

IFR press release

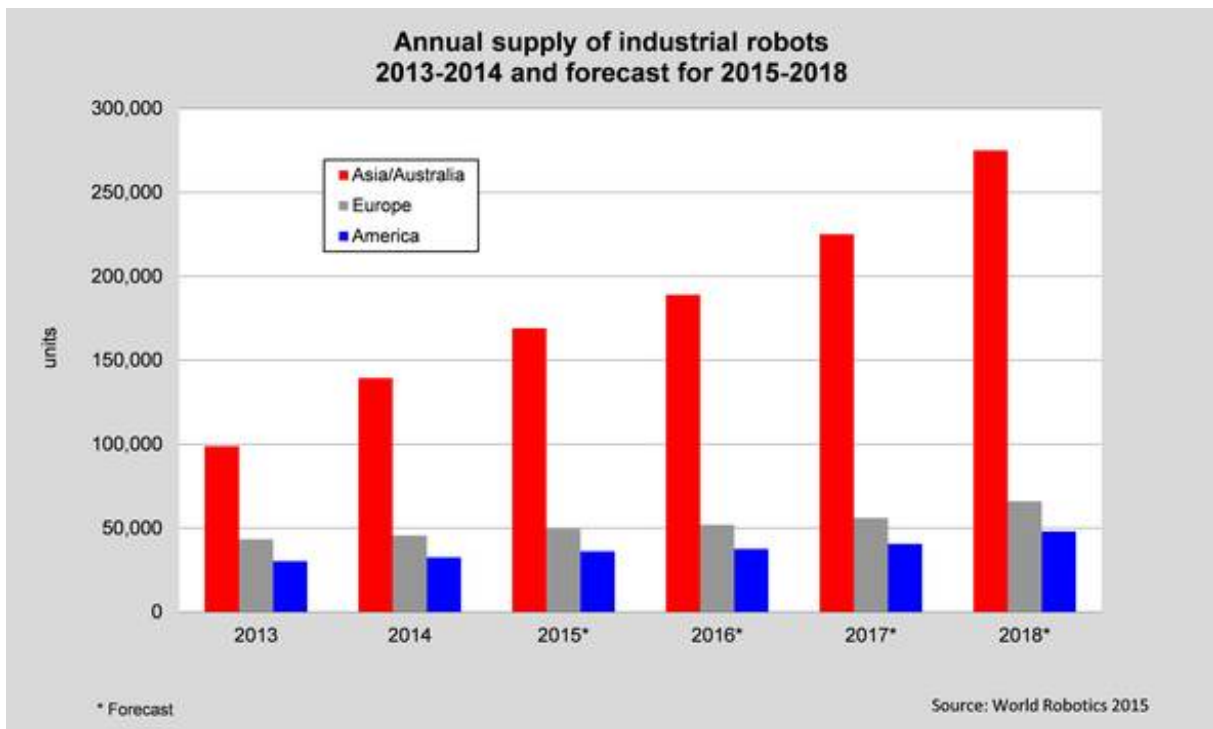
World Robotics Survey: Industrial robots are conquering the world

Frankfurt, 30 September 2015 - By 2018 global sales of industrial robots will on average grow year on year by 15 percent - the numbers of units sold will double to around 400,000 units. Five major markets representing 70 percent of the total sales volume: China, Japan, USA, South Korea and Germany. So says the 2015 World Robot Statistics, issued by the International Federation of Robotics (IFR).



"The main driver of this development is the global competition of industrial production. The automation witnessed by the automotive sector and the electrical/electronics industry comes out top here with a market share of 64 percent", says Arturo Baroncelli, President of the International Federation of Robotics (IFR).

Within this context, the rapid automation in China represents a unique development in the history of robotics. The number of industrial robots sold increased by 56 percent alone last year in comparison to 2013. China is the largest and fastest growing robotics market in the world. The potential remains enormous despite the recent economic downturn. After all Chinese production industries currently have a robotic density of just 36 units per 10,000 employees. To compare: As the front-runner South Korea deploys 478 industrial robots per 10,000 employees followed by Japan (315 units) and Germany (292 units). It is estimated that more than one-in-three of the global supply of industrial robots will be installed in the Republic of China in 2018.



The statistics on robotic density likewise indicate huge opportunities for growth in the USA. Production industries there deploy just 164 industrial robots per 10,000 employees right now. The USA is currently automating its economy at high speed. The aim is to strengthen the country as an industrial centre and to retrieve outsourced production. In 2014 the number of installed robots increased by 11 percent to around 26,000 units - making it third in the world.

In Europe it is Germany that takes the lead by some distance. Within one year (2014) the sales figures increased by around 10 percent to about 20,100 units - to date the largest number of sales registered within twelve months. Despite the already very high robotic density existing there, the world's fifth largest robotics market remains on a path of expansion - driven primarily by the automotive industry.

Global investments made by the automotive industry in industrial robots have increased significantly since 2010. 2014 was a new record year with about 100,000 newly installed robots - up 43 percent compared to the previous year. This boom has been fuelled by new production capacities in emerging markets and a wave of modernisation sweeping through established auto-making countries. A large proportion of robotics technology in 2014 was purchased by suppliers of electronic components to the automotive industry. These include battery manufacturers and car IT enterprises.

In 2014 the electrical/electronics sector likewise posted a new record - sales increased by 34 percent compared to the previous year. The strong demand for industrial robots in the production of consumer electronics, communication equipment as well as computer and medical technology adds up to a total global market share of 21 percent.

The wave of digital transformation and automation will continue to drive the triumphant march of industrial robots onwards up to 2018. "Industry 4.0" projects mean that human-robot teams, for example, are on the cusp of a break-through. Simplification of the use of robots will additionally open up the market for new applications. This is equally true of small and medium-sized companies as it is for large corporations in all sectors. Besides the automotive and electronics industries, this development is also being increasingly felt in the metal processing, plastics, food and packaging industries.

"The market volume available to industrial robots is enormous. Including supporting services we estimate the global market value to be 32 billion US dollars for 2014", sums up IFR President Baroncelli.

Executive Summary

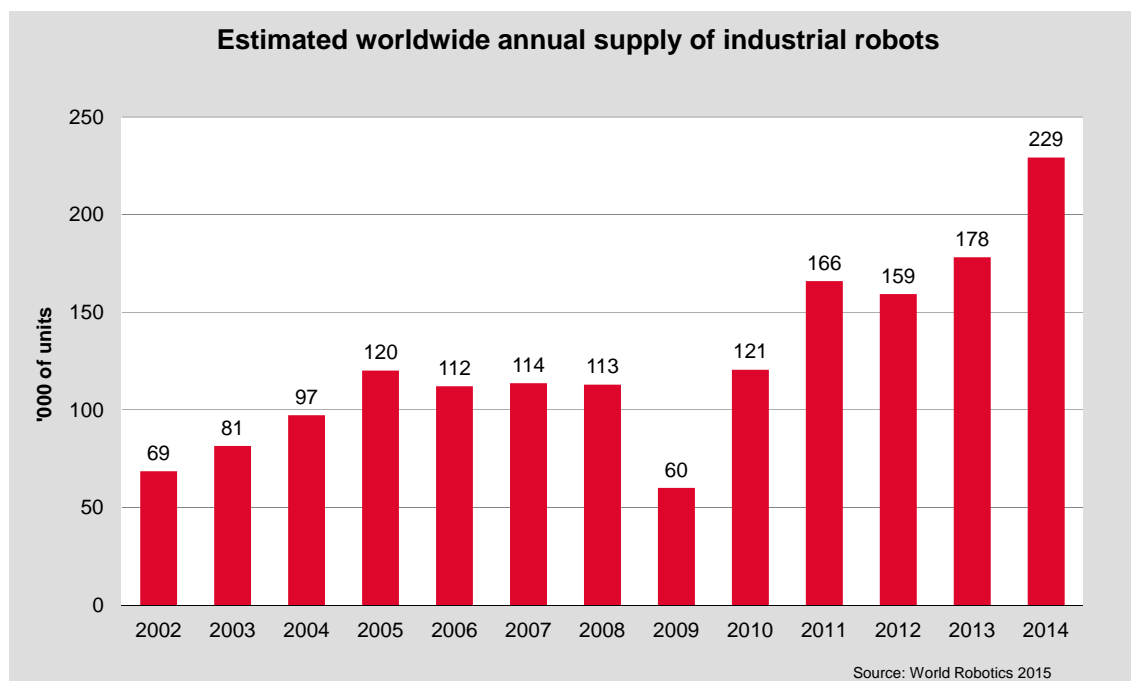
1. **World Robotics 2015 Industrial Robots**
2. **World Robotics 2015 Service Robots**

1. World Robotics 2015 Industrial Robots

2014: By far the highest volume ever recorded

In 2014, robot sales increased by 29% to 229,261 units, by far the highest level ever recorded for one year. Sales of industrial robots to all industries increased compared to 2013. The automotive parts suppliers and the electrical/electronics industry were the main drivers of the growth. China has considerably expanded its leading position as the biggest market with a share of 25% of the total supply in 2014.

