

Trend of Industrial Robot Share in Different Branches of Industry in America

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ABSTRACT

This paper provides an analysis of trend of the industrial robot share in different industrial branches in America. The automation and modernization of the manufacturing process in whomever industrial branch is not possible without industrial robot application. This paper shows how much the manufacturing process is automatized in different industrial branches in America. The annual and total (operational stock) industrial robot application has been analysed in following manufacturing process: handling material operations, welding, assembly, processing, dispensing and the other undefined, where robots couldn't be classified in the manufacturing process. The industrial robot application of the leading American countries has been analysed, with the developed industry or in the developing process, where the automation and modernization of the manufacturing process is performed. This paper provides the comparative analysis of the industrial robot application in last three years, at the annual level and the total number of the industrial robot applications. There has been given the percentage reference of the industrial robot application in different industrial branches in 2010. It also provides the prediction analysis of the industrial robot application in following period in America till 2014.

Keywords – automation, industrial robot, industry, manufacturing process.

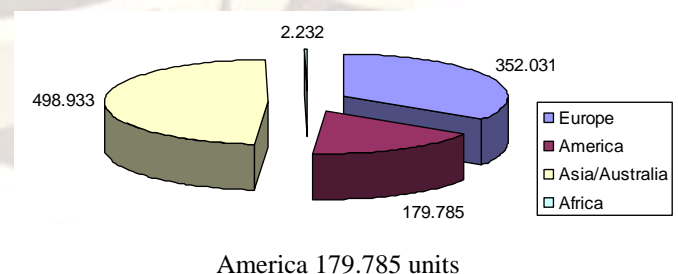
I. INTRODUCTION

With the modernization and automation of the manufacturing process in all branches of industry, with its flexibility and demands for the permanent change in manufacturing lines of the industrial robot functions, becomes more demanding and complicated due to the increasing trend of the industrial robot application. With the development of the new technologies and usage of the new materials, the different industries demand the new manufacturing lines which would lead to the increasing industrial robot applications. The diversity of the industrial robot application is in constant increase, which demands the flexible automation in food, pharmaceutical and elector/electronic industry and time decrease of product manufacturing, with continual high quality. There is a continual technological improvement in flexibility, accuracy, security and simplification of the industrial robot

application. The medium-sized and small business will start using the flexible automation in order to be competitive on a market. Their application is still maximal in automobile industry, but the other branches of industry are also increasing the number of the installed robots. With the development of the information technology there are continual changes in industrial robotics, leading to the new functional solutions and higher possibilities of the industrial robots application. Considering that the most of the manufacturing process are automatized on American continent, this paper provides an analysis of the industrial robot application. The analysis has been performed in countries: North America (USA, Canada, Mexico), Brazil and Argentina, considering the highest number of the applied industrial robots. There has been analyses the trend of the industrial robot application and parallel application analysis in different branches of industry and in different manufacturing process. It has been carried out in order to see the highest industrial robot abundance, i.e. to reveal which manufacturing process are automatized, which economy branches of industry in America are developed and in which countries, and which are modernizing and developing by industrial robot utilization [1,2,3,4,5,6,7].

II. INDUSTRIAL ROBOT APPLICATION IN AMERICA

When analysing the industrial robot application shown from Fig. 1 to Fig. 4, the statistical data has been taken from the International Federation of Robotics (IFR), the Economic Committee data from UN for Europe (UNECE) and Organization for Economic Cooperation and Development (OECD) [7,8,9,12,13].



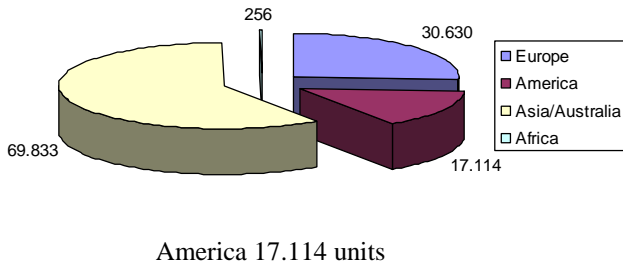


Fig. 1. Annual supply and operational stock of industrial robots by continents in 2010

