



# The Emerging Engineering Technologies in Manufacturing

Presented by:

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# Outline of Presentation

Introduction (Industry 4.0, etc)

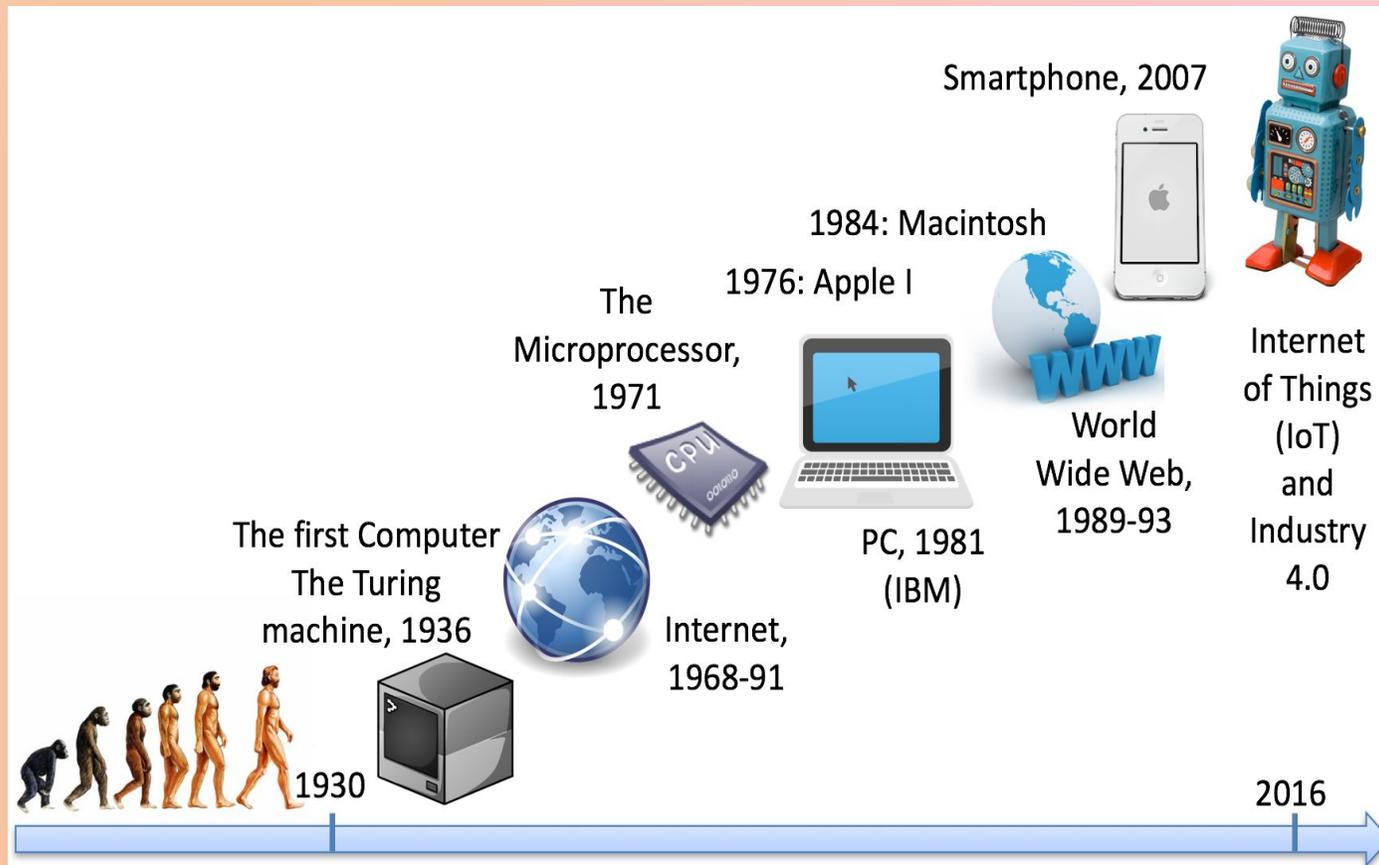
Types of Emerging Technologies in Manufacturing

