

## The Role of Automation in Technology

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### Abstract

The very vast extent of industry fields led the companies, Industrial enterprises, Owners of capital, and engineers to create a new revolution in the industrial fields. This extension has generated a new concept, which called "Automation". Industrial Automation has become a powerful and effective component of production processes; also it played an essential role in improving its productivity and efficiencies. The Industrial Automation has led to saving money; time also decreased the human efforts. The ideas of Automation governing have been achieved by receiving data systems, controllers and statements or any other data interaction from an automation device, therefore all of these data has been translated to the appropriate system (language) and optionally return a response of motion or any other action such as a result set. This paper tries to shed some light on the concept of Automation, the importance of Automation, levels of Automation, advantages, and disadvantages of Industrial Automation , technologies available today for industrial practice, and Automation after 2020.

**Key words:** Automation, Levels of automation, Industry 4.0, Robots.

## Introduction

1. During The last decades, a new concept has generated which called Automation; this one has led a step afar than mechanization. Undoubtedly, mechanization should be managed by human and mental thinking to achieve works; automation has reduced the requirement for humans as well as his mental requirements. Automation is the shift of a work process to automatic rather instead of human control. Automation has played an essential role in the manufacturing processes by using mathematical and digitalization tools to create complicated systems during the manufacturing processes to achieve the tasks at optimum production. The integration between computer systems and machines led to some new programs (tools) such as CAD/CAM (Computer-Aided Design / Computer-Aided Manufacturing), MRP (Manufacturing Requirements Planning), FMS (Flexible Manufacturing Systems). Industrialization periods (revolutions) divided into four stages, started about 1800 up to now. These four industrial revolutions are (1st industrial revolutions steam-powered factories – 2nd industrial revolution's application of science to mass production and manufacturing – 3rd industrial revolution's start into digitization. (Schwab, The Fourth Industrial Revolution, 2018) – 4th industrial revolution's cyber-physical systems (Automation). Nowadays Automation has become a basic matter in the manufacturing process especially in Industry 4.0 and the digitalization world. Early automation relied on mechanical and electromechanical control devices; during the last 40 years, however, the computer gradually became the leading vehicle of automation. Modern automation is usually associated with computerization [1].

### 1.1 Concept of Automation

The Automation is a new concept in the manufacturing science in which the use of controlling systems has begun important necessity, the computer, information technology, and robots has replaced the human being. These technologies are used for handling most of the manufacturing processes, so we can mention that the industrial automation is the second step beyond mechanization in the scope of industrialization [2]. These automation devices include PLCs (Programmable Logic Controller), PCs, PACs and technologies include various industrial communication systems. (Technology, 2015) Furthermore, these systems have reduced the level of operator involvement and observation required. Automation systems typically consist of feedback loops and sensory programs the automatically adjust operating conditions to meet the desired values based on real-time data.

The Oxford English Dictionary (2006) defines automation in terms of manufacturing as: *“Automatic control of the manufacture of a product through a number of successive stages; the application of automatic control to any branch of industry or science; by extension, the use of electronic or mechanical devices to replace human labor.”* [3].

## 1.2 Importance of Automation

“We stand on the brink of the technological revolution that will fundamentally alter the way we live, work and relate to one another. In its scale, scope and complexity, the transformation will be unlike anything humankind has experienced before. [4,5].”

We will witness an equally potent wave of automation, overturning commonly held beliefs of "oh we will never automate that" again and again. [6].