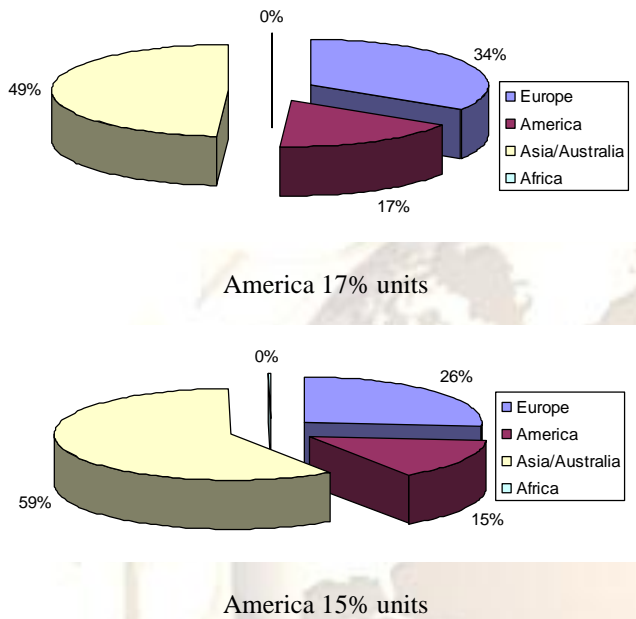


Fig. 2. Percentage of industrial robots annual supply and operational stock by continents in 2010

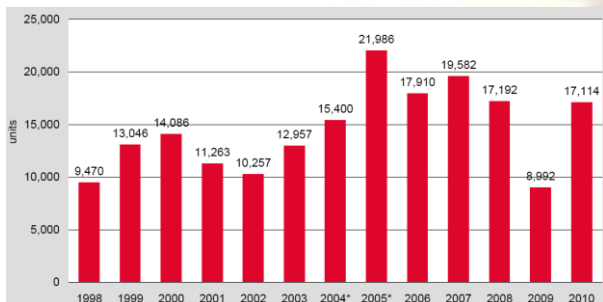
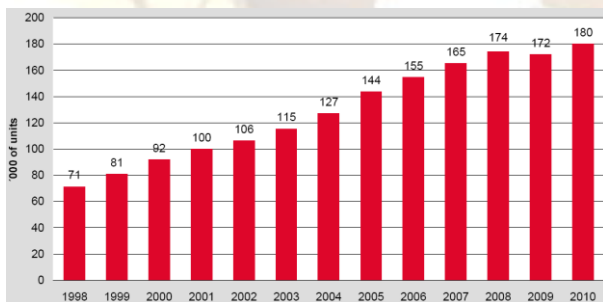


Fig. 3. Annual supply and operational stock of industrial robots in Asia/Australia in period 1998-2010 [7]

When analysing the Fig. 1, Fig. 2 and Fig. 3 we come to the conclusion that the highest number of robot applications in the world is in Asia with 498.933 units, the second place takes Europe with 352.031 units, then comes America with 179.031 units and the last place takes Africa with 2.232 units. With the annual analysis of robot application in the world in 2010, the drastic deviation occurs. The first place takes Asia with 69.833 units, Europe with 30.630 units, America with 17.114 units and Africa with 256 units of industrial robots. If we analyse the percentage reference of the industrial robot application in the world it would be: Asia with 49%, Europe with 34%, America with 17%, and the annual percentage reference in 2010 would be: Asia 59%, Europe 26% and America 15%. It is obvious that America takes the third place in industrial robot application as a continent in the world. The industrial robot application trend in America from 1998, considering the total number of industrial robot applications is in continuing increase, with slight fall in 2009 due to the financial industrial crisis. Regarding the annual robot application in America, according to Fig. 3, the drastic deviation has been observed. The highest fall of the industrial robot applications has been recorded in the following years: 1998, 2001, 2002. The least application has been recorded in 2009 with 8.992 units, due to the financial crisis.

III. INDUSTRIAL ROBOT APPLICATION IN DIFFERENT BRANCHES OF INDUSTRY OF AMERICA IN PERIOD 2005-2010

This analyse includes the next branches of industry: metal industry, electrical/electronics industry, automotive industry, plastic and chemical industry, agriculture, forestry and mining, food and tobacco industry, textile industry, paper industry, wood industry, building and leather industry. Regarding the manufacturing process where the industrial robots are used, the next process are included: handling process, welding, assembly, dispensing, processing and the other process not classified in given manufacturing process. The analysis of the industrial robot application in different branches of industry has been shown in Table 1 and Fig. 4. According to the table and graphic chart, the robot application in 2010 has increased in all branches of industry, in reference to 2009 due to the financial industrial crisis in 2009.

