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WHAT IS INDUSTRY 4.0

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Abstract - *Now we are at the 4th industrial revolution, can be accomplished by a smart manufacturing, the internet of things, cyber physical system and digital transformation. The definition of Industry 4.0 covers the digitalization of the horizontal and vertical supply chains, product and service growth and the creation of modern business models. Improving consumer service, rising pace to market, and lowering costs are among the main business factors of this transition. As a result, an Industry 4.0 development structure is adaptable and allows for personalized and specialized goods. The aim of this paper is to present and further an understanding of Industry 4.0 features, Scope, Business Benefits, Challenges and Implementation. Members of manufacturing companies have placed Industry 4.0 at the top of their agenda in order to reap the gains of this transition. Implementing an Industry 4.0 development environment, on the other hand, would be a multi-year process that will require modernizing legacy processes. When implemented, the applications of Industry 4.0 principles and technologies are limitless.*

Keys Words: *Smart Manufacturing, Internet of Things, Consumer Service, Development Environment, Supply Chain.*

1. INTRODUCTION

We are surrounded by cutting-edge innovations that are changing every part of our lives as well as the whole production process. From the First British Industrial Revolution until the Fourth Industry Revolution, also known as Industry 4.0, there has been a constant digitalization movement that has changed the way we live, communicate, and work both speaks and transacts. The 18th and 19th centuries saw the dominance of agrarian rural communities in Europe as well as the rise of industry with massive factories, industrial manufacturing, growing demand for labor and a need for high profitability. The original industrial revolution of the 18th century was a watershed moment in contemporary economic development and urban cultures today.

2. HISTORY

To learn how Industry 4.0 is today's phraseology, we should consider its ancestors. This will help us see how this transition differs from the others. By varying industry, finance and culture, the Industrial Revolution transformed the world. These shifts had a significant impact on the environment and continue to do so today. The timeline of industry and the business field in general is shown in the diagram below.

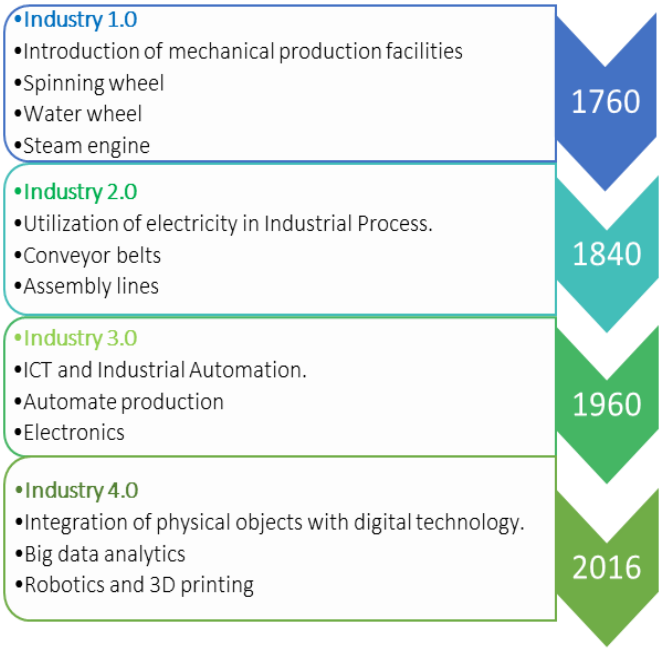

Fig-1: Industrial Revaluation Period [5]

2.1 THE 1st INDUSTRIAL REVOLUTION [7]

The process of transitioning from an agrarian and handicraft economy to one dominated by industry and machine manufacturing in modern history is known as the Industrial Revolution. This process began in Britain and spread throughout the world from there. While the word Industrial Revolution had been used by French authors before it was coined by English economist Arnold Toynbee (1852–83) to explain Britain's economic growth from 1760 to 1840.The word has been more widely used since Toynbee's time. The Industrial Revolution was characterized by scientific, socioeconomic and cultural developments.

The proto-industrialization era was followed by the first industrial revolution. It lasted from the end of the 18th to the beginning of the 19th century. The most significant shifts occurred in the manufacturing as a result of mechanization. Agriculture began to be replaced as the backbone of the societal economy by manufacturing as a result of mechanization. People saw huge coal mining at the time as

well as the crucial advent of the steam engine which led to the development of a revolutionary form of energy that eventually helped speed up the manufacturing of railroads thus accelerating the economy.

