation through Automation and Digital Deployment – Open House Facilitation** *Mr Pravin Purang, former MD, Royal Enfield Motors and Eicher*
15:35 – 15:50	**Leveraging the Common Engineering & Cyber Physical Facilities Centre** *Mr Anup Wadhwa, Director, Automation Industry Association*
15:50 – 16:00	Summing up

Annexure 2

Awareness Workshop on Industry 4.0 - Gurugram					
List of Speakers					
S. No.	**Name**	**Designation**	**Company Name**	**Email**	**Phone**
1	Satendra Singh	Head-Manufacturing & Strategy	Nokia Solutions and Networks India Pvt. Ltd.	satendra.singh@nokia.com	9940122470
2	Ravi Agarwal	President, Automation Industry Association and MD	Pepperl+Fuchs Factory Automation		
3	Dr Sunil Jha	Director	FSM & Lead Facilitator FSM Technology Team	suniljha@mech.iitd.ac.in	9958198399
4	Sandeep Singh	Director	Reckers Mechatronics Pvt Ltd		
5	Saroop Chand	Managing Director	Adroitec Information Systems		
6	Anup Wadhwa	Director	Automation Industry Association	anup.clair@gmail.com	9810026674

Presentations

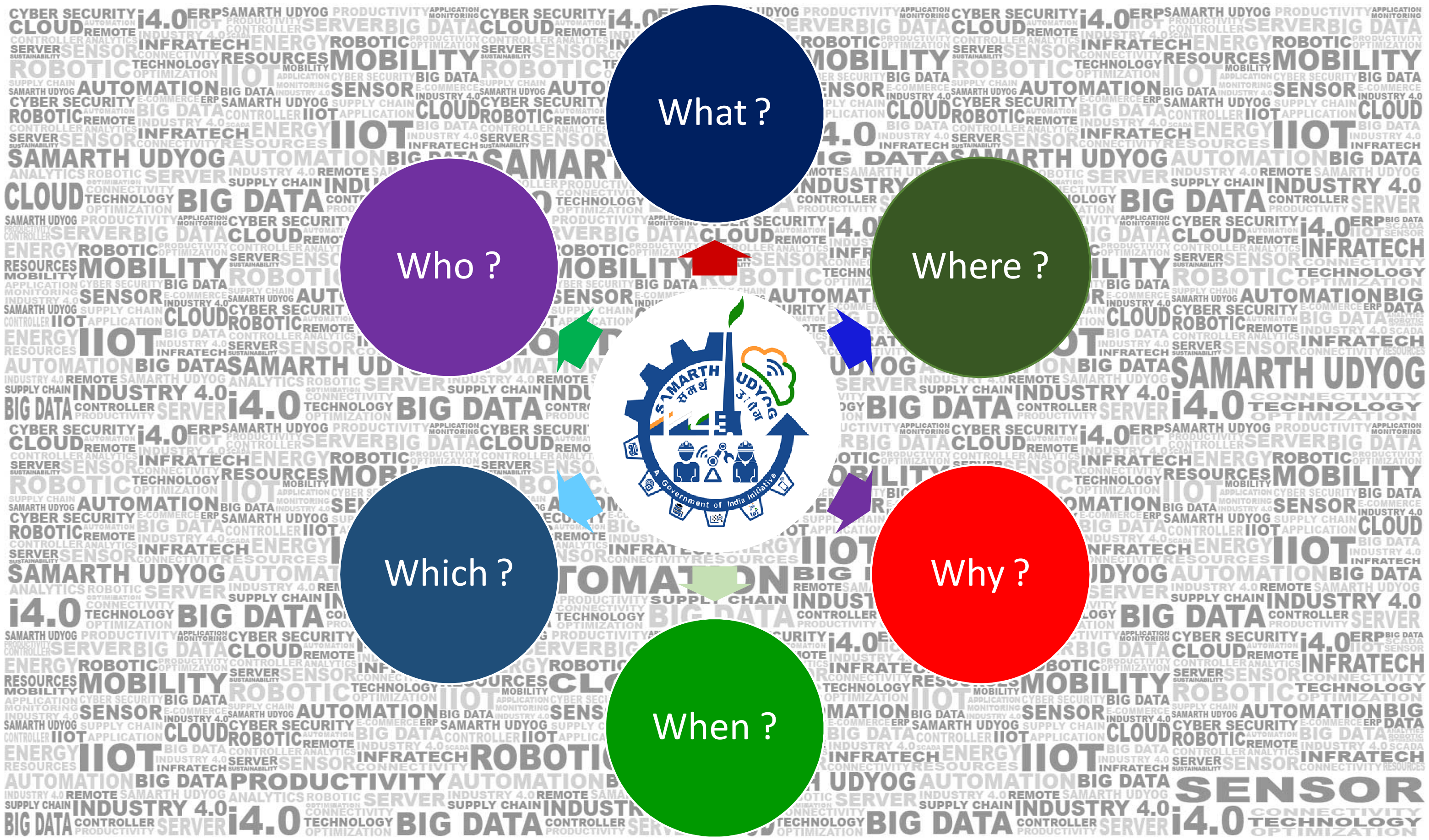
Samarth Udyog

Digitization of Markets and Industry in India

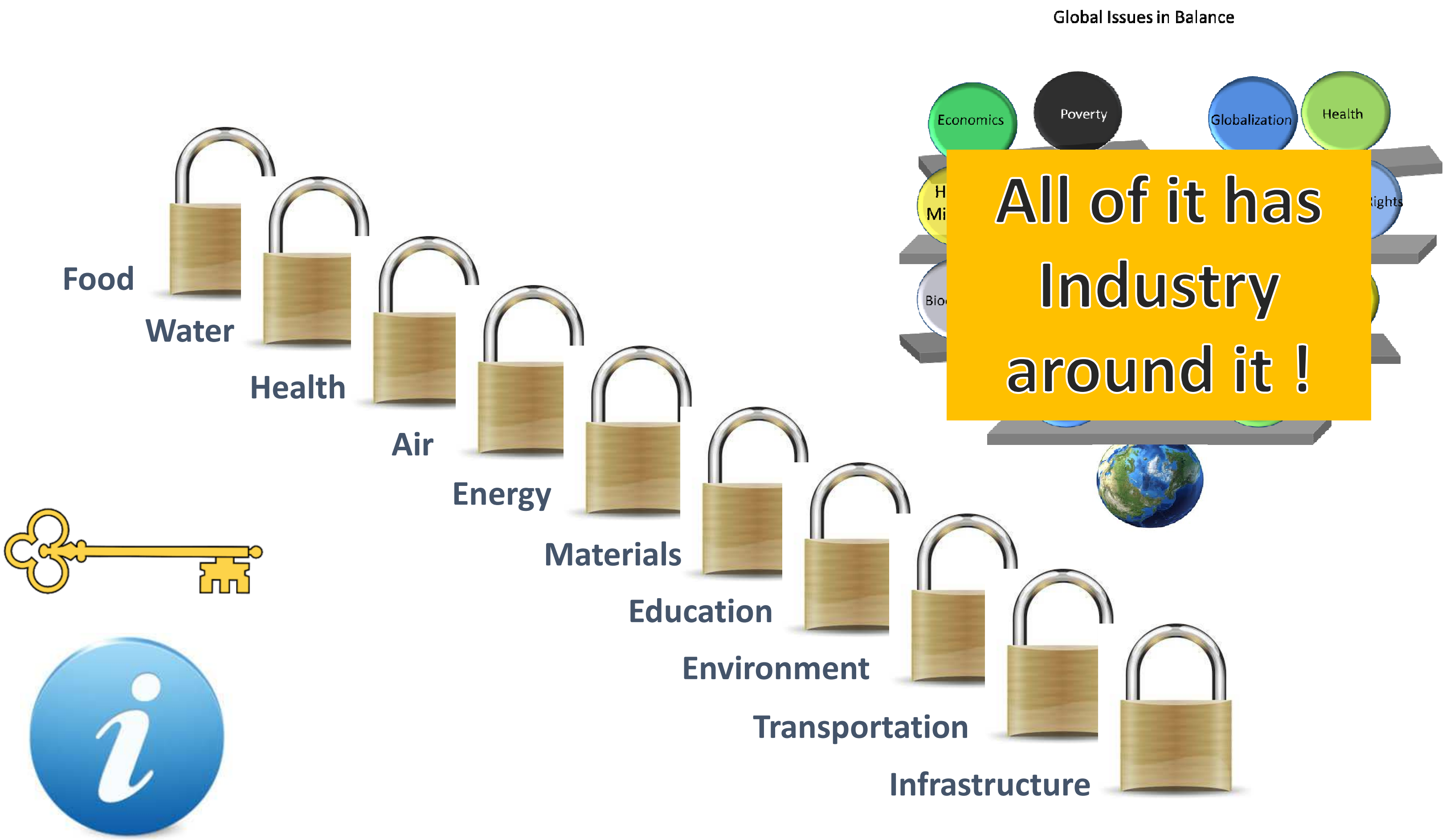
Ravi Agarwal

AIA, FSM, P+F

Samarth Udyog

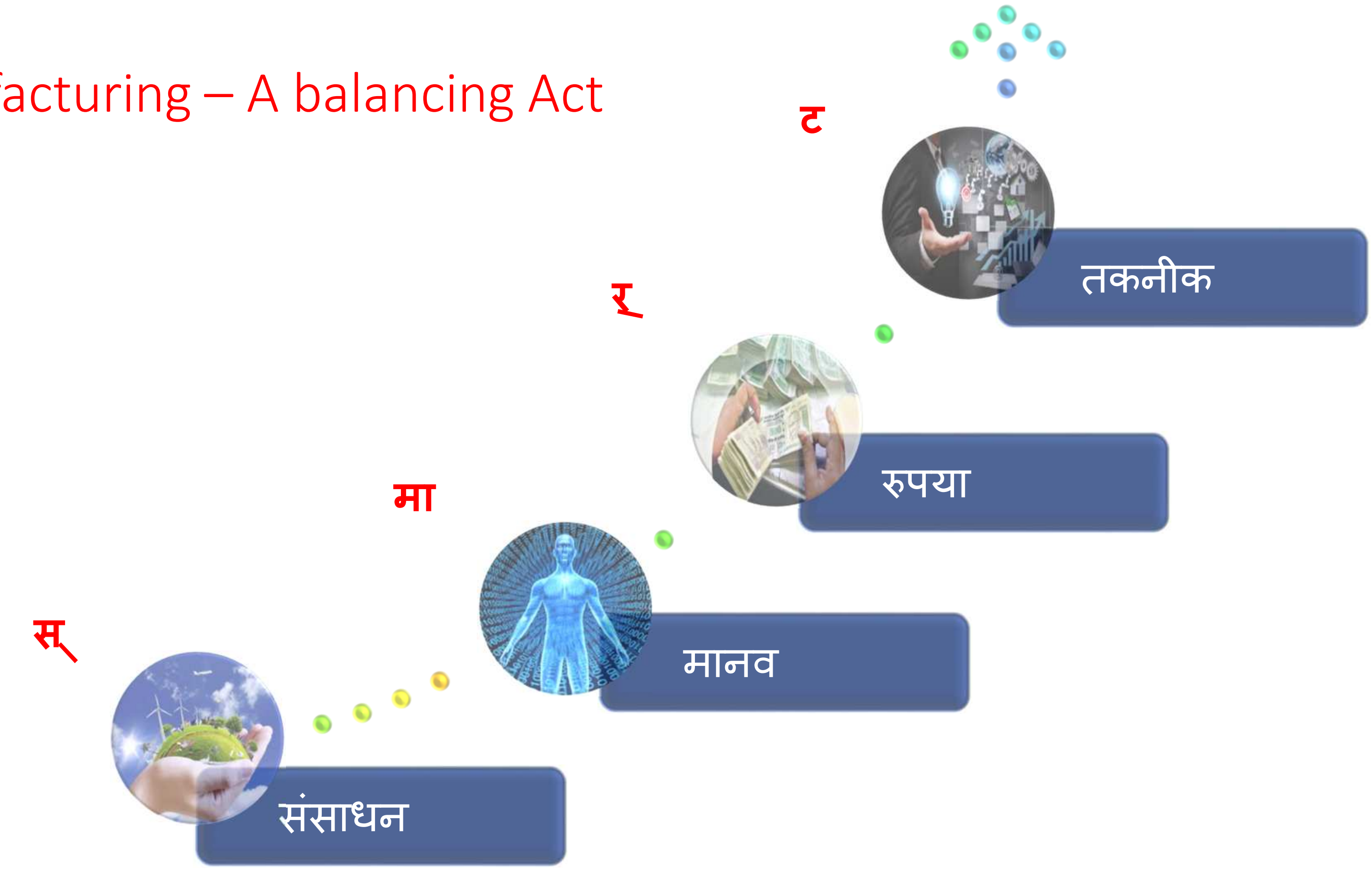


Unlocking the Industrial potential ?



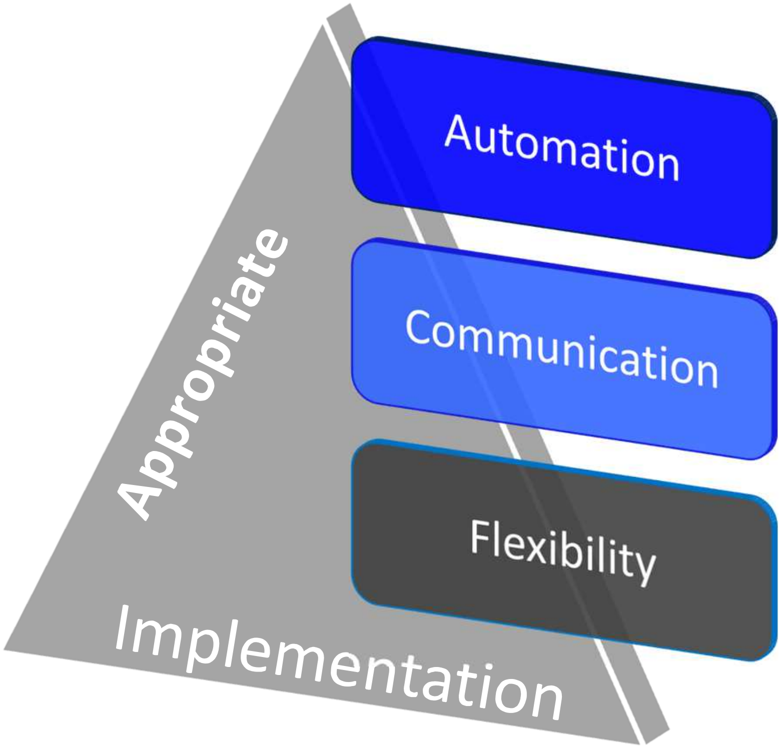
I4.0/SMART manufacturing/Samarth Udyog in India

स्मार्ट Manufacturing – A balancing Act



Applying it

Cut
Copy
Paste
Wouldn't work !
Inspiration &
Ingenuity would !



Key Technologies @ FSM

- IIoT
- RFID
- Augmented Reality for Enhanced Visualisation & Learning
- Cyber Physical System
- Computer Vision
- 3D Printing with Multi-material capability
- Collaborative Robots (Cobots)
- Manual Operating Station
- Smart Sensors
- Safety
- Network Security
- Implementation of OPC-UA
- MTConnect Agent based Services
- Pallet & different conveying system
- Manufacturing Execution System
- Manufacturing Analytics
- Grippers & Material Handling

Methodology

Operational, Technical, Financial, and Skill Assessment

- Process capability study
- Safety & Energy assessment
- Remote Monitoring, Tracking & Tracing
- Training Needs

Absorption and Implementation in the existing facilities

- Instrumentation
- M2M Communication
- Introducing Digitalization
- Upgradation of existing plant/facility
- Proof of technology model

Upgrading to Smart Manufacturing / Industry 4.0

- Inclusion of best practices
- Proving ROI and increased competitiveness and productivity
- Inclusion in National & Global integrated supply & production chain

Thank You !

Smart Automation and IIoT Layers

Case Study of Pilot Cyber-Physical Lab

Dr. Sunil Jha, Professor
Department of Mechanical Engineering,
IIT Delhi, Hauz Khas, New Delhi - 110016
suniljha@mech.iitd.ac.in

FSM

IITD-AIA Foundation
for
Smart Manufacturing
www.iafsm.in

Smart Manufacturing

Economic Potential

Ability to **accelerate** corporate **decision-making** and **adaptation** processes

Agility

Ability to implement **changes** in the company in **real-time**

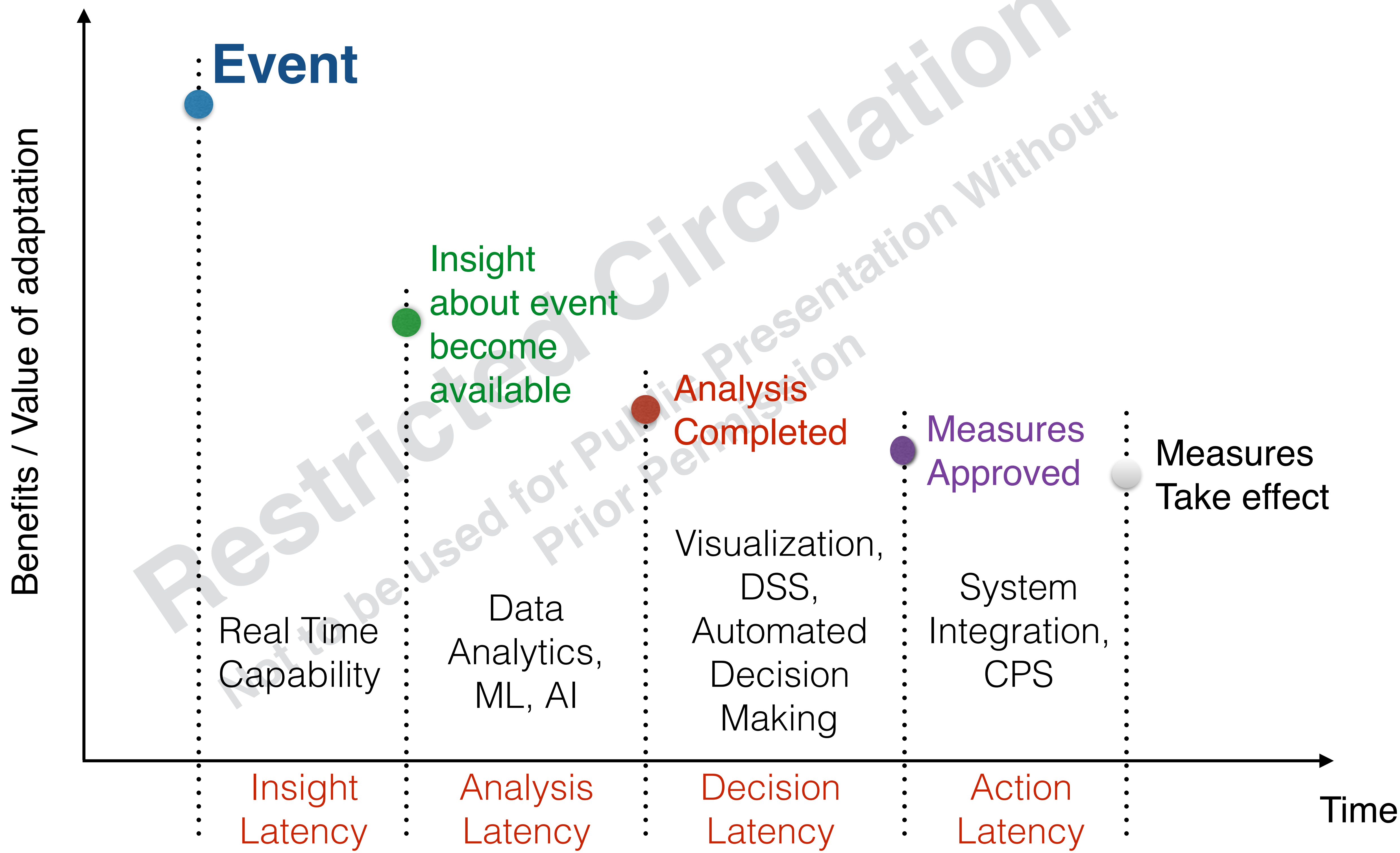
Smart Manufacturing

The **significance** of Smart Manufacturing lies in the role of **information processing** in enabling **rapid** organisational **adaptation** processes.

The **faster** an organisation can **adapt** to an event that causes a change in its circumstances,

Greater the **benefits** of the **adaptation**.

Corporate Adaptation Processes



Source: based on Hackathom 2002; Muehlen/Shapiro 2010

FSM

Smart Manufacturing

Smart Manufacturing is about manufacturing "**with intelligence**" at each step along the "**Design - Make - Use**" continuum

Smart manufacturing will **transform** how products are:

Designed | **Manufactured** | **Used / Operated** | **Serviced**

It will **transform** the **operations**, **processes**, and **energy footprint** of factories

and the **management** of manufacturing **supply chains**.