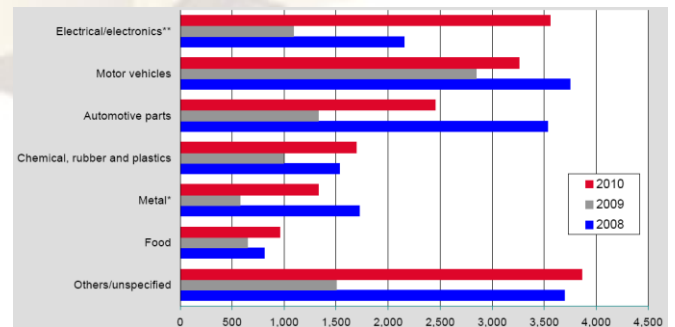


Fig. 4. Annual supply of industrial robots by industrial branches in America in period 2008-2010 [7]

TABLE 1 : ANNUAL SUPPLY OF INDUSTRIAL ROBOTS BY INDUSTRIAL BRANCHES IN AMERICA IN PERIOD 2005-2010 [7,8]

	Annual supply of industrial robots in America					
Industry / Year	2005	2006	2007	2008	2009	2010
Chemical, rubber and plastics	1.682	1.800	1.745	1.533	994	1.695
Metal product	2.126	1.518	1.468	1.724	578	1.329
Electrical/electronics	1.783	3.552	3.221	2.152	1.092	3.558
Automotive	13.352	7.719	9.817	7.282	4.176	5.713
Other/Unspecified *	3.044	3.323	3.331	4.501	2.152	4.819
TOTAL Σ	21.987	17.910	19.582	17.192	8.992	17.114

*Included: textile industry, food industry, agriculture, mining, gas, construction, education, research, development etc.

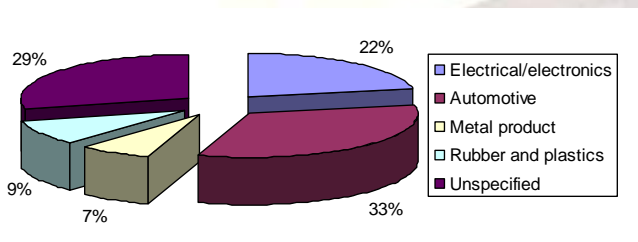


Fig. 5. Percentage of industrial robots annual supply by industrial branches in 2010

The analysis of the Table 1, Fig. 4 and Fig. 5 shows that the

first place in industrial robot application takes the automobile industry with 5.713 units in 2010 or 33%. The second place takes the electrical/electronics industry with 3.558 units or 21%, and the third place takes the chemical industry with 1.695 units or 10% in 2010. When analysing the robot application trend from 2005-2010, the automotive industry decreased (from 13.352 units in 2005 decreased to 5.713 units in 2010). In electro/electronic industry in 2010 the application trend has reached the trend from 2006, considering the number of units (the other years show decreasing trend). The metal industry records the decreasing trend, and the chemical industry almost has the constant trend, not considering the industrial recession in 2009.

TABLE 2 : ANNUAL SUPPLY AND OPERATIONAL STOCK OF INDUSTRIAL ROBOTS BY APPLICATION AREAS IN AMERICA IN PERIOD 2008-2010 [7,8, 9]

	Annual supply of industrial robots in America			Operational stock of industrial robots in America		
Application area	2008	2009	2010	2008	2009	2010
Handling	6.861	3.546	6.603	58.090	58.311	61.630
Welding	5.813	3.351	4.181	73.683	70.961	70.834
Assembly	1.255	844	1.819	11.383	11.691	13.042
Dispensing	724	162	560	8.233	8.143	8.422
Processing	389	83	300	4.452	4.213	4.513
Other/unspecified*	2.151	8.992	3.519	19.174	18.822	20.538
TOTAL Σ	17.192	8.992	17.114	173.937	172.141	179.785