Since 2010, the demand for industrial robots has accelerated considerably due to the ongoing trend toward automation and the continued innovative technical improvements of industrial robots. Between 2010 and 2014, the average robot sales increase was at 17% per year (CAGR). The number of robot installations had never increased so heavily before. Between 2005 and 2008, the average annual number of robots sold was about 115,000 units. Between 2010 and 2014, the number rose to about 171,000 units. This is an increase of about 48% and a clear sign of the significant rise in demand for industrial robots worldwide.



Asia, the most important region

Asia (including Australia and New Zealand) was by far the biggest robot market with about 139,300 industrial robots sold in 2014, 41% higher than in 2013. This was the highest sales level ever recorded for the third year in a row. Industrial robot sales to the second largest market, **Europe**, increased by 5% to almost 45,600 units (a new peak).

About 32,600 industrial robots were shipped to the **Americas**, 8% more than in 2013, reaching again a new peak for the third year in a row.

70% of the global robot sales went to five countries

There are five major markets representing 70% of the total sales volume in 2014: China, Japan, the United States, the Republic of Korea and Germany.

57,096 industrial robots were sold in 2014 in China, 56% more than in 2013.

Thereof, **Chinese robot suppliers** installed about 16,000 units according to the information from the China Robot Industry Alliance (CRIA). Their sales volume was about 78% higher than in 2013. This was partly due to an increasing number of companies that reported their sales data for the first time in 2014. **Foreign robot suppliers** increased their sales by 49% to 41,100 units, including robots produced by international robot suppliers in China. China, by far the biggest market for industrial robots, is also the fastest growing market worldwide. This rapid development is unique in the history of robotics. There has never been such dynamic rise in such a short period of time in any other market. A wide range of industries have been increasingly investing in automation. Between 2010 and 2014, total supply of industrial robots increased by about 40% per year on average.

Almost 29,300 industrial robots (+17%) were sold to **Japan** reaching the highest sales level in that country since 2008. Since 2013, Japan is the second largest market regarding annual sales. Robot sales in Japan followed a decreasing trend between 2005 (with the peak of 44,000 robot units) and 2009 (when sales dropped to only 12,800 units). Between 2010 and 2014, robot sales increased by 8% on average per year (CAGR).

Robot installations in the **United States**, the third largest robot market, continued to increase, by 11% to the peak of 26,200 units. Driver of this growth was the ongoing trend to automate production in order to strengthen American industries on the global market and to keep manufacturing at home, and in some cases, to bring back manufacturing that had previously been sent overseas.

Robot supplies in the **Republic of Korea**, fourth largest robot market, increased by 16% to about 24,700 units in 2014 compared to 2013, the second highest level after 2011 (25,536 units). Just like in 2013, the automotive parts suppliers (particularly for the production of electronic parts, e.g. batteries, etc.) increased their robot investments substantially, while almost all other industries bought fewer robots in 2014. Between 2010 and 2014, the annual robot sales more or less stagnated in the Republic of Korea.

Germany is the fifth largest robot market in the world. In 2014, robot sales increased by 10% to almost 20,100 units, which is the highest number ever recorded for one year. The robot supply to Germany increased between 2010 and 2014 by about 9% on average per year (CAGR) despite the already existing high robot density in the country. The main driver of the growth in Germany was the automotive industry.

Other important Asian markets

Since 2013, **Taiwan** has ranked number 6 among the most important robot markets in the world with regard to the annual supply. Robot installations increased considerably between 2010 and 2014, by 20% on average per year (CAGR). In 2014, robot sales increased by 27% to about 6,900 units, a new peak. However, the number of units is far below the number in Germany, which ranked number 5 with 20,100 units. **Thailand** is also a growing robot market in Asia. Its annual supply ranked number 8 in the world

in 2014. However, the total supply of about 3,700 robots represents only less than 2% of the global installations in 2014. Robot sales to **India** reached a new peak of about 2,100 units. Robot supplies to **other Southeast Asian** countries like **Indonesia, Malaysia, Singapore** and **Vietnam** all increased in 2014.

In 2014, there was a substantial increase in sales of industrial robots in **Asia** to **countries whose names were not specified in the collected data**: 10,140 units in 2014 versus 661 units in 2013. Most of these robots were packaging, picking and placing robots, exported by Korean robot suppliers. It is assumed that most of these robots went to China and Taiwan to the electronics industry as well as to the automotive electronic parts suppliers.

Other important European markets

Italy is the second largest robot market in Europe after Germany. Worldwide, it ranked 7th in 2014. Total sales of industrial robots were up by 32%, to about 6,200 units in 2014. This was the second highest level ever recorded for one year after 2001. This is a clear sign of economic recovery in Italy. Between 2010 and 2013, annual robot sales to Italy were rather weak due to the critical economic situation. The **French** robot market also recovered substantially in 2014, by 36% to almost 3,000 units. In **Spain**, sales of industrial robots decreased by 16% to about 2,300 units in 2014. After considerable investments in Spain between 2011 and 2013, sales to the automotive industry were significantly down in 2014, while almost all other industries continued to increase robot investments substantially. Sales of industrial robots to the **United Kingdom** further decreased in 2014 to almost 2,100 units after considerable investments of the automotive industry in 2011 and 2012. Robot sales to **Belgium/Netherlands**, which had followed an increasing trend up to 2013, decreased in 2014. Sales to Sweden were also down in 2014. Robot sales in the **Czech Republic** and in **Poland** increased substantially, while **other Central and Eastern European** markets were down in 2014. Sales to **Turkey** continued to increase in 2014.

Other important American markets

Robot sales to **Mexico** decreased by 9% to almost 2,500 units in 2014. Mexico is predominantly a production hub for car manufacturers that export to the United States and increasingly to South America. Between 2010 and 2013, robot installations rose considerably. In **Canada**, robot sales increased by 4% to about 2,300 units in 2014. Despite the increasing trend of robot installations since 2010, the volume in Canada is still below the peak levels of 2005 and 2007, when about 3,000 robots were installed in each year. The reason could be that the car manufacturers are expanding capacities in the United States and in Mexico rather than in Canada. Robot sales to **Brazil** further decreased to almost 1,300 units in 2014, 9% less than in 2013.