Levels of Smart Manufacturing

Decision Making

Make **optimised**, **real-time** **decisions** on production **levels**, **locations**, **options** etc. based on **corporate intelligence** created by **Smart Manufacturing enterprise**

Data Analytics

Applying DA to broad manufacturing **intelligence** to **optimise processes** and to iteratively design **smart products**

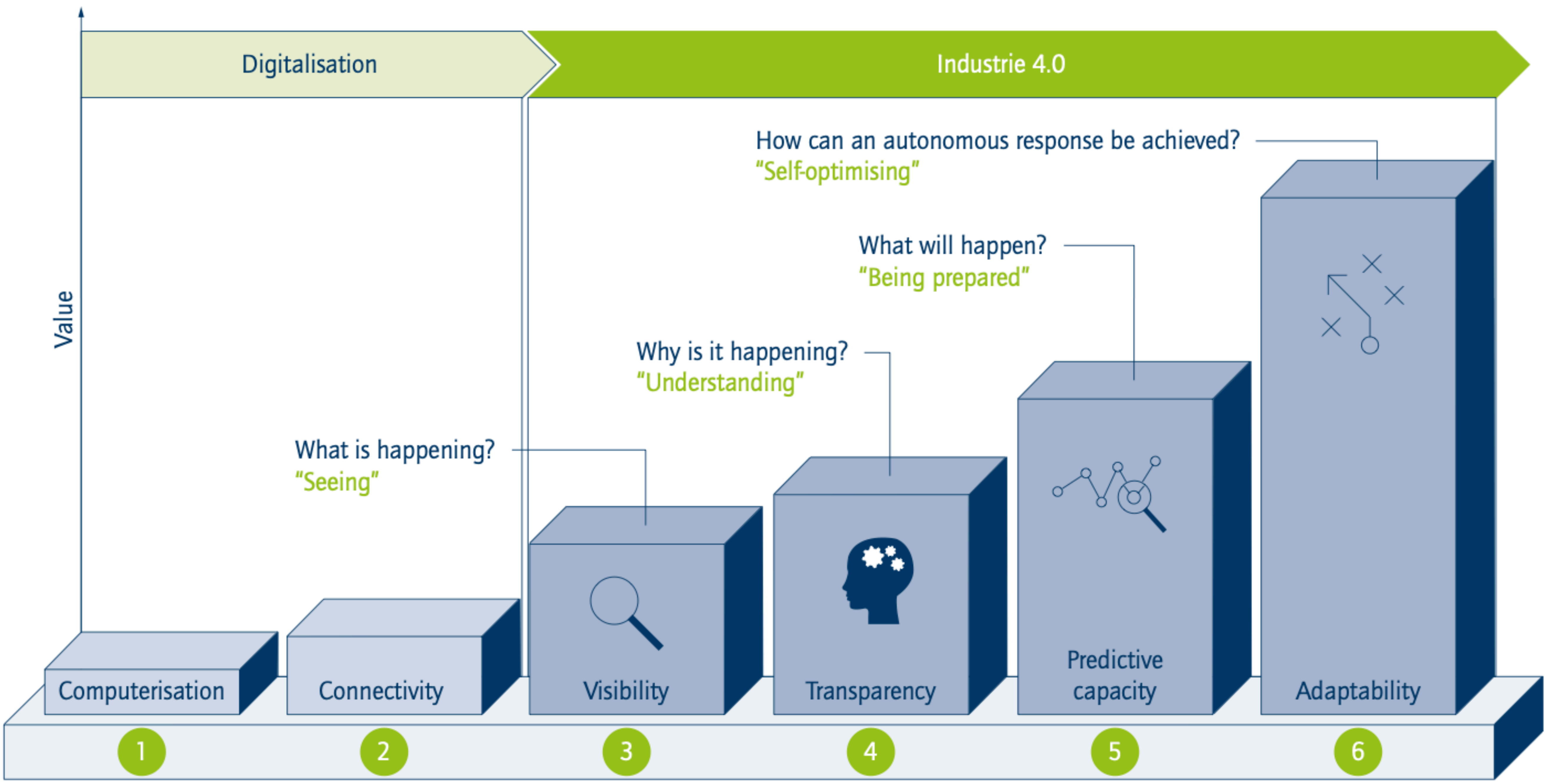
Digital Thread

Consolidates **information streams** from individual machines across **factory floor** by linking multiple process-chains together

Intelligent Machines

Production **equipments** equipped with **sensors** integrated into **IIoT** (***information stream***)

Stages in Smart Manufacturing Development Path



(source: RWTH Aachen University)

1: Computerisation

- Different **information technologies** are used in **isolation** from each other within the company.
- Computers are primarily used to perform **repetitive tasks** more efficiently
- Still possible to find many machines **without** a **digital** interface
- One example for the computerisation stage would be a **CNC milling machine.**

  CAD data detailing actions still often has to be transferred to the milling machine manually – in other words, the **machine is not connected**.

- Semi-automated quality assurance is carried out at a test station, but the recorded data is not associated with the corresponding work order

2: Connectivity

- The **isolated** deployment of **information technology** is replaced by **connected** components.
- Widely used business applications are all connected to each other and mirror the company's core business processes
- Parts of the operational technology (OT) systems provide connectivity and interoperability, but **full integration** of the IT and OT layers has **not yet** occurred
- Connectivity means **seamless information exchange** between design, production, maintenance and service.

3: Visibility

What is happening?

- **Sensors** enable processes to be captured from **beginning** to **end** with large numbers of **data points**.
- This makes it possible to keep an up-to-date **digital model** of **factories** (company's **digital shadow**) at all times.
- Producing a digital shadow is a **major challenge** for many companies.
    - data is often held in decentralised silos,
    - very little data collected,
    - data captured is only visible to a limited number of people

3: Visibility

What is happening?

- In order to achieve the goal of an **agile learning enterprise**, comprehensive **data capture** right across the company is **essential** for the provision of relevant data about the operation throughout the business.

Real-time KPIs and dashboards	Rapidly determine the delivery date variance	Production planning can be adjusted	Inform customers and suppliers

- The **combination** of existing data sources with **sensors** on the shop floor can deliver significant benefits.

- Integrating **PLM**, **ERP** and **MES** systems provides a comprehensive picture that creates **visibility** regarding the **status quo**.

4: Transparency

Why is it happening?

- The next stage is for the company to **understand** why something is happening and use this understanding to **produce knowledge** by means of **root cause analyses**
- In order to **identify** and **interpret** interactions in the digital shadow, the captured **data** must be **analysed** by applying **engineering knowledge**.
- New technologies that support the **analysis** of **large** volumes of **data**
- Recorded parameters are **searched** for mutual **events** and **dependencies** that are then **aggregated** to produce complex events reflecting the condition of the machine or equipment.

5: Predictive Capacity

What will happen?

- Once it has reached this stage, the company is **able** to **simulate** different **future scenarios** and identify the most likely ones.
- Companies are able to **anticipate future developments** so that they can take decisions and **implement** the appropriate **measures** in good time.
- A company's **predictive capacity** is heavily **dependent** on the groundwork that it has **previously** undertaken.
- A properly constructed **digital shadow** combined with a **knowledge** of the relevant **interactions** will help to ensure correct **forecasts** and the right **recommendations.**

6: Adaptibility

Achieving Autonomous Response

- Predictive capacity is a fundamental requirement for **automated actions** and **automated decision** making.
- **Continuous adaptation** allows a company to **delegate** certain decisions to **IT systems** so that it can **adapt** to a **changing** business environment as **quickly** as possible.
- The degree of adaptability depends on the complexity of the decisions and the cost-benefit ratio
- Important to **carefully assess** the **risks** of automating approvals and acknowledgements for customers and suppliers.
- The **goal** of adaptability has been **achieved** when a company is able to **use the data** from the digital shadow to **make decisions**

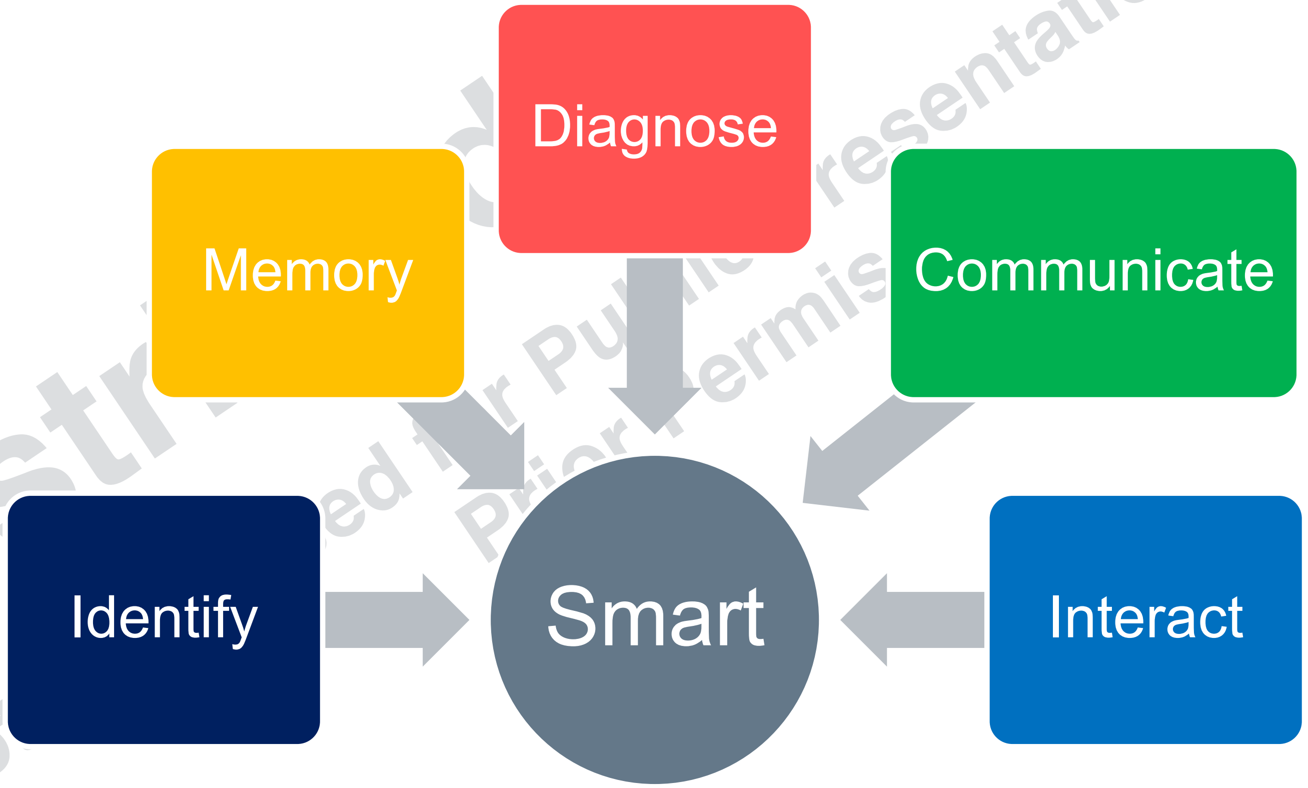
Smart Sensors

Dr. Sunil Jha, Professor
Department of Mechanical Engineering,
IIT Delhi, Hauz Khas, New Delhi - 110016
suniljha@mech.iitd.ac.in

IITD-AIA Foundation
for
Smart Manufacturing

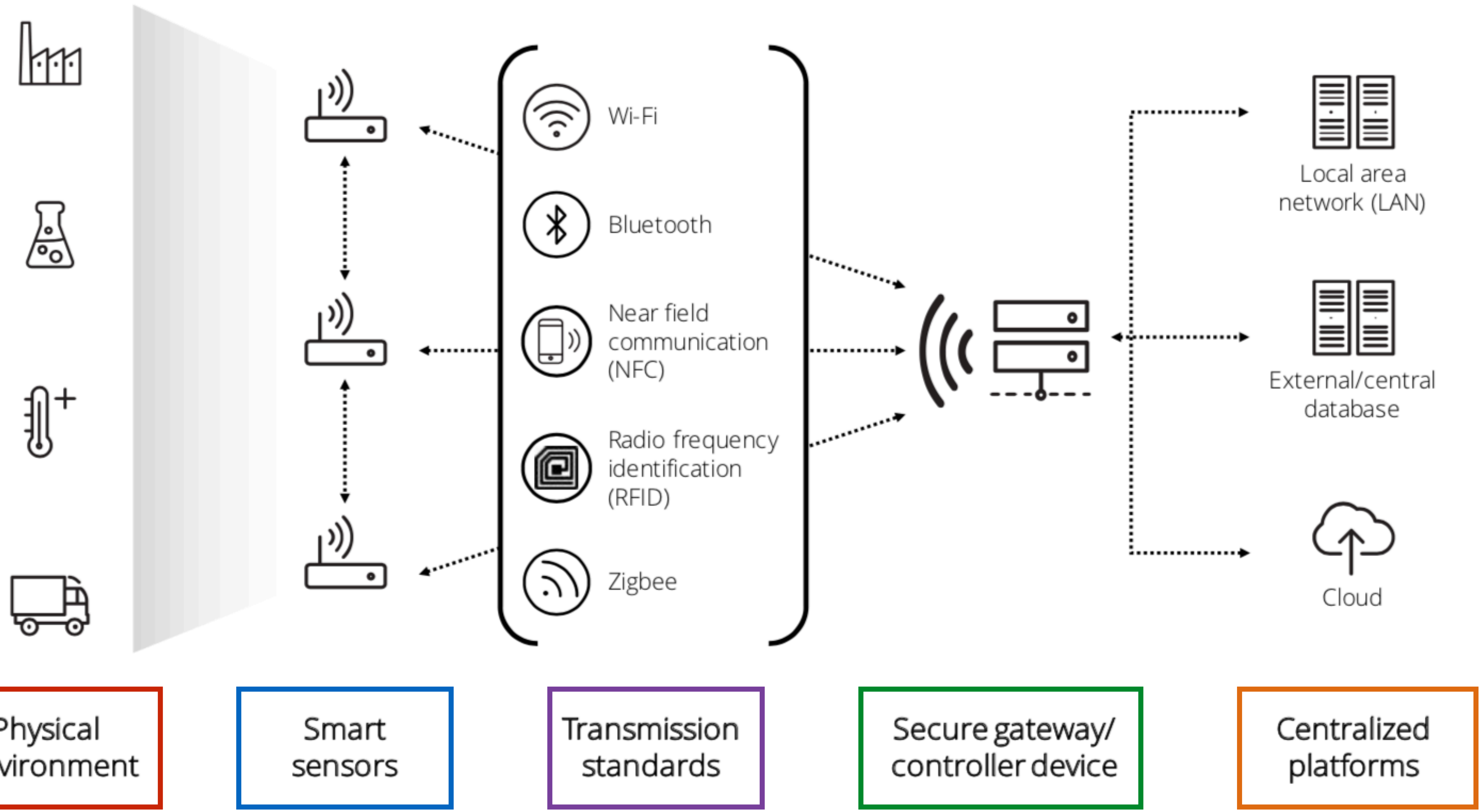
What are Smart Sensors?

Smart sensors are **advanced platforms** with onboard **technologies** such as **microprocessors**, **storage**, **diagnostics**, and **connectivity** tools that **transform traditional feedback signals into true digital insights**.[1]



These **smart sensors** can provide the **timely** and **valuable data** to power **analytical insights** that can in turn drive **improvements** in **cost**, **performance**, or **customer experience**.

Smart Sensor Ecosystem



Smart Sensors

Need of smart sensors

Smart sensors transform the **physical world** into **digital insights** that are used to create **new value**.

By arming managers with **real-time information** about their **inventory**, **machinery**, and **purchased materials**,

Smart sensors create **visibility** across the supply chain and fuel **analytics** that can be used to understand and anticipate **demand**, **optimize sourcing**, and drive **high-value** manufacturing **decisions**.

Smart Sensor

Recent Developments

Computing Capabilities

Enabling **data processing** and **analysis** at or **near** the **source** ("edge computing") and **reducing** the **amount** of **data** that moves between the **device** and **platform**.

Compact

MEMS technology allowed for more **compact**, higher functioning smart sensors by effectively incorporating **microelectronic** functions in **minimal space**

Connectivity

New **wireless** technologies are offering connectivity solutions that are more **scalable** and **tailored**

Low-power wide area networks (**LoPWAN**), for example, have **reduced cost**, **power consumption**, and **range** issues for smart sensor usage.

Smart Sensor Recent Developments

Recent Developments

Analytics Tools

Extracting **insights** from sensor-created data is getting **easier** as **analytics** tools continue to improve.

Big Data

Handling and storing large, complex data sets is becoming more **manageable** through **Big data platforms**.

Real Time Processing

Tools enable **processing** and **analysis** of data on a **real-time** or a near-real-time basis, driving **timely decision making** and **action**.

New Algorithms

Algorithms continue to advance, expanding the **capability** to predict and **prescribe** courses of **action**.

Industrial IoT

Dr. Sunil Jha, Professor
Department of Mechanical Engineering,
IIT Delhi, Hauz Khas, New Delhi - 110016
suniljha@mech.iitd.ac.in

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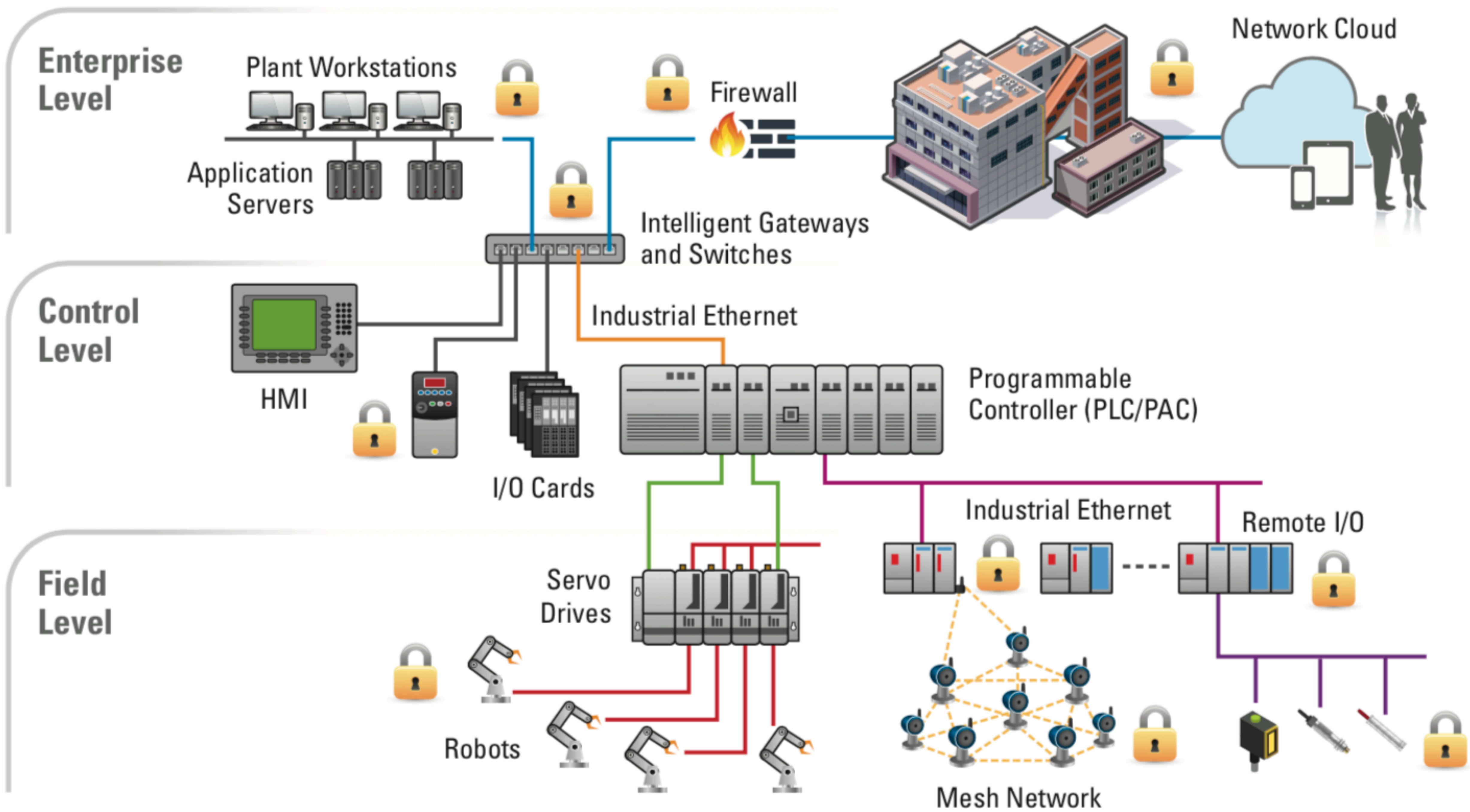
Why IIoT ?

- Ensuring **reliability** and **quality** of the product or process
- Improving **efficiency** of the manufacturing processes and adding **predictive maintenance**
- Introducing **products** faster with more **intelligent asset management**
- **Connecting** interdependent **multi-located** manufacturing facilities

White Paper on "Smart Factory Connectivity for the Industrial IoT", Ashish Pathak, Industrial Automation Segment, Renesas Electronics America Inc. February, 2017

Smart Factory Connectivity for IIoT



White Paper on "Smart Factory Connectivity for the Industrial IoT", Ashish Pathak, Industrial Automation Segment, Renesas Electronics America Inc. February, 2017

IIoT for Condition Monitoring

Reactive	Preventive	Predictive
Fix it When it Breaks	Schedule Maintenance	Maintain it Before it Breaks

Condition Monitoring Enables

Increase in Productivity

12-18% 8-12%

IIoT Key Ingredients

People	• How are they identified? • How do they interact with the data (near real-time)? • How do they consume the data (notifications, trends, alerts)?
Devices	• What are they? • How do they communicate with systems? • How are they managed?
Data	• What happens with data flowing in? • What happens when data needs to flow out? • How can data converted into business value (Monetization)?

What qualifies as complete IOT use case?

