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Automation in Manufacturing

Academic skills - ACHA4005

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1 Introduction

The purpose of this report is to look at the brief history of automation in manufacturing, the new age and impacts of automation in the manufacturing space, advantages and disadvantages, and the future of automation in manufacturing. This information will then be used to analyse impact of automation on the workplace for those working in industry and if automation in manufacturing has a positive or negative toll on the manufacturing industry.

1.1 What is Automation in Manufacturing?

Automation is the introduction of automatic equipment in manufacturing. Manufacturing can be seen as the making of large articles on a large-scale using machinery which can also be seen as industrial production. Automation in manufacturing uses robots that are computer controlled to do strenuous, dangerous and precise tasks that will help boost the efficiency of the production line and will also reduce labour and production costs(Maciej Serda *et al.*, 2013). There are three levels of manufacturing automation that depend on the degree of substitution of humans by machines. These three are hard automation, programmable automation and full automation.

1.1.1 Hard Automation

In hard automation, a program's configurable variables fix the order in which processing activities are performed. Since the order is predetermined, the activities are carried out in order. Hard automation is typically distinguished by a high starting cost and a high output rate. Therefore, where the items have a very large demand and volume, hard automation is ideal for discrete mass production systems and continuous production flow. Processes used in distillation, paint shops, conveyers, and transfer lines are instances of hard automation. In the following situations, hard automation is appropriate (Kharagpur 2019):

1. Products are produced in large quantities but have few variations in terms of their sizes, forms, materials, and functions.
2. For a period of two to five years, product demand is stable and predictable.
3. A high manufacturing throughput is anticipated.

1.1.2 Programmable automation

For a flexible sequence of production operations, control systems can reprogramme the machines using programmable automation. The automation of machines enables control programmes to be

created for various industrial processes to create product variants. Programming machines or a series of procedures for various items is a difficult task. Investment in programmable machinery is thus only financially viable when manufacturing processes don't alter drastically. The batch manufacturing processes with medium to high product volumes benefit the most from programmable automation. Programmable automation covers a wide range of applications. For instance, NTIS (1984) separated programmable automation into three categories: computer-aided design (CAD) for goods and machine tools, computer-aided manufacturing (CAM) for robots, computerised machine tools, flexible manufacturing systems, and computer-aided management techniques, such as management information systems and computer-aided planning. Computer integrated manufacturing (CIM) refers to the combination of various technologies. Numerical control (NC) devices, commercial robots, steel rolling mills, and paper mills are a few examples of programmable automations.

1.1.3 Full automation

Full automation seeks to produce a variety of items with a minimum amount of changeover time. Computer programmes should ideally be able to autonomously adjust both hardware and software systems (Westrom, 2020). A fully automated system can create various combinations and schedules to carry out product manufacturing procedures. Some fully automated product facilities, such as automated guided vehicles (AGVs), robotics, and computer numerical controls (CNCs), are included in a fully automated system. The following situations are suitable for full automation:

1. A corporation has its own business methods to satisfy the vastly different wants of its clients. A product mix calls for the blending of various parts, components, and goods that must be produced using the same manufacturing method.
2. Product facilities require frequent updates to adopt new functionalities and technologies and to meet the diverse needs of new customers because product lifecycles are very brief and demand for product volumes is extremely unpredictable and changes swiftly about time.
3. A corporation produces things in very large quantities or batches, with very short lead times and wildly fluctuating and unpredictable demand for its products.

2 Literature Review

2.1 Brief History of Automation

As stated in the introduction the Ford Motor Company established an “automation department”. At this period, feedback controllers were quickly copied in manufacturing to facilitate several production processes, such as accurately positioning large objects on a production line. It was this that made the Fortune magazine publish a cover story titled “Machines Without Men” which painted out a near-future of workerless factories. By the early 1960s and 1970s, digital computers were being connected to machine tools. The programmable logic controller (PLC), which was invented in 1968 was a computer made for usage in rough industrial settings. By 1980, computer-controlled automation had been widely copied all over the manufacturing industry and was even being copied in sectors like retail and pharmaceutical industries.

2.2 Modern Automation in Manufacturing

Our modern automated manufacturing industry has recently just entered what is called Industry 4.0 which is described as the fourth industrial revolution, which covers things such as modular automation to cloud computing. Today’s automation is being run by sophisticated technologies like Artificial Intelligence (AI) and machine learning that can copy human thinking very well(automation - Manufacturing applications of automation and robotics | Britannica). In many industries AI has already replaced a vast number of workers in factories. This means that computers are on the verge of being able to solely function by themselves, but not quite yet as the software’s and hardware are still developing. Automation in industry to date is showing signs of becoming one of the most efficient industries in the world, but this will take time as it is quite expensive to obtain this automation software and hardware leaving it to only the rich and big players in the industry who can afford to adopt this(A New Era of Automation in Manufacturing - RapidMiner).

