

# INDUSTRY 4.0: FROM AUTOMATION TO AUTONOMOUS

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**Abstract-** Industry 4.0 has a basic focus on the production process within a "smart factory", while the Internet of Things focuses on the utilization phase of digitalized and connected devices and products. In this paper we will discuss what industry 4.0 is, and applications of IoT in implementing industry 4.0. The aspects and perceptions have been discussed. The ways to implement the concept of Industry 4.0 are also discussed.

**Index Terms-** IoT: Internet of things, OT: Operational technology, IT: Information Technology, I 4.0: Industry 4.0, CPPSs: Cyber-physical production system, IIOT: Industrial Internet of things.

## I. INTRODUCTION

**Y**ou have probably heard about the Internet of Things (IoT), or the Industrial Internet of things (IIoT), also called Industry 4.0. But what is it?

The IoT is composed to offer society the greatest opportunity for advancement since the Industrial Revolution: a world where all kinds of things are connected, communicating, and improving our standard of living. We're all going to be a part of it, and preparing for it now will let us take full advantage of its benefits.

Industry 4.0 vision, the "Internet of Things", is the universal connection of people, things and machines. It is characterized by the increasing digitization and interconnection of products, value chains and business models that has arrived in the industrial sector. It is understood as a new level of organization and control over the entire value chain of the life cycle of products, it is geared towards increasingly individualized customer requirements. This cycle begins at the product idea, covers the order placement and extends through to development and manufacturing, all the way to the product delivery for the end customer, and concludes with recycling, encompassing all resultant services. The basis for the fourth industrial revolution is the availability of all relevant information in real time by connecting all instances involved in the value chain. The ability to derive the optimal value-added flow at any time from the data is also vital.

The connection of people, things and systems creates dynamic, self-organizing, real-time optimized value added connections within and across companies. These can be optimized according to different criteria such as costs, availability and consumption of resources.

If the objective of automating manufacturing systems was to reduce human errors, the use of Industry 4.0 is to improve productivity by making data available at all touch points.

## II. ASPECTS OF INDUSTRY 4.0

### A. Digitization and increased integration of vertical and horizontal value chain.

This is the first main aspect of industry 4.0. Vertical networking uses cyber-physical production system (CPPS's) to enable plants to react quickly to changes in demand or stock levels and to faults. CPPS's are online networks of social machine which work in a similar way to social network. CPPS's enables not only autonomous organization of production management but also maintenance. Resources and products are networked, and materials and parts can be located anywhere and at any time. Processing stages are logged, and alteration to orders, fluctuations in quality or machinery breakdowns can be dealt more rapidly. This enables wear and tear on materials to be monitored more effectively or pre-empted.

Horizontal value chain networks are real-time optimized networks that create high level of flexibility and transparency across entire process chain-from purchasing to sales. Customer-specific adaptations can be made in development, ordering, planning, composition and distribution of products, enabling factors such as quality, time, risk and price to be handled dynamically and in real time. This can generate completely new business model, due to integration between customers and business partners.

### B. Acceleration through exponential technologies.

Industry 4.0 requires automation solutions to be highly cognitive and autonomous. Artificial Intelligence (AI), advanced robotics and sensor technology have the potential to increase autonomy further still and to speed up individualisation and flexibilisation. It can help to plan driverless vehicle

routes to factories more flexibly, save time and cost, increase reliability in production.

Functional nanomaterials and nanosensors can be used in production to control functions to make quality management, flying maintenance robots and drones to make inventories of warehouse stock levels and deliver spare parts, at any time day or night and in any terrain weather can be further applications.

### C. Secure value-creation network

Safety and security for Industry 4.0 includes, firstly, the protection of people from machinery-related hazards (safety) and secondly, the protection of production facilities and corporate IT from attacks and faults from the surrounding environment (security). The latter involves the securing of sensitive data as well as the prevention of intentional and unintentional malfunctions. Safety and security are not static properties but processes that have to adapt to fast-changing challenges and threats. The evolution from value-adding chains to inter-company and inter-regional value-creation networks with data flowing across their boundaries have made these issues more important than ever. All partners of value creation networks have to apply the same standards and processes to make the common network safe and secure.

## III. PERCEPTION OF INDUSTRY 4.0

Most of the people are unfamiliar with industry 4.0 concept, so there is a need to create awareness regarding the functionality and value that industry 4.0 will bring.