Uniquely identifiable and connected things

Data capture, contextualization and storage

Analytics triggering automated responses

Measurement and reporting of relative changes in performance

Return on Assets

Use Case Theme

Sense → **Analyse** → **Intervene** → **Learn**

Sense	Analyse	Intervene	Learn
Visual Temperature Vibration Wear Energy Consumption	Maintenance History Asset Specifications Useful Life Repair Parts/Spares Resource Availability Usage Schedule	Alert Operators Schedule Inspection Order Parts Schedule Maintenance Reroute Production Update Records	Asset Selection Maintenance Planning Operating Conditions Training ROI

IIoT Survey

Source: www.infor.com

IIoT Survey

Priority

How important is IoT in your business?

A. Top Priority

B. Top Three

C. Top Five

B. Not a Priority

IIoT Survey

Business Impact

Indicate the impact you anticipate IoT will have on your business?

A. Major	**C.** Minimal
B. Moderate	**B.** None

IIoT Survey

Benefits

Where do you anticipate the biggest benefits of IoT in your business (select 3)?

- **A.** Machine & Equipment Utilization
- **B.** Productivity
- **C.** Insight & decision Making
- **D.** Visibility & Traceability throughout Suppy Chain
- **E.** Plant Floor Automation
- **F.** New Revenue Streams
- **G.** Product Quality
- **H.** Safety & Security
- **I.** No benefits anticipated from IoT in our business
- **J.** New Services

IIoT Survey

Urgency

What would be your top concerns if your business were not to implement an IoT strategy in the next 3 yrs?

A. Competitor will gain productivity & cost advantage	**E.** Employee productivity will fall
B. We might not catch up innovative services / product	**F.** Harder to attract new customers
C. May become harder to stay Compliant	**G.** Harder to attract / retain skilled employee
D. May not be able to support customers & suppliers	**H.** No Concerns

FSM

IIoT Survey

Readiness

How ready is your business to Capitalize on the opportunity of IoT?

A. Hardware & Software in place, fully equipped

C. Capturing data but No Smart business systems

B. Capturing data, but Unconnected to application

D. No Smart devices / sensors deployed in the business

IIoT Survey

Summary

Customer Survey

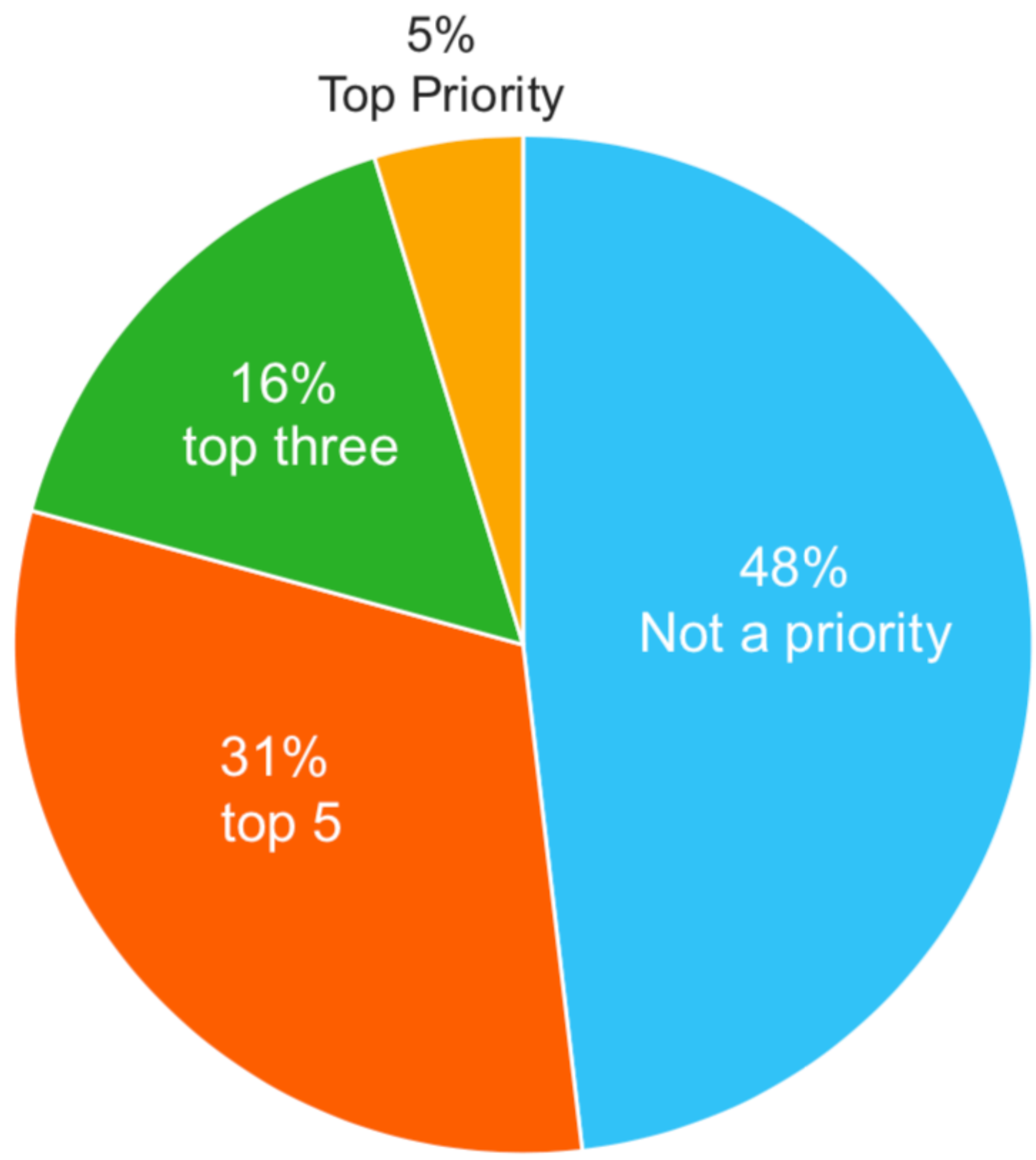
Source: www.infor.com

Priority

How important is IoT in your business?

Over half report IoT in **Top 5** priorities

20% identifying it as a '**Top 3**' business priority

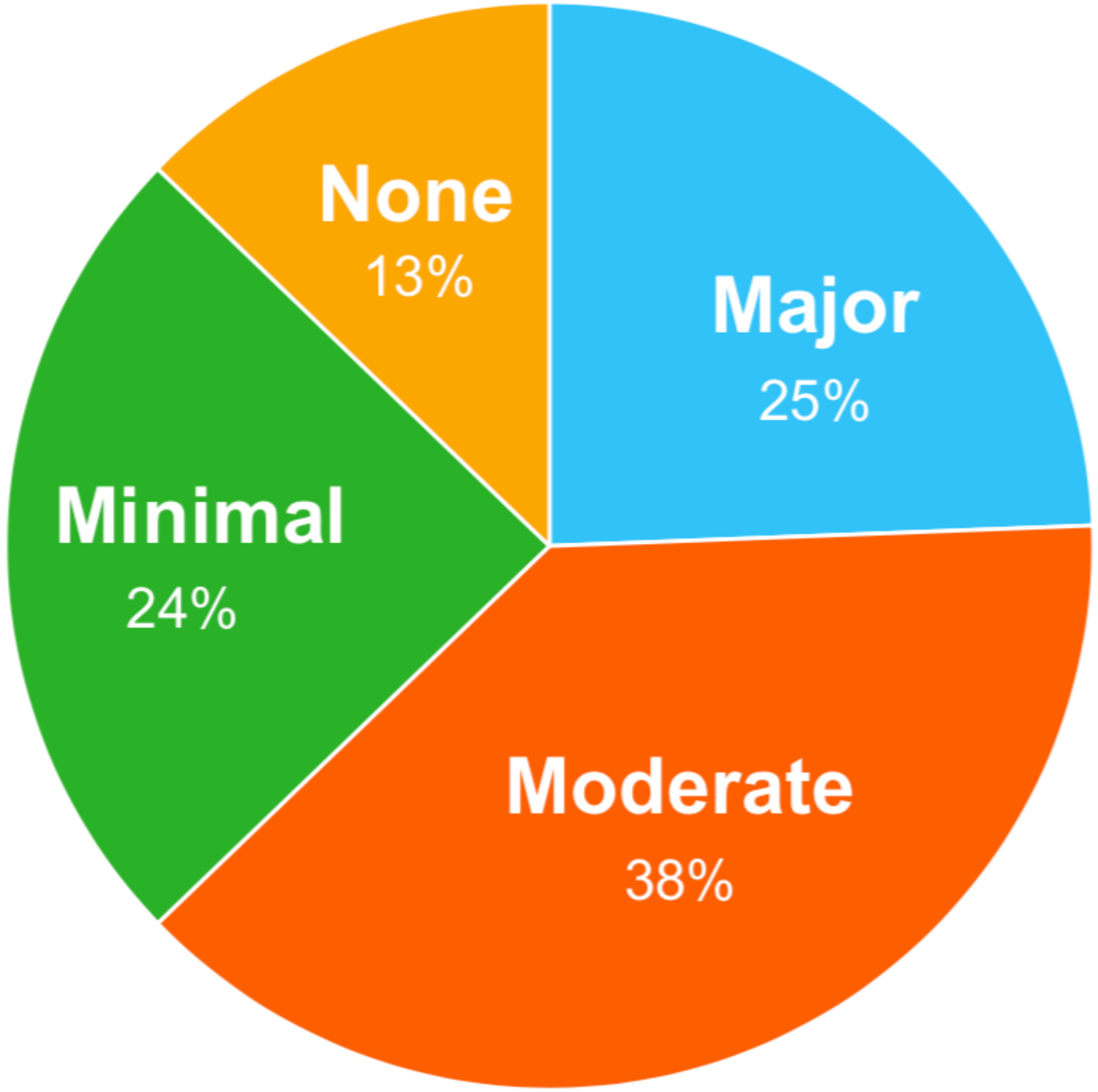


Customer Survey

Source: www.infor.com

Business impact

Indicate the impact you anticipate IoT will have on your business?



Quarter anticipate **major** impact

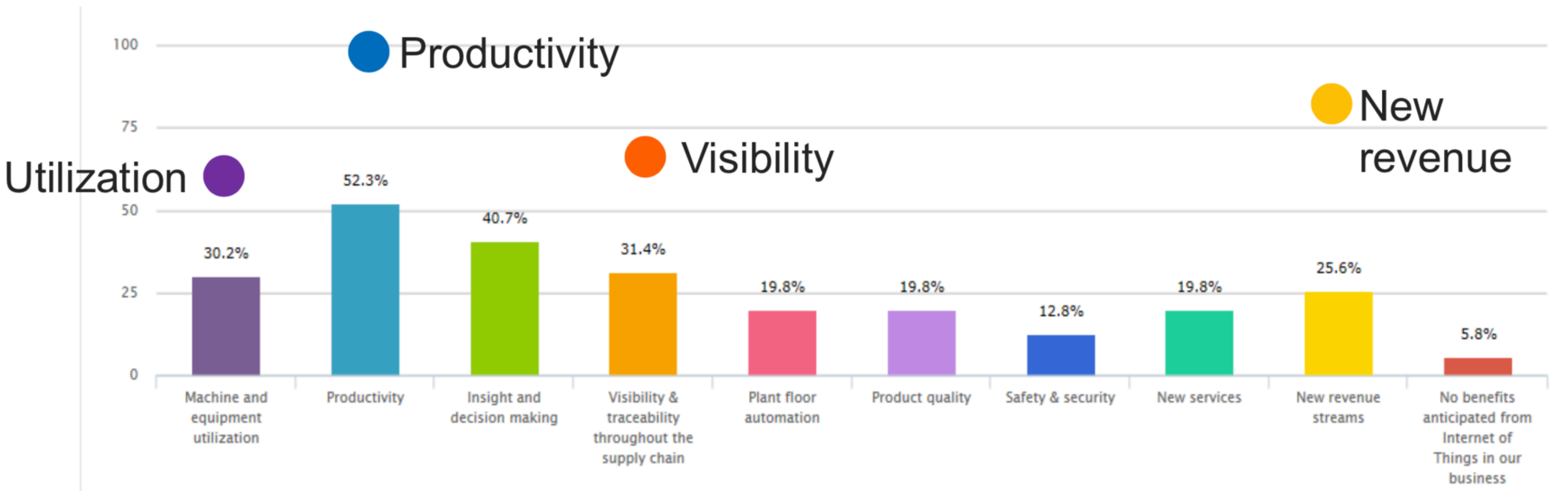
Only **13%** anticipate **no** impact

Customer Survey

Source: www.infor.com

Benefits

Where do you anticipate the biggest benefits of IoT in your business (select 3)?

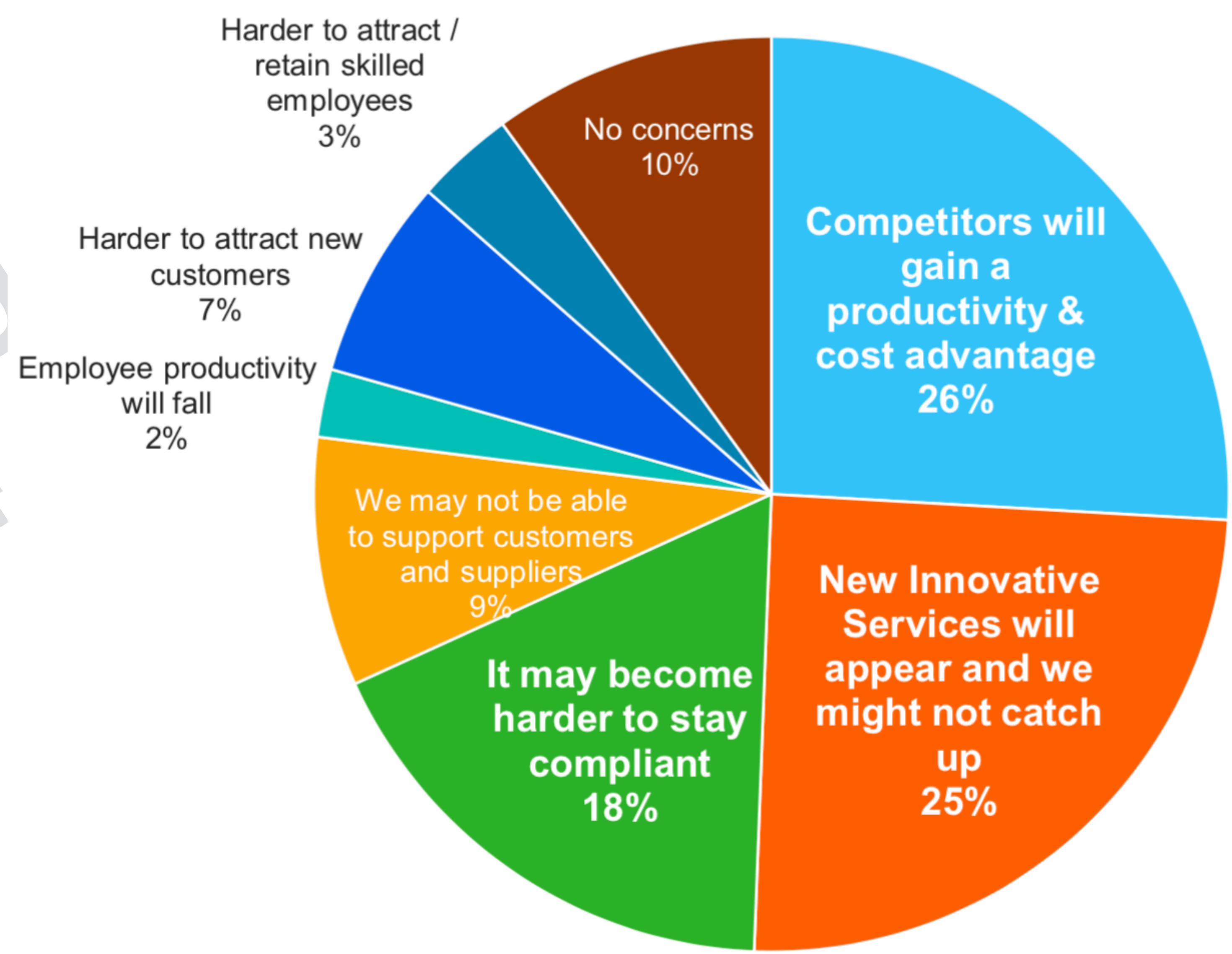


Customer Survey

Source: www.infor.com

Urgency

What would be your top concerns if your business were not to implement an IoT strategy in the next 3 years?



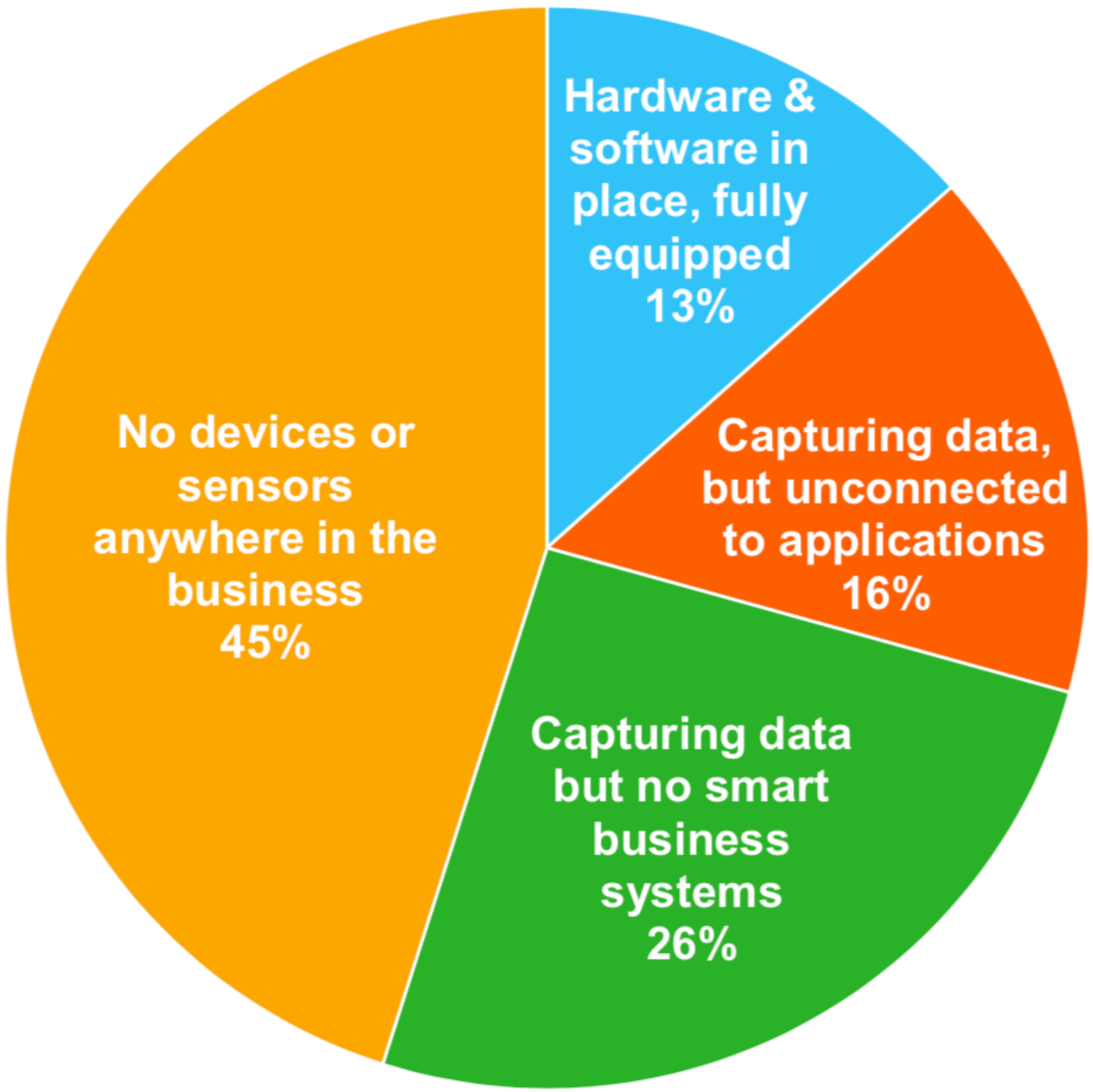
Productivity, Service Innovation & Compliancy major concerns of failing to adopt IoT

Customer Survey

Source: www.infor.com

Readiness

How ready is your business to capitalize on the opportunity of IoT?