The Automation refers to the automatically operations of producing goods throughout the use of robots, control systems with a minimal direct human operation. Here some benefits of using the industrial automation, they are:

1. Automation has led the firms to produce products with low costs and decrease the capital investment.
2. Automation has helped the labors to create new plans to produce products with aesthetic outlook, moderate and fashioned.
3. Automation with help of robots became cheaper than human labors, the initial cost only of robots and their maintenance. These robots need no (salaries – healthcare – health insurance and zero demonstrations).
4. Automation permitted the time and money control.
5. Automation has abled the firms to produce products with great range of diversity at the same time with more differentiation in shapes and sizes.
6. Automation has helped the firms to produce their products with properties of (reliable – precision – accurate – quick in production and more productivity).
7. Automation has declined the concept of traditional documentation such as paper documents and printing ...etc. The concept of digitalization in Automation saved the (system information – money – time etc).
8. Automation has decreased the labors accidents at firms and has eliminated the hazards those workers subjected to such as (dangerous chemical, working in poor conditions such as high or low temperature and lifting up heavy weights).

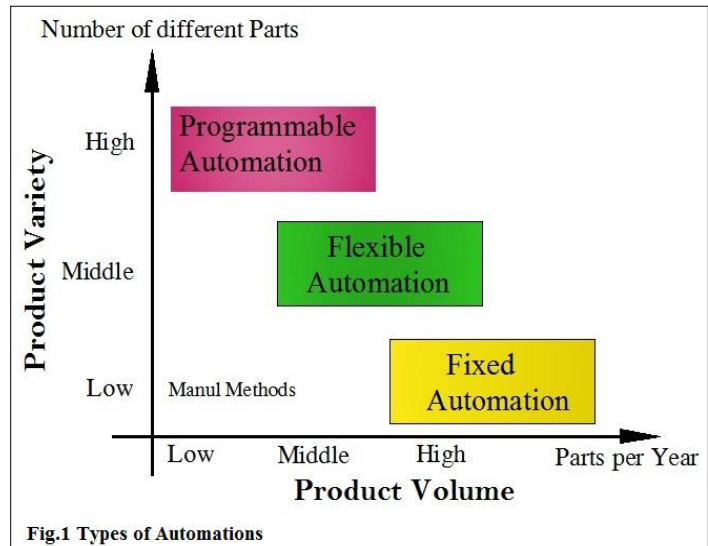
## 1.3 Limitations of Automation

As mentioned above the automation is very important at the field of manufacturing. Here it wouldn't be truthful if some of limitations on the automation hasn't mentioned. Some of these limitations are:

1. Automations needs experts at machine and computer software to run the robots also it requires to high cost for maintenance of machines.
2. Automation requires very high capital to start with.
3. Automation maybe will control the workers and they become slave to the automated machines.

## 2.0 Types of Automation

Industrial automation is currently employed countless of industries by automated systems doing all things starting from performing manufacturing jobs reaching to operating an ATM and more. The level of complication and human interaction with an automated system varies by application. While there are uncountable applications of industrial automation solutions, nearly all fall into 1 of 3 automation categories: fixed, programmable, and flexible. Figure (1) shows the types of automation. This chart shows what options might be best to consider, depending on the variety and demand of the product.



### 2.1-A- Fixed Automation

This type of automation is used for fixed and repetitive operations to achieve high production rates, it can be distinct by its less cost per produced unit, high level of productivity and dependable quality in production. Here special purpose or dedicated equipment is used to



Figure (2) - Coca-Cola Factory in Dubai using the Fixed Automation Type

automate the fixed sequence assembling or processing operations. Once it is set up, it is relatively hard to change or vary the product design. However, it is relatively inflexible when it comes to making changes to the product, the figure (2) shows the Coca-Cola factory in Dubai used the type of fixed automation during the manufacturing process. This is relatively useful for many companies who use automation to create food products of one type and variant. It allows them to effectively produce that item and package it in bulk. Foods that require chemical processes, for example, may use this to ensure the consistency of the chemical processes. It is clear that fixed automation is suitable for high demand and generic products that demand no changes. For example the Coca Cola continues to use the type of fixed automation in their firms. This allows for production of large quantities of the soft drink to meet the high demands of their daily products. [7].