### A. Impact of Industry 4.0 on Swiss manufacturing companies.

- 20% are feeling the impact of the digital transformation.
- 16% have neutral thought about the impact of this concept
- 24% were already feeling the impact strongly
- 12% were feeling the impact of Industry 4.0 very strong

### B. Asian manufacturing companies in Industry 4.0 Implementations

- 12% have already implemented industry 4.0 solution
- 12% are planning a project in next 12 months
- 64% indicate they are evaluating technology for use in their own facility
- 12% do not have any plans.

## IV. HOW DO WE GET THERE?

The movement towards I 4.0 has already started taking place and is growing exponentially every year. It will not happen overnight, even with large investments in IoT being made, there are significant

hurdles to be overcome.

We won't be able to capture benefits without major changes in the way technologies interact in business. Within the given enterprise are Operational Technology systems and Information Technology systems.

*Operational Technology (OT)* is “hardware and software that detects or causes a change through the direct monitoring and/or control of physical devices, processes and events in the enterprise.” That's the industrial control and manufacturing automation part of the business.

*Information Technology (IT)* is “the entire spectrum of technologies for information processing, including software, hardware, communications technologies and related services.” That's the company computer network and databases.

Both technologies and each set of systems were purpose-built, and neither was designed to work with the other. So both OT and IT function within the enterprise to create output (goods and services).

To create output most efficiently, they need to work together.

But in today's enterprise, there is a significant communication gap between OT and IT technologies. Each uses its own methods of connectivity, from the physical connectors and buses that data rides on, to the language each uses to convert bits and bytes into human readable and actionable information. Designed years ago, OT and IT technologies remain far apart today.

If you're excited about the possibilities the IoT offers for your application—or if you just want to be prepared for the future—here are some ideas to get started now.

### Start small

The Internet of Things is a big concept with lots of moving parts. Developing a strategy to begin implementing IoT in your business doesn't have to be complicated. Start small and experiment.

The IoT is a concept, an idea, not a hard-and-fast set of rules. It's a method of looking at disparate systems and asking ourselves, what if those two machines could talk to each other? What could we learn if we could quickly pull any data we wanted and look for correlations between datasets? Over time, getting different devices to communicate with each other will become easier and easier.