Only 13% fully ready to capitalize on IoT

45% report no smart devices deployed in the business

Cyber Physical System (CPS)

Dr. Sunil Jha, Professor
Department of Mechanical Engineering,
IIT Delhi, Hauz Khas, New Delhi - 110016
suniljha@mech.iitd.ac.in

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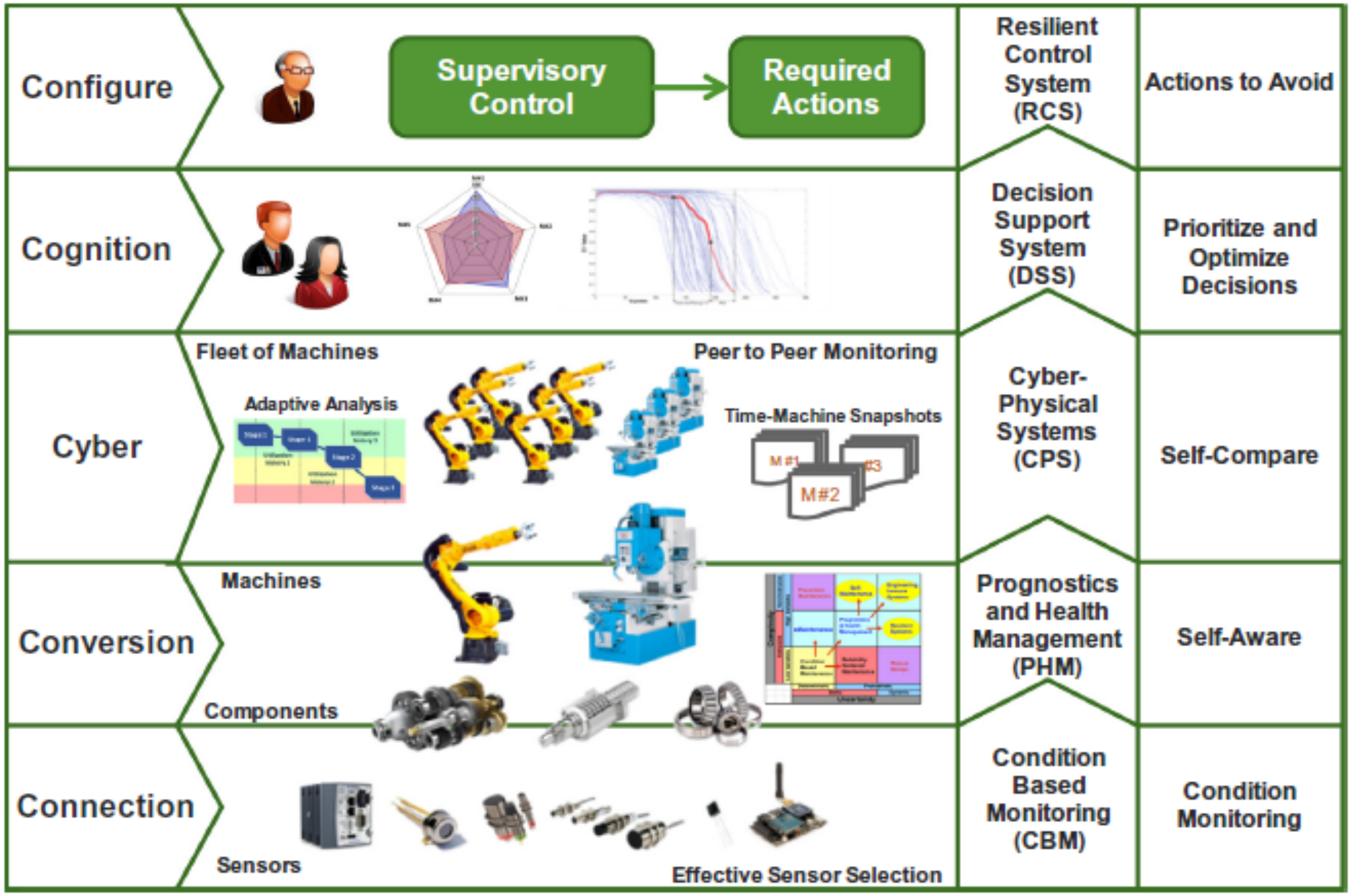
Cyber Physical System (CPS)

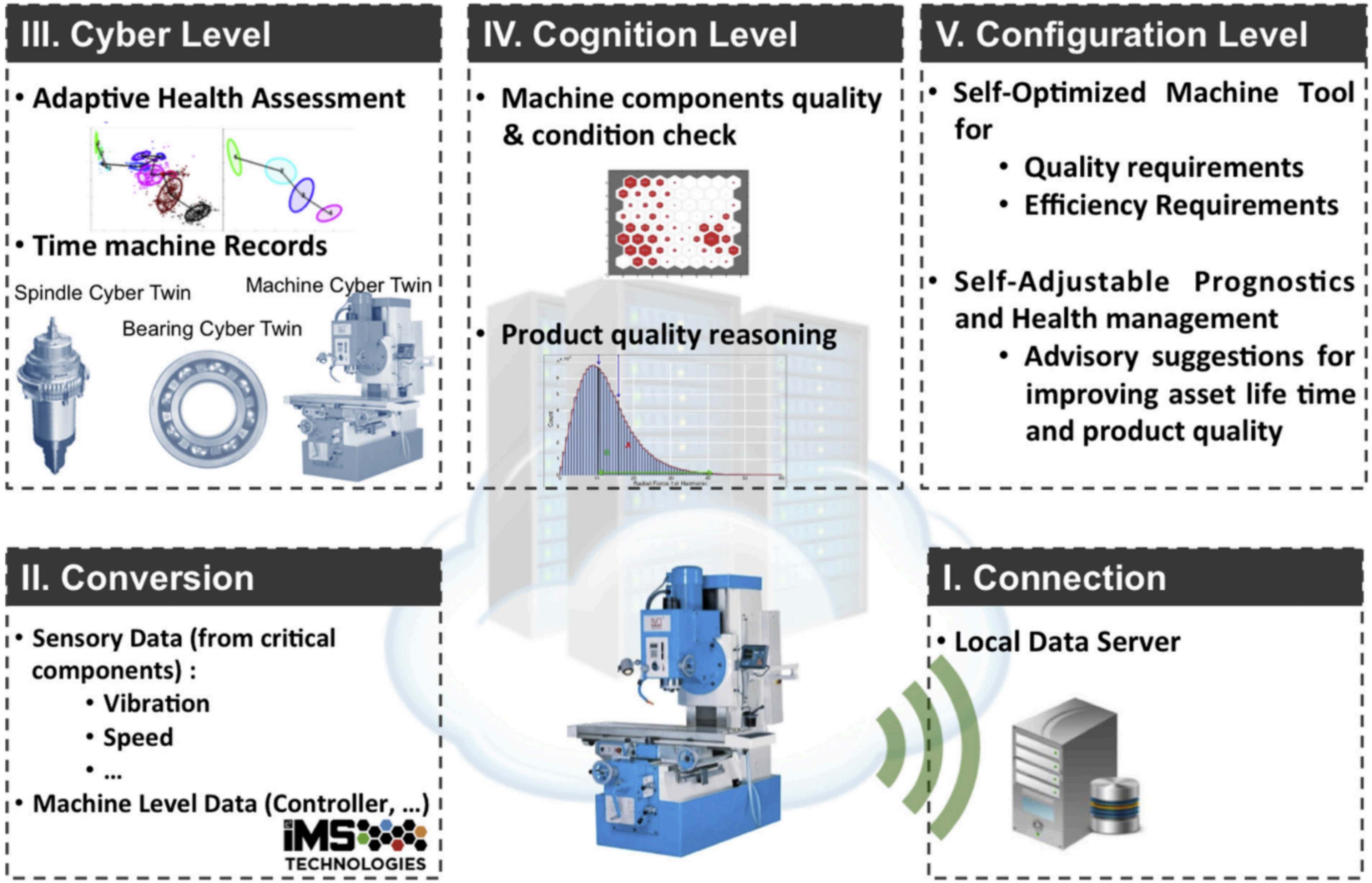
- Making **machine tools intelligent** for Smart Factory which can implement **self-aware**, **self-prediction**, **self-compare**, and **self-configure** to be more **resilient** to dynamic changing environments



J. Lee, B. Bagheri, and H. Kao, A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems, *Manufacturing Letters,* 3(2015), 18–23.

Cyber Physical System (CPS)

5C architecture for CPS as a guideline for implementation in manufacturing



J. Lee, B. Bagheri, and H. Kao, A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems, *Manufacturing Letters,* 3(2015), 18–23.

Machine Learning

Dr. Sunil Jha, Professor
Department of Mechanical Engineering,
IIT Delhi, Hauz Khas, New Delhi - 110016
sunilјha@mech.iitd.ac.in

IITD-AIA Foundation *for* Smart Manufacturing

Machine Learning

Powering Predictive Maintenance

- **Maintenance** represents a **significant** part of any manufacturing operation's **expenses**.

Traditional Predictive Maintenance:

Using SCADA systems set up with **human-coded thresholds**, alert **rules** and **configurations**.

Semi-manual approach

- doesn't take into account the more complex dynamic behavioural patterns of the machinery,
- or the contextual data relating to the manufacturing process at large.

Machine Learning

Powering Predictive Maintenance

ML Approach: Machine Learning algorithms are fed

OT data (from the production floor: sensors, PLCs, historians, SCADA)

IT data (contextual data: ERP, quality, MES, etc.)

Manufacturing process information describing the synchronicity between the machines and the rate of production flow

In AI, "**training**" enables the ML algorithms to **detect anomalies** and **test correlations** while searching for **patterns** across the various **data** feeds.

Machine Learning

Powering Predictive Maintenance

The power of Machine Learning

- Capacity to **analyze** very large amounts of data in **real time**, and propose **actionable** responses to issues that may arise.
- The **health** and **behaviour** of **every asset** and system are constantly **evaluated** and component **deterioration** is identified **prior** to **malfunction**

Machine Learning

Enabling Predictive Quality Analytics

The **quality** of **output** is **crucial** and product quality deterioration can also be predicted using Machine Learning.

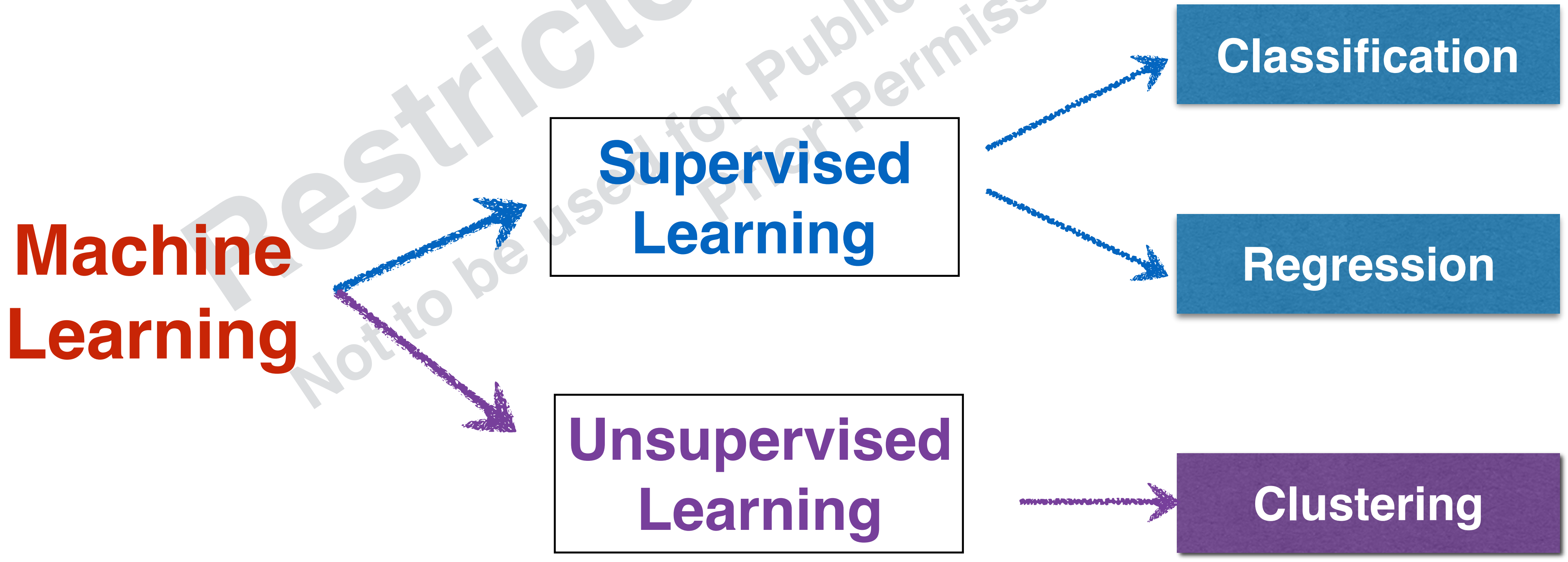
Knowing beforehand that the **quality** of products being manufactured is destined to **drop**

- prevents the wastage of raw materials
- valuable production time

Machine Learning

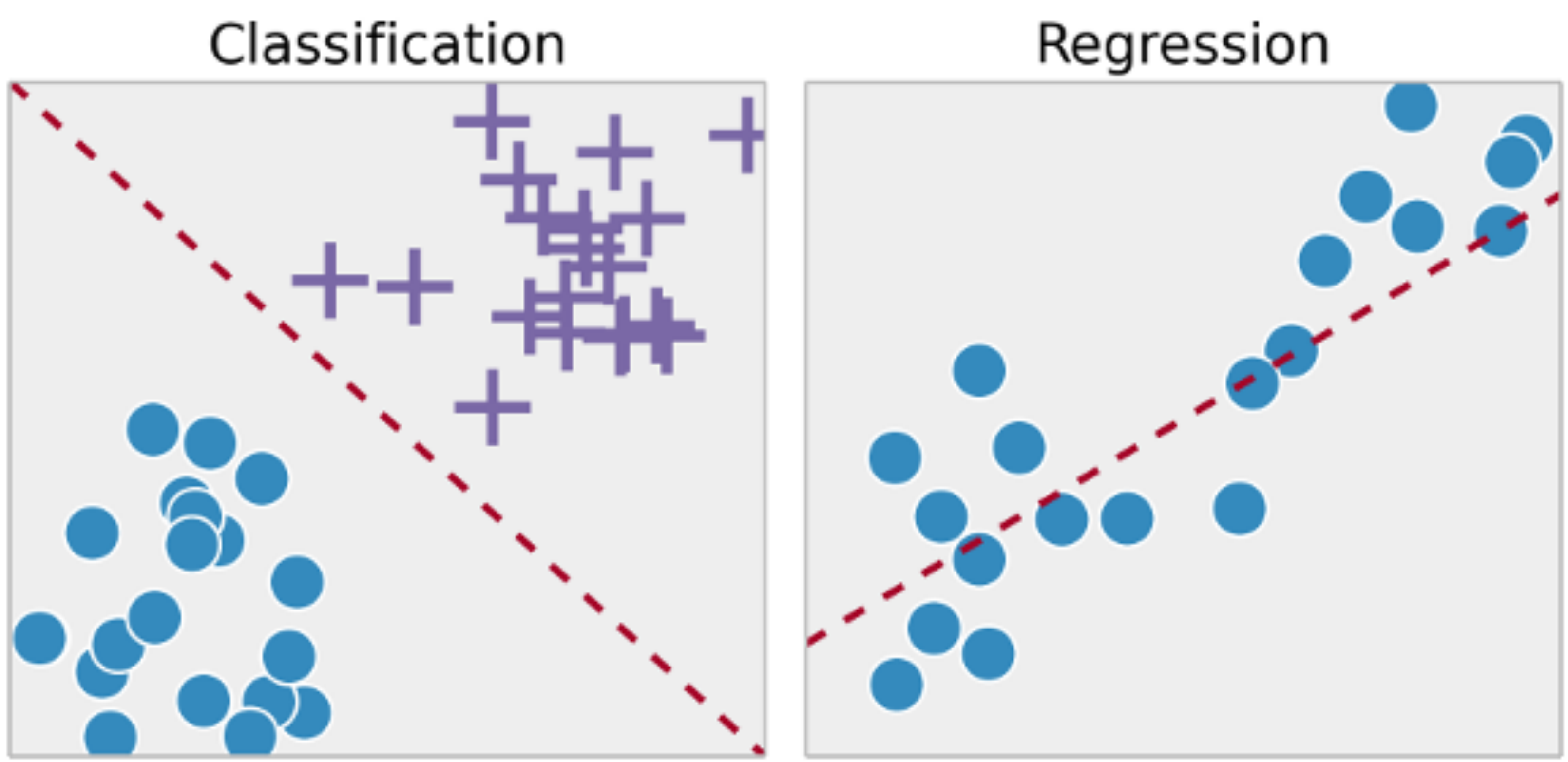
Machine learning is the process of **developing**, **testing**, and **applying predictive algorithms** to achieve the **goal** of efficient data sets.

Focus is over the application of machine learning to maximize the benefits it brings to **improve situational intelligence**, **performance**, and **reliability**



Machine Learning

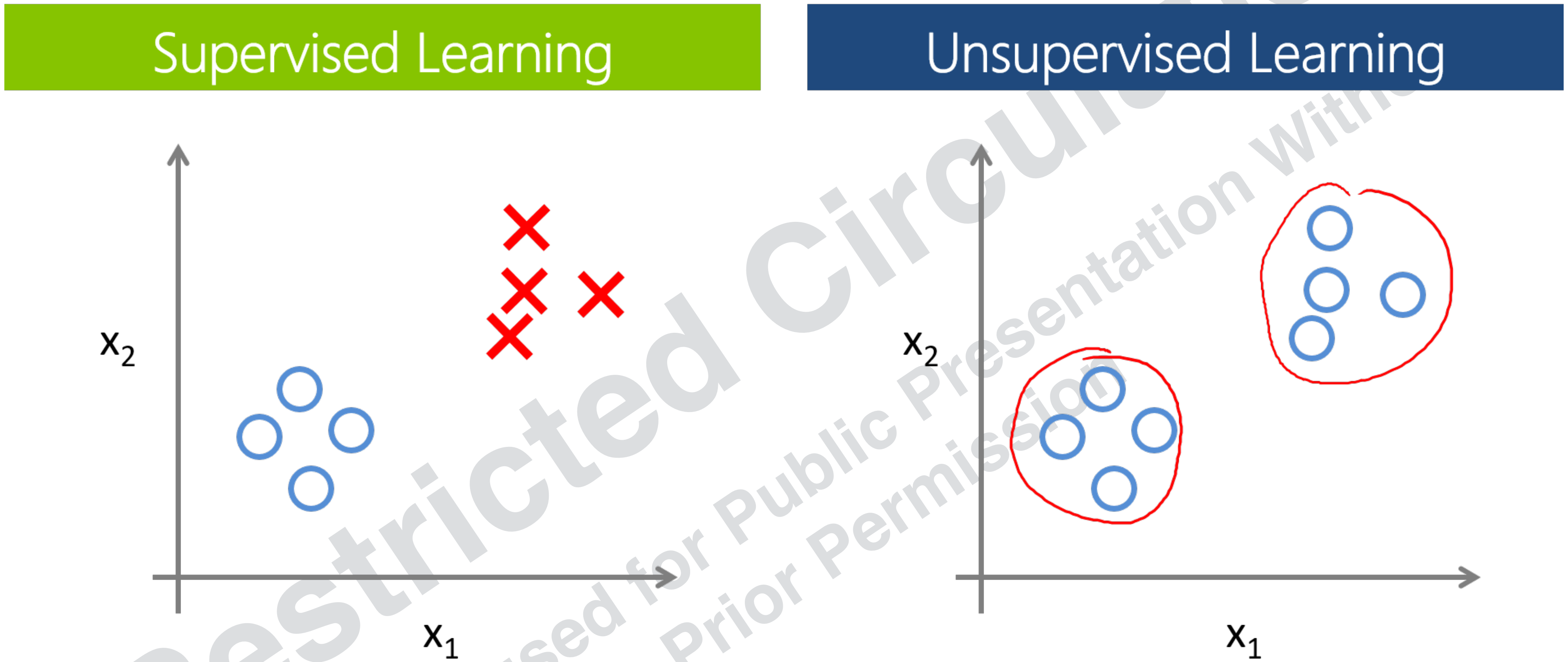
Supervised Learning



In **Manufacturing**, one of the most powerful **use cases** for Machine Learning is **Predictive Maintenance**, which can be performed using two Supervised Learning approaches: **Classification** and **Regression**.

Machine Learning

Unsupervised Learning



Used to draw **inferences** from datasets consisting of input data **without labeled** responses

Unsupervised learning can be used to find **normal operating modes** of your assets and **detect trends** and **anomalies**

Machine Learning

Data Preparation

Machine learning is all about **data**, so understanding some key elements about the **quality** and **type** of data needed is extremely important in ensuring accurate results.

With Predictive Maintenance, for example, we're focused on **failure events**.

Therefore, it makes sense to start by **collecting historical data** about the machines' **performance** and **maintenance** records in order to form **predictions** about **future failures**.

- historical data of many years
- static information about the machine/system

Machine Learning

Data Preparation

What question do we want the **Machine Learning** model to **answer**?

Is it **possible to answer** this question using the **data** that's **available**?

