CHINA AS A LEADING COUNTRY IN THE WORLD IN AUTOMATION OF AUTOMOTIVE INDUSTRY MANUFACTURING PROCESSES

Isak Karabegović[1], *Ermin Husak*[2]

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1. INTRODUCTION

In the last twenty years, the rapid development of information technology led to a sudden development and a constant improvement of production technology. Also, all kinds of new technologies appear every day, as well as new production technologies with the aim to reduce the time of product production, and thereby increase productivity as well as the quality of the finished product. Integration of the production process, automation and modernization of production processes, which is impossible to imagine without the introduction of industrial robots into a production process, have led to the increase in product quality and reduced time of the finished product production. When it comes to the automotive industry, it is impossible to imagine the production process in the automotive industry without industrial robots being involved. The use of industrial robots and new technologies leads to a rapid increase in production in the automotive industry, both in terms of number of produced vehicles and the number of different models. When it comes to the automotive industry, the application of industrial robots at the very beginning was related to the performance of activities that affected the health of workers, such as welding and painting. The development of information technology and sensor technology led to the development of industrial robotics, so we have a concurrent connection of several industrial robots in performing identical operations, which leads to a shortening of the processing time [1, 2, 3-11]. The development of sensor technology has a direct impact on the development of different grippers which allow the application of industrial robots in various operations of productive processes of the automotive industry. Industrial robots are used in manufacturing processes of the automotive industry for the following purposes: car parts machining (axles, bearings, motors, etc.), production of plastic parts and carosserie parts, carosserie welding, carosserie painting, control of manufactured car parts, assembly process, as well as in the process of controlling elements embedded during a vehicle assembly [2,10,11,18-21]. It can be concluded in the end that there is no single manufacturing process of the automotive industry in which an industrial robot could not be installed. Steady growth in production in the automotive industry leads to an increased application of industrial robots in manufacturing processes of the automotive industry, which will be discussed in the next chapter.

2. TREND OF INDUSTRIAL ROBOTS APPLICATION IN THE WORLD

The trend of annual supply of industrial robots in the world is shown in Figure 1, and statistical data that have been used are obtained from the IFR (International Federation of Robotics) [7, 8, 9].

[1] *Isak Karabegović, University of Bihać, Faculty of Technical Engineering, Irfana Ljubijankića bb. 77000 Bihać, Bosnia and Herzegovina, isak1910@hotmail.com*
[2] *Ermin Husak, University of Bihać, Faculty of Technical Engineering, Irfana Ljubijankića bb. 77000 Bihać, Bosnia and Herzegovina, erminhusak@yahoo.com*

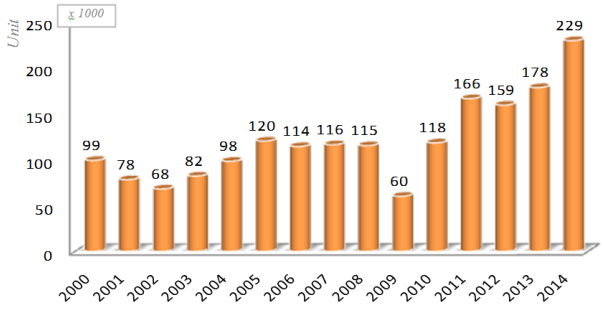
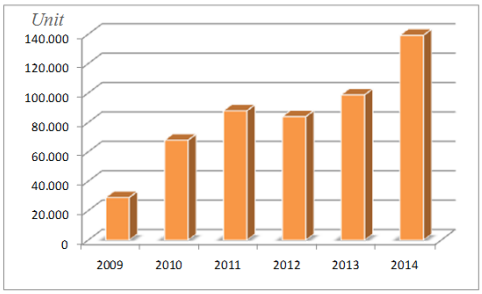


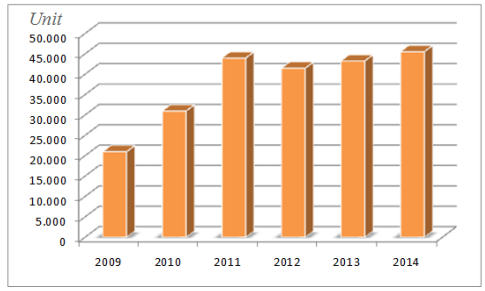
Figure 1 Annual supply of industrial robots in the world for the period 2000-2014 [7-9]

Based on Figure 1, it can be concluded that the trend of annual application of industrial robots had a growing tendency from 2002 to 2014, but this trend declined to 60.000 robot units in 2009 due to the economic and industrial crisis. From 2010 to 2014, an average increase of industrial robots accounted for 17% per annum. In comparison to the period of application from 2005-2008 when an average of about 115.000 units was applied, the number increased to about 171.000 units in the period 2010-2014, which represents an increase of 48.7%.