Others, not specified

The category "Others, not specified" includes:

- Exports from North America with country of destination not specified
- Estimates of companies which did not report directly to the IFR
- Exports from the Republic of Korea with country of destination not specified

The number of robots counted in "Others, not specified" increased significantly in 2014. The reason is:

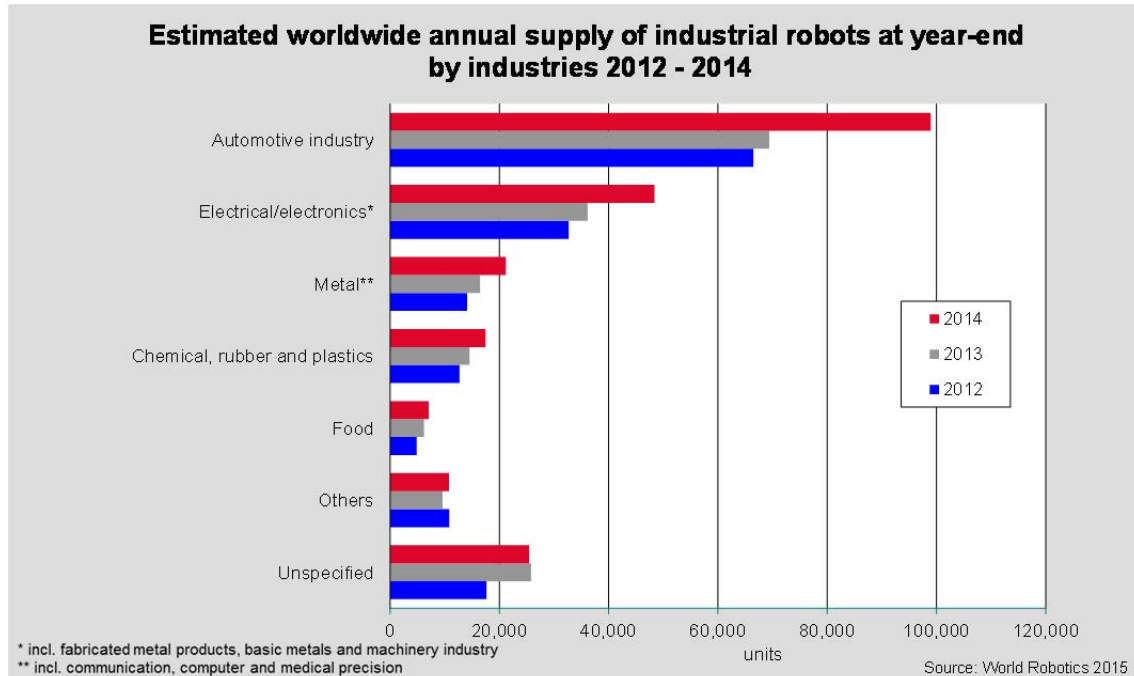
A significant number of packaging, picking and placing robots reported for the Republic of Korea were actually exported elsewhere. The final destinations of these exports

were not known, therefore the data attributed to these robots are included in “other Asia” and in “other countries not specified”. It is assumed that most of these robots were shipped to China and Taiwan to the electronics industry as well as to the automotive electronic parts suppliers. Others were possibly installed in Europe or in the Americas.

Main drivers of the growth: automotive industry and electrical/electronics industry

Since 2010, the **automotive industry** – the most important customer of industrial robots – has considerably increased investments in industrial robots worldwide. About 98,900 new robots, 43% more than in 2013, were installed in this industry in 2014, establishing again a new peak. The share of the total supply was about 43%. Between 2010 and 2014, robot sales to the automotive industry increased by 27% on average per year (CAGR). Investments in new production capacities in the emerging markets as well as investments in production modernization in major car producing countries have caused the number of robot installations to rise. In 2014, a major part of robots were sold to the automotive electronics parts suppliers for battery production as well as for other electronic parts in cars.

Robot sales to the **electrical/electronics industry** (including computers and equipment, radio, TV and communication devices and equipment and medical, precision and optical instruments) increased considerably in 2014, by 34% to 48,400 units, establishing a new peak. Share of the total supply in 2014 was about 21%. The rising demand for electronic products and new products, as well as the need to automate production (particularly in low wage countries), were the driving factors for an accelerating demand.



Sales to **all industries, except for automotive and electrical/electronics**, increased by 21% in 2014. Between 2010 and 2014, the average growth rate per year was 17%. The respective growth rate for the automotive industry was 27% and for the electrical/electronics industry 11%. This is a clear sign that not only the main customer industries (automotive industry and electrical/electronics industry) but also other industries have increased robot installations considerably in recent years. The robot suppliers have been reporting a significant increase in the number of customers in the

past years. However, the number of units ordered by these customers is often very small.

Worldwide operational stock of industrial robots increased again considerably in 2014

The total worldwide stock of operational industrial robots at the end of 2014 increased by 11% to about 1.5 million units. Since 2010, the stock has been increasing considerably.

Value of the global market was up to US\$10.7 billion

In 2014, the sales value increased by 13% to a new peak at US\$10.7 billion. It should be noted that the figures cited above generally do not include the cost of software, peripherals and systems engineering. Including the mentioned costs might result in the actual robotic systems' market value to be about three times as high. **The worldwide market value for robot systems in 2014 is therefore estimated to be US\$32 billion.**

High potential for robot installations in many countries

When comparing the distribution of multipurpose industrial robots in various countries, the robot stock, expressed in the total number of units, can sometimes be a misleading measure. In order to take into account the differences in the size of the manufacturing industry in various countries, it is preferable to use a measure of robot density. One such measure of robot density is the number of multipurpose industrial robots per 10,000 persons employed in manufacturing industry or in the automotive industry or in the "general industry" (which is all industries excluding the automotive industry).

The average global robot density is about 66 industrial robots installed per 10,000 employees in the manufacturing industry. The most automated markets are the Republic of Korea, Japan and Germany. In 2014, the **Republic of Korea** had again the highest robot density in the world by far due to continued installation of a large volume of robots in recent years. 478 industrial robots were in operation in 2014 per 10,000 employees. The robot density in **Japan** further decreased to 314 units, and in Germany it continued to increase to 292 units. The United States which is one of the five the biggest robot markets regarding annual supply has a robot density of 164 units in 2014. The robot density in China, the biggest robot market since 2013, reached 36 units in 2014 unveiling the huge potential for robot installations in this market.

In 2014, the average robot density in the following regions was: 85 in Europe, 79 in the Americas, and 54 in Asia.

The considerable high rate of automation of the automotive industry compared to all other sectors is demonstrated in the evaluation of the number of industrial robots in operation per 10,000 employees in the automotive industry and in all other industries.

Despite its shrinking robot density, Japan had by far the highest robot density in the automotive industry. 1,414 industrial robots were installed per 10,000 employees in the automotive industry. It is followed by Germany with 1,149, the United States with 1,141, the Republic of Korea with 1,129 units.

The robot density in the automotive industry in China has increased considerably since 2007 but is still on a rather moderate level (305 units). The reason is the huge number of employees working in the automotive industry. According to the China Statistical Yearbook about 3.4 million people worked in the automotive industry (including automotive parts) in 2013. In 2014, about 20 million cars were produced in China, the

highest volume of cars produced in a country, accounting for about 30% of the global car production. Necessary modernization and further increase of capacities will boost robot installations in the coming years. The potential for robot installations in this market is still tremendous.

The robot density in the automotive industry in the United States increased only moderately between 2010 and 2014 (from 1,104 robots per 10,000 employees in the automotive industry to 1,141 robots), while the operational stock of robots rose considerably. The reason is the remarkable rise in employment in the automotive industry in the same period. The employment rate in the automotive industry increased by 29% in 2014 compared to 2010.

The **robot density in the general industry (all industries excluding automotive)** is still comparatively low. However, countries with an important electronics industry have a higher rate. The Republic of Korea is on top with 365 robots installed per 10,000 employees. It is followed by Japan with 211 robots, Germany with 161 robots and Sweden with 142 robots. Germany and Sweden do not have any important production sites regarding the electronics industry. The comparatively high rate in both countries is due to a more diversified distribution of industrial robots in all industries. The robot density in the general industry of Taiwan (which is mainly the electronics industry), has already had a considerable increase in recent years. It ranked fifth with a robot density of 138 units in 2014. All other countries have lower robot density rates in the general industry. Most of the emerging robot markets have a robot density rate below 30.

The overall conclusion indicates that in almost all the surveyed countries, the potential for robot installations in the general industry is still tremendous. It is also considerably high in the automotive industry among the emerging markets and in some traditional markets as well. Continued necessary modernization and retooling guarantee continued robot investments in already highly automated countries as well. Relocation of productions may result in declining investments in the relevant country. However, robot investments will be shifted to the new production base in another country.