Machine Learning

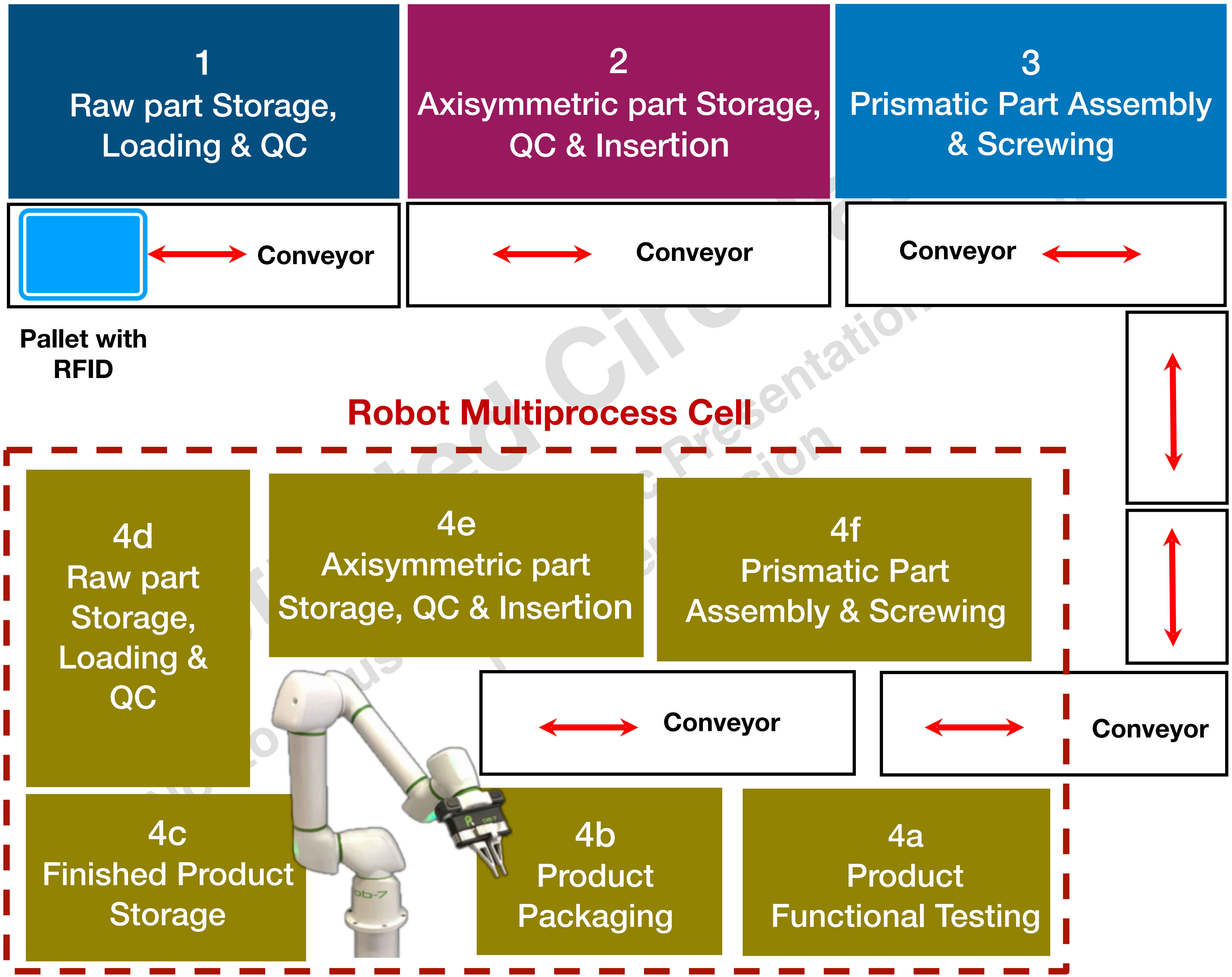
Data Preparation

Certain **questions** should be answered to help focus on the **data** that is **most crucial** to our needs:

- What are the various **types** of **failure** that can occur with this component / machine / system?
- Which **failure events** are we interested in trying to **predict**?
- Is the **failure** a **sudden**, **focused event**, or is there a **slow decline** before complete malfunction?
- Which **components** are typically associated with this type of failure?
- Which **parameters** should be measured that **most signify** the state of component / machine health?
- What is the required accuracy and frequency of the measurements needed?

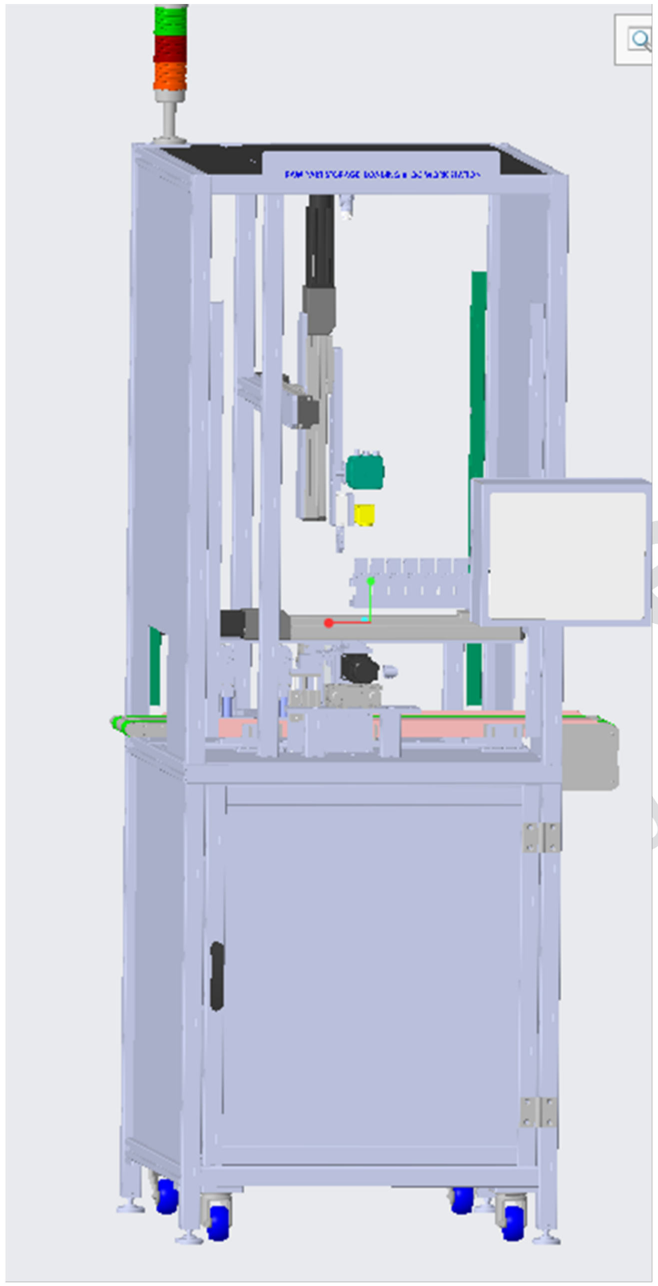
Cyber Physical Lab

Electromechanical Component Assembly

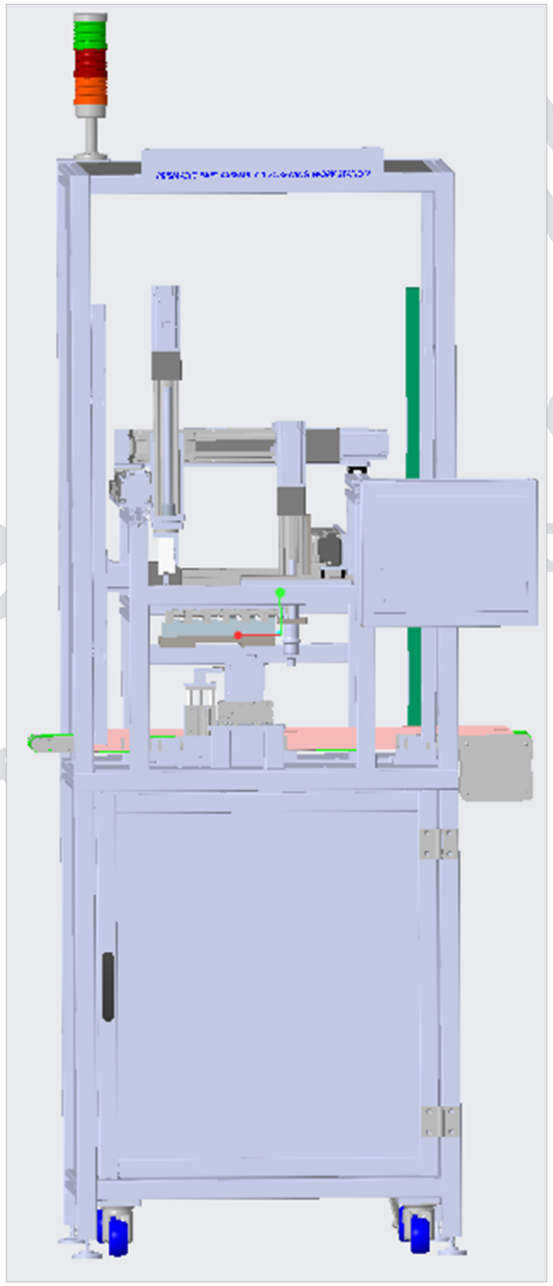


Cyber Physical Lab

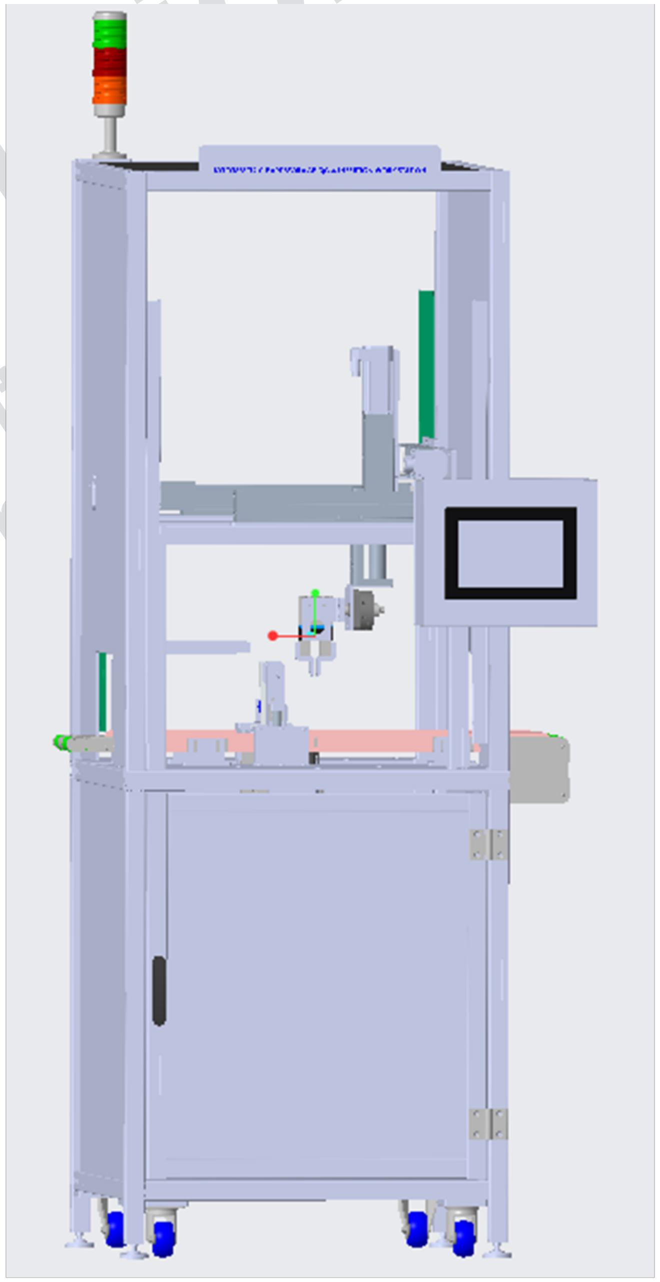
Electromechanical Component Assembly



Raw part Storage, Loading & QC



Axisymmetric part Storage, QC & Insertion



Prismatic Part Assembly & Screwing

Cyber Physical Lab – Modular Stations

Raw part Storage, Loading & QC

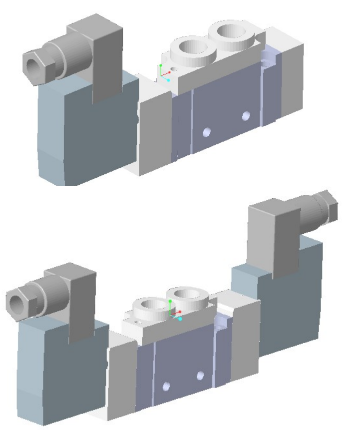
Axisymmetric part Storage, QC & Insertion

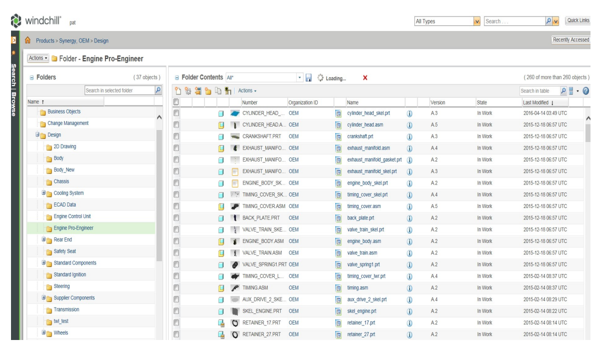
Prismatic Part Assembly & Screwing

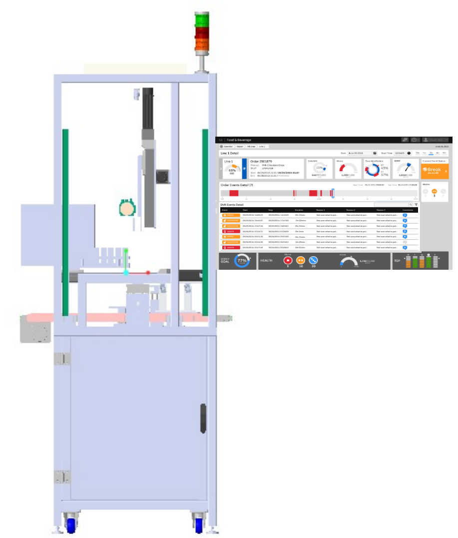
Digital Thread in FSM

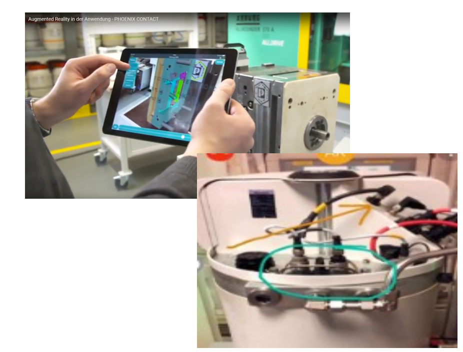
Cyber Physical Lab

Concept & Detail Design	Manage Design Information	Smart Manufacturing	Connected Service
creo	windchill	thingworx	vuforia Studio
Mathcad	integrity		vuforia chalk









Concept & Detail Design
- 3D MODELING & DETAILED DESIGN
- DESIGN VALIDATION
- ENGG CALCULATION

Manage Design Information
- ENGG- BOM
- ASSOCIATIVE MFG- BOM
- COLLABORATION
- REQUIREMENTS MGMNT

Smart Manufacturing
- OPERATIONAL INTELLIGENCE/OEE
- REMOTE DIAGNOSTICS ANALYTICS

Connected Service
- PREDICTIVE SERVICE
- AR ENABLED SERVICE
- REMOTE EXPERT COLLABORATION

Thank You


Adroitec ….
……Enabling you to leap forward
Saroop chand
Saroop.chand@adroitecinfo.com

Adroitec Group

ÅDesign

ÅEngineering

ÅRobotic & Automation

ÅIOT

ÅKnowledge Management

Å3D printing

Evolution of 3D printing – Beyond Prototyping

ÅMaterial to meet standard

ÅSpeed for Prebatch Production

ÅSize of parts

ÅEase of operation

ÅFunctional parts

ÅReliable systems for 24X7 operations

Factory on the move

3D printing to meet the growing challenges

Personalisation

Frequent ECO

on

systems

to many models every year

More than 100 changes in each model which means 300 to 400 job tkts every year

Even cricket has transformed

Global development , manufacturing & usage

Smart Products

Global product development for Global customers-Groups to work collaboratively

The Challenge:

Enable concurrent work on separate design elements, and synchronize those collective efforts while minimizing product integration issues.

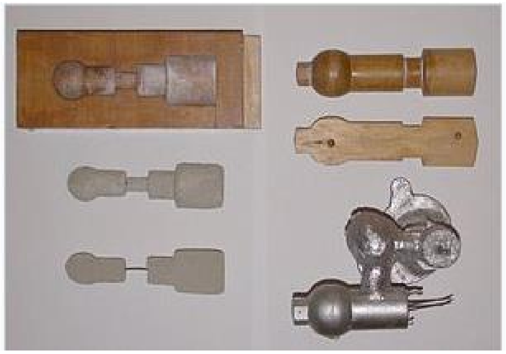
- FMC applied modular product architecture definition to significantly improve on-time delivery of its subsea systems.

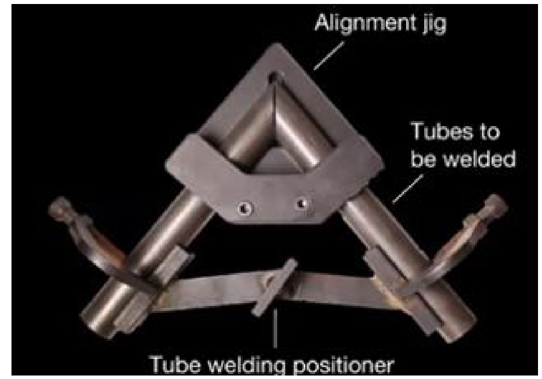
Making Distributed Design and manufacturing Work and be ready to service anywhere any time

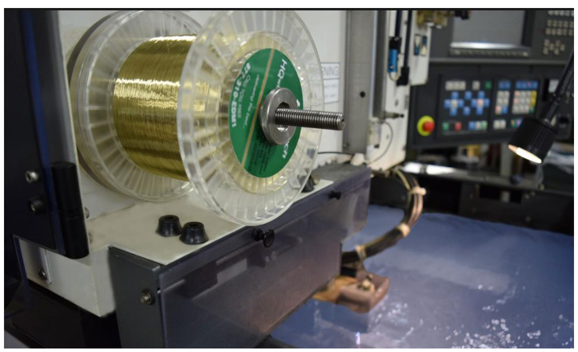
Intelligent, adaptive , self diagnostic

Introduction of new product – 100’s of parts need to be developed or procured

Present multiple Processes







Significant cost and time

SME and Start-up: Challenges

ÅLimited Capital

ÅSkilled resources

ÅVendor Network

ÅEconomy of scale

ÅMarket Branding

3D printing- Great Equaliser for SME & Startups

ÅRapid Innovation
ÅToolless manufacturing
ÅEconomic Pre-batch production
ÅEarly roll out to market
ÅMultivariant for Market Branding
ÅLess inventory for today and for maintenance
ÅHigher Capital Efficiency

Design Without boundaries

Developers emerging and evolving the 3D print process to reduce cost, time impossible products and assured parts meeting standards

Technologies:

Laser-SLA, SLS, SLM, DLP ,
Binding- Mark forged/desktop metal
continuous fibre reinforcement
Voxel Jetting HP - MJF

Materials:
Plastic, high temperature, composite, continuous reinforced, strong and castable resins, metals and alloys, ceramics, Clay

BASF, GKN, SABIC, HOGAN, Arkem, Lubrizol, Evonik, Henkel

Software:

PTC, Siemens, Dassault, ANSYS, Nastran, Altair, Moldflow

Standards:

ASTM, ISI-NASSCOM, FDA

Size, SPEED, Post processing, cost, Standards

HP Driving the transformation to industrial-scale 3D manufacturing

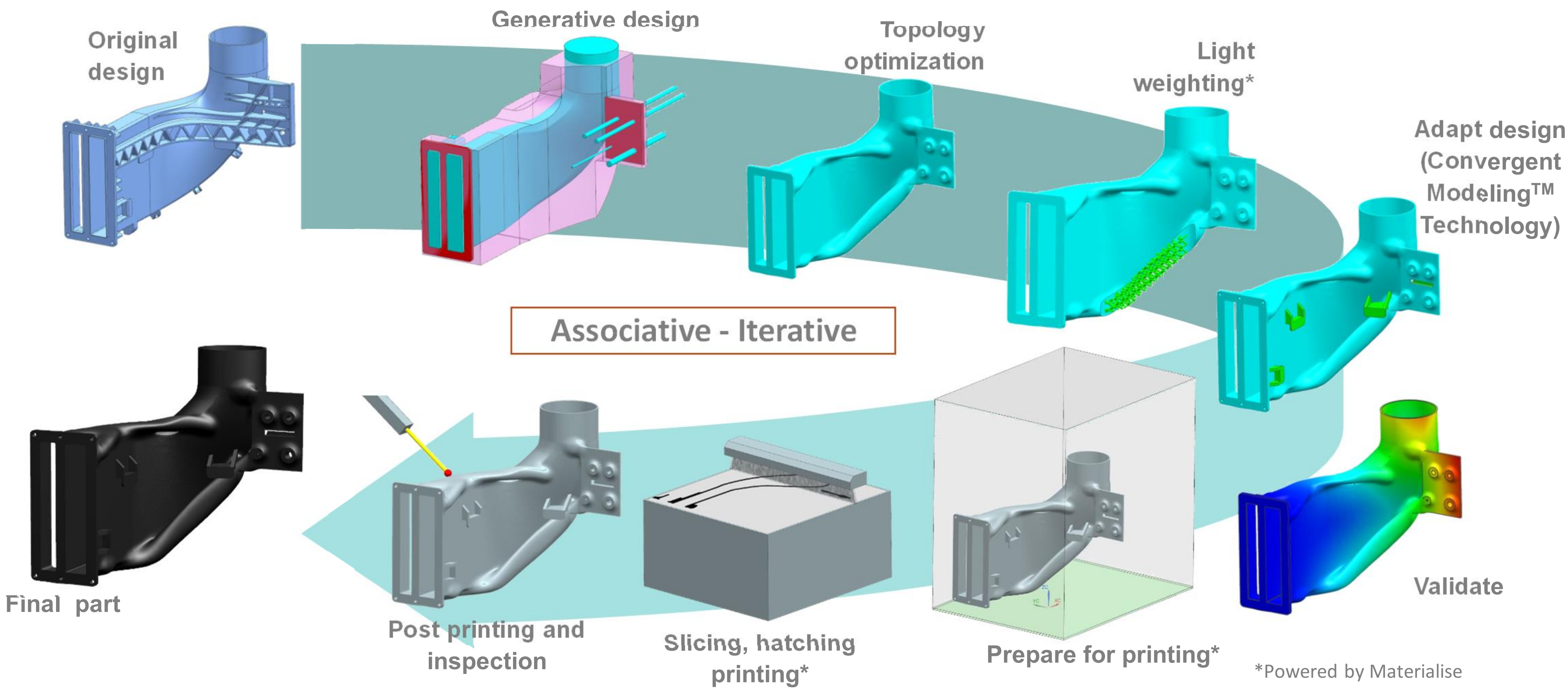
Large build size
for heavy production

Continuous printing

Economics to disrupt
manufacturing

Siemens - Digital Enterprise Suite for Additive Manufacturing

Integrated end-to-end process in one system



MATERIALS

PLASTICS: ABS, TPU, PC, NYLON ETC

CLAY, SOIL, CONCRETE ETC

METAL: SS, TS, TI, AL, INCONEL, ALLOYS ETC

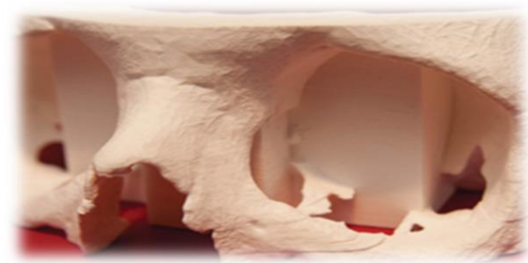
CASTABLE, WAXES

RESINS, PHOTOCURABLE

CERAMICS

LIVE CELLS, TISSUE, ORGANS ETC

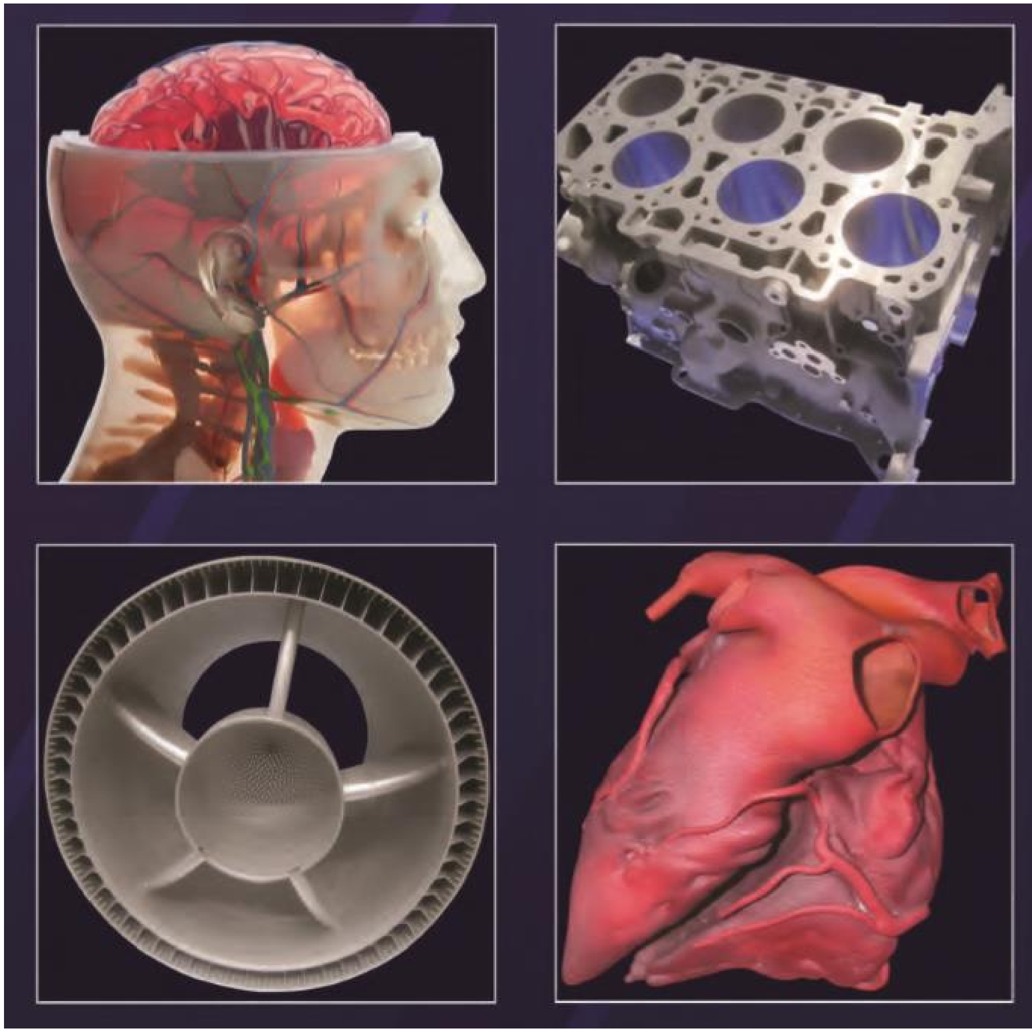
BIO COMPATIBLES



DAY TODAY WASTES

Additive Printing/3D printing
- Beyond Prototyping,

Functional parts ,
Tool Room- jigs & fixture,
Gauges, CMM Testing ,
Assembly process,
Manufacturing,
Die making – conformal cooling,
Pattern making – sand mould



TYPICAL APPLICATION CATEGORIES

Machine Setup

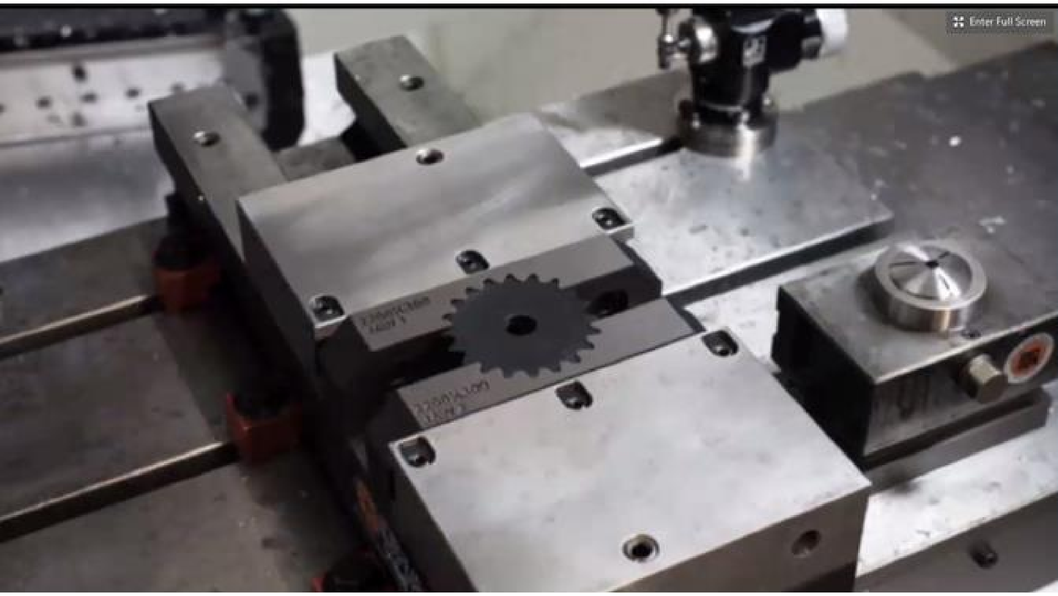
Calibration jigs and machine repair and maintenance tools improve line startup efficiency when getting production up to speed

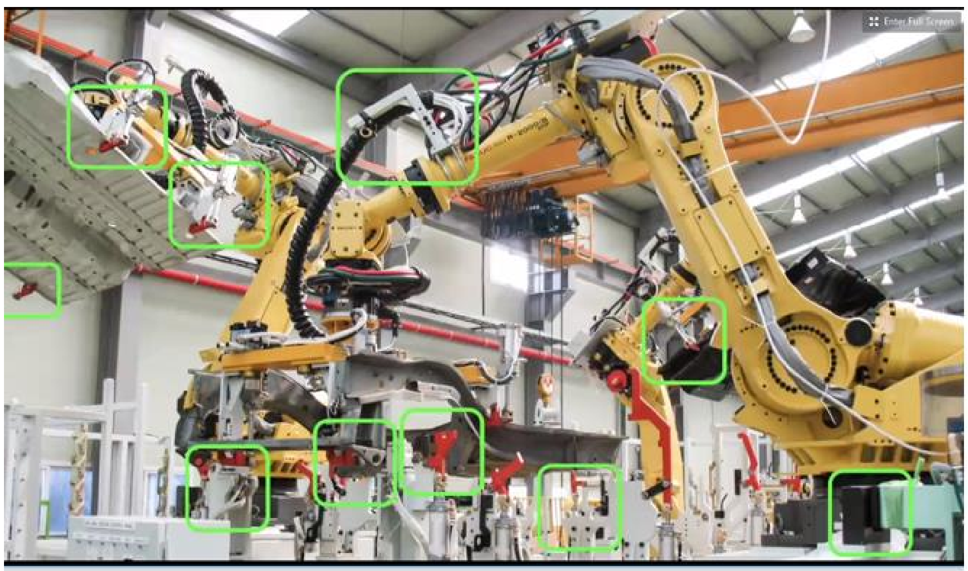
Fixturing, Positioning & Tooling

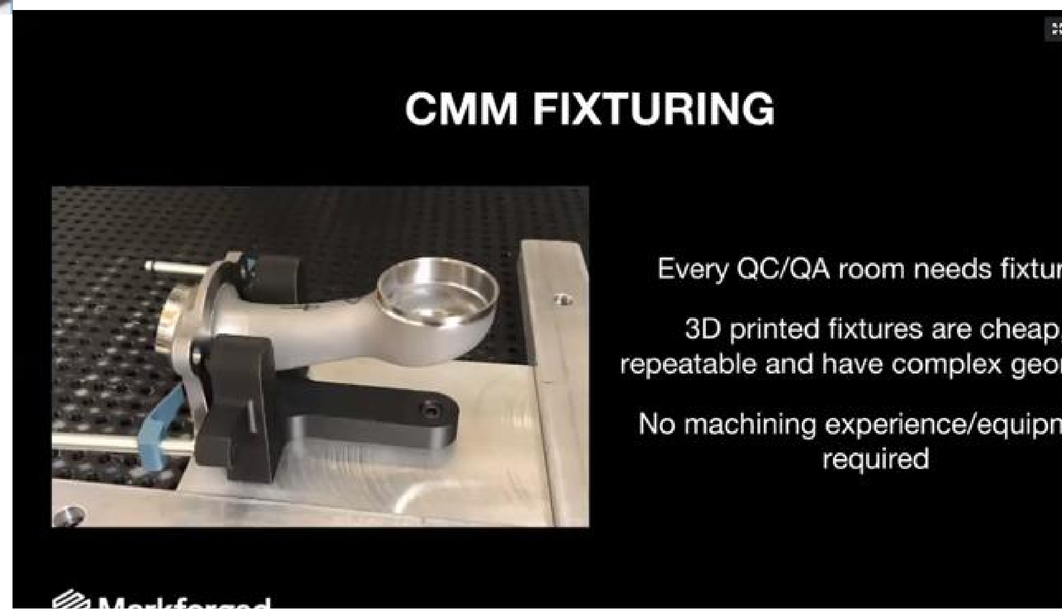
Inspection fixtures, soft jaws, assembly jigs, and other workholding devices require alignment features that can be hard to machine

Line Optimization

Custom end effectors, line add-ons and upgrades, and ergonomic equipment can improve line efficiency and safety






CMM FIXTURING
Every QC/QA room needs fixtur
3D printed fixtures are cheap
repeatable and have complex geo
No machining experience/equipn
required

LASER MARKING FIXTURING

Enables laser marking of complex or non-planar surfaces

Quick, cheap solution for positioning

Parallelized fixtures enable high throughput scaling

CNC LATHE BAR PULLER

$13 print replaces $700 - $1000 standard CNC bar puller tool

Fully customizable to non-standard geometries

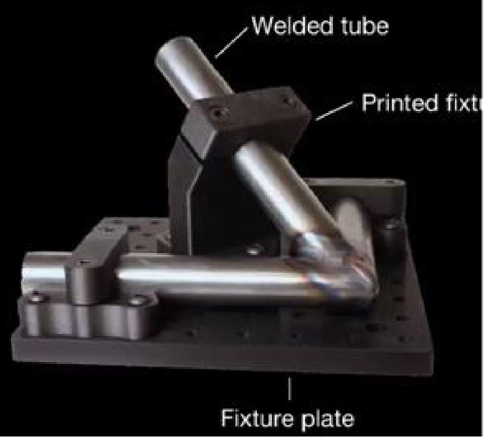
Easily replaceable in-house in case of breakage

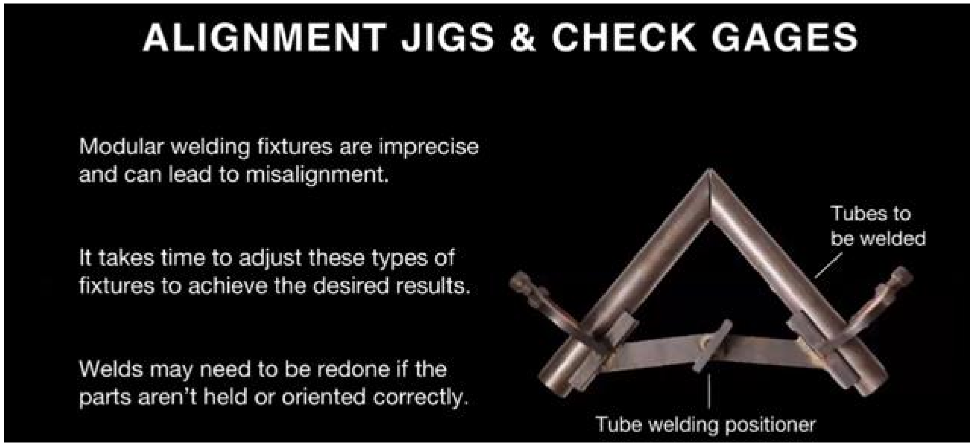
PRINTED FIXTURING

Complex structures with non-standard geometries are difficult to fixture.

Traditional fixtures make the process lengthy and custom fixturing is costly.

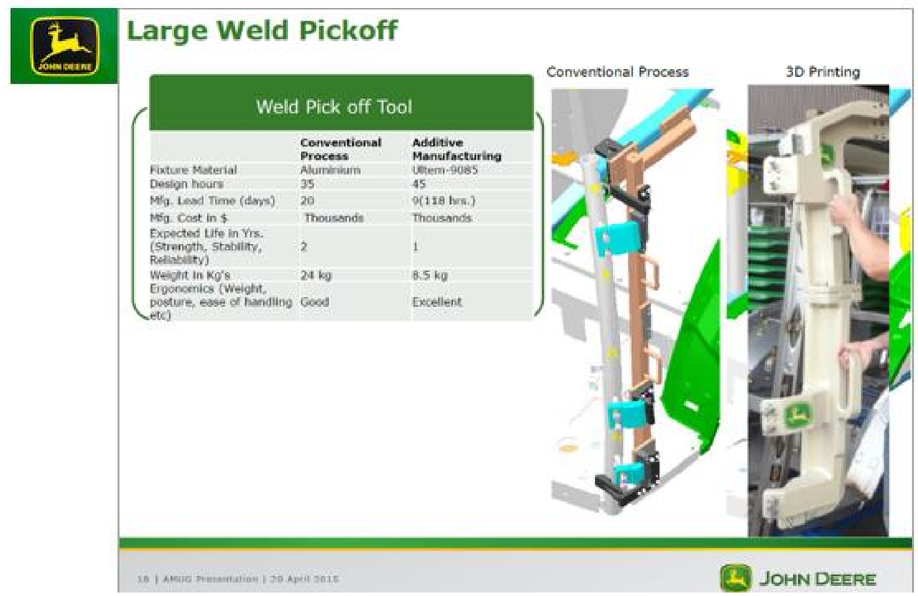
Printed fixtures are an affordable solution for tack welding steel and simplify setup.





PRODUCTION

Production Support - Assembly Aids



Weld Pick off Tool

	Conventional Process	Additive Manufacturing
Fixture Material	Aluminium	Ultem-9085
Design hours	35	45
Mfg. Lead Time (days)	20	9(118 hrs.)
Mfg. Cost in $	Thousands	Thousands
Expected Life in Yrs. (Strength, Stability, Reliability)	2	1
Weight in Kg's	24 kg	8.5 kg
Ergonomics (Weight, posture, ease of handling etc)	Good	Excellent

Haas Automation

NORTHROP GRUMMAN

DELPHI
Automotive Systems

Kimball Office

Johnson Controls

GONZAGA UNIVERSITY

TREK

VARIDESK

NIKE

United Technologies

ELKAY

TINKER AIR FORCE BASE

DANA

plexus WORLDWIDE

PEDIGO

Hallmark

FedEx

GM

UC San Diego

JOHN DEERE

ASHLEY
FURNITURE INDUSTRIES, INC.

TELEDYNE

JOINT BASE PEARL HARBOR-HICKAM

EATON

Northern Illinois University

syngenta

DBM REFLEX

RECARO

CHAPARRAL

Middlesex University

firstbuild

MEGGITT

THE UNIVERSITY OF SYDNEY

Crayola

CATERPILLAR

Walt Disney Imagineering

Raytheon

YASKAWA

WOODWARD

	MILITARY AND DEFENSE	AEROSPACE	MOBILITY & TRANSPORTATION	HEALTHCARE	CONSUMER Goods & Electronics	INDUSTRIAL & SERVICES	AGRICULTURE & MINING &ENERGY
FUNTIONAL PROTO	**All Sub-segments** Functional Prototyping - Drones - Exoskeleton 		**All Sub-Segments** Functional Prototyping - Fluid & Air ducts - Impellers - Snap fit - Housing - Grills 		**HH Appliances** Functional Prototyping - Fluid & Air ducts - Snap fit - Housing - Living hinges 	**Electronics** Functional Prototyping - Fluid & Air ducts - Snap fit - Housing - Living hinges 	
TOOLING		**Tooling** Jigs & Fixtures 	**Tooling** Jigs & Fixtures - Temporary/dummy parts - J&F for production line - Ergonomic tools - Tools organizer **Tooling** Molds - Thermoforming - Metal Stamping	**Tooling: Dental** Molds Thermoforming for dental aligners 	**Tooling** Jigs & Fixtures - Dummy parts - J&F for production line - Ergonomic tools - Tools organizer	**Tooling** Jigs & Fixtures - Dummy parts - J&F for production line - Ergonomic tools - Tools organizer **Tooling** Molds - Thermoforming - Embossing - Sand Casting - Metal Stamping	**Tooling** Jigs & Fixtures
FINAL PART				**Medical Equipment** Final Part - Housing - Internal components	**HH Appliances** Final Part - Housing - Internal components - Fluid vessels (air) 	**Machinery & Equipment** Final Part - Temporary/dummy parts - Parts of machinery - Fluid vessels - Pipe connectors  **Robots** Final Part - End effectors - Vacum grippers 	**Cattle Industry** **Feed Industry** Final Part - Fluid vessel - Air ducts for ventilation

SPM manufacturers – Digital Manufacturing of Smart Machines

- Complete trial of the system in short time and low capital cost
- No Minimum Order
- No coordination of multiple vendors
- No inventory for production
- Integration of subassembly- Reduction of parts
- No storage of spares for maintenance

AUTOMOTIVE

Doctors





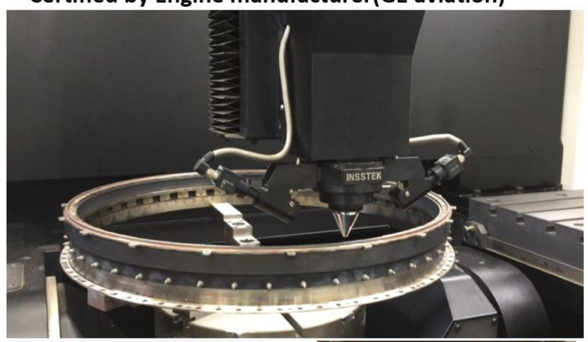



Aircraft

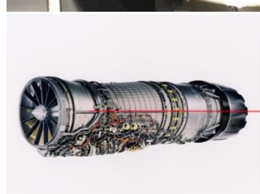
Worlds First Privately
Funded 3D Printed Aircraft

- ROKAF, F110 Engine HPT Shroud Support

- Certified by Engine manufacturer(GE aviation)



- Requirement: repair of worn out parts
- Base: IN718(Ni alloy)
- Printing material: Stellite25(Cobalt)



F15E's F110 engine(GE)

HPT Shroud Support

- Saving Cost
  30K$/EA → 4K$/EA
- Lead time
  60days → 20days

ARCHITECTURAL

Total cost of acquisition

ÅMaterial cost

ÅProcessing cost of different machines and manpower

ÅInventory cost

ÅMaintenance part cost and availability

ÅCost of capital investment and space

ADROITEC Group

- 350 + Strong Team,
- 25 + Years Old Company
- Focused on Engineering Design solutions
- 10000 + Satisfied Customers base
- Growing 20% Y.O.Y for last 5 Years
- 9 offices spread across the country , Germany and USA

LISTEN.
THINK.
SOLVE.®

RECKERS MECHATRONICS PVT LTD

ROCKWELL CERTIFIED SYSTEM INTEGRATOR

Allen-Bradley • Rockwell Software

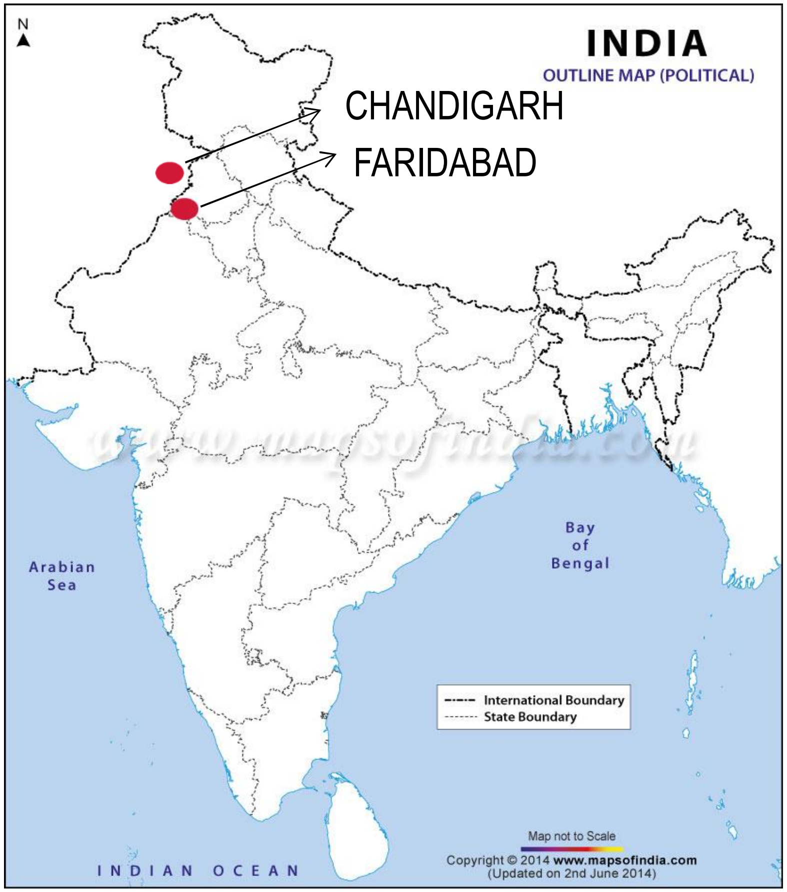
Rockwell Automation

RcSI Introduction

Rockwell Automation

INTRODUCTION-AREA OF WORK

- Industrial Automation
- Smart Productive System Solution
- Data Acquisitions Solutions-[OEE/ENDON]
- M2M interfacing
- Connected Enterprise Network
- Intelligent Safety Solutions
- Condition Monitoring Solutions
- Remote Access Solutions – Cloud Based
- Validations and Compliances in Food and Pharmaceutical Industries.(FDA and MHRA Compliance)
- Handshaking Capability with ERP



PRESENT INDUSTRIAL CHALLENGES

Rockwell Automation

TECHNOLO
INTEGRATI

SECURITY
OR
MANUAL INTERVEN

DATA ISLAN

MAN MANAGEMEN

COMPARATIVE
REPORTS

RECKERS MECHATRONICS PVT LTD.