Factory of the Future & Lights-out Manufacturing

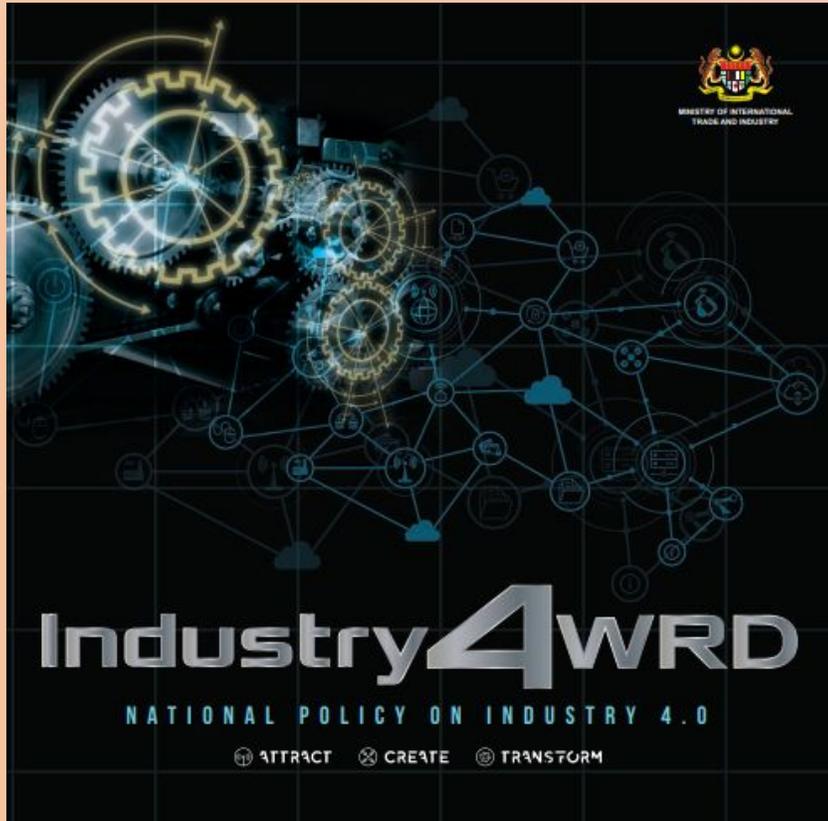
Take away message

# the emerging engineering technologies in manufacturing

## Industry 4.0



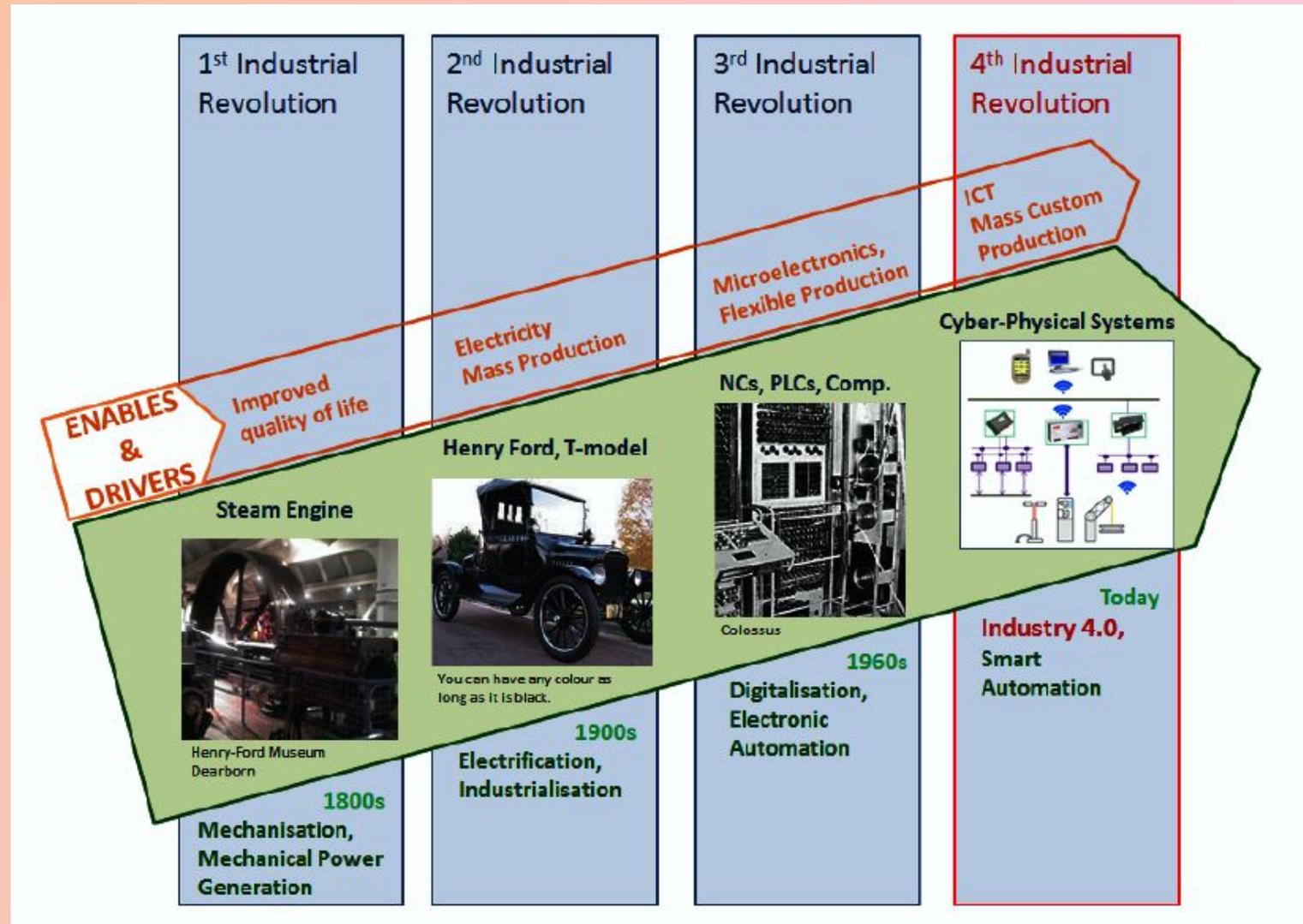
# the emerging engineering technologies in manufacturing