2.2 THE 2nd INDUSTRIAL REVOLUTION [8]

The Second Industrial Revolution occurred mainly in the United Kingdom, Germany and the United States but also in France, the Low Countries, Italy and Japan. It came after the First Industrial Revolution which began in Britain in the late 1800s and spread throughout Western Europe. Although the First Revolution was distinguished by the limited usage of steam engines, interchangeable parts and mass production and was mostly fuelled by water (especially in the United States), the Second Revolution was marked by the construction of railroads, large-scale iron and steel production, extensive use of machines in manufacturing, vastly expanded use of steam technology, widespread use of the telegraph and the development of new technologies. Petroleum usage and the start of electrification. It was also around this period that new operational strategies for running large-scale companies across large regions became common.

The idea was first used by Patrick Geddes in Cities in Evolution (1910) and it was already being used by economists like Erick Zimmerman (1951) but David Landes' usage of the word in a 1966 essay and in The Unbound Prometheus (1972) standardized academic meanings of the term which was most vigorously advocated by Alfred Chandler (1918–2007).

2.3 THE 3rd INDUSTRIAL REVOLUTION [9]

Another century has passed and the Third Industrial Revolution has begun. We see the rise of yet another stream of untapped at the time electricity in the second half of the twentieth century, Nuclear Power, Electronics, Telephone and of course computers all arose during the third revolution. The third industrial revolution opened the door to space exploration, research and biotechnology through emerging technologies. Two big developments in the industrial world Programmable Logic Controllers (PLCs) and Robots helped usher in a new age in high-level automation.

2.4 THE 4th INDUSTRIAL REVOLUTION [4]

Industry 4.0 began with the one thing that everybody does every day at the turn of the third millennium The World Wide Web. From the first industrial revolution which rooted for scientific phenomena to Industry 4.0 which creates augmented reality environments encouraging us to break the rules of physics thus we can see the change.

The word "Industries 4.0," abbreviated as I4.0 or simply I4, was coined in 2011 as part of the German government's high-tech policy, which encourages the computerization of production. In the same year, at the Hannover Fair, the word "Industrie 4.0" was first used officially. The Working Group on Industry 4.0 provided the German federal government with a series of guidelines for Industry 4.0 adoption in October 2012. Industry 4.0's founding leaders and organizing force are thought to be the founders and allies of the workgroup. The final report of the Industry 4.0 Working Group was delivered on April 8, 2013 at the Hannover Fair. The future is shaped by the four Industrial Revolutions. They are the foundation of the world's economies. There are programmers and campaigns being launched all around the world to assist people in taking advantage of the fourth revolution's marvels in their daily lives.

3. OVERVIEW OF INDUSTRY 4.0 [2][4]

The world is changing at a faster rate than it has ever been before. Organizations are looking to transform quickly as the use of emerging technology begins to accelerate. Furthermore, a new economic order is emerging, in which existing manufacturers must contend with both major digital companies and creative start-ups, both of which are focused on developing new revenue models. New technology, goods and services, and business models all have the potential to be disruptive. Adopting Industry 4.0 values becomes a must in this situation and tomorrow's leaders must be willing to follow a new organizational framework.

The Industry 4.0 principles are proposed to enable businesses to have more flexible production processes and to interpret vast volumes of data in real time, resulting in better strategic and organizational decision-making.

This latest industrial stage has been made possible by the increased usage of ICTs in industrial settings as well as the lower cost of sensors which has led to increased sensor installation in physical objects. These advances paved the way for the development of embedded and linked systems. These devices are designed to track and manage machines, conveyors and goods via a feedback loop that collects a large amount of data (big data) and updates virtual models with data from physical processes, resulting in a smart factory. As a result, different technologies have evolved and been implemented in production processes since the development of digital manufacturing in the 1980s such as cloud computing for on-demand manufacturing facilities, modeling for commissioning additive manufacturing for modular manufacturing systems and so on. Industry 4.0 is made possible by technology that links the digital and physical realms, such as:

3.1 THE INTERNET OF THINGS (IoT)

Connecting an increasing number of systems, computers, sensors, properties and people through networks ranging

from wireless low-power wide-area networks to wired high-capacity networks.
The internet of things or IoT is a networked infrastructure of interconnected computing systems, mechanical and digital computers, objects, organisms or individuals with unique identifiers (UIDs) and the ability to transmit data over a network without needing human-to-human or human-to-computer interaction.