2.3 Advantages of Automation in Manufacturing

Automation in manufacturing brings a lot of advantages as it helps the manufacturing industry in many ways such as:

1. Improving productivity - this is because robots and machinery dedicated to specific tasks can increase production rate and labour output, due to them not getting tired and their capability.

2. It cuts down costs - making a plant automated is more advantageous from a competitive point of view, as it allows products to be manufactured a lot quicker and easier, saving time and money in the process(5 Ways Automation is Changing Manufacturing Today).
3. It reduces errors - this means that automation not only speeds up the manufacturing process but also has better repeatability and makes fewer mistakes.
4. It performs dangerous jobs – it prevents employees from having to perform dangerous tasks that can cause them injury which makes work environments safer and cuts the number of workplace accidents.

2.4 Disadvantages of Automation in Manufacturing

As much as automation in manufacturing is a positive thing, it also has its disadvantages that make it not to great in specific areas such as:

1. Needs large amount of capital - As much as automation is admirable it is quite expensive to adopt as the software and hardware are worth millions in some cases.
2. Loss of jobs – Automation has caused a lot of unemployment in the last decades as the technology is getting better and smarter allowing it to mimic exactly the way humans think and react. This has caused a huge unemployment wave in the manufacturing industry that will only get worse and worse in the future.

2.5 Future of Automation in Manufacturing

In the future of automation, we will see processes and systems to allow for the creation of intelligent networks controlling each other. This will allow machines to be smart enough to be able to predict their own failure and being able to adjust to unexpected changes in the quantity of products being manufactured. These same machines will now be able to think for themselves and be able to add to its knowledge. This will mean manufacturing will be a faster process as they will be self-sufficient and can be monitored remotely. This could mean the future could bring 24/7-hour factories that run fully by themselves meaning that manufacturing will be one of the most efficient industries in the world(The role of automation in the future of manufacturing).

3 Discussion

3.1 Does automation have a positive or negative toll in manufacturing?

As much as automation in manufacturing has been praised and has brought a positive change to the manufacturing world, it has caused a problem in the manufacturing industry that keeps getting worse as the decades pass by. This problem is unemployment. Unemployment has been a growing problem in the manufacturing industry as robots and self-operating machines are taking over the employment in this industry. This has been causing a never-ending loop of protests as workers have been abruptly dismissed from their jobs. The unemployment trend in the manufacturing industry shows that most jobs at risk are male jobs in the long term as shown in the graph below in (Figure 1):(How will automation impact jobs: PwC UK)

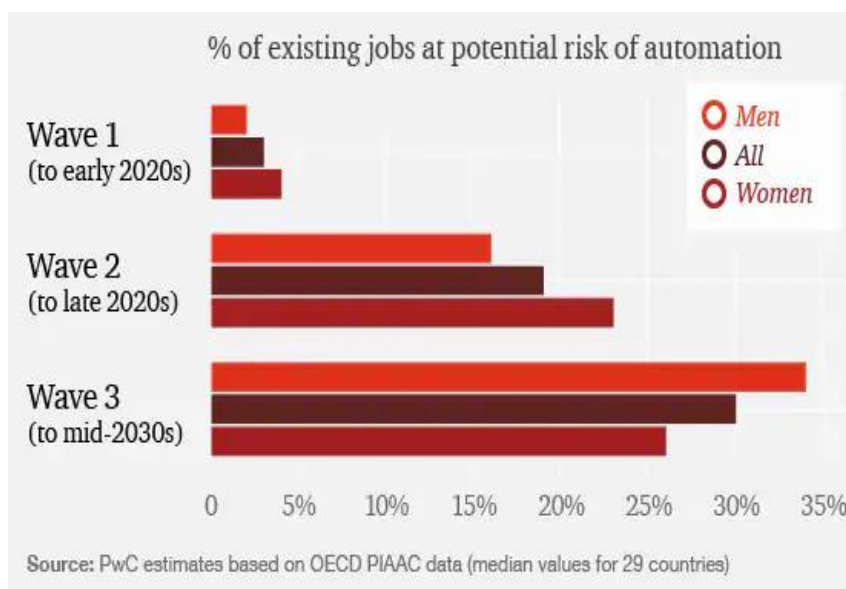


Figure 1

Although people are against automation because of job loss, from the data provided we can see that the advantages outweigh the disadvantages, proving that many people are happy to see automation progress to the stages it has progressed to in the last few decades.

4 Conclusions

In conclusion I believe manufacturing is at the forefront of a technological revolution pushed not only by robotics, but also by the adoption of artificial intelligence (AI), and machine learning.

Together, these technologies have changed our thoughts of what's possible with automation in manufacturing, and by them being successful it is possible to automate an entire production process, and consistently outperform industry competitors. Although it seems all good automation will always be a two-sided revolution as some are against it due to the loss of jobs that was created by automation, but the general trend shows that automation has been a positively welcomed industrial change.

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