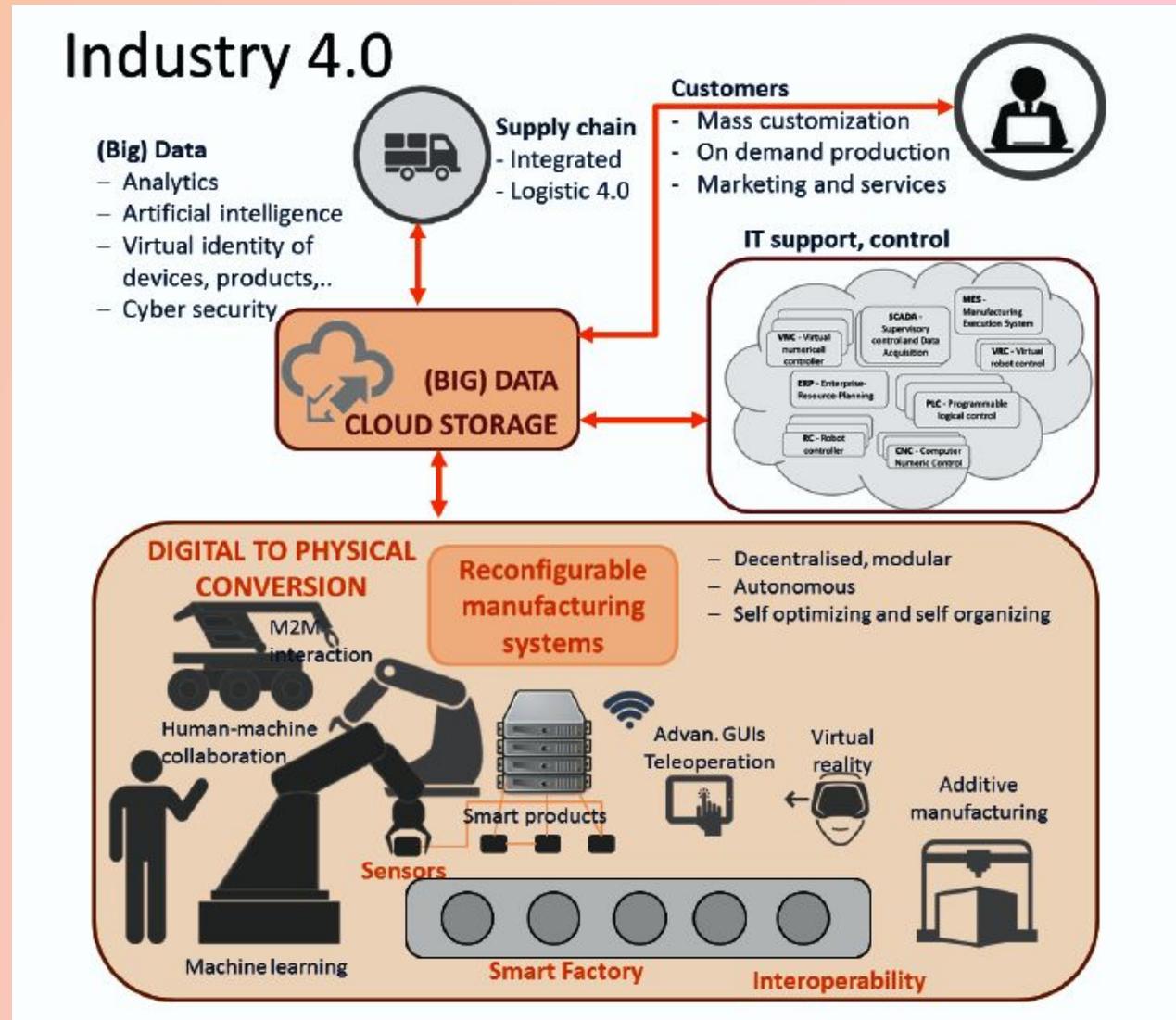
 Additive Manufacturing	 Artificial Intelligence (AI)	 Big Data Analytics	 Advanced Materials	 Cybersecurity
<p>Additive manufacturing is advancing with the use of new materials, opening completely new possibilities. For example, 3D printing of organic tissues has created opportunities for growing live organs. It is revolutionising traditional production, aided by a recent surge in metal additive printing.</p>	<p>AI is a concept that is made up of numerous subfields such as machine learning, which focuses on the development of programs that can teach themselves to learn, understand, reason, plan and act when exposed to new data in the right quantities. AI technology will supplement the smart factory towards networked factory, in which data from supply chains, design teams, production lines and quality control are linked to form a highly integrated and intelligent engines.</p>	<p>Increasingly big data techniques are being applied in manufacturing industry to improve customer experience and product quality, realise energy efficiency and conduct predictive maintenance. It is now possible to collect masses of data from several different sources to direct decisions that anticipate product or equipment failure.</p>	<p>New materials and nano-structures are being developed, allowing for beneficial material properties, e.g. shape retention and thermoelectric efficiency. Together with additive manufacturing technologies, it will allow for massive customisation and development of products that were not possible until now.</p>	<p>The industrial communication is expanding and strongly connected, as such, digital security becomes a critical aspect that must not be overlooked in the industrial environment. It has now become more complex as it consists of connected devices and environments that cannot be protected by traditional cybersecurity approaches. Current cybersecurity has largely been developed for IT-centric devices and environments.</p>

 Simulation	 Cloud Computing	 Augmented Reality	 Internet of Things (IoT)	 Autonomous Robots	 System Integration
<p>While many engineers are already familiar with simulations in the field of product design, the advent of augmented reality, AI and big data is expected to take simulations to the next level. It will be possible to simulate manufacturing processes using different production settings to find the optimal way to manufacture a product. Simulations can also be used to test product usage under different operating environment using different types of materials.</p>	<p>Past industrial revolutions required significant capital as a ticket for entry. With cloud computing, many of the Industry 4.0 technologies can be made available to even smaller companies as a utility with minimal upfront capital investment. Companies can leverage cloud-based product design, simulation, AI and big data solutions to improve their production processes and build products better suited for their customers.</p>	<p>While the initial augmented reality technologies are still in nascent stages, they are advancing at a rapid pace. Some of the first applications can be found in the delivery of information and training, e.g. augmented reality can be used to deliver part replacement instructions to maintenance staff in the field.</p>	<p>Industry 3.0 brought in an era of computing and interconnectedness but it often relied on humans to make even the most trivial decisions. Industry 4.0 technologies embody an unprecedented proliferation of sensors and connectedness among these sensors. Combined with other technologies such as AI and big data, it is now possible to envisage entirely autonomous systems that revolutionise manufacturing.</p>	<p>Machinery and robots are transformed towards their next generation. Robots can do more on their own, including learning on the job and teaming up with other robots and humans. This technology allows systems to think, act and react autonomously as well as conduct remote decision making. This can help contribute to a company's competitiveness, productivity and profitability.</p>	<p>System integration occurs in vertical (within the industry value chain) and in horizontal systems (across multiple value chains), eventually achieving end-to-end digital integration across the entire value chain.</p>