Double-digit growth between 2015 and 2018

Industrial robots are conquering the world:

- Industry 4.0, linking the real-life factory with virtual reality, will play an increasingly important role in global manufacturing.
- Human-robot collaboration will have a breakthrough in this period.
- Simplification of the use of robots will open up huge potentials in all industries including small and medium-sized companies.
- Global competition requires continued modernization of production facilities.
- Energy-efficiency and using new materials, e.g. carbon-composites, require continued retooling of production.
- Growing consumer markets require expansion of production capacities.
- Decline in products' life cycle and an increase in the variety of products require flexible automation.
- There is an increasing demand, particularly from manufacturers of electronics products such as smart phones, tablets etc., for easy to use robots with limited

applications and short life cycle that have a low price, e.g. for simple assembly tasks which do not require high precision.

- Continuous quality improvement requires sophisticated high tech robot systems.
- Robots improve the quality of work by taking over dangerous, tedious and dirty jobs that are not possible or safe for humans to perform.

Major growth is expected in Asia, particularly China and Taiwan, Korea, India and most of the other Southeast Asian markets. China will remain the main driver of the growth and will expand its dominance. The continuing need to increase automation has been recognized by Chinese industries and the government. Installations of robots will accelerate despite decelerating growth rates of the GDP. It is estimated that more than one third of the global supply in 2018 will be installed in the Republic of China. Continued growth in North America as well as recovering sales in Brazil are expected. Sales to Eastern European countries will gain momentum. Sales in Western European countries will continue to grow.

The main customer, the automotive industry, is continuing to invest heavily in robot installations. The robot supply may slow down in certain markets; however the automotive industry will continue to be the innovator for new technology. The growing global demand for electronics products, new products, and new production technologies are boosting investments in retooling of existing production processes and expanding production capacities of the electrical/electronics industry particularly in Asia. A significant number of rather low-priced robots will continue to be sold to the electronics industry in the coming years. A further increase of robot orders from other industries is also likely, particularly from the rubber and plastics industry, the metal and machinery industry, the pharmaceutical industry and the food and beverage industry.

Global robot installations are estimated to increase at least by about 15% to 264,000 units in 2015. Robot supplies in the Americas will increase by 11% and in Asia/Australia by 21%, while robot sales in Europe will rise by 9%.

From 2016 to 2018, robot installations are estimated to increase again, at least by 15% on average per year (CAGR): about 10% in the Americas and in Europe, and about 18% in Asia/Australia. Total global sales will reach about 400,000 units in 2018.

Between 2015 and 2018, it is estimated that about 1.3 million new industrial robots will be installed in factories around the world.

The global robotics industry is prepared for this challenge. Production capacities have been expanded and some have established or will establish robot production assemblies in the most important markets, China or in the United States.

In terms of units, it is estimated that the **worldwide stock of operational industrial robots will increase from about 1,480,800 units at the end of 2014 to 2,327,000 units at the end of 2018**, representing an average annual growth rate of 12% between 2015 and 2018. In 2015, the stock will increase by 12% to about 1.7 million units. Certain risks are involved with regard to this forecast (2015-2018). A declining global economy may result in restrained investments. However, since investments in automation are necessary, they are deemed to eventually continue, but perhaps shifted to a later point in time.

Table 1

Estimated yearly shipments of multipurpose industrial robots in selected countries. Number of units

Country	2013	2014	2015*	2018*
America	30,317	32,616	36,200	48,000
Brazil	1,398	1,266	1,000	3,000
North America (Canada, Mexico, USA)	28,668	31,029	35,000	44,000
Other America	251	321	200	1,000
Asia/Australia	98,807	139,344	169,000	275,000
China	36,560	57,096	75,000	150,000
India	1,917	2,126	2,600	6,000
Japan	25,110	29,297	33,000	40,000
Republic of Korea	21,307	24,721	29,000	40,000
Taiwan	5,457	6,912	8,500	12,000
Thailand	3,221	3,657	4,200	7,500
other Asia/Australia	5,235	15,535	16,700	19,500
Europe	43,284	45,559	49,500	66,000
Czech Rep.	1,337	1,533	1,900	3,500
France	2,161	2,944	3,200	3,700
Germany	18,297	20,051	21,000	25,000
Italy	4,701	6,215	6,600	8,000
Spain	2,764	2,312	2,700	3,200
United Kingdom	2,486	2,094	2,400	3,500
other Europe	11,538	10,410	11,700	19,100
Africa	733	428	650	1,000
not specified by countries**	4,991	11,314	8,650	10,000
Total	178,132	229,261	264,000	400,000

Sources: IFR, national robot associations.