*included: clean room robots

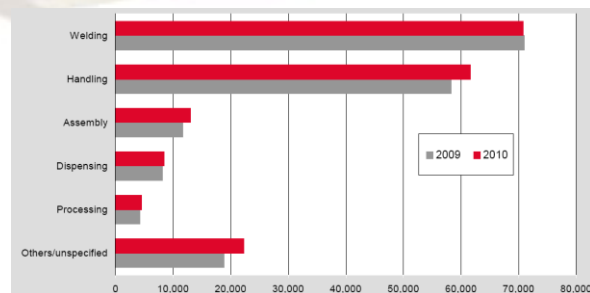
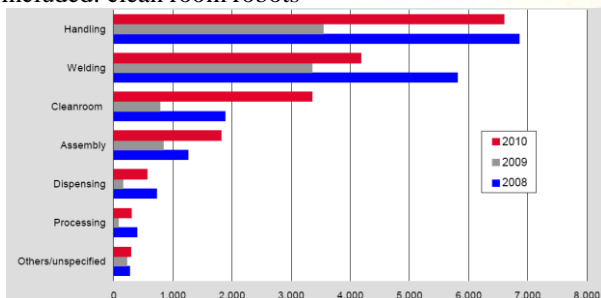


Fig. 6. Annual supply and operational stock of industrial robots in America by application areas in period 2008-2010

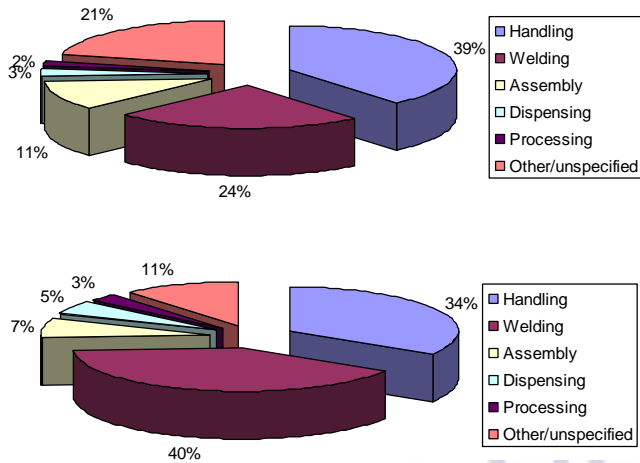


Fig. 7. Percentage of industrial robots annual supply and operational stock by application areas in 2010

According to the Table 2, Fig. 6 and Fig. 7 we can conclude the following: in America in 2010 have been applied 17.113 units of the new industrial robots, which is for 110% higher then in 2009, in handling jobs 39% and welding 24% at the annual level. Also in automobile industry 33%, electro industry 28%, and in chemical industry has been applied 10% of industrial robots more. If we observe the annual application in 2010, in America there is slightly higher number of industrial robots then in 2009, with the negligible difference. In handling jobs 34% of the industrial robots has

been applied, and in welding 40%. The application trend of the industrial robots at the annual level in the last three years is following: in 2008 with 17.192 units, in 2009 with 8.992 units, 2010 with 17.114 units. The sudden fall in 2009 has caused the financial industrial crisis. When considering the total industrial robot application in the last three years is following: 173.937 units have been applied in 2008, 2009 counts 172.141 units, and in 2010 there have been 179.785 robot units. It has been concluded that the total robot application trend in the last three years is almost constant.

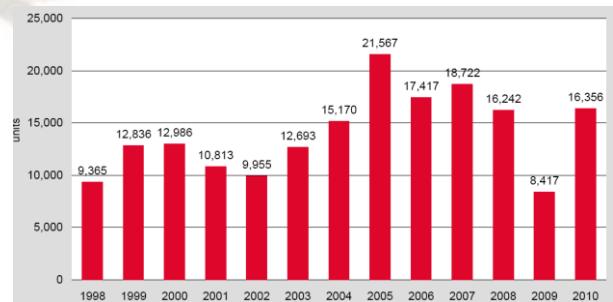
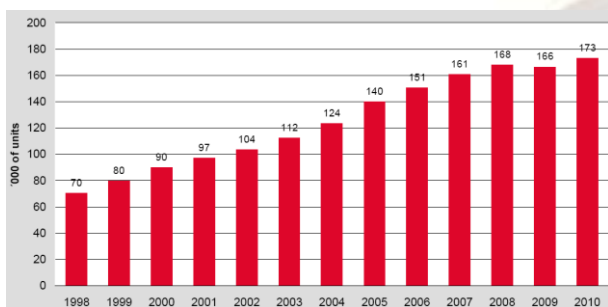
IV. APPLICATION ANALYSIS OF INDUSTRIAL ROBOTS IN AMERICAN COUNTRIES IN DIFFERENT APPLICATION AREAS