Rockwell Automation

CUSTOMER CHALLENGES	DELIVERED SOLUTION
❖ Manual Intervention ❖ Changes in Report ❖ Duplicate signature ❖ Data Manipulation	✓ Meet the Industry Compliance ✓ Ex: 21CFR Part 11 ✓ Privatization of Data ✓ Real Time Report

CUSTOMER CHALLENGES	DELIVERED SOLUTION
❖ Downtime ❖ Information about Machine ❖ Data Monitoring ❖ Difficult to fault Tracing ❖ Product Back Tracing	✓ Digitization of Equipment ✓ Real Time TAG Accessing ✓ Diagnosing Feature ✓ Real Time Data ✓ Multiple Location Of same data

CUSTOMER CHALLENGES	DELIVERED SOLUTION
❖ Target Achievement ❖ Meet the expected Number ❖ Machine management	✓ Planning In Controller/SCADA level ✓ Utilization of available Equipment

RECKERS MECHATRONICS PVT LTD

Rockwell Automation

CUSTOMER CHALLENGES	DELIVERED SOLUTION
❖ Conventional OEE Calculation ❖ Manual Data logging ❖ Manual Machine Monitoring ❖ Synchronization of DATA	✓ Enhance OEE ✓ Provide digital Solution ✓ Machine Level calculation ✓ Controlling of Quality ✓ Monitoring of Availability in Real Time ✓ Controlling the Performance of machine/operator

CUSTOMER CHALLENGES	DELIVERED SOLUTION
❖ The Real Causes of LINE STOP ❖ Clarification of Production Stop ❖ Manual Intervention ❖ Information Channel ❖ Downtime	✓ Installation Of END-ON system ✓ Work Station Information ✓ Operator to Responsible on Channel information ✓ LINE STOP with actual CAUSE DISPLAY ✓ Intimation to the concern person during Line OFF

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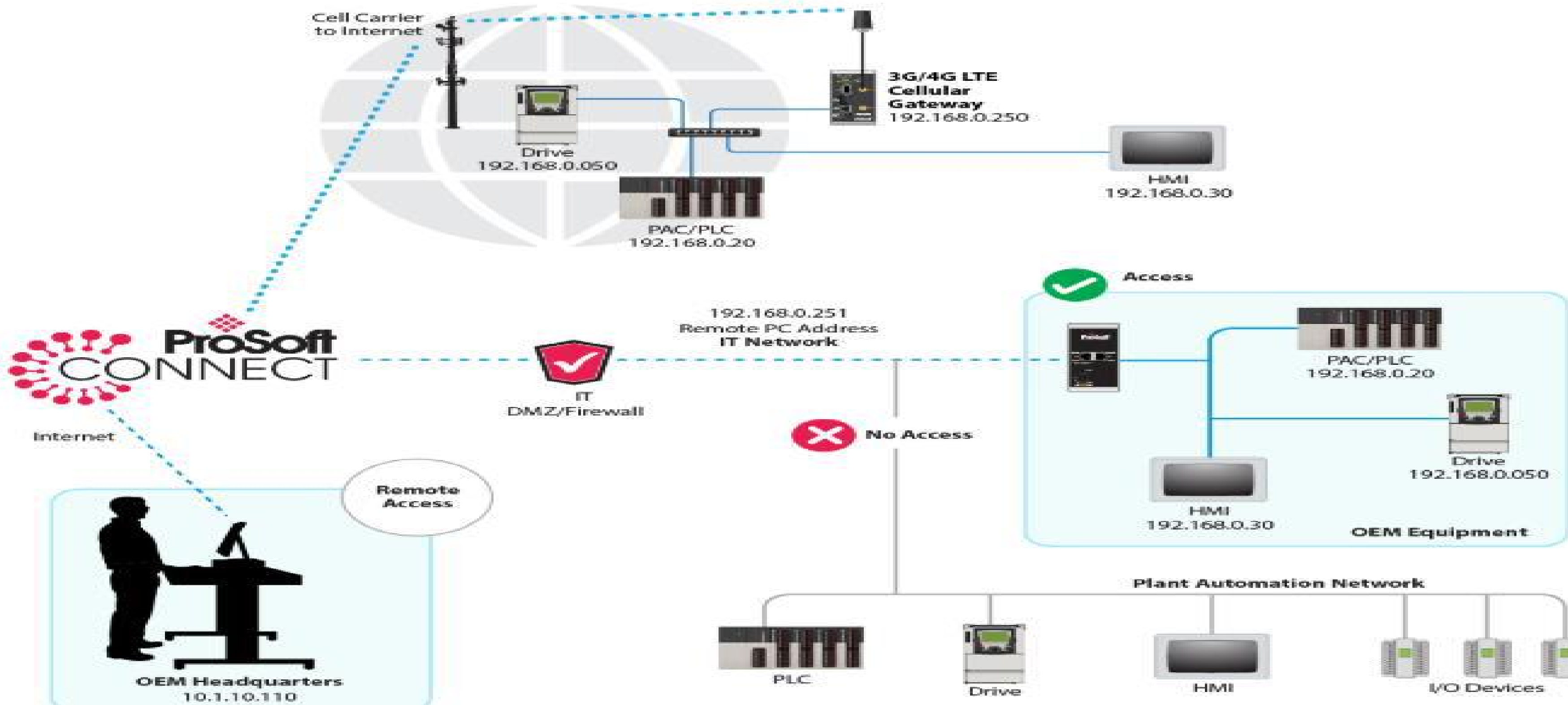
Digitization Architecture



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DISCRETE MACHINE DIGITIZATION

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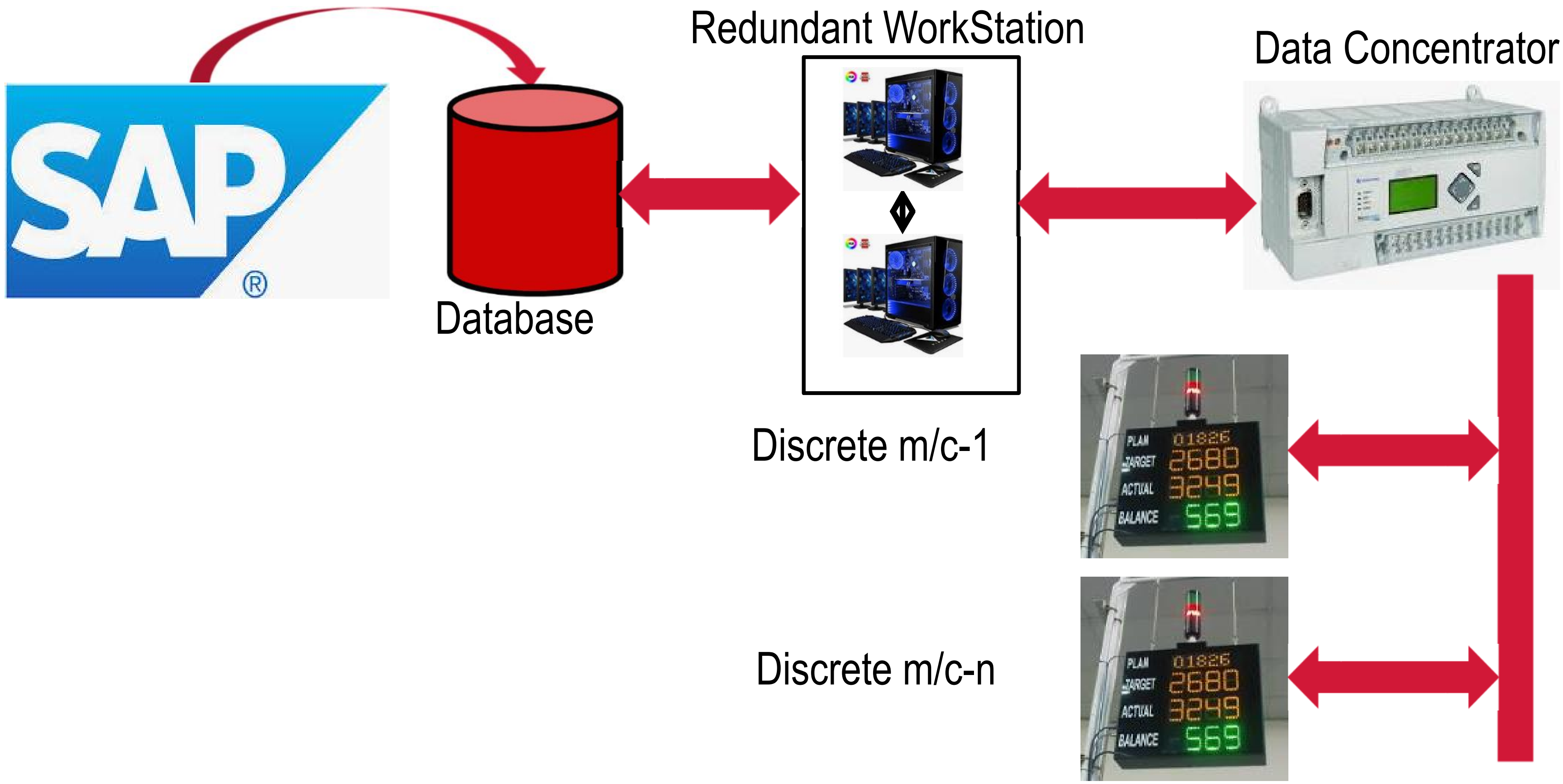

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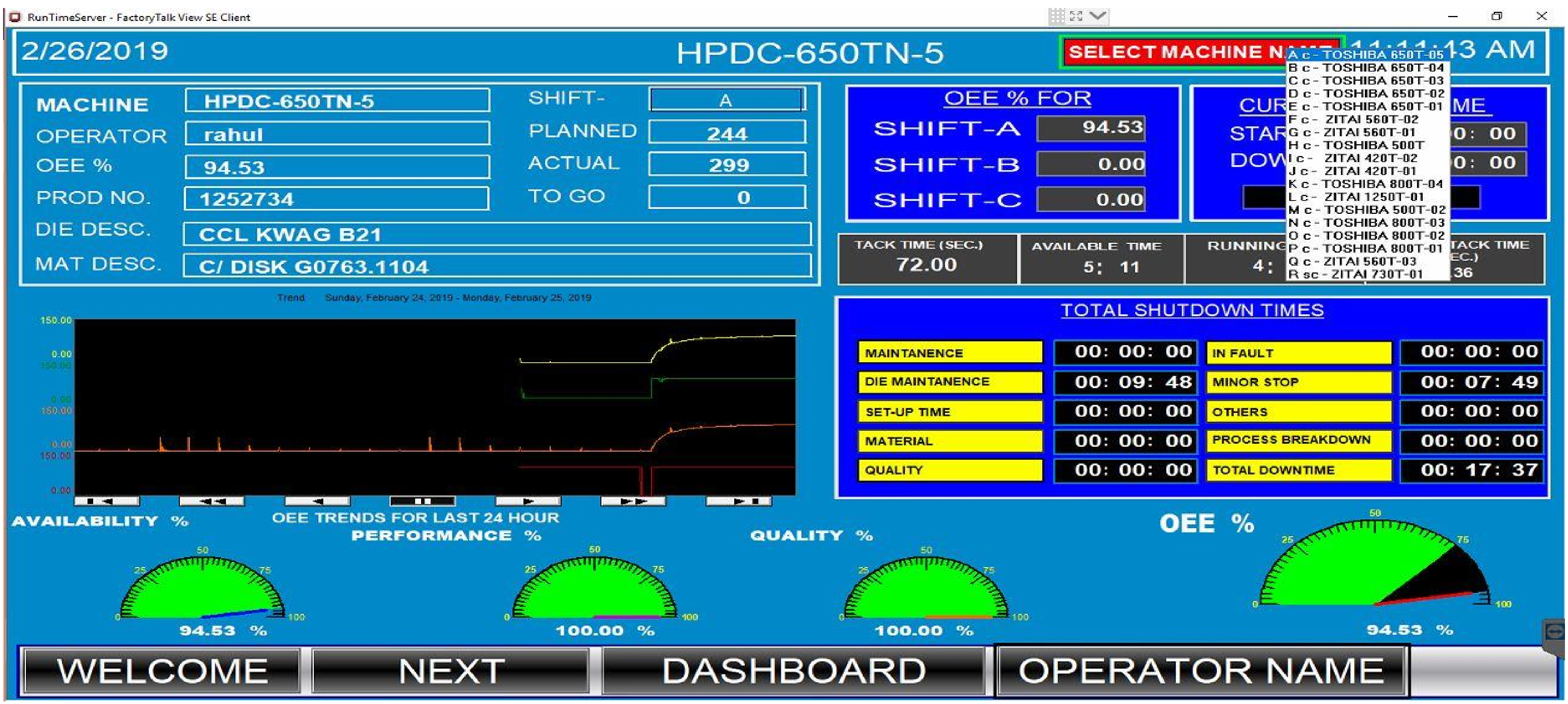

RECKERS MECHATRONICS PVT LTD

Rockwell Automation

Report Structure

RECKERS

Date	08-02-2019	Shift	WholeDay	Machine No.	HPDC4202

Date & Time	Operator Name	Material	Production Order No.	Die No.	No. of cavity	Total Plan	Total Shots	Total Qty.	OK Qty.	Rej. Qty	Efficiency	Utilization	Quality	OEE	Operational time	Available Time
08-Feb-2019 11:59		5215020009	1252715	10000058	1	414	409	409.00			98.79	96.90	100.00	95.73	08:46:00	08:59:00
08-Feb-2019 12:59		5215020009	1252715	10000058	1	486	486	486.00			100.00	97.29	100.00	97.29	07:46:00	07:59:00
08-Feb-2019 13:59		5215020009	1252715	10000058	1	558	581	581.00			100.00	97.59	100.00	97.59	08:46:00	08:59:00
08-Feb-2019 14:59		5215020009	1252715	10000058	1	70	76	76.00			100.00	100.00	100.00	100.00	01:59:00	01:59:00
08-Feb-2019 15:59	suraj	5215020009	1252715	10000058	1	142	153	153.00			100.00	100.00	100.00	100.00	02:59:00	02:59:00
08-Feb-2019 16:59	suraj	5215020009	1252715	10000058	1	214	226	226.00			100.00	100.00	100.00	100.00	03:59:00	03:59:00

10

CONTINUOUS LINE DIGITIZATION

PROJECT-VARIANT MANAGEMENT SYSTEM

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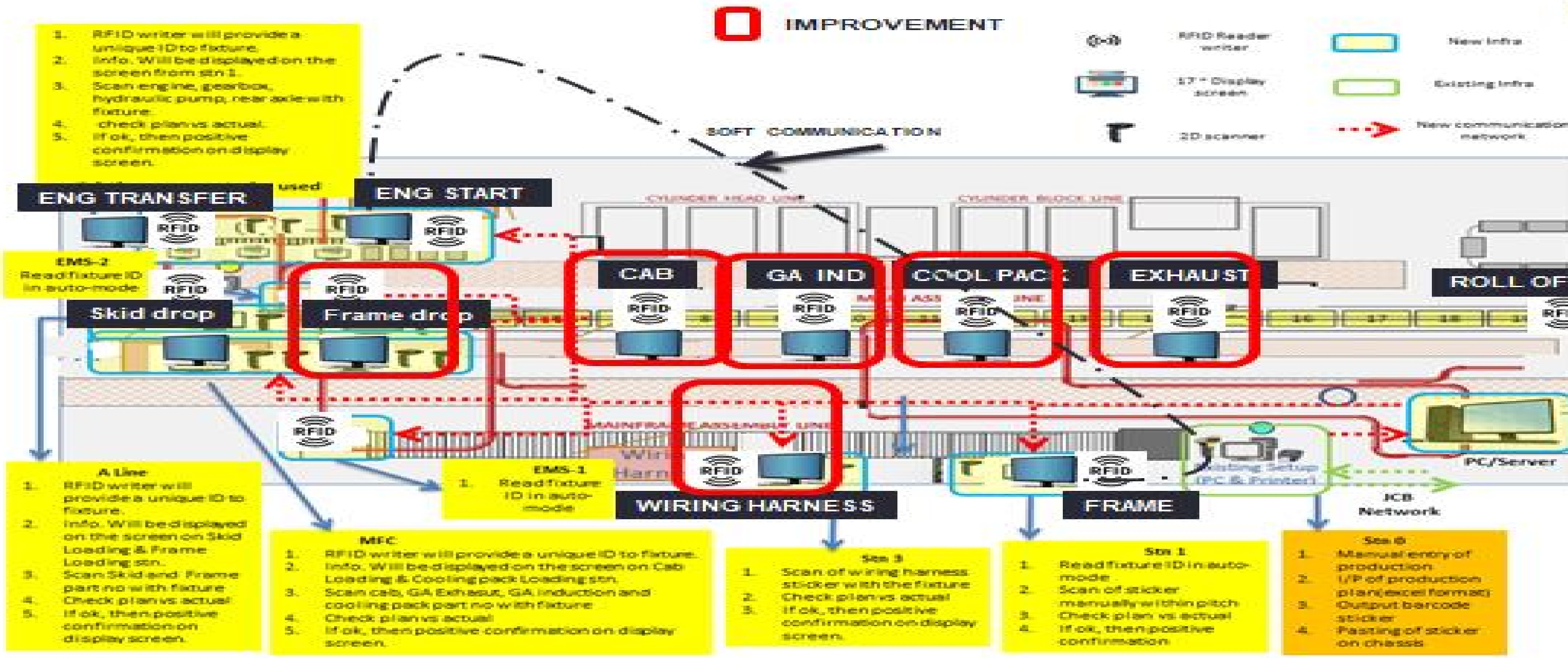