*forecast

** reported and estimated sales which could not be specified by countries

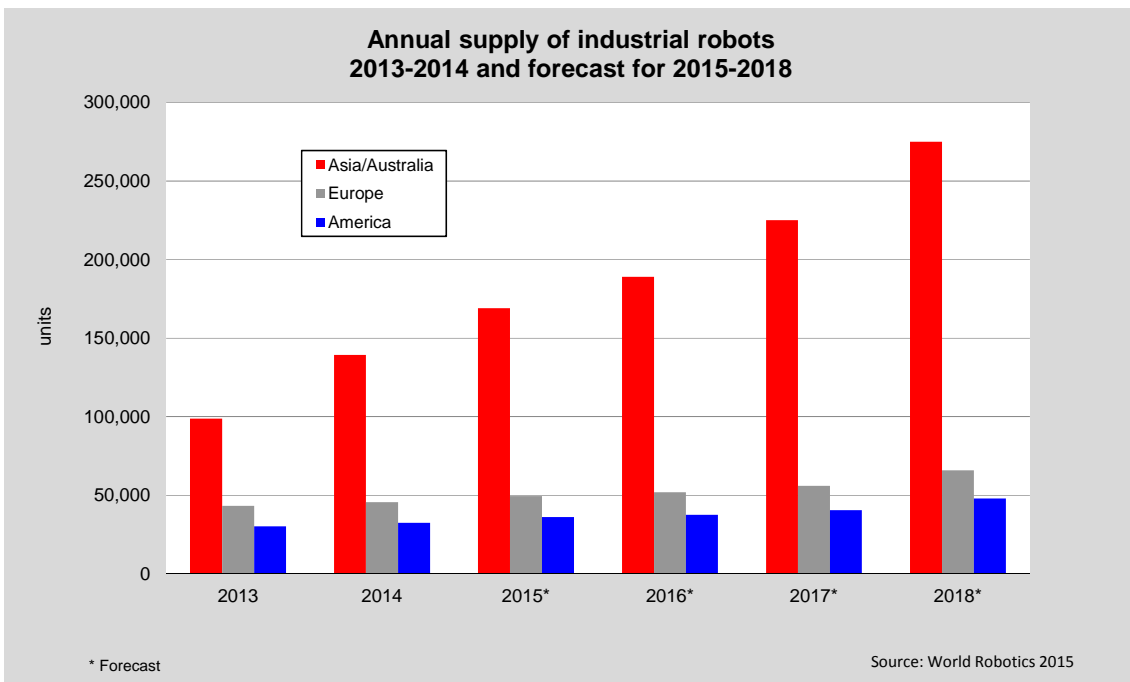


Table 2

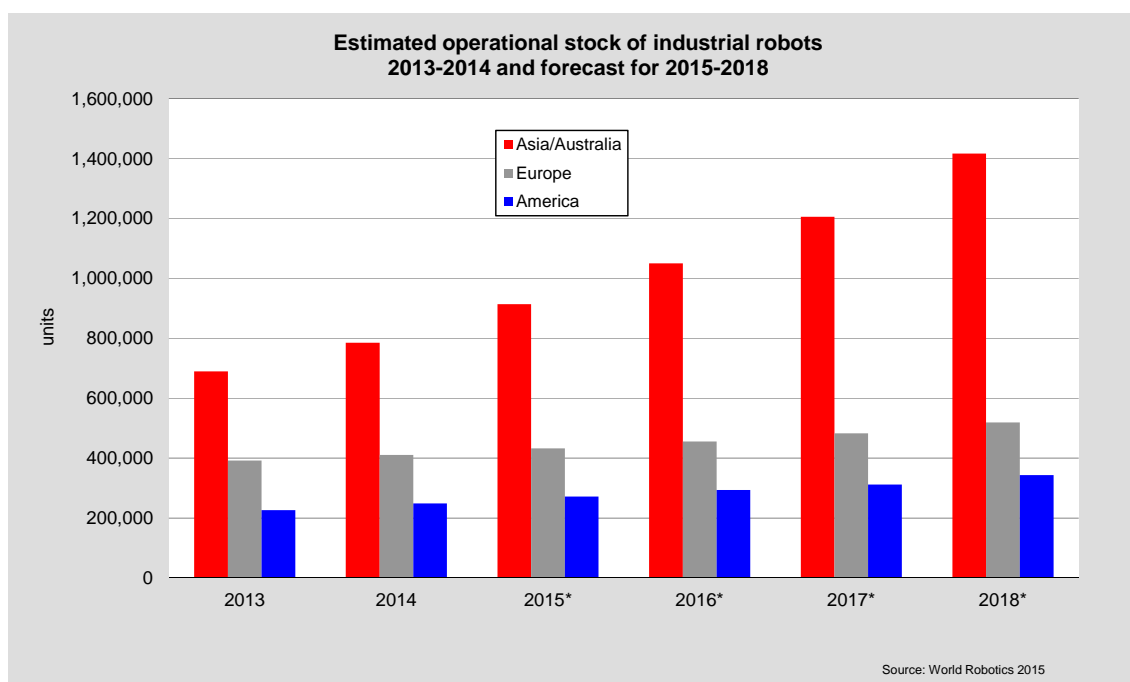
Estimated operational stock of multipurpose industrial robots at year-end in selected countries. Number of units

Country	2013	2014	2015*	2018*
America	226,071	248,430	272,000	343,000
Brazil	8,564	9,557	10,300	18,300
North America (Canada, Mexico, USA)	215,817	236,891	259,200	323,000
Other America	1,690	1,982	2,500	1,700
Asia/Australia	689,349	785,028	914,000	1,417,000
China	132,784	189,358	262,900	614,200
India	9,677	11,760	14,300	27,100
Japan	304,001	295,829	297,200	291,800
Republic of Korea	156,110	176,833	201,200	279,000
Taiwan	37,252	43,484	50,500	67,000
Thailand	20,337	23,893	27,900	41,600
other Asia/Australia	29,188	43,871	60,000	96,300
Europe	392,227	411,062	433,000	519,000
Czech Rep.	8,097	9,543	11,000	18,200
France	32,301	32,233	32,300	33,700
Germany	167,579	175,768	183,700	216,800
Italy	59,078	59,823	61,200	67,000
Spain	28,091	27,983	28,700	29,500
United Kingdom	15,591	16,935	18,200	23,800
other Europe	81,490	88,777	97,900	130,000
Africa	3,501	3,874	4,500	6,500
not specified by countries**	21,070	32,384	40,500	41,500
Total	1,332,218	1,480,778	1,664,000	2,327,000

Sources: IFR, national robot associations.

*forecast

** reported and estimated sales which could not be specified by countries



2. World Robotics 2015 Service Robots

The total number of professional service robots sold in 2014 rose by a solid 11.5% compared to 2013 to 24,207 units up from 21,712 in 2013. The sales value slightly increased by 3% to US\$3.77 billion. Since 1998, a total of about 172,000 service robots for professional use have been counted in these statistics. It is not possible to estimate how many of these robots are still in operation due to the diversity of these products resulting in varying utilization times. Some robots (e.g. underwater robots) might be more than 10 years in operation (compared to an average of 12 years in industrial robotics). Others like defence robots may only serve for a short time.

With 11,000 units, service robots in defence applications accounted for 45% of the total number of service robots for professional use sold in 2014. Thereof, unmanned aerial vehicles seem to be the most important application and their sales increased by 7% to 9,022 units. A number of 1,629 unmanned ground based vehicles which include e.g. bomb fighting robots were sold, 9% less than in 2013. The number of demining robots was 350 units in 2014, compared to 300 units in 2013. The value of defence robots can only roughly be estimated. It was about US\$1,023 million, 13.5% more than in 2013. This accounts to about 27% of the total sales of professional service robots. However, the true number of these robots as well as the value might be significantly higher.

5,180 milking robots were sold in 2014 compared to 4,790 units in 2013, representing an 8% increase. 160 units of other robots for livestock farming such as mobile barn cleaners or robotic fencers for automated grazing control were sold in 2014, resulting in an increase of 33%. The total number of field robots sold in 2014 was about 5,700 units, accounting for a share of 24% of the total unit supply of professional service robots. The sales value of field robots increased by 12% to US\$989 million, accounting for about 26% of the total value of professional service robot sales. Other robots used for livestock farming as well as agricultural robots are getting grounded in the market also. Automation of farming and livestock breeding is increasing. 69% of the total unit sales of professional service robots in 2014 were defence or field robots.

Sales of medical robots decreased by 5% compared to 2013 to 1,224 units in 2014, accounting for a share of 5% of the total unit sales of professional service robots. The most important applications are robot assisted surgery and therapy with 978 units sold in 2014, 6% less than in 2013. The total value of sales of medical robots decreased to US\$1,317 million, accounting for 35% of the total sales value of the professional service robots. Medical robots are the most valuable service robots with an average unit price of about US\$ one million, including accessories and services. Therefore, suppliers of medical robots also provide leasing contracts for their robots.

2,644 logistic systems were installed in 2014, 27% more than in 2013, accounting for 7% of the total sales of professional service robots. 2,164 automated guided vehicles in manufacturing environments and 400 in non-manufacturing environments are building up an increase of 29% compared to automated guided vehicles sales numbers in 2013. It is assumed that the actual number of newly deployed systems is far higher. The value of sales of logistic systems is estimated at about US\$261 million. Medical robots as well as logistic systems are well established service robots with a considerable growth potential. About 1,800 mobile platforms in general use, 150% more than in 2013 were sold in 2014. Sales of all other types were still considerably low or no reliable information was available.

In 2014, about 4.7 million service robots for personal and domestic use were sold, 28% more than in 2013. The value of sales increased to US\$2.2 billion.

Service robots for personal and domestic use are recorded separately, as their unit value is generally only a fraction of that of many types of service robots for professional use. They are also produced for a mass market with completely different pricing and marketing channels.

So far, service robots for personal and domestic use are mainly in the areas of domestic (household) robots, which include vacuum and floor cleaning, lawn-mowing robots, and entertainment and leisure robots, including toy robots, hobby systems, education and research.

Handicap assistance robots have taken off to the anticipated degree in the past few years. In 2014, a total of 4,416 robots were sold, up from 699 in 2013 - an increase of 542%. This increase is partly due to a more complete coverage. Numerous national research projects in many countries concentrate on this huge future market for service robots. In contrast to the household and entertainment robots, these robots are high-tech products.

The market of robots for personal transportation could not be surveyed sufficiently because the available information was poor. However, this market as well as home security and surveillance robots will gain importance in the future.

In 2014, it was estimated that 3.3 million robots for domestic tasks, including vacuum cleaning, lawn-mowing, window cleaning and other types, were sold. The actual number might, however, be significantly higher, as the IFR survey is far from having full coverage in this domain. The value was about US\$1.2 billion. Compared to 2013, this represents an increase of 24%.

As for entertainment robots, about 1.3 million units were counted in 2014, 40% more than in 2013. Numerous companies, especially Asian ones, offer low-priced "toy robots". But among those mass products, there are increasingly more sophisticated products for the home entertainment market. For many years now, the LEGO® Mindstorms® programme has belonged to the more high quality products offering software environments which reach well into high-tech robotics.

Projections for the period 2015-2018:

About 152,400 new service robots for professional use to be installed

Turning to the projections for the period 2015-2018, sales forecast indicate an increase to about 152,375 units with a value of US\$19.6 billion.

Thereof, about 58,800 robots for defence applications will be sold in the period 2015-2018. They are followed by milking robots with about 28,600 units. This is probably a rather conservative estimate. These two service robot groups make up 60% of the total forecast of service robots at the current time.

