

MODERNIZATION AND AUTOMATION OF AUTOMOTIVE INDUSTRY PRODUCTION PROCESSES WITH INDUSTRIAL ROBOTS

Subject review

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SUMMARY

The paper aims to answer if the industrial robot is a motif of accelerated trend of automation and modernisation of production processes in automotive industry in the world. It describes the application of industrial robots in the World for the period from 2009 – 2014. It offers analysis of the application of industrial robots in the automotive industry, as well as metal industry, which is also related to the automotive industry. Based on this analysis, conclusions were made about the role of industrial robots in the growing trend of modernisation and automation of production processes in the automotive industry. The role of industrial robots is interesting when it comes to energy efficiency, as well as the role of new materials from the aspect of weight reduction, as well as innovation when it comes to IT technology. Information technologies provide new softwares whereby we get a far greater utilization of industrial robots from the point of performing a large number of operations, and therefore improves the automation of production processes in the automotive industry. The materials and their combinations are always demanding both in the metal as well as in automotive industries, and require new skills with applications such as sewing, weaving and knitting all types of fiber (for the car industry) that represent a challenge and are introduced in robotics. Changes, such as integration of engineering disciplines, bring improvement in production processes. The paper gives an overview of the increase in the production of vehicles in the world through the use of industrial robots. The stated example is China, which is the first in the world by the application of industrial robots, and the first in the world for producing automobiles. Industrial robots are essentially a reason for the accelerated trend of modernization and automation of production processes in the automotive industry.

1. INTRODUCTION

For successful and efficient automation of the production process, it is fundamental to know the production process and its technology, but also the means to implement automation. Nowadays, the means for the implementation of automation are far more advanced than those in the last 10 years. When one mentioned automation 30 years ago, it was meant only electronics, but those times changed. From a contemporary aspect, a technical progress—when it comes to the modernization and automation of production processes— is conditioned not only with a continuous improvement, but also with a continuous development and improvement of technologies such as robotic, sensor, computer, pneumatic, hydraulic, etc., as well as their interaction.

The development of mathematics itself contributed to the development of automation of production processes, because every production process can be mathematically analyzed, processed, systematized, and then the technology that will automate the production process is selected. The goal of any modernization and automation of the production process is to stabilize that process, even though it goes through a lot of changes, as well as to improve its efficiency. The future of industrial robots application in production processes is in the potential for multi innovation, but mechatronics is so-to-speak a bridge which opens technological possibilities provided there is a growing and more secure cooperation between an industrial robot and a worker

[1,6,7,8,9,12,13,18]. If we analyze the proportion of value, mechanical components in the past amounted to approximately 80% of the industrial robots, but now the software components have an increasing share of the value of industrial robots.

2. IMPLEMENTATION OF INDUSTRIAL ROBOTS IN AUTOMOTIVE AND METAL INDUSTRIES IN THE WORLD

Implementation of industrial robots in the world in the period from 2009 to 2014 is shown in Figure 1. Statistical data are retrieved from the International Federation of Robotics (IFR), United Nations Economic Commission for Europe (UNECE), the Organization for Economic Cooperation and Development (OECD), as well as the literature [1, 2, 3, 4, 5].

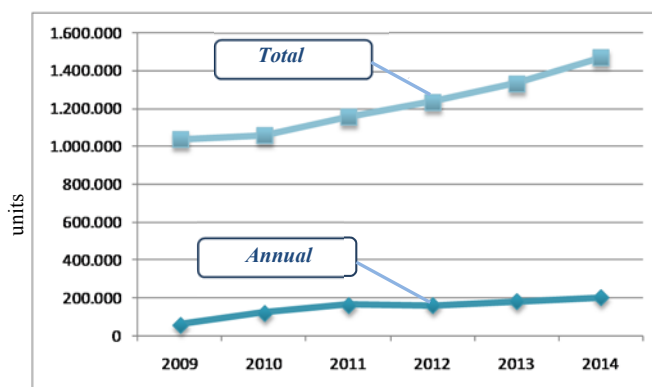


Figure 1. Implementation of industrial robots in the World from 2009 – 2014

The trend of industrial robots application in the World for the period from 2009–2014 at the annual level is shown in Figure 1., based on which we can conclude that it has an increase in applications from 58 000 robot units to 178 000 units since 2009. The minimum application of industrial robots was in 2009 due to economic and industrial crisis in the world, which had effect on the application of industrial robots. The total stock of industrial robots is constantly on the rise since 2009, with around 1 000 000 up to 1 400 000 units of robots in 2014. It has been estimated that the number of applications of industrial robots will increase every year. The reason for this trend is the application of industrial robots lies in a fact that there is a development, modernization and automation of production processes of the automotive industry. The trend of industrial robots installation in the automotive and metal industry is shown in Figure 2.