The Table 3 shows the annual and total industrial robot application in American countries from 2008 till 2010. The analysed countries are: Brazil, Argentina, North America (USA, Canada, Mexico) and the other countries like Chile, Colombia, Porto Rico, Venezuela and the other not mentioned. The Table 3 shows that the first place in robot application in America, at the total and annual level takes North America. The application in the other countries is almost negligible. If we analyse the countries individually at the annual level in 2010 the sequence would be: USA with 14.380 units, Canada with 1.076 units, Mexico with 900 units, Brazil with 640 units, Argentina with 96 units and at the end all the other countries of America with 22 industrial robot units.

TABLE 3 : ANNUAL SUPPLY AND OPERATIONAL STOCK OF INDUSTRIAL ROBOTS IN NORTH AMERICA, BRAZIL AND ARGENTINA IN PERIOD 2008-2010 [7,8]

Country / Year	Annual supply of industrial robots			Operational stock of industrial robots		
	2008	2009	2010	2008	2009	2010
BRAZIL	781	495	640	4.586	5.081	5.721
ARGENTINA	150	45	96	581	626	722
NORTH AMERICA	16.242	8.417	16.356	168.489	166.183	173.174
•USA	(13.380)	(6.831)	(14.380)	-	-	-
•Canada	(1.813)	(513)	(1.076)	-	-	-
•Mexico	(1.049)	(1.073)	(900)	-	-	-
Other countries	19	35	22	286	211	118
TOTAL Σ	17.192	8.992	17.114	173.977	172.141	179.785

North America



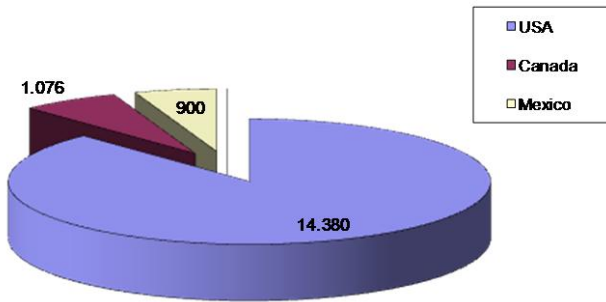
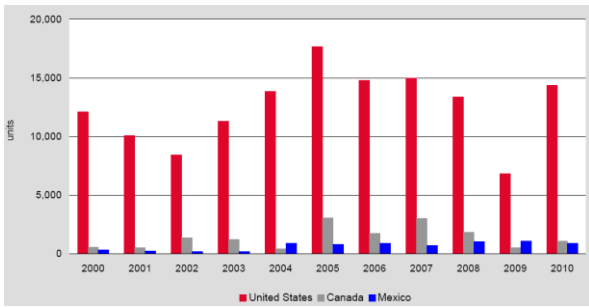


Fig. 8. Annual supply and Operational stock of industrial robots in North America (USA, Canada, Mexico) [7]

The total trend of industrial robot application in North America is in continual increase year after year. When considering the annual robot application, the highest number of robots has been applied in 2005 with 21.567 units and the least in 1998, 2002 and 2009 when there have been applied 8.417 units. From these three countries, the first place takes USA and drastically rebounds in industrial robot application with regard to Canada and Mexico. In 2010, in America have been applied 14.380 robot units, in Canada 1.076 units and Mexico 900 robot units.