A strongly growing sector will be mobile platforms in general use. Service robot suppliers estimate that about 16,000 mobile platforms as customizable multi-purpose platforms use will be sold in the period 2015-2018. Also, sales of logistic systems will increase considerably in this period. More than 14,500 units are estimated, thereof, about 13,300 automated guided vehicles. About 700 robots for rescue and security applications will be sold between 2015 and 2018 mainly surveillance and security robots. Robots for professional cleaning will increase to about 6,650 units in the same period, mainly systems for floor cleaning. About 7,800 medical robots will be sold plus 4,000 robots for inspection and maintenance.

These forecasts are, as mentioned earlier, based mainly on individual sales projections by companies and professional organizations. It is the opinion of the IFR Statistical Department that the forecasts should be seen as trends concerning market direction rather than actual and precise sales forecasts.

Projections for the period 2015-2018:

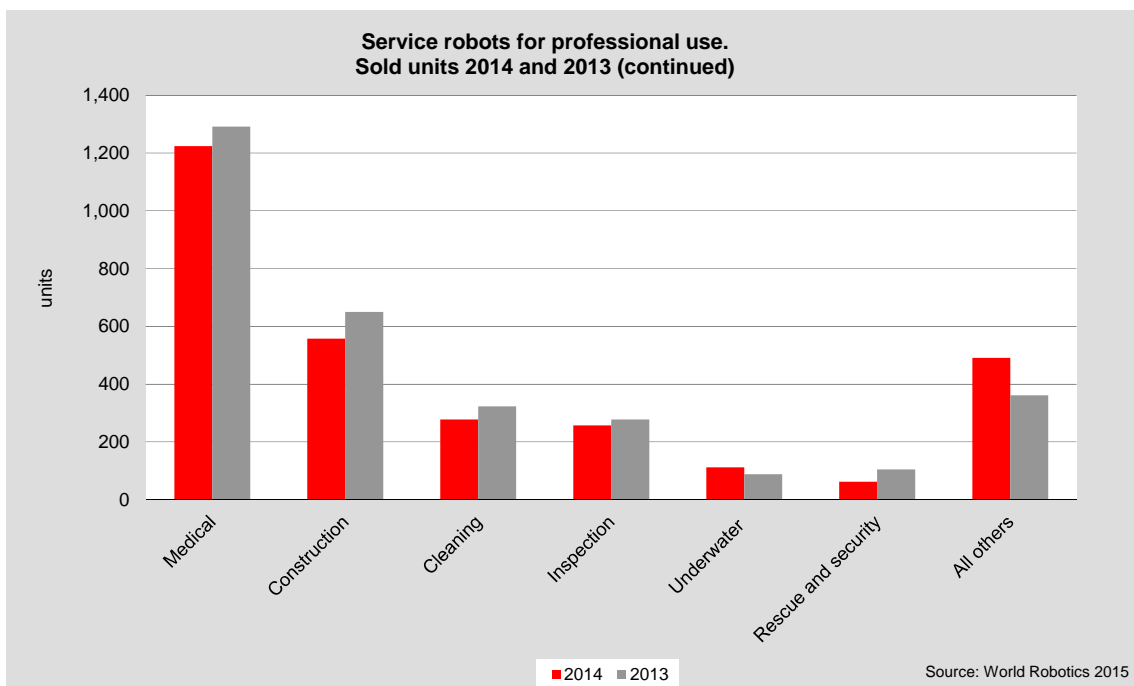
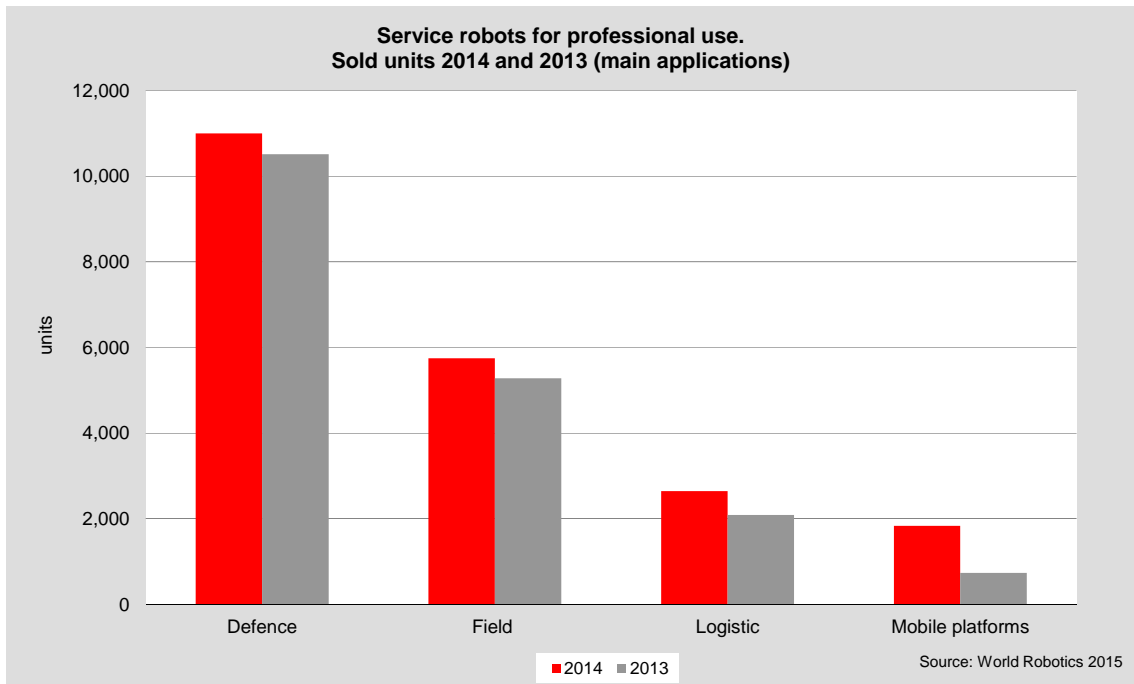
About 35 million units of service robots for personal use to be sold

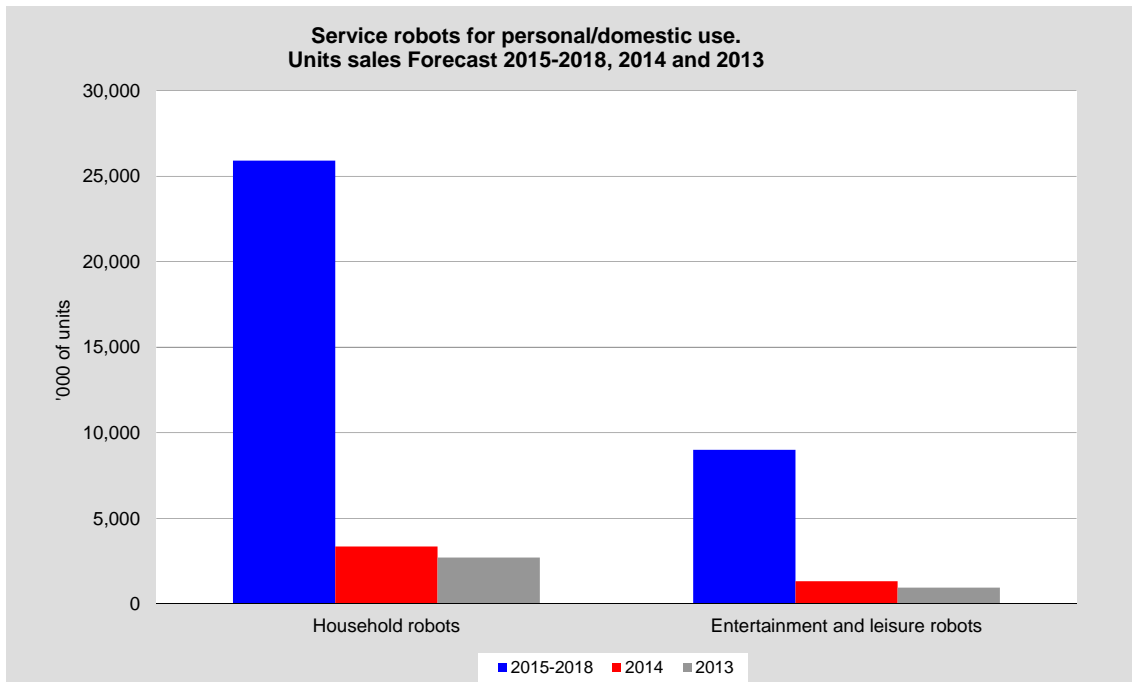
Vacuum and floor cleaning robots will enter more and more households in the world. It is estimated that between 2015 and 2018 about 25.2 million units will be sold. Regarding lawn-mowing robots, another 496,500 units are forecast for the period 2015-2018.