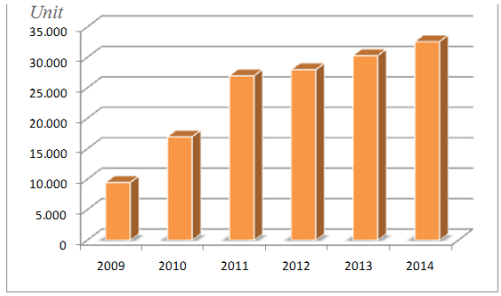
This leads to the conclusion that there has been a significant increase in industrial robots application in the automation of production processes.



Asia/Australia



Europe



America

Figure 2 Trend of annual application of industrial robots from 2009-2014 in Asia/Australia, Europe and America [1,7-9]

When it comes to the application of industrial robots in the world shown in Figure 2, the continent number one is Asia/Australia, where around 140.000 units were applied in 2014. The second is Europe with about 46.000 units of industrial robots applied in 2014. The third continent is America, where about 32.000 units were applied in 2014. The analysis of industrial robots application in 2014 yields the conclusion that industrial robots application is around 80.5% bigger in Asia than in Europe and America together, which means that the automotive industry and the automation and modernization of manufacturing processes in the automotive and electrical industry are developing in Asia, because industrial robots are the most used in these two industries. The diagrams in Figure 3 confirm this statement.

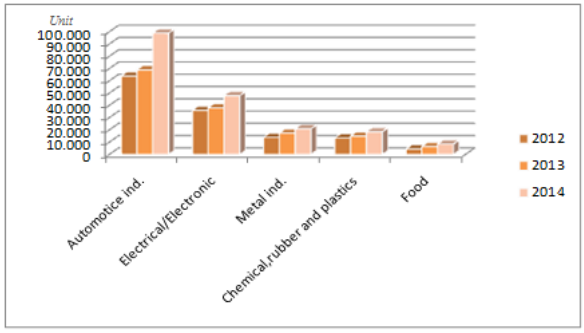
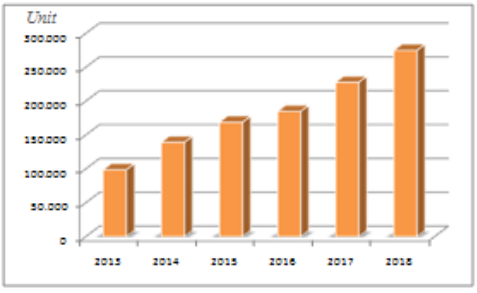
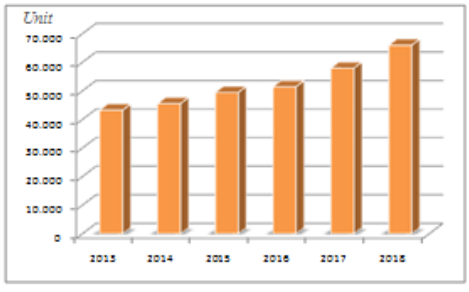


Figure 3 Industrial robots application from 2012-2014 in industries [7]

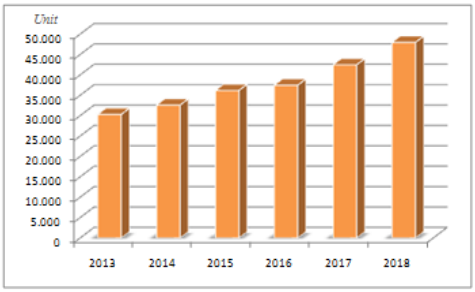
The graphs in Figure 3 show that it holds the first place when it comes to industrial robots application in the automation of production processes in the automotive industry. Then these industries follow: electrical/electronics industry, metal industry, chemical industry (production processes in rubber and plastic industry) and the food production process. It can be concluded that trend of industrial robots application increased in the period from 2012-2014, and the increase is the most evident in the automotive industry, where it reached the worth of about 100.000 units in the world in 2014. Overview of the industrial robots application in the period that follows will be given in Figure 4.