MIG-WELDING MACHINE DIGITIZATION

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Solution-1

Tracking by RFID System

Challenges-

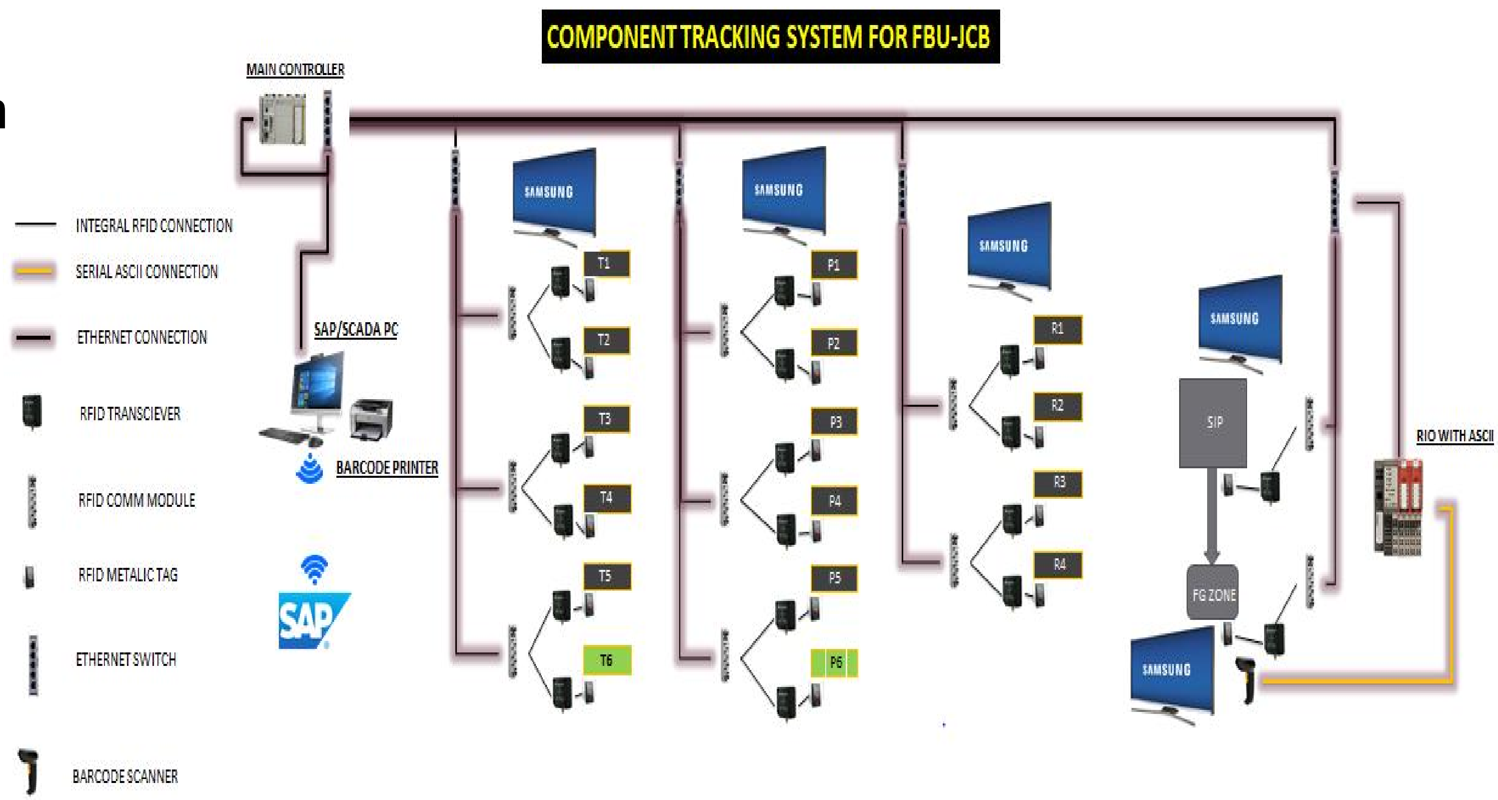
Å Metallic Structure

Å Limited frequency range

Solution-

Å HF vr. UHF

Å Integration of RFID with Barcode



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Rockwell Automation

After Execution

- ❑ Now data is updating itself from remote server.
- ❑ Real time Data Flow from Remote data to Discrete Machines.
- ❑ Plan vr. Actual Information.
- ❑ Operator to Manager Direct Connectivity.
- ❑ Use of Existing conventional machines for IOT.
- ❑ Increase in productivity.
- ❑ Managed information flow.
- ❑ Increased individual efficiency.

15

RECKERS MECHATRONICS PVT LTD

Rockwell Automation

OCCL

Hero

AIS

FRICK

ANDRITZ Hydro

JCB

Johnson Matthey

RM Chemicals The Food Additives People

ROCKMAN INDUSTRIES LTD.

ESCORTS

Cadila Healthcare Limited

DELPHI

alchem

FEDERAL MOGUL

JBM Group

NPL Nabha Power Limited

Gates

Hindustan Unilever Limited

PERFETTI van Melle

varroc

Reckitt Benckiser

Johnson & Johnson

and many more…

16

Thank You

PUBLIC

Achieving Success in the VUCA world

Embracing the Potential of Cyber Physical Intelligence

Anup Wadhwa
Director
Automation Industry Association

What we are used to…

Operators and partly automated Machines

Mechanized Operations

Improved productivity over Manual operations

Vital Process parameter control

Quality can not be predicted

Data Analysis is not a key skill set

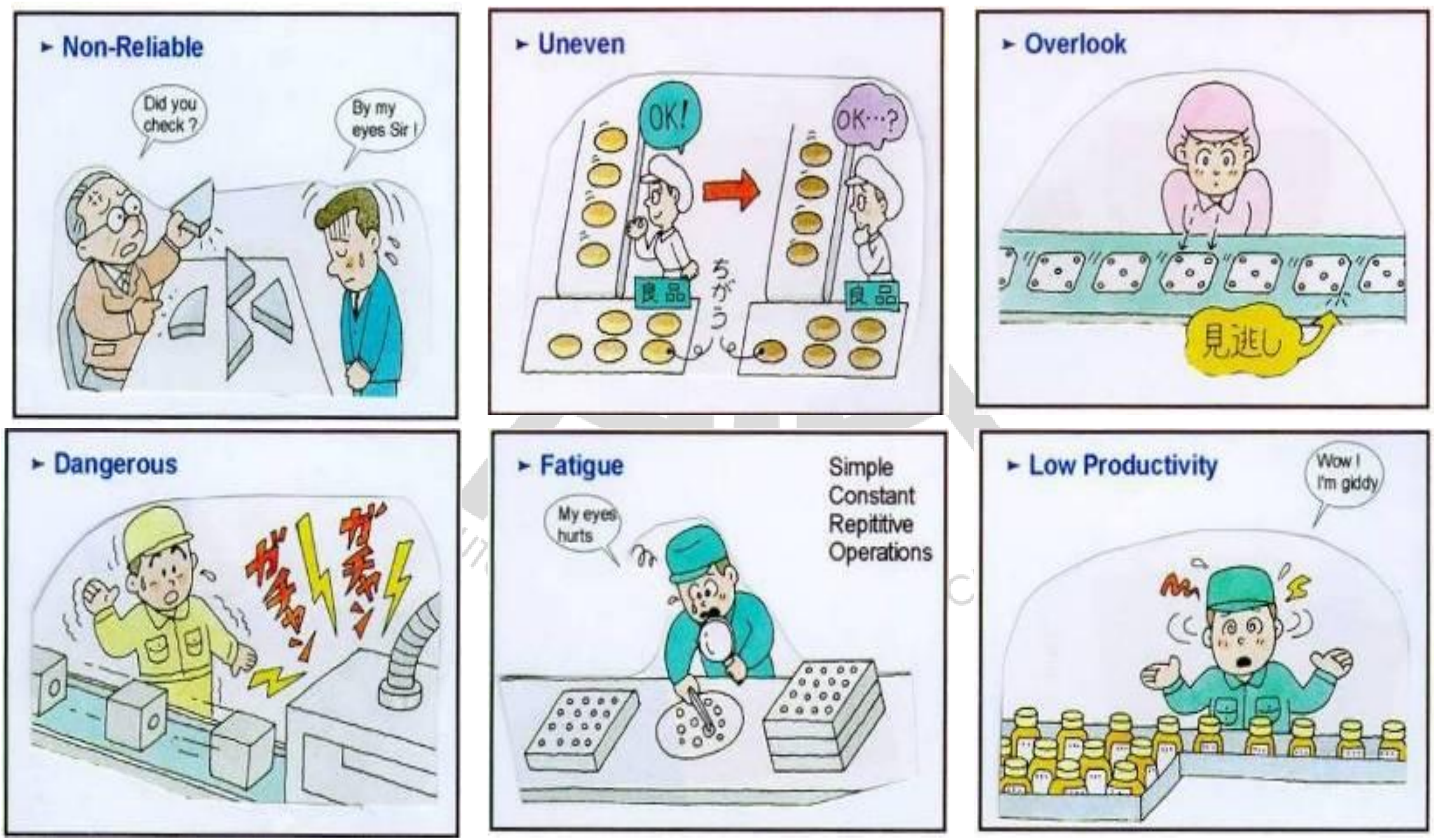
Safety standards are soft

What we have to be conscious about…

- GDP per person hour worked in India is about 1/5th of Germany
  - Means we are doing the lowest end jobs
  - And that too, most inefficiently
- "The world is dangerously open". Innovators and R&D teams need to be mindful of technology obsolescence.
- High technology execution demands having smooth control of parameters like
  - Throughput
  - Quality
  - Consistency
  - Predictability
  - Rate of improvement of above
  - Getting everything RIGHT faster than before

Volatile, Uncertain, Complex, Ambiguous

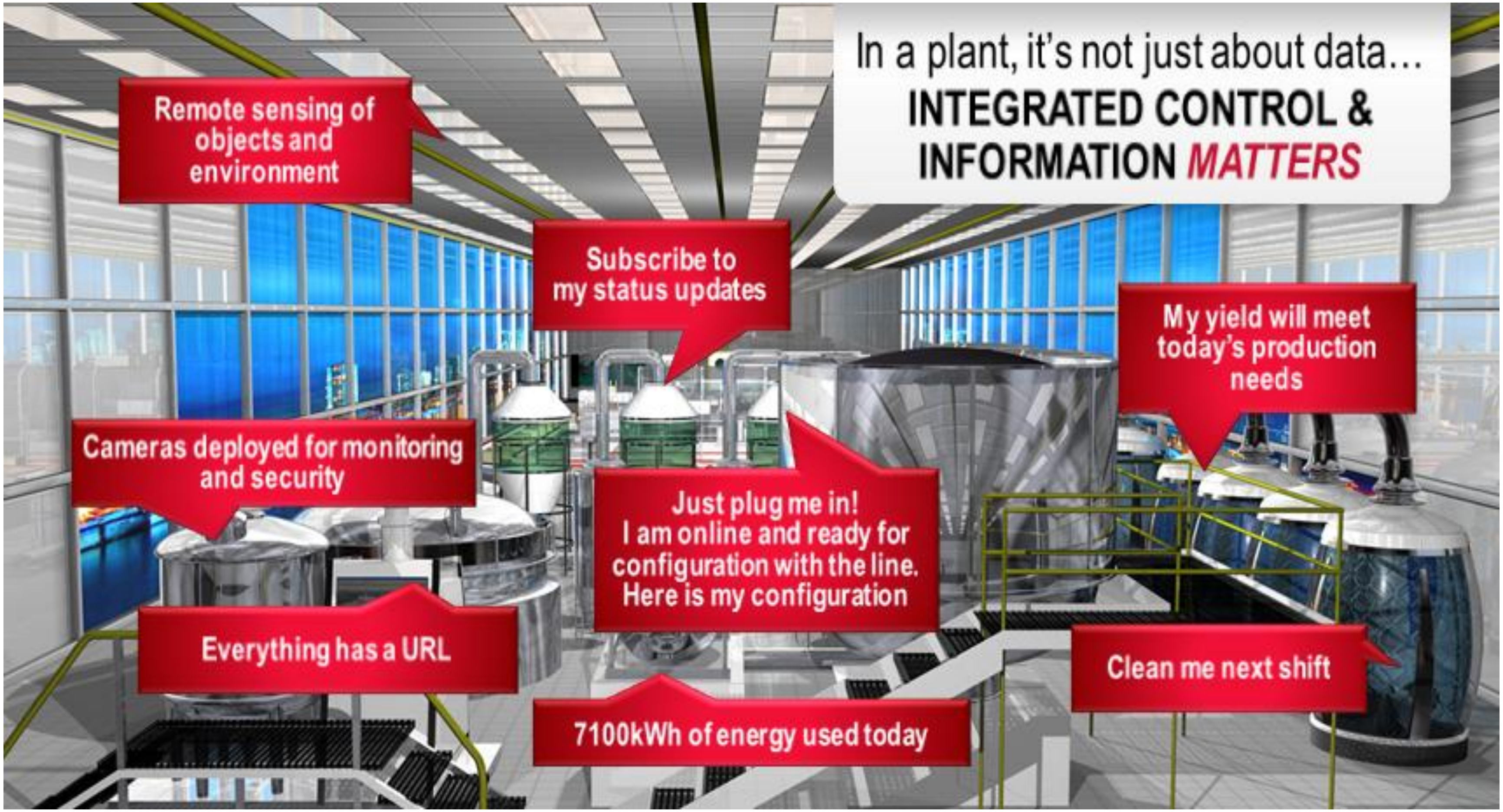
Future of low wage is UNCERTAIN



COMPLEX Challenges

- Awareness and Relevant Use Cases
- Economic Risk of Small Scale
- Budget , Funds, Subsidies
- Knowledge to go into Measurements and Beyond
- Competence to Manage Automation and Scaling Up
- Culture of Delegation and Transparency

Winners Embrace Smart Ways

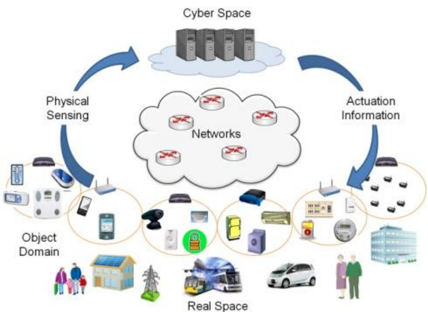


It is a DIFFERENT TERRAIN

- VIDEO 1
- VIDEO 2

The NEW GAME is very aspirational and requires new competencies

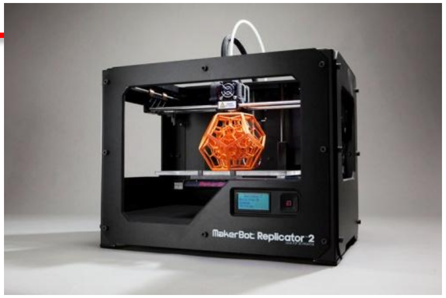
Interplay of Technologies



Industrial IoT and Cyber Physical System

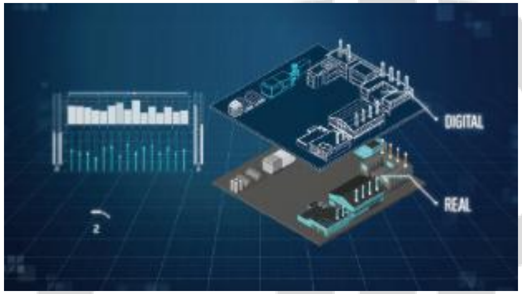

Collaborative Robots


Smart Sensors, Actuators & Controllers



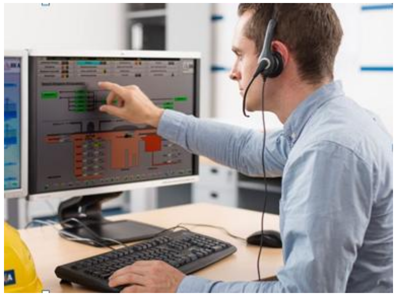
Rapid Prototyping and Tooling

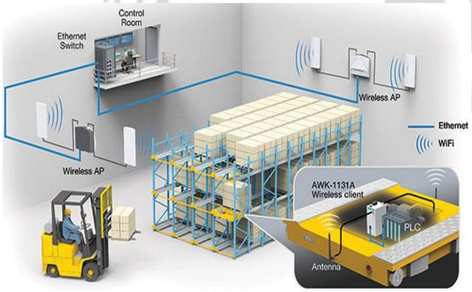

Augmented Reality



Advance Simulation, Digital Twin

Analytics, Mfg Ops Mgmt


Remote Maintenance



Wireless Instrumentation

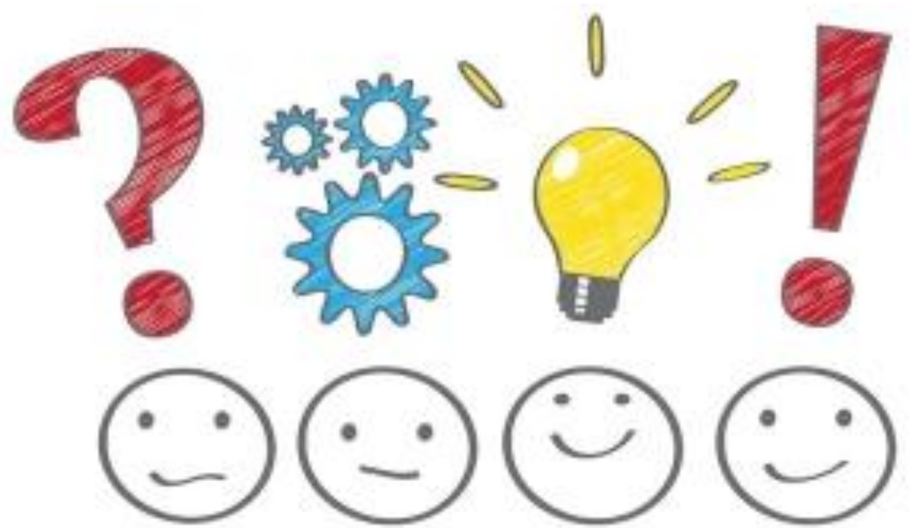
Industrial Safety


Cyber Security, Mobility

Connect and Collaborate

The CEFC at FSM supports and facilitates Users, Digital Business Architects, Digital Manufacturing Integrators & Master Trainers

IITD-AIA Foundation for Smart Manufacturing



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Confederation of Indian Industry

Department of Heavy Industry
Government of India

Smart Manufacturing Simplified

Photo Gallery

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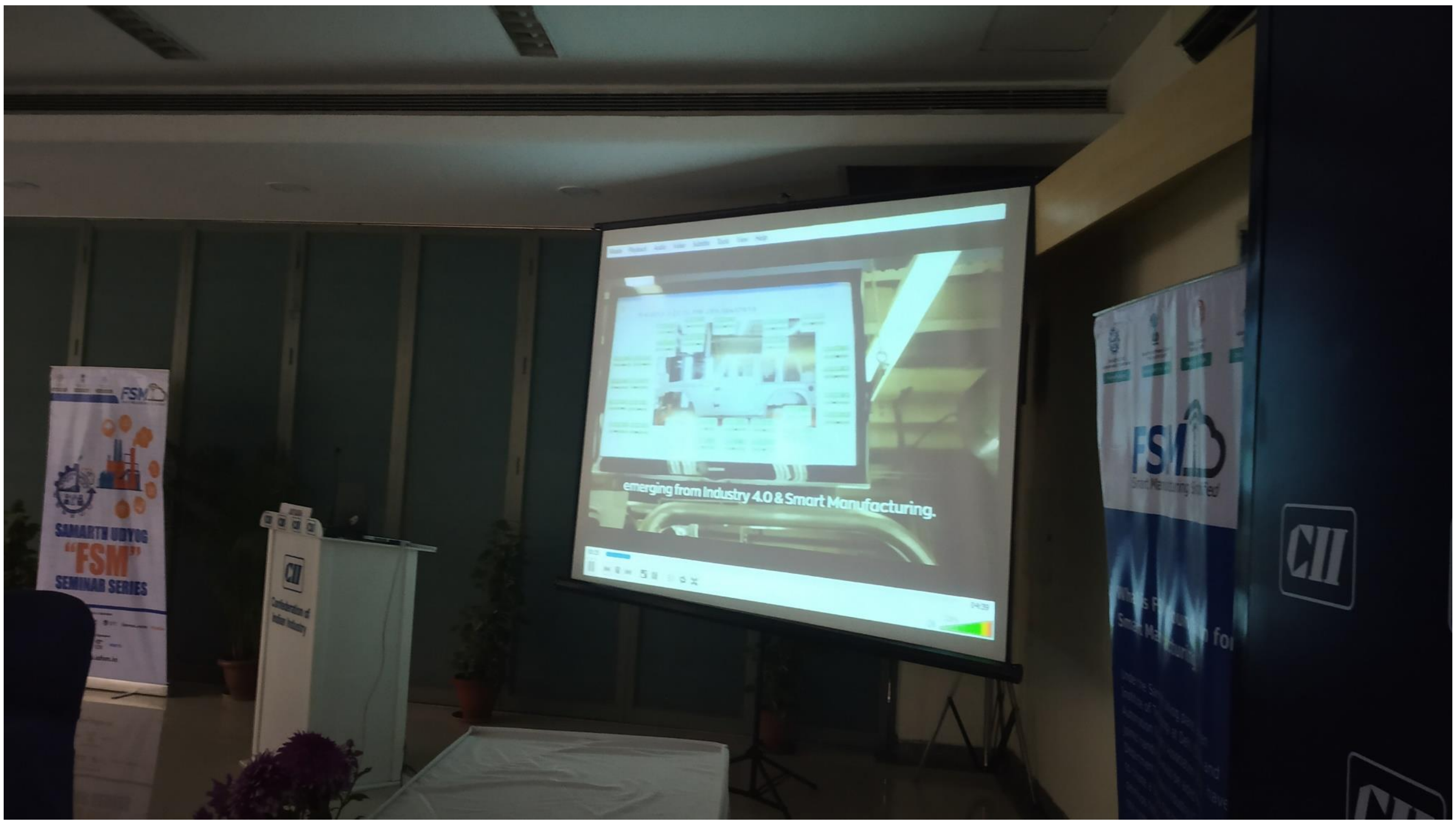
FSM Smart Manufacturing Simplified

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