3.2 CLOUD COMPUTING [6][15]

Huge volumes of data can be stored using cloud computing. This ability is primarily valuable for storing data produced during a production process given that machines and sensors generate more data than an individual and that such data is often associated. Similarly, cloud infrastructure decreases investments in computational capital by allowing storage and processing power to be contracted on demand resulting in greater versatility, agility and adaptability. The cloud allows for the consumption of services on demand thanks to its modular nature. Which allows for cost savings by avoiding the purchase of computers, permits and the recruiting of skilled staff for servicing as well as energy savings. Furthermore, it allows for easy access to storage from a variety of locations and on a variety of schedules. Regardless of the network or the gadgets that attach to it. All of this makes it easier to build production environments and allows consumers and vendors to collaborate. The client in particular will engage in all levels of the manufacturing chain and increasing their satisfaction.

3.3 MOBILE SOLUTIONS [13]

To build an adaptive, flexible and fully interactive environment, forward-thinking, manufacturing organizations are using mobile devices as tools from which plant managers and staff can effectively access and collaborate with these cloud technology and at scale.

To site an example, a 5S Lean Audit software, monitors workplace organization with the goal of reducing waste and increasing productivity. 5S audits, when performed on a daily basis, result in quality growth, lowering manufacturing costs while increasing efficiency, protection and employee satisfaction.

3.4 CYBER-PHYSICAL SYSTEMS (CPS)

Computation, networking and physical operations are also included with cyber physical networks. Computers and networks use feedback loops to track and manage physical processes. The physical device reacts and the system uses equipment to optimize processes by self-optimization systems will respond to the traffic profile and network environment autonomously. Autonomous Mobile Robots (AMRs) are an essential component of the Smart Factory because their autonomous thinking integrates the factory, allowing for smooth operations. Siemens Electronic Works in Amberg, Germany is setting a good example, Smart computers manage manufacturing, global delivery or a made-to-order process involving approximately 1.6 billion parts. When the Smart Factory is realized it will mark a watershed moment for Industry 4.0 as the transition will continue to spread through many industries. Various industries ranging from hospitals to consumer products would adopt Industry 4.0 innovations that were first envisioned in the Smart Factory. Acts are interpreted by algorithms and the effects are tracked. The concept revolves around computers and applications being integrated in devices where the primary use is not computing but rather a loop of action and machine learning.

4. WHAT ARE THE CHALLENGES? [5]

The complexities of Industry 4.0 are many.

Today's manufacturers must compete with massive amounts of material both organized and unstructured stored in databases that are not always properly linked. To generate consumer value and meet consumer needs in terms of creativity, personalization and speed to market, these silos must be connected to allow a single unbroken set of data that is distributed along the supply chain. To do this the following issues must be addressed.

AWARENESS- Many suppliers are also ignorant of the opportunities offered by Industry 4.0 technologies and company-specific market examples do not adequately explain this.

PEOPLE- Employees' daily activities will be transformed as new organizational models, business systems and linked goods and services are introduced. Companies want new people and expertise to implement Industry 4.0 technologies. Certain occupations such as those of factory workers will shift or even become obsolete. Warehouse staff, for example is likely to be replaced by self-driving robots. New positions have been developed such as "robot supervisor" and "data scientist" while repetitive and physically exhausting jobs will be phased out. Data scientists, for example gather and interpret data and use their findings to enhance production procedures and goods. Robot coordinators keep an eye on the machines on the factory floor reacting to malfunctions and performing repair activities. Staff in the manufacturing industry must adjust to new positions and job conditions. Operators can also track various devices and systems at the same time and repair technicians are aided by virtual reality technologies and remote assistance from specialist's offsite.

CYBERSECURITY- Traditional IT protection is insufficient to secure the company in the age of digital factories and a digitally integrated supply chain. Ignoring this fact jeopardizes the company's profitability and protection. When businesses innovate, the "attack surface layer" or the enterprise area that is vulnerable and expands. The difficulty lies in comprehending the possible cyber danger that creativity entails. A single plant shutdown will result in daily production losses of millions of dollars. As a result,

cybersecurity threats must be reduced. Industrial IoT devices must be designed to be highly safe and securely incorporated with current automation and information system architectures. Since breaches are unavoidable, prevention and reaction processes in industrial control systems (ICS) must therefore be in effect. This will provide the organization with the requisite degree of resilience. Under these conditions the importance of protecting industrial control systems and ensuring cybersecurity cannot be overstated. This is an example that can also assist manufacturing firms in differentiating themselves from the market.