### 2.1-B - Programmable Automation

This type of automation permits the production equipment and automation to be changed according to needs, it is achieved by controlling the automation through a program that may be coded in certain ways for the automation. It can be distinct by its suitability for one type of batch. Programmable automation is used more commonly in low to medium levels of production, often being most suitable for batch production. This type will often be used by



Figure (3) - Batch Production ERP use the Programmable Automation Type

factories that make different variants of foods. This allows them to make batches, from a few dozen to potentially thousands at a time, of one product. The figure (3) explains the type of programmable automation type. If the product needs changing, it simply needs to be re-programmed. Some limitations of this type must be mentioned such as the high cost of equipment, fewer production levels and extended time to change one type of production.

### 2.1-C Flexible Automation



Flexible automation, also known as “soft automation”, is comparable to the type of programmable automation. It may be complicated in programming. Flexible automation allows the production of different types of products without time wastage when reprogramming. Figure (4) shows that the Tesla Factory focusing on flexible automation type. This system can produce various combinations of products efficiently without having to



Figure (4) - Shows Tesla Factory uses the Flexible Automation Type

separate them into different batches, as required in batch production. This type of automation tends to have medium levels of production. This type of automation has some limitations such as the cost of programming also the cost of the produced unit is high. Flexible automation distinguishes by the ability of physical setup and programs, without loss in time and productivity. Changing any part program done by coding the program offline on a computer and then transferring it to the automated order. The programmable automation is proper for medium requirements and constant changes and large variations in the products. Determining which type of automation to use for production can't be easy.

### 3.0 Development of industrialization.

The main idea of the industry is to change raw material into products via providing added values during machines and tools and equipment. The industrialization is evolving over the years. This development can be divided into four phases which called (Industrial Revolution). The figure (5) shows the four stages of stages of industrial revolutions and their levels of development. These four revolutions are: The

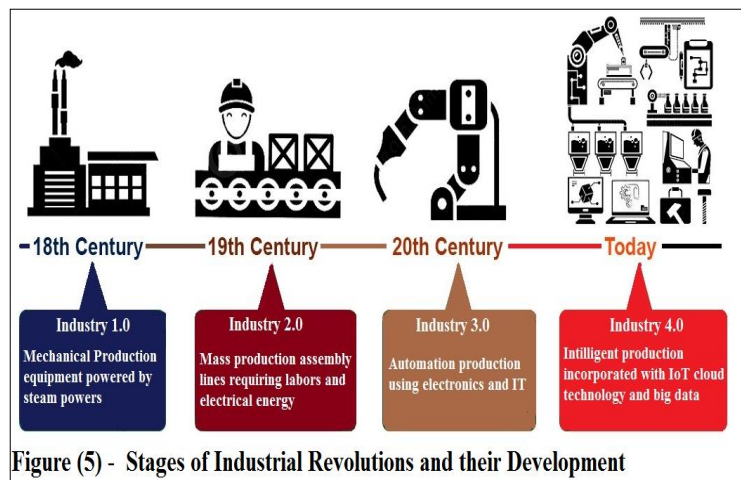
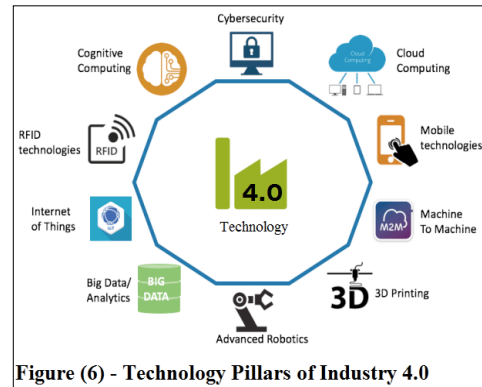


Figure (5) - Stages of Industrial Revolutions and their Development

first revolution occurred about the year 1785, which was the mechanical production based on water and steam [8]. The Second Revolution occurred at the beginning of the 20th century during the introduction of mass production and assembly production lines. The third revolution has distinct in the digital automation of production using information technology systems. Today, the industrial is known by the fourth revolution with rise of autonomous robots, cyber-physical systems, the internet of things, the internet of services, and so on. Throughout this revolution of technology, robots are used to achieve the most complicated problems in the industry fields. The figure (6) shows the real visions of industry 4.0 pillars. This revolution categorized by productivity, versatility, safety and flexibility. This is what is called smart factories. No one can deny that Industry 4.0 has created an unprecedented level of value in the entire ecosystem information for the evolution of automation and digitalization.