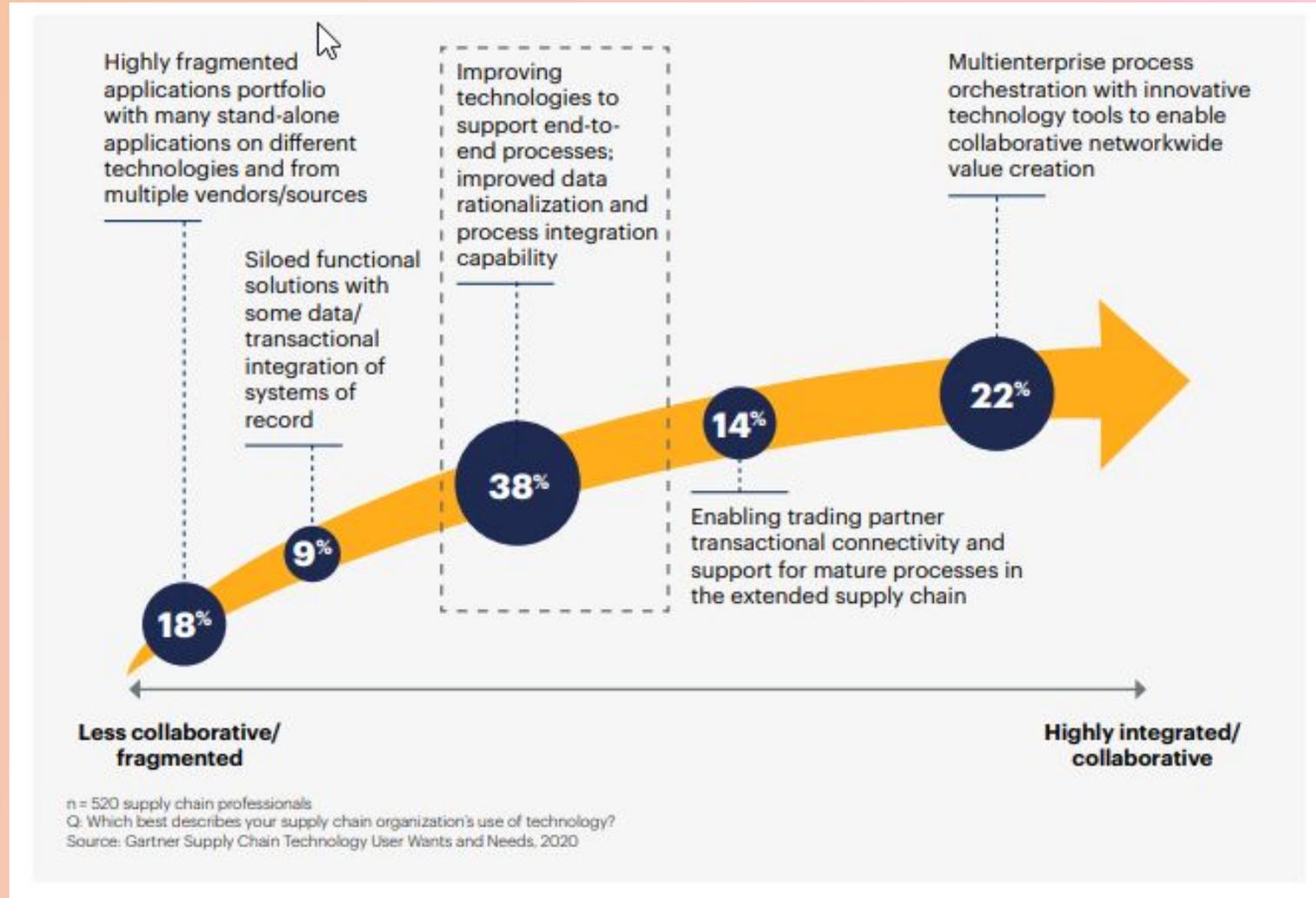
# Through the industrial revolutions



# Industry 4.0 Smart Factory



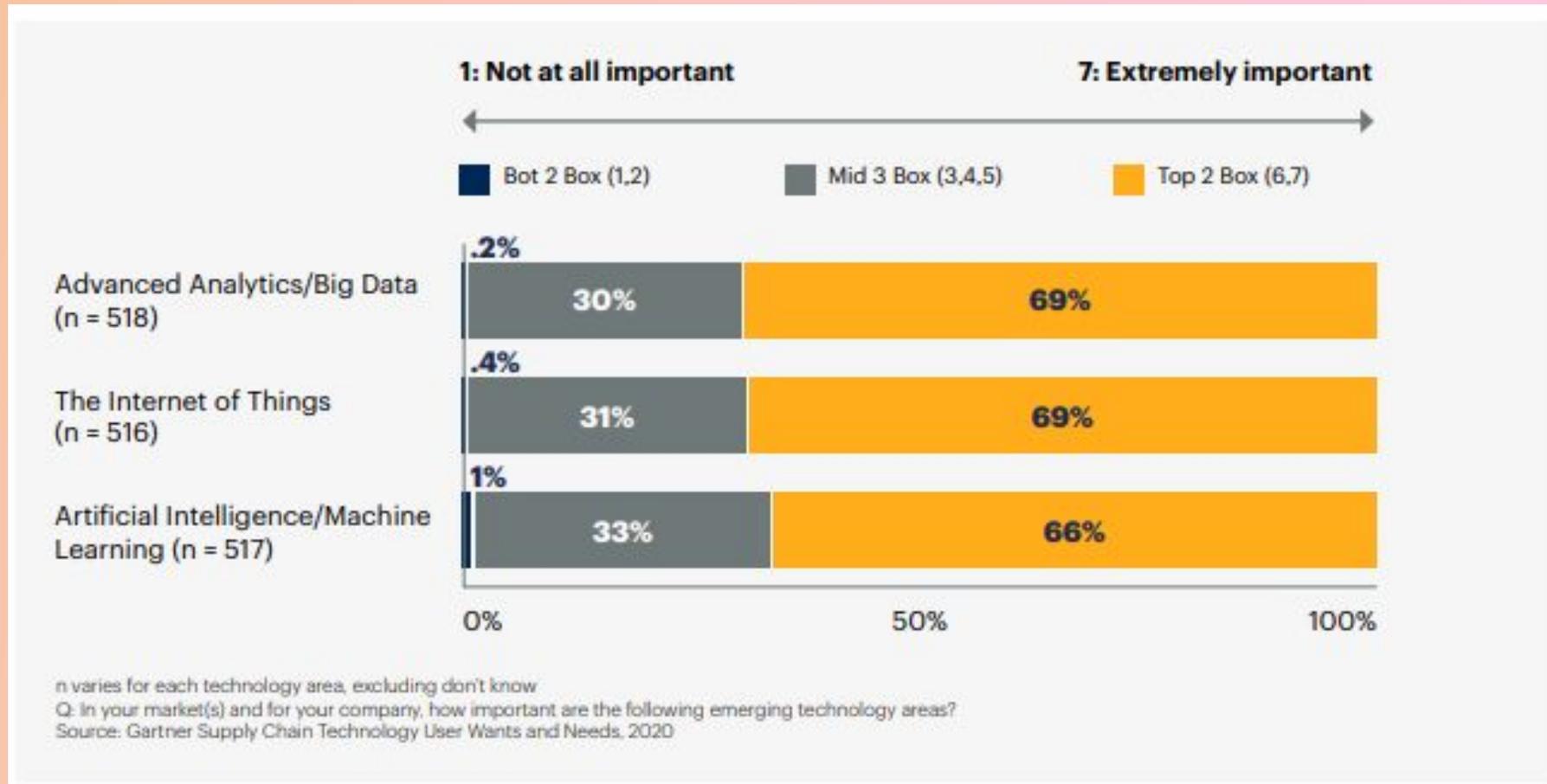
# Introduction: Supply Chain Use of Technology