INVESTMENTS- Significant investments are expected to build a stable and reliable network infrastructure and update or replace existing networks in order to incorporate Industry 4.0 solutions. Benefits must be quantified, unequivocally and consistently in order to support these expenditures. Collaboration since Industry 4.0 implementations are built on various systems and applications that operate on diverse networks, no one provider can currently have all of the features required to execute them. An ecosystem of IT manufacturers, OT vendors, device integrators and emerging IoT startups will aid in the delivery of Industry 4.0 solutions. Near coordination between the companies, IT and OT is a crucial success factor.

STANDARDIZATION- Existing manufacturing standards are inadequate to allow Industry to completely realize its potential. 4.0 as well as new engineering, design and business standards are needed. As there is a growing a large range of patented correspondence protocols using equipment and applications are introduced in the sector, data silos form resulting in a dynamic network of interconnections. There are no uniform guidelines, despite the fact that various standardization bodies and business consortia have issued reference architectures and standards. This makes it difficult for businesses to eliminate data silos. In reality the Industry 4.0 environment will be comprised of many reference architectures, specifications and protocols for several years to come.

IT MODERNIZATION- At the moment, industrial automation technology implementations are a jumble of proprietary systems and networks. We would need to bind business planning and logistics solutions, manufacturing operations management solutions and industrial control systems such as supervisory control and data collection, In the future (SCADA), Human-machine interface (HMI), distributed control system (DCS) and programmable logic controller (PLC) (HMI). Processes would no longer be operated by a single programmable logic controller (PLC) but by a service oriented, decentralized control device, comprised of distributed microcontrollers communicating through Internet standards.

5. BUSINESS BENEFITS OF INDUSTRY 4.0 [5]

Managers must consider the key elements and innovations as well as how their interactions relate to Industry 4.0 before beginning to incorporate Industry 4.0. The corporation will then reap a variety of benefits.

5.1 IMPROVE PRODUCTIVITY [17]

Improved in a nutshell, Industry 4.0 innovations enable you to do something with fewer. To put it another way, you can generate more and faster while allocating capital more cost effectively and efficiently. Because of improved process control and automated/semi-automated decision-making, the manufacturing lines will face less downtime. In reality as the plant gets closer to being an Industry 4.0 Smart Factory, general OEE (Overall Equipment Effectiveness) will increase.

As a result of Industry 4.0-related technology, several areas of the production line can become more effective. Some of these efficiencies have already been listed less computer maintenance as well as the potential to produce more goods at a higher rate. Improved performance can also be seen in quicker batch changeovers, automatic monitor and trace procedures and automated monitoring. NPIs (New Product Introductions) become more effective as well as do management decisions and more.

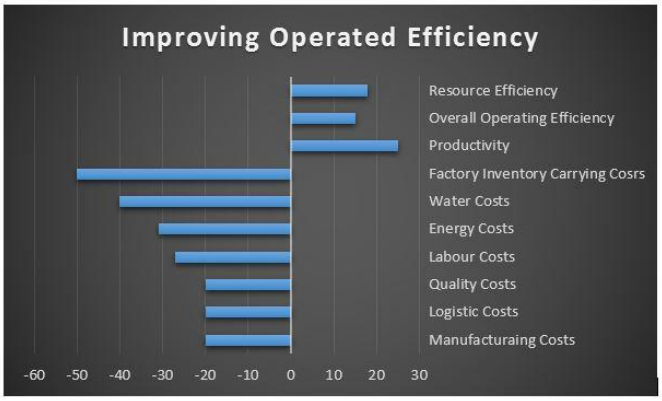

Fig-2: Improving Operated Efficiency [5]

5.2 IMPROVE REVENUE

Many of the points mentioned above will lead to increased sales for your production facility.

For example, you might add a new change with low labor costs to accommodate an increase in demand or bid for a new contract by completely automating the manufacturing line and incorporating other Industry 4.0 technology.