Sales of robot companions/assistants/humanoids are projected that between 2015 and 2018 8,100 units of these robots will be sold. However, up till now, there have been no significant sales of humanoids as human companions to perform typical everyday tasks in production, office or home environments. Quite a few Japanese companies (HONDA, Kawada, Toyota and some others) and also American, Korean and European companies are in the process of developing these general-purpose robot assistants beyond the toy and leisure stage. First shipments of these humanoid robots started in 2004 to international laboratories and universities as high-end robotics research and development platforms. So, this forecast seems to be realistic for the period between 2015 and 2018 especially given the recent product successes in the field.

It is projected that sales of all types of robots for domestic tasks (vacuum cleaning, lawn-mowing, window cleaning and other types) could reach almost 25.9 million units in the period 2015-2018, with an estimated value of US\$12.2 billion. The size of the market for toy robots and hobby systems is forecast at about 6 million units, most of which for obvious reasons are very low-priced. About 3 million robots for education and research are expected to be sold in the period 2015-2018.

Sales of all types of entertainment and leisure robots are projected at about 9 million units, with a value of about US\$7.6 billion. Sales of robots for elderly and handicap assistance will be about 12,400 units in the period of 2015-2018. This market is expected to increase substantially within the next 20 years.







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Schedule

- Welcome and introduction of the attendees
- Sales, Forecast, Trends – Human-Robot Collaboration
World Robotics Industrial Robots
- Sales, Forecast, Trends
World Robotics Service Robots
- Questions
- Get together and personal interviews



Source: Fanuc

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Arturo Baroncelli
 IFR President
 Business Development Manager,
 Comau Robotics, Italy



Joe Gemma
 IFR Vice President
 President and CEO,
 KUKA Robotics Corp, USA



Martin Hägele
 Chairman IFR Service Robot Group
 General Head of Department "Robot and
 Assistive Systems",
 Fraunhofer IPA, Germany



Gudrun Litzenberger
 IFR General Secretary, Frankfurt

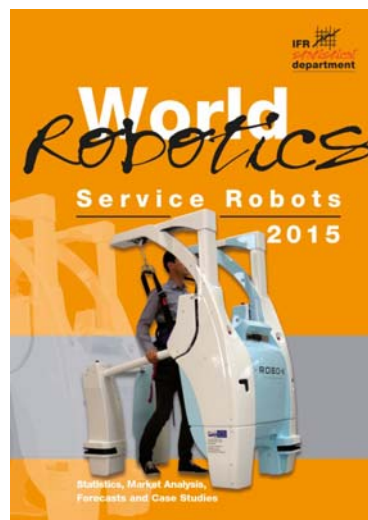
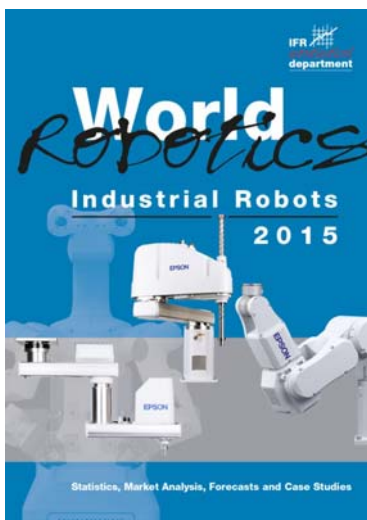


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World Robotics 2015



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International Federation of Robotics

Represents the global robotics industry

Robotics turnover 2014: \$32 billion

>50 members:

- National robot associations

- R&D institutes

- Robot suppliers

- Integrators

Sponsor of the International Symposium on Robotics (ISR)

Co-Sponsor of the IERA Award

Primary source for world-wide data on use of robotics – IFR Statistical Department



IFR
International
Federation of
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Robotics

Industrial Robots are conquering the world

Arturo Baroncelli
Joe Gemma



IFR
Statistical
department

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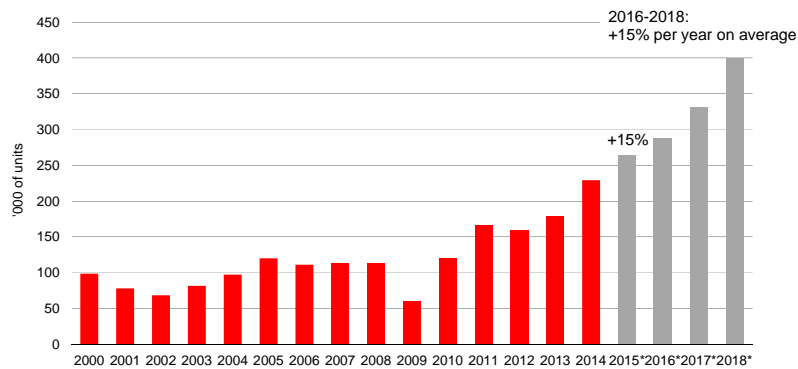


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Continued double digit growth

Worldwide annual supply of industrial robots
2000 - 2018*



*forecast

Source: IFR World Robotics 2015

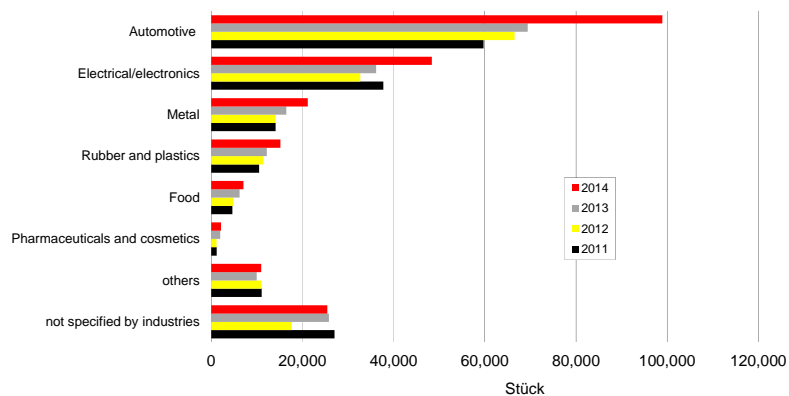
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Main drivers: automotive and electronics

Estimated worldwide annual supply of industrial robots
at year-end by main industries 2011 - 2014



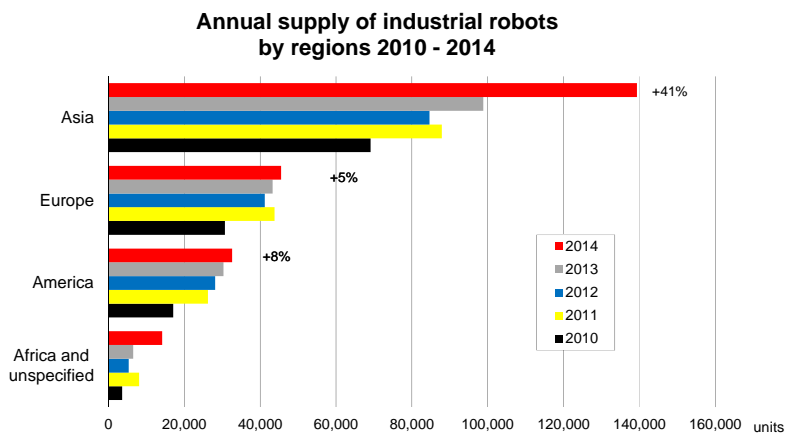
Source: IFR World Robotics 2015

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2014: Asia is the driver of the growth



