Chapter

Introductory Chapter: Mass Production and Industry 4.0

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1. Introduction

When it comes to the history of mass production enterprises, the revolutionary developments in mass production come to mind from the past to the present. To be able to better adapt to today's industrial revolution, of course it is necessary to understand the past industrial revolutions. On the basis of industrial revolutions, each of which is more or less rooted in a technological and cultural basis, there was always an effort to achieve better and faster solutions. Of course, economic concerns have always been taken into consideration. Industry 4.0 is a target of the research policy of the German government. Today, in the focus of integrated mass production, systems benefit from the advantages of this novel industrial revolution.

Since it is a great way to meet the large-scale demand of most products, mass production is used in many industries which are big and/or small. For instance, automobiles, computers, and cellular phones are the typical examples of mass production products. A high demand rate for a product is the main specification of mass production. The manufacturing area is typically dedicated to the production of a single type product and/or its variations.

Typical or conventional manufacturing methods can be adapted as mass production lines which are machining, casting, joining, and forming or plastic deformation. Each of them has its principles, manufacturing parameters, application areas, methods, and technologies to be considered in detail. It is always hard to set manufacturing systems to produce large quantities of standardized parts. Controlling these mass production lines needs deep knowledge and hard experience and the required related tools as well. The use of modern methods and techniques to produce large quantity products within productive manufacturing processes provides improvements in manufacturing costs and product quality. In order to serve these purposes, many works aim to reflect advanced manufacturing systems of different alloys in production with related components and automation technologies. Additionally, there are many works that focus on mass production processes designed according to Industry 4.0 considering different kinds of advanced quality and improvement research in mass production systems for high productive and sustainable manufacturing [1, 2]. This chapter gives general information about the components of a conventional mass production system and an Industrial 4.0-adapted mass production system with their individual advantages.

2. Components of a conventional mass production system

Conventional mass production processes may be also called as continuous production that involves the fabrication of a known part in a specific production way and shape, in a consistent manner. In the mass production area, there are typical

manufacturing processes dedicated to the production of a single type product and/or its variations. However, there are lots of benefits of mass production including decreased labor, decreased time in manufacturing, increased output, and lower cost per unit [3]. Besides, there are many components of a conventional production system which need to be considered in detail. The machining lathe, the processing tool, the processed material, the process parameters, and others directly affect the quality of the product. One of the main disadvantages of the conventional manufacturing systems is being not very flexible systems. It is usually difficult to adapt the production line to a different kind of process. Conventional manufacturing systems require close inspection to control the process parameters which are in a close relationship with the quality of the product. With the help of related quality control methods, the required quality works can be reached in conventional mass production systems.

3. Components of an industry 4.0-adapted mass production system

Today, some Industry 4.0-adapted factories are called as "smart." A "smart factory" has a highly flexible production system, which is capable of producing single individual parts with high precision and better quality in an economically efficient way. Additionally, a component-driven logistic system is required to achieve this task besides high flexible production systems and processes. In order to meet the requirements of the hard manufacturing task, digitalization of the systems and sub-systems is also essential. Calling a factory as smart requires at least following the supporting systems of the last industrial revolution [4].

A "cyber-physical system" is a physical object or a process that is connected and interacting with a digital representation of that object or process. This is one of the key tools supporting the development of smart factories. The definition of cyber-physical system includes a permanent digital interaction of the object from the physical world and the virtual representation. A permanent flow of data and information between both is the core of the cyber-physical system definition. One of the most important steps toward a functional cyber-physical system and a challenge today is to digitize and network non-digital machines and processes.

"The Internet of Things" is a system that supplies an ability to transfer data over a network. Cyber-physical system is enables every device and even every sensor and actor in a production or logistic system to communicate with each other over a common digital network. According to the vision of a smart factory, it is not only internally digitally connected but also with the external supply chain for the product to be produced. In a networked supply chain, smart factories have a network system of hundreds or thousands of cyber-physical systems. They are connected to a common exchanging data and information Ethernet network.

"Component-driven production" has been formulated to control the process chain of a product inside of the production. To achieve this, components need to carry their construction plans and other information for manufacturing. In this way the components are taking individual paths toward the production plant without complex planning. Of course, to plan the production future of a component requires knowing the past of that part in detail.

"Big Data analytics" is an inevitable tool of an Industry 4.0. It was always hard to analyze the data than to collect it. Additionally we are talking about diverse and larger data than being in the past. A smart factory must have advantages of some analytical techniques against to process that kind of large and diverse data. The data can be supplied from different sources and sizes and be a structured, semi-structured, or unstructured type. With those data-driven solutions, the processed

high-quality data can be used at each step of the system even in the complex systems.

"Flexible manufacturing systems": As being discussed at the second section, one of the main disadvantages of the conventional manufacturing systems is being not very flexible systems. This disadvantage of the conventional manufacturing systems could be eliminated by the flexible manufacturing systems of Industry 4.0. One of the most important tasks of Industry 4.0 is to realize a highly flexible production system. The system is usually capable to produce with small lot sizes. The smart factory has to deal with smaller lot sizes and an increasing number of changeover processes during the day-to-day work. Therefore, equipment and labor requirements are prepared in order to cope with the flexibility requirements of the process not only for the present times but also for the possible needs in the future [5].

4. Conclusions

In competitive market conditions of manufacturing, the enterprises should produce high-quality products within productive manufacturing processes. Mass production requires standardized processes for manufacturing of interchangeable parts in large quantities at comparable prices. In fact, it is a hard work which requires many components to be considered in great detail. The use of modern methods and techniques of mass production provides decreases in the manufacturing costs and improvements in product quality. Manufacturers are trying to survive and/or to take share in hard global market conditions by using such these advantages. With the associated advanced technologies of Industry 4.0 such as cyber-physical systems and Internet of Things, mass production has been revolutionized, but it looks like it will always have issues like quality control of the production process.

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