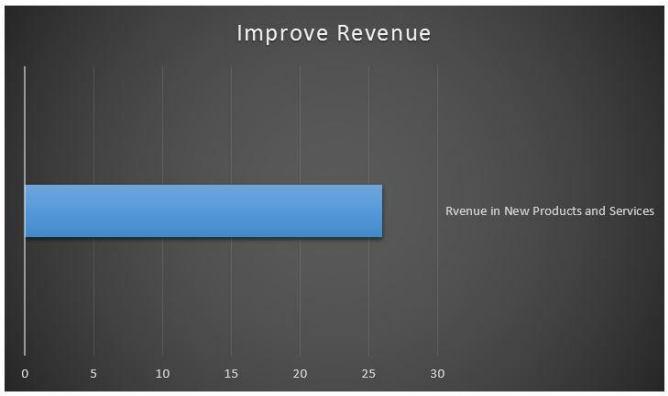

Fig-3: Improve Revenue [5]

5.3 IMPROVE SUPPLY CHAIN [16]

Better communications with vendors are possible with cloud-based material management systems. You will avoid working in "individual silos" by establishing seamless exchanges and ensuring that you:

1) High fill rates for service parts.
2) High levels of stock uptime with reduced risk.
3) Higher levels of customer service.

You will boost your market predictions by at least 85% by combining your inventory management scheme with a big data analytics approach. Complex systems such as SAP S/4HANA, allow companies to take advantage of Industry 4.0 and data analytics to quickly adapt supply to consumer demand. You can also perform real-time supply chain optimization to obtain a better understanding of potential bottlenecks, allowing you to expand your company.

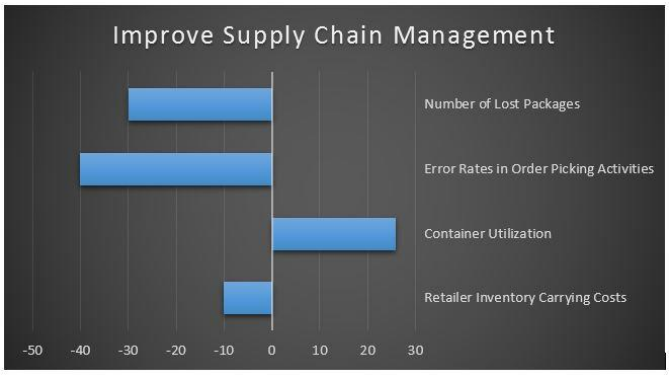

Fig-4: Improve Supply Chain Management [5]

5.4 IMPROVE ASSETS MANAGEMENT [16]

In Industry 4.0, predictive maintenance ensures the equipment loss can be detected before it occurs. Repetitive behaviours that precede faults can be detected by ML-powered devices, which can alert the teams and plan an investigation. Such devices also improve over time, being capable of detecting ever more granular shifts and assisting you in continually optimising the manufacturing operation.

Fig-5: Improve Asset Management [5]

5.5 BETTER CUSTOMER EXPERIENCE [17]

Industry 4.0 also has ways to boost customer engagement and improve the customer experience. You can easily fix issues with automatic track and trace capabilities. Furthermore, you will have less stock supply challenges, product consistency will increase and you will be able to provide consumers with more options.

5.6 CREATES INNOVATION OPPORTUNITIES [17]

Industry 4.0 solutions allow you to have a better understanding of the production process, supply chains, delivery chains, market results and even the goods you produce. This opens up doors for innovation such as evolving a market process, creating a new product, optimizing a supply chain and increasing OEE, among other things.

6. CONCLUSIONS

The history and evolution of the Industry 4.0 definition are discussed in this article. From design and hierarchical framework to products, utilities and business models. Industry 4.0 will transform the whole industrial sector. The implementation and introduction of these technologies will take time and be part of a long-term pattern but the moment is now.

The definition of Industry 4.0 encompasses not just the company's direct production but also the whole supply chain from suppliers to clients as well as all of the company's corporate operations and services.

Industry 4.0 is a branch of the Internet of Things that focuses on the retail and industrial sectors. It implies real-time data storage which raises the problem of processing and analyzing large amounts of data as well as cybersecurity concerns. Industry 4.0 is a 21st-century technological innovation that allows industries to produce “smarter” goods and services by lowering prices and increasing productivity, where the human aspect is critical for the implementation and the work is dependent on current literature in the field. Smart Factory provides a technology

that can assist manufacturing firms in further optimizing their operations and greatly increasing their internal productivity due to the system's streamlined procedures, uncomplicated configuration including easy, need-based implementation and finally, high degree of scalability

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