Source: Gartner Supply Chain Technology User wants and needs, 2020

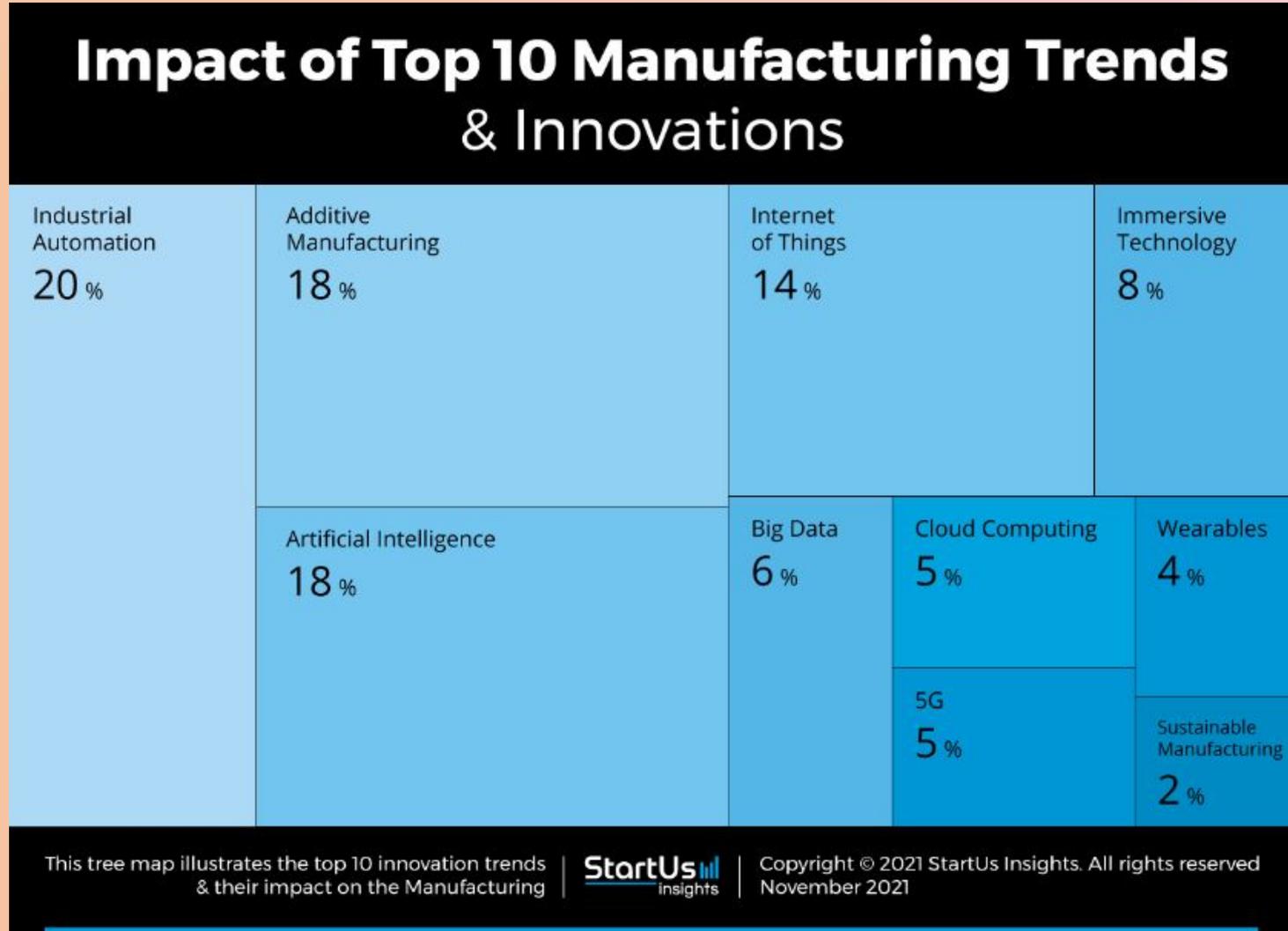
# Introduction: Importance of Emerging Technology Areas

*How important are the following emerging technology areas?*



Source: Gartner Supply Chain Technology User wants and needs, 2020

# Introduction: Impact of Top 10 Manufacturing Trends



- Industrial Automation
- Additive Manufacturing
- Artificial Intelligence
- Internet of Things
- Immersive Technology
- Big Data
- Cloud Computing
- 5G
- Wearables
- Sustainable Manufacturing

Source: 2021 Startups Insights, November 2021

# Common Issues in Manufacturing

- Forecasting Demand for Product
- Controlling Inventory
- Improving Efficiency at Manufacturing Plants
- Increasing ROI
- Skilled Labor Shortage (Manpower)
- Managing Sales Leads
- Coping with New Technological Advances

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# **Types of Emerging Technologies in Manufacturing**

# Artificial Intelligence (AI): More Accurate Decision-Making



## What to Expect F

October 26, 2022

Identified as the key reinforcement, AI has risen in such field, AI in visual inspection – has been becoming across industries.

In the recent online show and **Schaeffler** discuss 'Inspection'. All parties training duration in manufacturing brownfields factories.



## Industry 4.0 Brings Opportunities To Infuse Artificial Intelligence Into Manufacturing

July 7, 2022

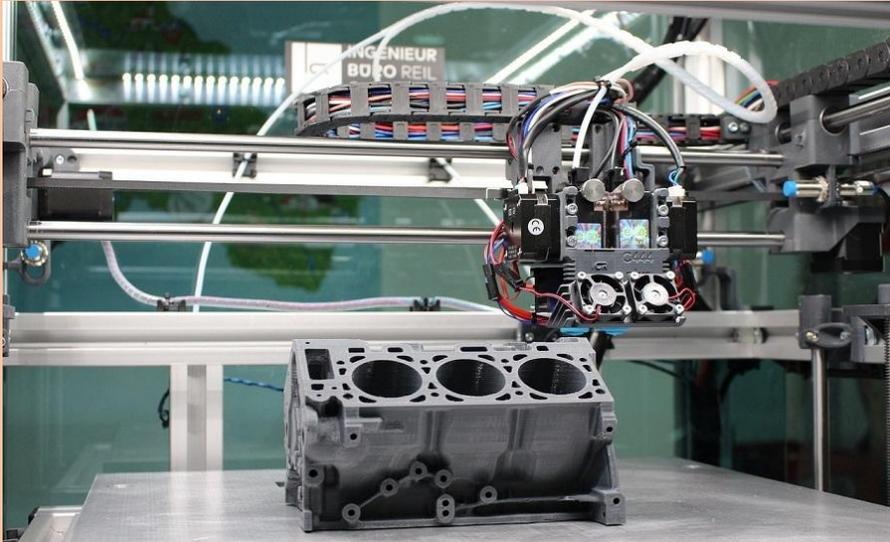
We live in the age of Industry 4.0. This Fourth Industrial Revolution with its unprecedented speed and scale allows you to take a more data-driven approach to operations. This data, pulled from your assets, adds value and enables smarter decisions. As you integrate more assets into business workflows, along with