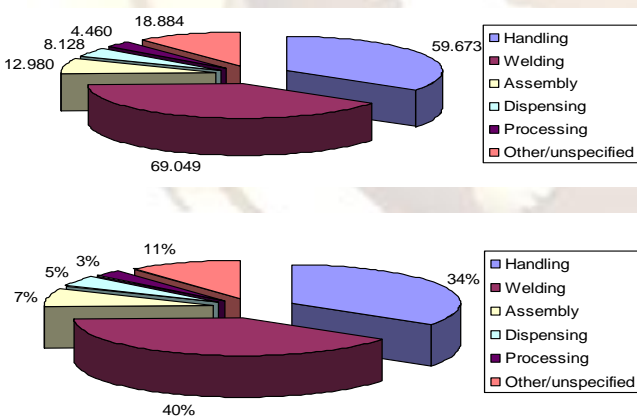


Fig. 9. Operational stock of industrial robots by application areas in North America (USA, Canada, Mexico) in 2010

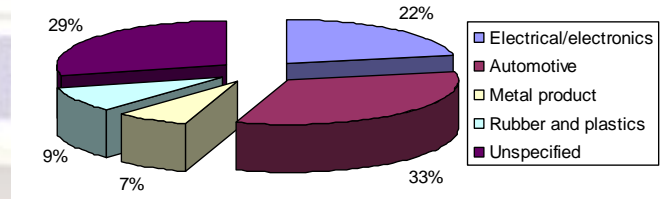
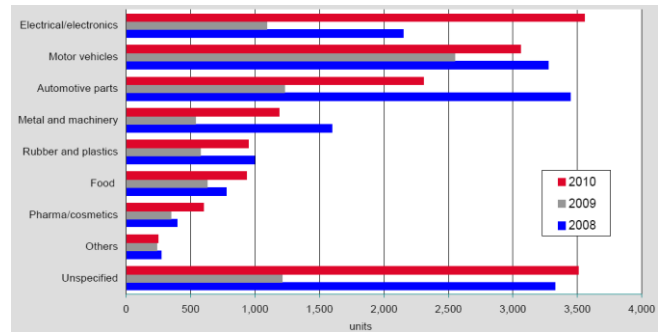
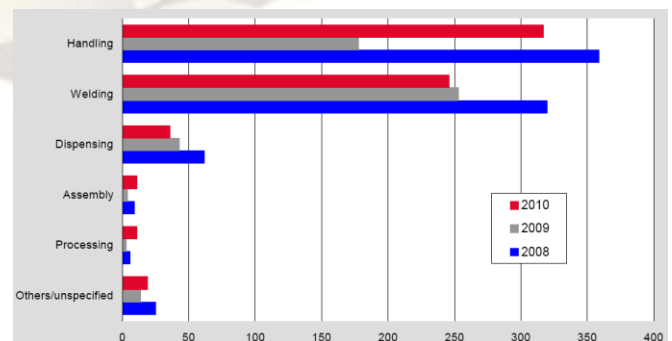
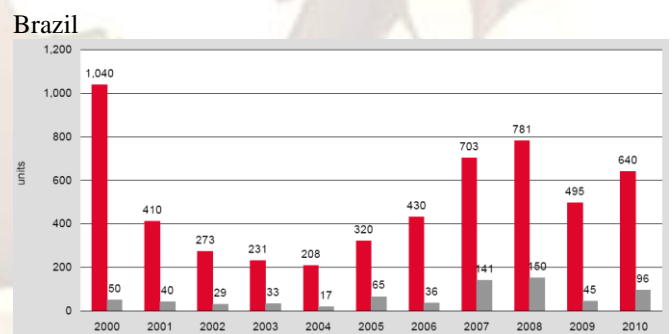


Fig. 10. Annual supply of industrial robots by industrial branches in period 2008-2010 and percentage in 2010 in North America [7,8]

The highest number of the industrial robot application in North America, Fig. 8, is in welding manufacturing process with 69.049 units or 40% in 2010. The second place takes the handling operation with 59.673 units or 34%, the third place takes assembly process with 12.980 units or 7%, then dispensing with 8.128 units or 5%, then processing with 4.460 units or 3%. When considering the industry, Fig. 9, the first place takes the automotive industry with 33% of industrial robot applications in 2010, then electro/electronic with 21%, metal industry with 7%, and plastic and chemical industry with 9%.