Asia/Australia



Europe



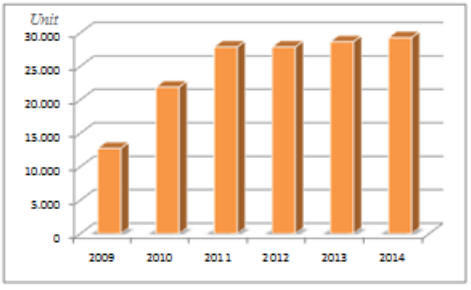
America

Figure 4 Trend of anticipated annual application of industrial robots by 2018 in the Asia/Australia, Europe and America [7]

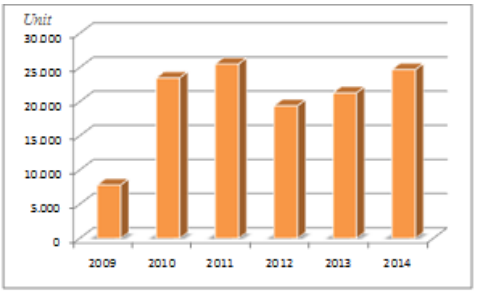
When it comes to the application of industrial robots in the future period, the figure 4 shows that the application will have a growing trend in all three continents, but the number one will be Asia/Australia. Predictions are that about 270.000 units of robots will have been applied in 2018 in the automation process in various industrial branches, primarily in the automotive industry. It can be concluded that industrial robots application will be twice as larger on the continent of Asia/Australia than in Europe and America together. This means that there will be a development of the automotive and electrical/electronics industry, as well as automation and modernization of production processes in these industries through the use of new technologies. In order to verify this conclusion, let us analyze the application of industrial robots in five countries in the world that use industrial robots the most.

3. CHINA, LEADING COUNTRY IN THE WORLD IN INDUSTRIAL ROBOT APPLICATION

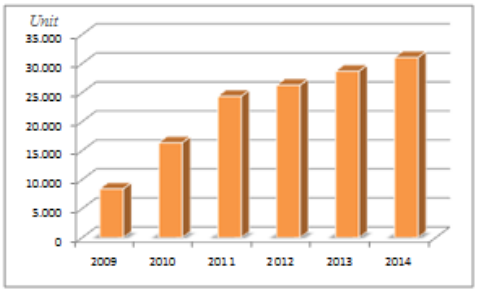
Given that Asia/Australia is the number one continent in application of industrial robots, let us analyse industrial robots application in the following countries: Japan, the Republic of Korea, China, North America (USA, Mexico and Canada) and Germany.



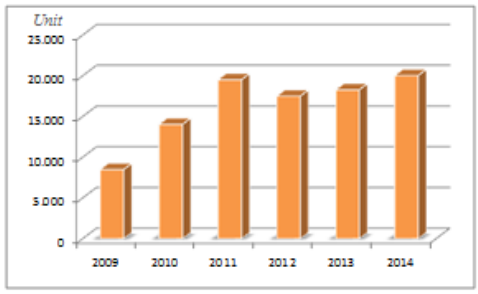
Japan



Republic of Korea



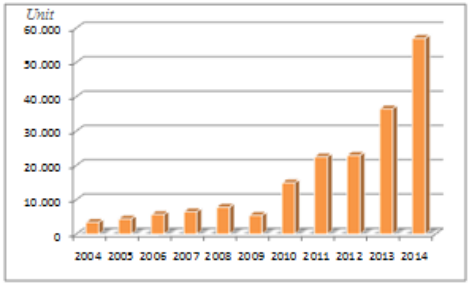
North America(USA,Canada,Mexico)



Germany

Figure 5 Industrial robots application in Japan, the Republic of Korea, North America and Germany from za 2009-2014 [1,7,14,15,16,17]

The Figure 5 indicates that industrial robots application is constantly increasing, so that the application in Japan and North America was between 25.000-30.000 units from 2012-2014, while it was around 20.000 units in the Republic of Korea and between 15.000-20.000 units in Germany in the same period of time. The reason for such a large application of industrial robots in these four countries lies in global competition in the market of the automotive industry (because these four countries are among the first countries in the world in the production of vehicles), which requires continuous modernization and flexible automation of production processes through the continuous improvement in quality by applying sophisticated industrial robots of high technology. Simplifying the use of industrial robots presents an enormous potential in their application in all industrial branches, including the automotive industry. Also, growing demand in the automotive industry requires an expansion of production capacities and a creation of new companies that want a full modernization and a flexible automation of production processes in the automotive industry. One of the countries is China, which has become number one in recent years when it comes to both industrial robots application (shown in Figure 6) and the production of vehicles in the world (Figure 7).