- AI algorithm is asked to process, the more it learns and the more accurate it becomes because of the way the algorithms are organized.
- Machine learning allows for recognition of what is being asked for
- Infuse AI into machine could help improve productivity and reduce waste

Source: What to Expect  
26, 2022

Source: Industry 4.0 Brings Opportunities To Infuse Artificial Intelligence Into Manufacturing, July 7, 2022

# Additive Manufacturing (AM) or Additive Layer Manufacturing (ALM) (3D Printing)



- Additive manufacturing (AM) or additive layer manufacturing (ALM) is the industrial production name for 3D printing, a computer-controlled process that creates three dimensional objects by depositing materials, usually in layers.
  1. Ability to generate almost any 3-D shape allows designers the freedom to create parts that perform better or cost less than conventional alternatives.
  2. No need for molds or fixed tooling, every part produced by a machine can be unique, paving the way for mass-scale customization.
  3. Eliminating time-consuming toolmaking and fabrication operations accelerates both product development and production, reducing time to market
  4. Simplify the maintenance and support of products in the field, reducing the need for spare-parts inventories, enabling on-demand production of items from digital files.

# Big Data Analytics



- Big data analytics is the often-complex process of examining big data to uncover information -- such as hidden patterns, correlations, failure, process variation -- that can help organizations make informed manufacturing decisions.

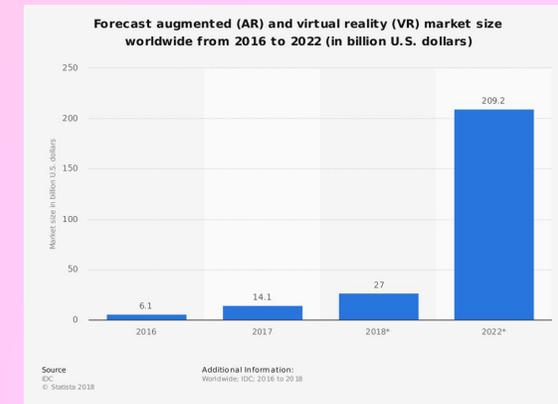


Example of a Barco monitoring and controlling all critical assets of the production process

# Augmented Reality



- Augmented reality (AR) is the integration of digital information with the user's environment in real time. Unlike virtual reality (VR), which creates a totally artificial environment, AR users experience a real-world environment with generated perceptual information overlaid on top of it.
- AR could help in troubleshooting, training, assembly process in a manufacturing environment



# Internet of things: A connectivity agent

- Sensors placed within various components

Electrical and  
measure the  
device.

Automation initiatives  
the smart tags  
(e.g., movement

that will

move across

**Factory OEE** Equipment Utilization Management System

On Line Monitor Menu

Equipment Overview

Equipment Utilization

Equipment WFP Util.

Utilization Trend - Line

Shift

Line

Status distribution

Status distribution

Utilization Trend - Machine

Shift

Machine

Status distribution

Status distribution

Utilization Trend - Work Order

Utilization Rate Report

Change Time Analysis

Language

None

Equipment Utilization

IoT device (e.g., sensor)

IoT device (e.g., antenna)

IoT device (e.g., microcontroller)

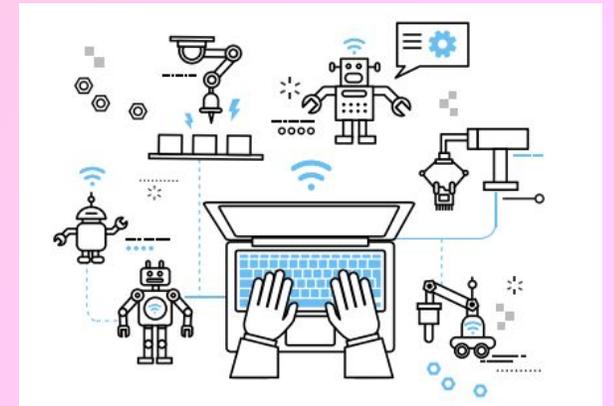
Back-end systems

# Autonomous Robot



Autonomous Guided Vehicles (AGV) for SMT Line

- True autonomous robots are intelligent machines that can perform tasks and operate in an environment independently, without human control or intervention.
- Automate tasks that are highly predictable

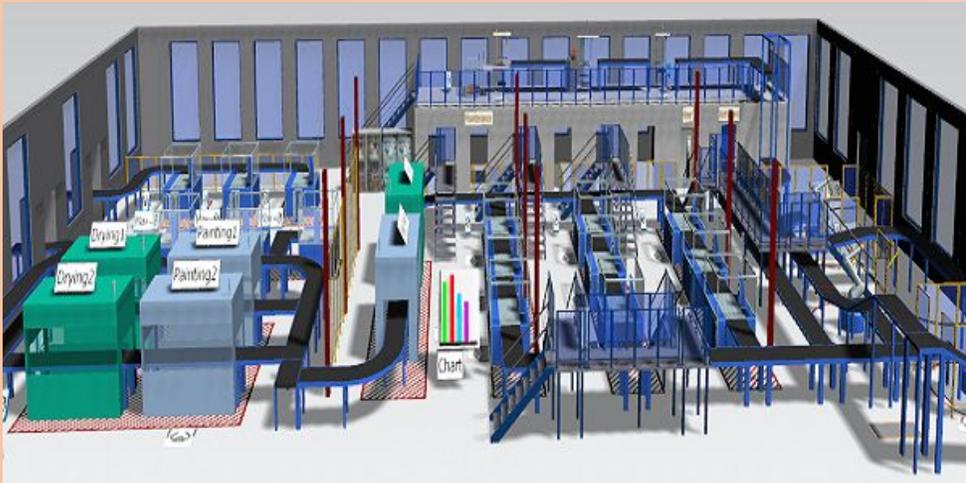


# Cloud Computing



- Cloud computing means storing and accessing data and programs over the Internet instead of your computer's hard drive.