In chart we can see the representation of industrial robots application on an annual basis in automotive industry and metal industry. The use of robots in the automotive industry has a growing trend from year to year so that it reached 68 000 units in 2013. The reason for this trend of increasing applications of industrial robots is the fact that the process of welding of automotive body is fully automated, as well as painting and assembly of carrosserie, where industrial robots are mostly applicable. Also, when it comes to the process of manufacturing vehicles, we can conclude that the modernization and automation are carried out almost every day, which requires the application of industrial robots. The consequence of such trend and investment in the modernization is the competition of companies at the market. Examples of industrial robots application in the automotive industry are presented in Figure 3.

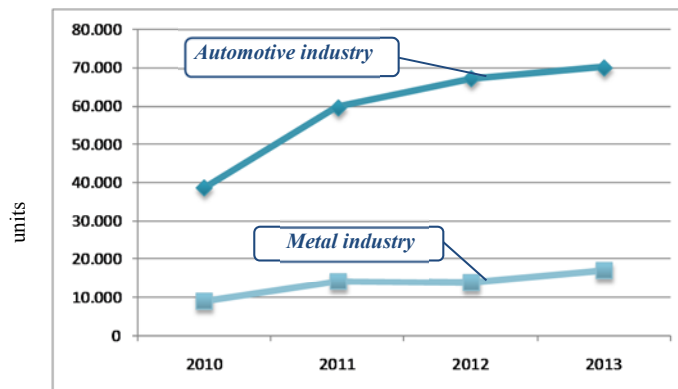


Figure 2. Annual installation of industrial robots in automotive and metal industries in the period 2010 – 2013 [2,17]



Figure 3. Application of industrial robots in the automotive industry [19,20]

In the production process of welding and painting in automotive industry, the application of industrial robots is inevitable for two reasons, the first being the exclusion of workers from these processes due to the negative effects of these processes on workers' health, and the other is high-quality assurance.

3. APPLICATION OF INDUSTRIAL ROBOTS IN AUTOMOTIVE INDUSTRY IN CHINA

The trend of total vehicle production in the world is shown in the Figure 4, according to the data by the OECD (*Organization for Economical Co-operation and Development*).

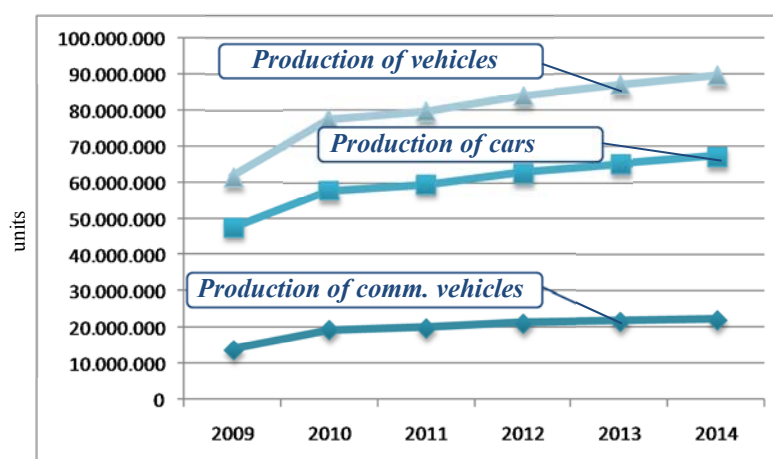


Figure 4. Production of vehicles in the world in period 2009 – 2014 [10, 11, 25]

From the chart can be concluded that the number of produced vehicles increases every year, and this can be attributed to the application of new technologies, as well as application of industrial robots in automotive production processes. Annual production of vehicles in the world has reached a level of about 89 million units of vehicles. Figure 5 presents the production of automobiles in 2014 in 10 countries in the world in which the most vehicles is produced.