### 3.1 Role of Automation

The manufacturing industry is a powerful human demand. It contributes £7.0 trillion to the global economy and employs billions of people in the entire world. a world without manufacturing would not be the same, and an industry without automated processes would be a far cry from manufacturing. Increasing quality requirements, shorter delivery times, falling prices, and growing pressure from the competition are the challenges faced by companies in the manufacturing sector. Intelligent Automation is a solution that can meet all these challenges and much more. Robotic processes and intelligent automation tools can help businesses improve the effectiveness of services faster and at a lower cost than current methods. A range of societal and business challenges are creating demand for intelligent automation.[9].



### 3.2 Development of the Industrial Automation

The new industrial robots can help the manufacturers to achieve the production demand at a rapid pace. Industrial robots are compiling with artificial intelligence to create a new

type of robot called “collaborative robots”. Collaborative robots are different from industrial robots in several aspects. In brief, there are some uncommon and paramount differentiates between a collaborative robot and a conventional robot. The older generations of robots need manual input of commands to perform a task. They are capable to perform the task based on input and lack of intelligence. Meanwhile, collaborative robots are the updated forms of conventional robots. Industrial manufacturers can make these robots work for multiple tasks with a single input and hence can reduce men from work. These collaborative robots can even work with radioactive rays which might reduce human risks of working in nuclear power plants. Industrial robots are becoming increasingly capable and adaptable. Fixed factory-floor robots are easier than ever to program and can be adapted to different products and product lines. Although they have not yet reached the level of understanding natural-language instructions. Robots play an important role in the modern manufacturing industry. The number of multipurpose industrial robots developed by founder An essential face of Industry 4.0 is autonomous production methods powered by robots that can complete tasks intelligently, with the focus on safety, flexibility, versatility, and collaborative. Without the need to isolate its working area, its integration into human workspaces becomes more economical and productive and opens up many possible applications in industries.

### **3.3 Automation in Future**

During the next decades, the Automation industry will more development due to the high and rapid innovation. This advance is due to artificial intelligence, wireless sensor networks, robots, and more automation of machines. The next manufacturing shop floors will look quite different compared to today. Wasting of labors will be noticed, dangerous are fewer and more productivity, quality and innovation will be noticed too. The effect of this development by automation could be a revival in manufacturing in both industrialization and developing countries. This will lead to low-cost manufacturing goods, high-quality products.

## **4.0 Conclusion and Recommendations.**

### **4.1 Conclusion**



The main goal of this paper is try to shed some light on the affect of Automation and its main role on the industrialization. Sequences of industrial revolutions have been studied which started from about 230 years up today. The Industry 4.0 is our period which we live now have been covered by the Automation of most manufacturing and this lead to developing a system for Industrial Automation using Internet of things with the help of Artificial Intelligence to make system automated which will take intelligent decisions.

## 4.2 Recommendations.

Here we recommend some points that very useful to help the governments to control the advantages of Automation and the fourth Industrial revolution, they are:

1. The keen interest and emphasis on STEM issues to encourage laborers and staff how to deal with new technologies used for automation.
2. Support the companies and firms for the enhancement spread of knowledge of Automation.
3. Creating a permanent experience for staff expertise in its human-robot interaction to avoid a future expertise gap.
4. Support entrepreneurship, by giving firms businesses the chance to improve their efficiency and raise their income by using new technologies.
5. Support women's involvement in STEM programs and activities to reduce the gender gap.

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