# Simulation



Source: Siemens Tecnomatix Plant Simulation

- The word “simulation” is defined as “the imitation of the operation of a real-world process or system over time.” With this definition in mind, it is easy to understand why simulation is ubiquitous in engineering and industrial organizations; imitating a real-world process or system allows experts to study the process or system they are interested in within a controlled, repeatable environment.
- Benefits:
  - Identifying manufacturing bottlenecks and opportunities to increase throughput
  - Identifying cost savings opportunities such as optimization of direct and indirect labor
  - Validating the expected performance of new and existing production facilities or value streams

The background of the slide is a composite image. On the left, a portion of the Earth is visible, overlaid with a white network of nodes and connecting lines, symbolizing global connectivity or technology. The rest of the background is a dark space filled with numerous small, bright white stars, creating a cosmic atmosphere. The text is overlaid on this background.

With all this technology, what is happening in the manufacturing industry?

“Factory of the future”

# Factory of the future



- Provides flexibility
- Display a wide range of automation and robotic solutions
- End to end flexible automated manufacturing process
- Fully automated factory





# Welcome to the factory of the future

Our smart factory in Dresden, Germany, is one of the most advanced wafer fabs in the world. It uses state-of-the-art technology to create a highly automated manufacturing process. The microchips produced in this factory are destined for our products in the domain of automated driving and will enable connectivity in other products, too



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# LS ELECTRIC SMART FACTORY

LS ELECTRIC's Cheongju Smart factory manufactures the company's flagship low-voltage circuit breakers and electric switches.

**LS**ELECTRIC





# LS ELECTRIC SMART FACTORY

LS ELECTRIC's Cheongju Smart factory manufactures the company's flagship low-voltage circuit breakers and electric switches.

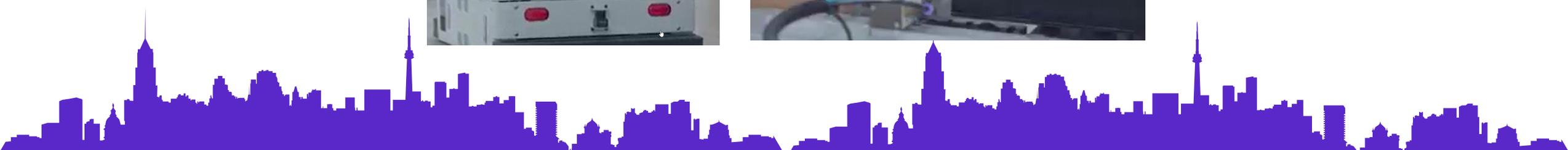
The PLC is interconnected to the PC as well as the manufacturing execution system (MES).



Automated guided vehicles (AGV) are utilized for delivering components



Such as assembling electrical power equipment through testing and packaging.





# Lights-out Manufacturing

# Benefits of Lights-Out Manufacturing

- Manufacturing are entirely self-sufficient, reduce downtime and increase efficiency in production.
- An increase in quality and consistency of products
- Maintain production throughout the night and during public holidays
- Increasing innovation with implementation of new robots, cobots and vision systems



# Example: Lights-out manufacturing



Fanuc factories in Japan has been operating with lights out since 2021, which includes assembling CNCs, Servo Amplifiers, Servo motors, ROBOTS, ROBOSHOTS, and ROBOCUTs, machining, press, die cast and paint factories.

- A fully automated factory
- Needs little or no human intervention
- So, it can manufacture with lights out
- This is not a futuristic fantasy
- Can achieved long hours of continuous unmanned machining.



Makuta, Inc.'s state-of-the-art manufacturing facility was specifically built to house our "lights out" micro injection molding manufacturing operations. We run 24/7/365 with 5 manned shifts and 16 un-manned shifts per week.

# FANUC

# Example: Lights-out manufacturing

MALAYSIA CORPORATE

Select Language

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## WESTERN DIGITAL BATU KAWAN RECOGNIZED AS MALAYSIA'S FIRST LIGHTHOUSE BY THE WORLD ECONOMIC FORUM

Sponsored Content / The Edge Malaysia  
November 01, 2021 00:00 am +08



### THE GLOBAL LIGHTHOUSE NETWORK BY THE WORLD ECONOMIC FORUM

The Global Lighthouse Network (GLN) is an initiative by the World Economic Forum (WEF) in collaboration with McKinsey & Company. It honours manufacturing leaders that have shown successful adoption of the Fourth Industrial Revolution (4IR) technologies to transform factories, value chains and business models.

- WD automating production sees a 360% increase in labor productivity
- 32% factory cost improvement
- 50% reduction in product inventory and order lead time.
- Produce more for less