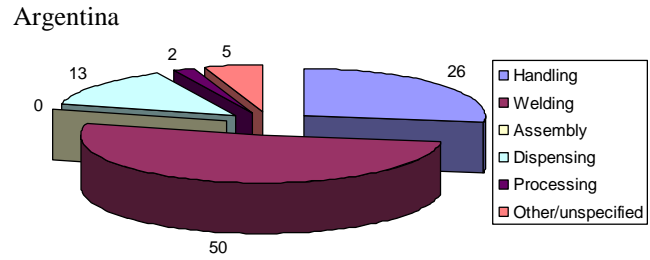
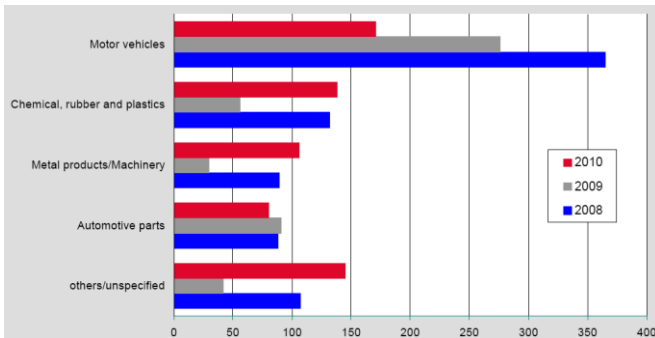


Fig. 11. Industrial robots application charts by industrial branches and application areas in period in 2008-2010 in Brazil and Argentina

TABLE 4 : ANNUAL SUPPLY IN OTHER COUNTRIES OF AMERICA [7]

Country	2005	2006	2007	2008	2009	2010
Chile	3	6	3	6	5	7
Colombia	-	1	9	3	-	3
Puerto Rico	30	-	-	-	-	-
Peru	1	1	-	1	-	-
Venezuela	-	-	2	7	2	7
Other	-	20	2	2	28	5
Total Σ	34	28	16	19	35	22

According to the Table 4 in other countries in America like: Chile, Colombia, Puerto Rico, Peru, Venezuela and the other countries of the American continent, the industrial robot application is negligible due to the small robot number, and can be neglected with regard to the robot number and the annual and total applications in North America (Table 3).

V. APPLICATION PREDICTION OF INDUSTRIAL ROBOTS IN AMERICA TILL 2014

This chapter will provide the performed predictions of the industrial robot applications in America till 2014, according

to the International Federation of Robotics (IFR), the Economic Committee data from UN for Europe (UNECE) and Organization for Economic Cooperation and Development (OECD). The Table 5 shows the predictions in industrial robot application in America till the 2014 at the annual level, with 100.000 units or 16% concerning the other continents, i.e. at the total number of applied robots in the world. Concerning the total application level it is also predicted increase to 695.000 units or 18% in relation to the total number of applied robots in the world.

TABLE 5 : PREDICTION OF INDUSTRIAL ROBOT ANNUAL SUPPLY AND OPERATIONAL STOCK IN WORLD IN PERIOD 2010-2014 [7]

Country/Year	Yearly supply			Operational stock		
	2010	2014	2014	2010	2011	2014
Europe	17.114	22.450	26.700	179.785	189.200	229.000
America	69.833	81.200	100.000	498.933	539.900	695.000
Asia/Australia	30.630	34.700	38.900	352.031	360.700	376.000
Africa	259	400	500	2.232	2.600	3.000
TOTAL Σ	118.337	139.300	166.700	1.035.016	1.095.000	1.308.000

VI. CONCLUSION

According to the obtained research we can conclude that in America, in 2010 has been applied 17.114 units of industrial robots or 15%. The total application is 179.785 of robot units or 17%, concerning the total number of applied robots in the world. From year to year, the total trend of the industrial robot application from 1998-2010 is in constant increase. When concerning the industrial robot application in industry, the first place takes the automobile industry

with 33%, then electro/electronic with 21%, and the third place takes the chemical industry with 10% in 2010. After the analysis of the industrial robot application in manufacturing process, the first place takes the welding process with 40% from the total number of applied robots. When it comes to America, the first place in industrial robot application takes North America (USA, Canada, Mexico) with 16.356 units. In North America, the first place takes USA with 14.380 units, then Canada with 1.076 units and

Mexico with 900 units of applied robots. The predictions of the industrial robot application in America till 2014 are with the application increase trend at the annual and total level. It leads us to the conclusion that the manufacturing process are automatized and modernized, so that today we have flexibility improvement, accuracy, security and simplification of the industrial robot applications.

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