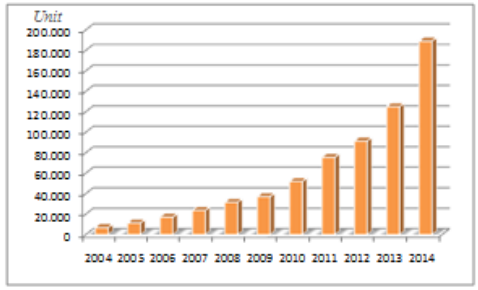


Figure 6 Annual and overall application of industrial robots in China from 2004-2014 [7,8,9]

The analysis of the graph in Figure 6 indicates that industrial robots application in China had a growing trend both at the annual and overall levels year after year from 2004-2014, so that in the last three years it is a leading country in the world which applies the most industrial robots. The growing trend of industrial robots application results in a fact

that China is the leading country in the world in the production of vehicles, as shown in Figure 7.

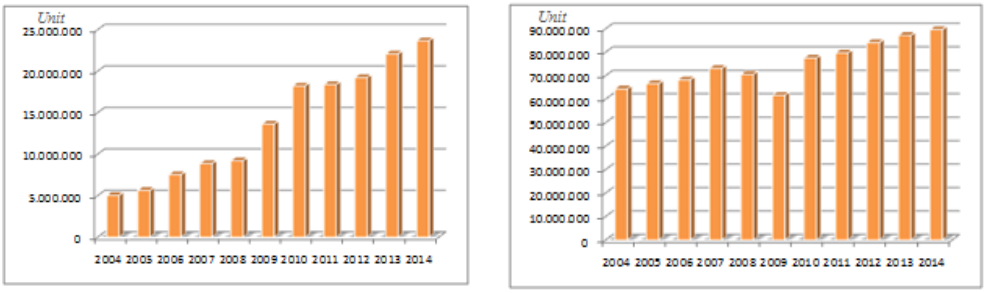
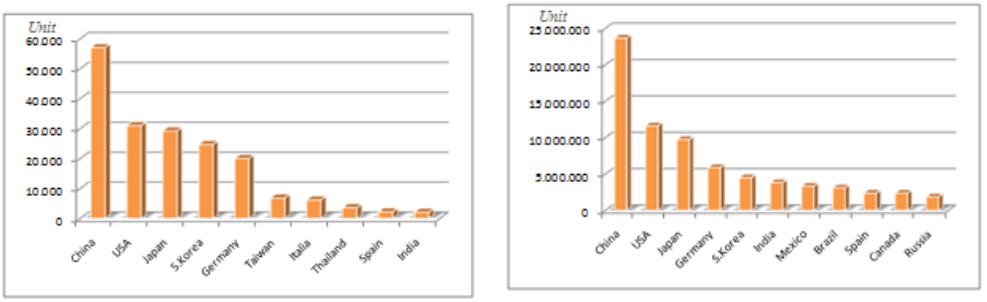


Figure 7 Vehicle production in China and the World from 2004-2014 [4,5,6,21]

As seen in Figure 7, China ranks first in the production of vehicles in the world in recent years, with the production of 23.723.000 units of vehicles in 2014. Given that 89.750.000 vehicles were produced in the world in 2014, this figure presents more that the fourth of produced vehicles in the world, i. e. 26.4%. This conclusion is also confirmed by the Figure 8, which shows a graph of industrial robots application and vehicles production in certain countries in the world for 2014.



Industrial robots *Vehicles*

Figure 8 Application of industrial robots and vehicle production in 2014 in ten countries [7,21]

Figure 8 shows the application of industrial robots and production of vehicles in 2014 in ten countries, on the basis of which we can conclude that China is the leading country when it comes to both the industrial robots application and the production of vehicles in the world. It is followed by these countries: the USA, Japan, North Korea and Germany, because these are the five countries with a developed automotive industry. Also, these are the countries that present a competition to each other on the automotive industry market. The obvious reason why the automotive industry is of interest is that the largest number of industrial robots is installed precisely in the automotive industry, as shown by Figure 3.

4. CONCLUSIONS

Based on the analysis conducted in this paper and shown argumentative results, it can be said that the car industry is the leading world industry in the application of industrial robots, and it is followed by the electrical/electronics industry. The reason for such a trend of industrial robots application in the automotive industry is global competition on the market of automotive industry, which requires a continuous modernization and a flexible automation of production processes in the automotive industry using industrial robots. The use of industrial robots in the automotive industry improves quality continuously because sophisticated industrial robots with new technologies systems are used. The development of sensor and information technology has particularly led to the improvement of grippers on industrial robots, which found their application in all operations of vehicle production. China is in the leading position in the world when it comes to the application of robots. It is assumed that it will expand its dominance in the application of industrial robots, so it is expected that more than one-third of industrial robots in 2018 will be installed in China. Simplifying the use of industrial robots will create a huge potential in industrial robots application in all industries, including small and medium enterprises.

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