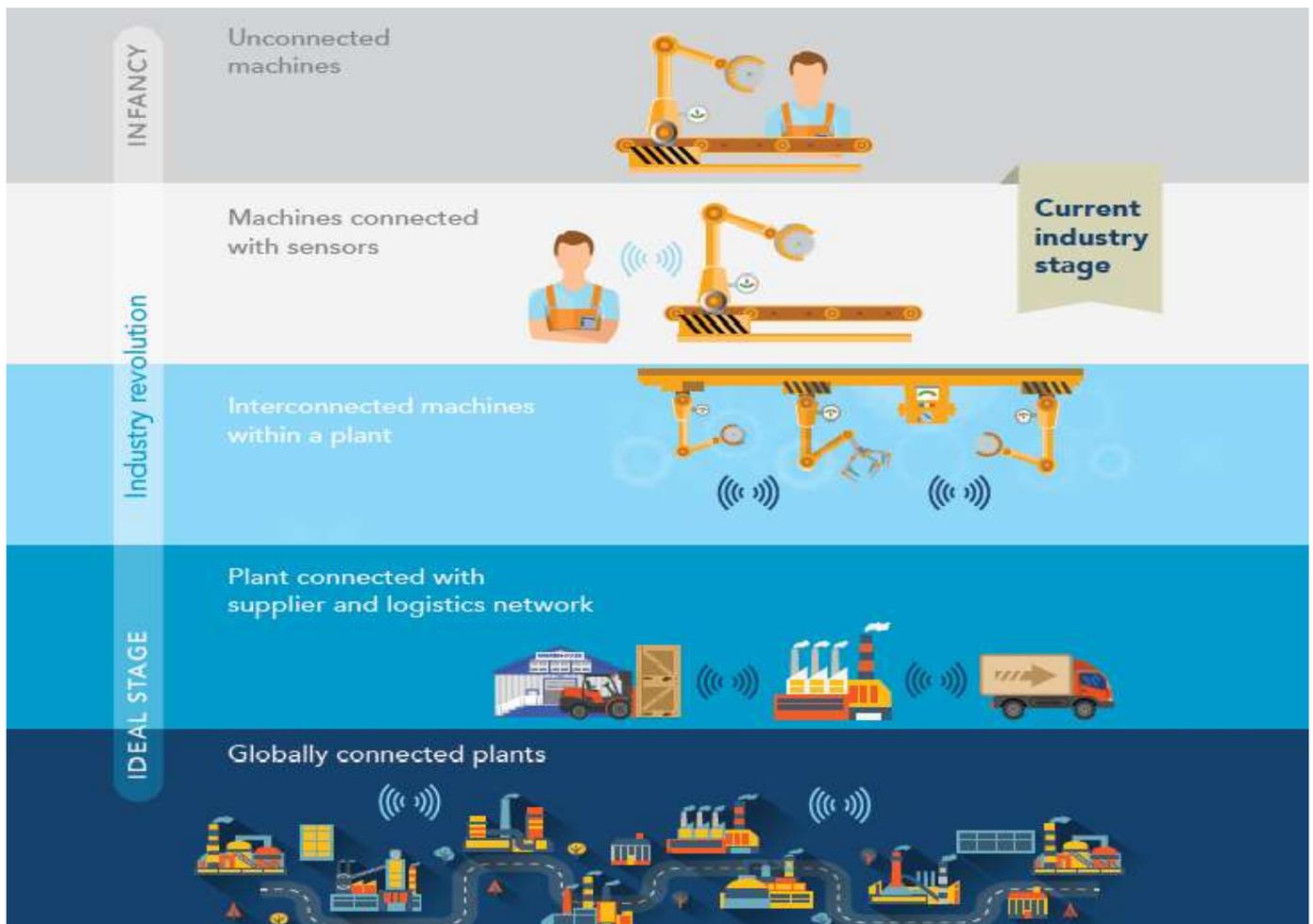
### Educate

A good place to start is to learn about new technologies that are involved with the IoT. If you're

coming from the process control and industrial automation side of the OT/IT convergence, it's a

good idea to bone up on your basic networking skills.

#### V. THE WAY FORWARD WITH INDUSTRY 4.0



**Figure 1: The way forward with Industry 4.0**

#### IV. STUDIES AND FINDINGS

While today only one fifth of the industrial companies have digitized their key processes along the value chain; in five years' time, 85% of companies will have implemented Industry 4.0 solutions in all important business divisions.

Here are some key findings:

1. *By 2020, European industrial companies will invest €140 billion annually in industrial internet applications.*

Over the next five years, the industrial companies surveyed will invest, on average, 3.3% of their annual revenues in industrial internet solutions. This is equivalent to nearly 50% of the planned new capital investments and an annual sum of €140 billion.

2. *In five years, more than 85% of companies will have digitized their value chains.*

One quarter of companies have already achieved a high degree of digitization, However it is mostly only individual units and isolated applications that have been automated and digitized thus far. The companies expect that 86% of horizontal and 80% of the vertical value chains will have a high degree of digitization by 2020.

3. *China is advocating "Made in China 2025", a ten-year action plan to revitalize its manufacturing sector through a system of mandates and subsidies.*

China will be the largest market for Industry 4.0 technology by 2020, with 49% of Asia Pacific spending centered in the country.

4. *The integrated analysis and use of data are the key capabilities for the industrial internet.*

The efficient analysis and use of data is of great

significance for all companies. Moreover 90% of companies believe that ability to analyse data will be decisive to their business model in next five years

5. *The industrial internet increases productivity and resource efficiency — an 18% increase in efficiency within five years.*

The industrial internet allows higher productivity and resources efficiency which creates the conditions for sustainable and efficient production. The companies anticipate an average efficiency increase of 3.3% per year across all industry sectors due to digitization of value chains. This amounts to a total of 18% in next five years. This will also give annual savings of 2.6% with respect to cost reduction.

6. *Digitized products and services generate approximately €110 billion of additional revenues per year for the European industry.*

Companies anticipate double-digit growth in next five years due to the intensified digitization of their product and service portfolio. 2.5% increase in sales is expected per annum, which is about €30 billion for Germany and reaches up to €110 billion of additional revenues for the European industry in total.

7. *The successful implementation of Industry 4.0 will require the widespread support of Policy-makers.*

Successful implementation of Industry 4.0 will require support from government, Research and development promotions in institutions and universities, International Standardisation etc.

8. *A sustained successful business model will require a combination of multiple aspects of Industry 4.0*

Key aspects of successful business models are stronger digital networking with customers and partners, Expansion of digital services with additional customers' benefits, Efficient and safe cloud technologies, Development of value services, strengthening own position with regard to new digital players.

#### VI. CONCLUSION:

Industry 4.0 holds out promises that would completely automate manufacturing by interconnecting systems across organizations. Systems and equipment would have the necessary intelligence to dynamically configure themselves to be adaptable to varied customer requirements. The approach towards successful Industry 4.0 Projects should be systematic.

Understand the needs and challenges which you will face, identification of operational issues is very much important, formulate a plan to execute trail project with small investment, Validation of project after successful trials and last is to calculate efficiency.

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