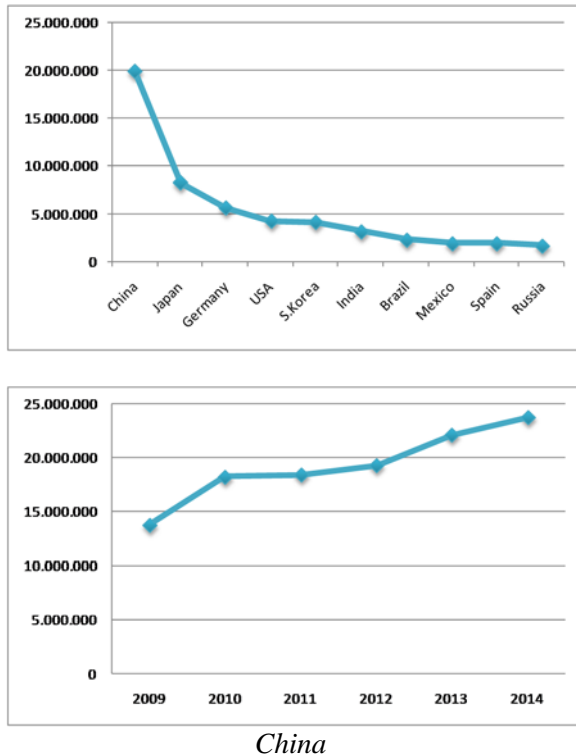
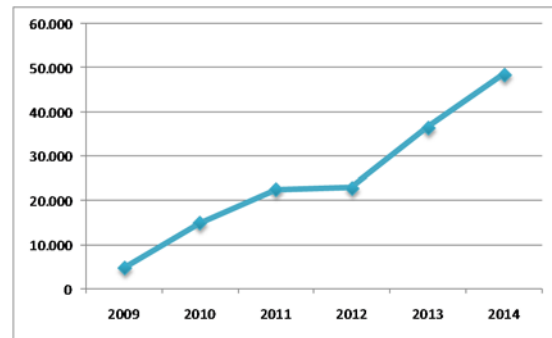


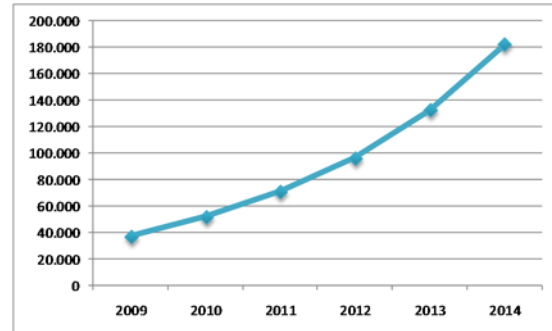
Figure 5. Production of automobiles in China in period 2009 – 2014 and other 10 countries in the world in 2014 [25, 26]

Based on Figure 5, we can conclude that China comes first when it comes to the production of automobiles in the world, and it reached production of about 20 million units of vehicles in 2014.

As we can see from the Figure 6, annual application of industrial robots in China is increasing from year to year, reaching application of about 48 000 units in 2014, which resulted in a total production of vehicles that also increases from year to



a) Annual installation of robots



b) Total stock of robots

Figure 6. Annual supply and total stock of industrial robots in China in the period 2009 – 2014 [2,3,4,10,27]

year and it reached the value of about 24 million units (automobiles and commercial vehicles). Since most industrial robots are used in manufacturing processes of welding, painting, varnishing and control in the automotive industry, the trend of vehicle production in China is logical. China is the world's first when it comes to the application of industrial robots, and it can be said that 90% of those robots is installed in a production process of the automotive industry to the aforementioned activities, which resulted in an increase in vehicle production and China has become a leading country in the world for the production of vehicles.

4. CONCLUSION

Analyzing the application of industrial robots in the world, then their implementation in the production processes of the automotive industry, it can be concluded that each year installation of new industrial robots increases. Rapid development of new technologies which include information technology, robotic technologies, new materials, intelligent systems, has resulted in the development of the automotive industry, through

modernization and automation of production processes of the automotive industry using industrial robots. Industrial robots are the most represented in the processes of: welding, painting, assembly and control when it comes to automotive industry. The increase in the industrial robots application in the production processes of the automotive industry has resulted in an increase in the number of production vehicles, and we can take China as an example. In the last six years (from 2009 to 2014) in China, the number of industrial robots increased by seven times. In the same period, total vehicle production doubled which suggests that the application of industrial robots in the automotive industry leads to the modernization and automation of production processes of the automotive industry.

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