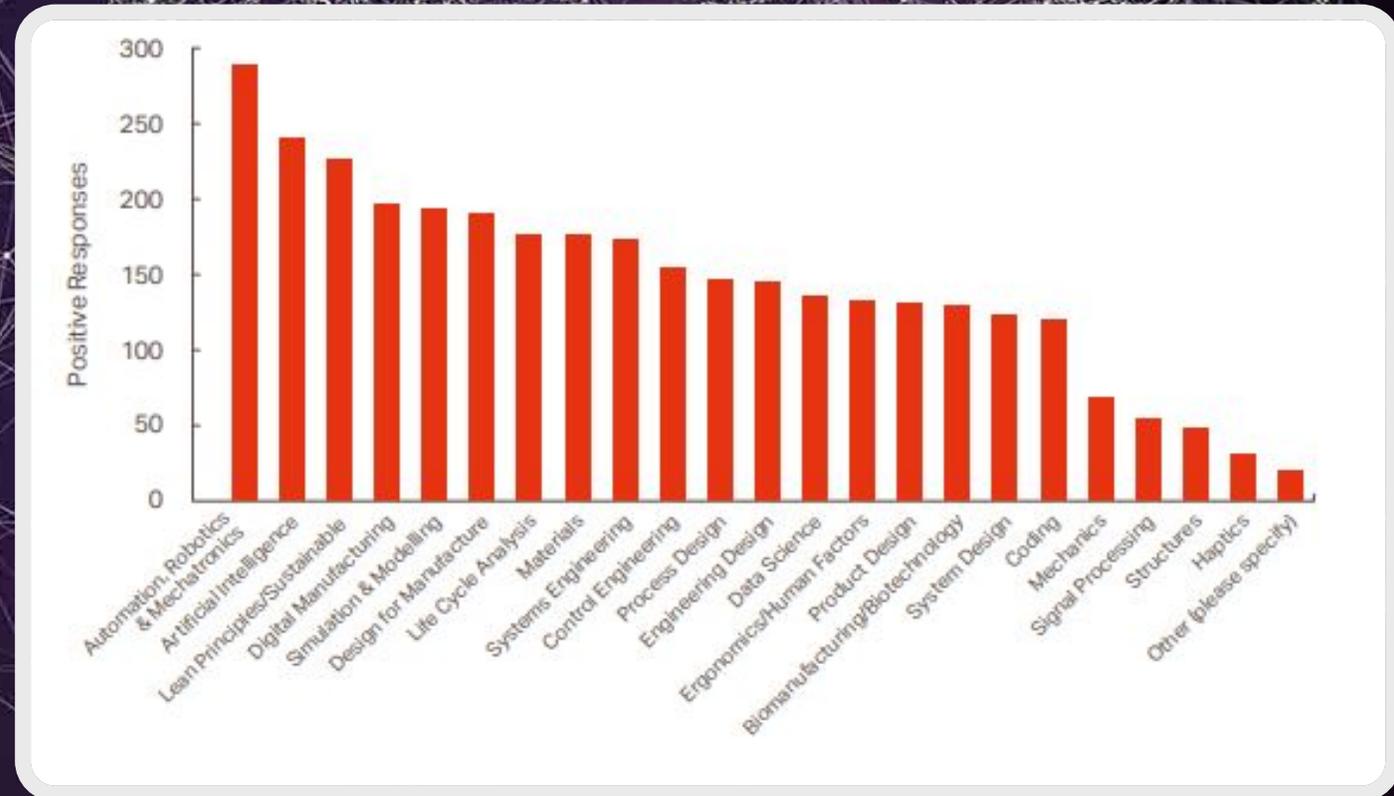


*Take away message:*

*With all this emerging technologies  
what is in it for us, Engineers?*

# What is to us as engineers? What acquire skills does one needs?

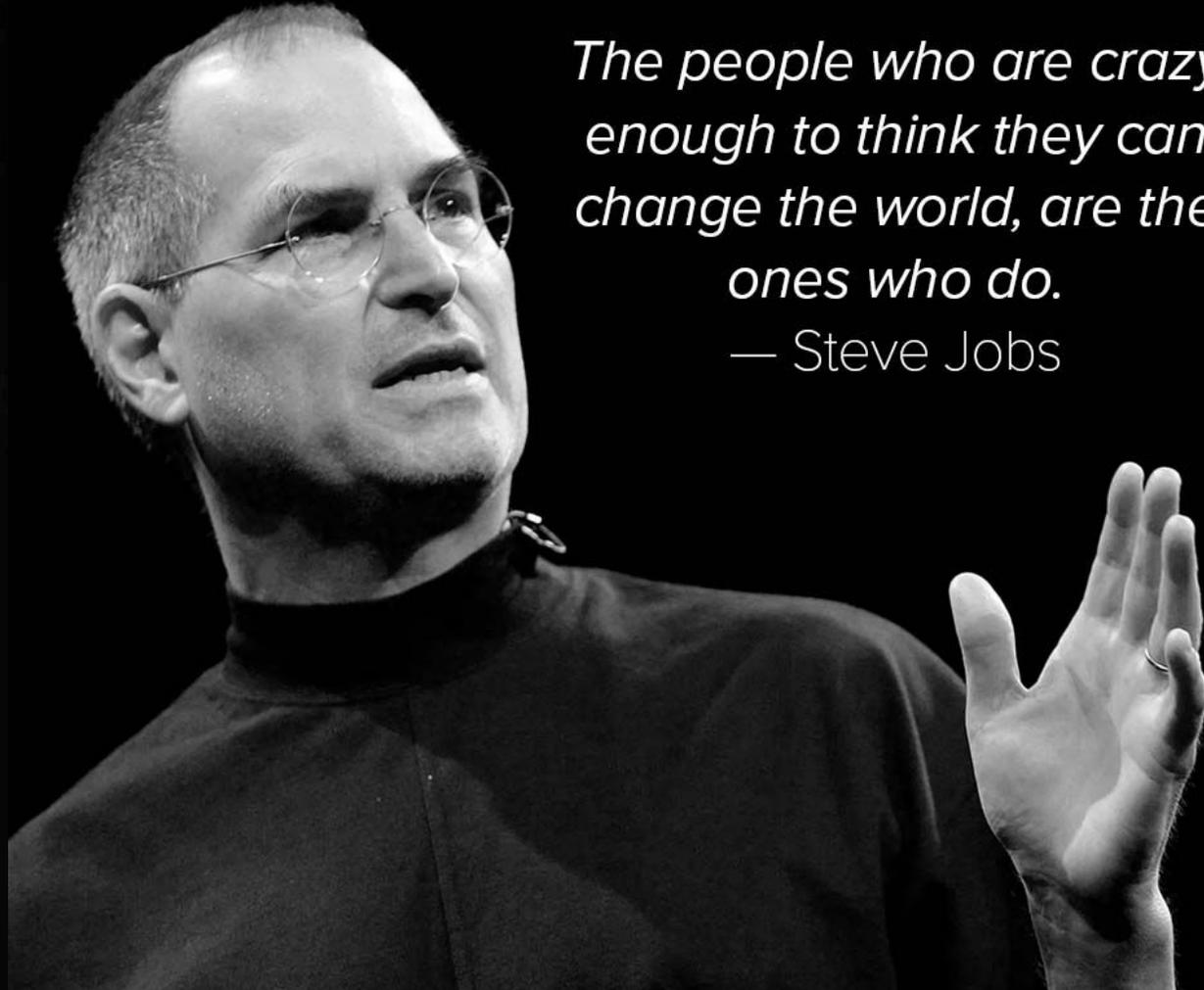
- Automation, robotics and mechatronics
- Artificial Intelligence
- Lean Principles/Sustainable manufacturing
- Soft skills:
  - Communication skills
  - Creativity
  - Design thinking



”

*The people who are crazy  
enough to think they can  
change the world, are the  
ones who do.*

— Steve Jobs





# THANK YOU



Committed to Engineering Excellence

**BOARD OF ENGINEERS MALAYSIA**

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