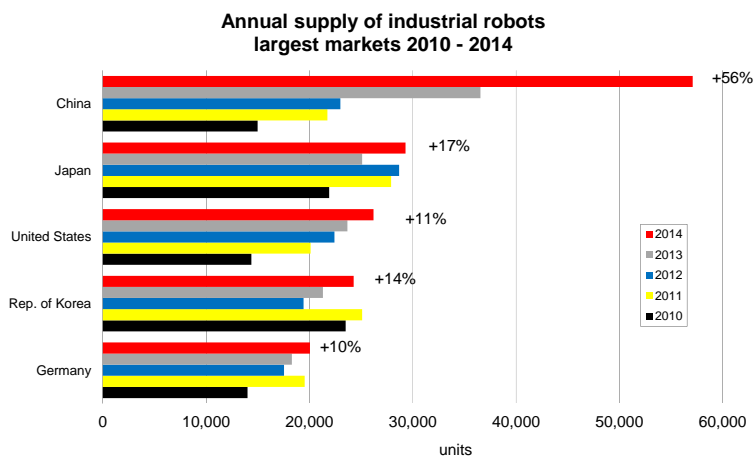
Source: IFR World Robotics 2015

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2014: about 70% of global supply in 5 markets



Source: IFR World Robotics 2015

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China: Rapid increase of robot installations

Annual supply of industrial robots to China
2005 - 2014



Source: IFR World Robotics 2015

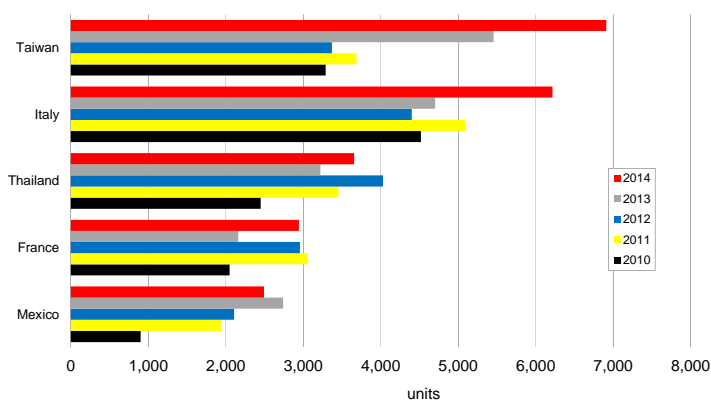
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Increasing importance of Taiwan Strong recovery in Italy

Annual supply of industrial robots
largest markets - continued 2010 - 2014



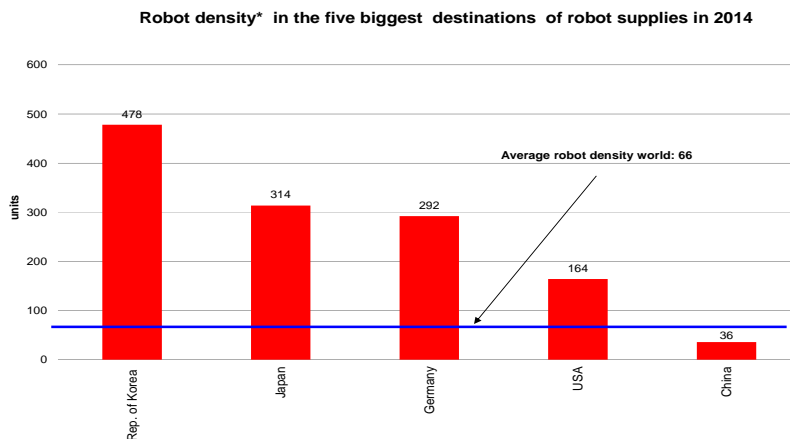
Source: IFR World Robotics 2015

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Still very low robot density in China



*Number of multipurpose industrial robots (all types) per 10,000 employees in the manufacturing industry (ISIC rev.4: C) 2014

Source: IFR World Robotics 2015

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Main trends 2015-2018: Industry 4.0

- Robots will play an important role in the new era of manufacturing: Industry 4.0
- Manufacturing will be transformed
 - Communication is all around
 - Integration of machinery, warehousing systems and production facilities as Cyber-Physical Systems
 - Vast increase of flexibility, cost effectiveness and productivity in smart factories
 - Jobs in factories will change
 - workers will be freed from repetitive routine tasks, and
 - will focus on jobs that require judgment, common sense, creativity, problem-solving skills and dexterity.

Source: IFR World Robotics 2015

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Main trends 2015 and 2018

■ Breakthrough of human-robot collaboration

- industrial robots assist workers in a variety of tasks
- improve manufacturing quality and processes
- increase productivity
- assist an aging workforce, e.g. in physically demanding tasks



Source: KUKA

Source: IFR World Robotics 2015

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Main trends 2015 and 2018

■ Simplification of the use of robots

- essential for all industries to be able to sustain efficient and flexible manufacturing
- High potential in small and medium sized companies



Source: Universal Robots

■ Mobile Robots

- support human-robot collaboration, and
- flexible manufacturing
- important tool for Industry 4.0



Source: KUKA

Source: IFR World Robotics 2015

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Bright prospects for robots between 2015 and 2018

- Most important driver of the growth: China
- And other Southeast Asian countries
- Continued increase of demand from North America
- Increasing sales in Western European countries
- Sales to Eastern European countries will gain momentum



Source: Yaskawa

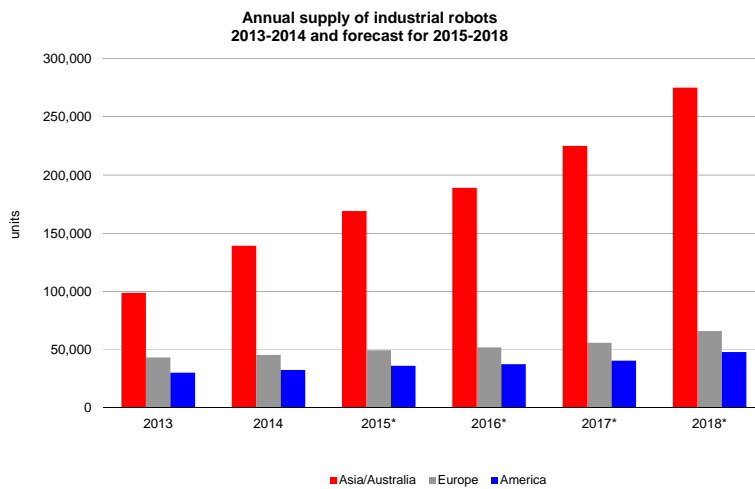
Bright prospects for robots between 2015 and 2018

- Automotive still strong
- High volume electronics manufacturing
- General Industry will grow faster
- Energy-efficiency and using new materials require continued retooling
- Decline in products' life cycle and increase in the variety of products require flexible automation



Source: ABB

2015-2018: above average increase in Asia

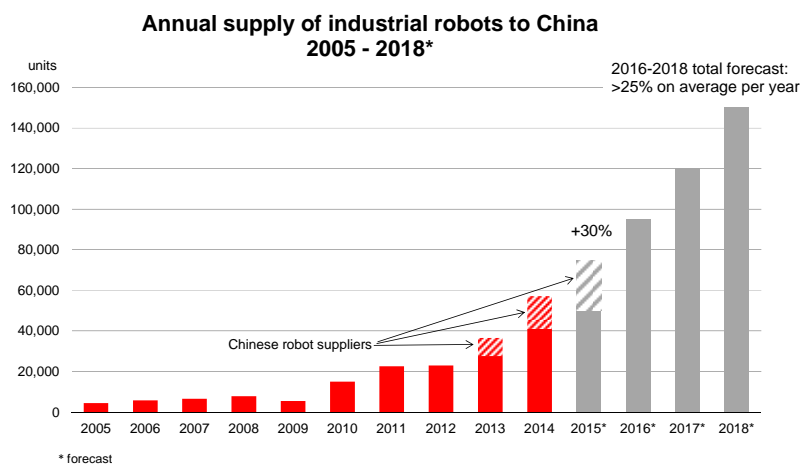


Source: IFR World Robotics 2015

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China: Continued substantial increase



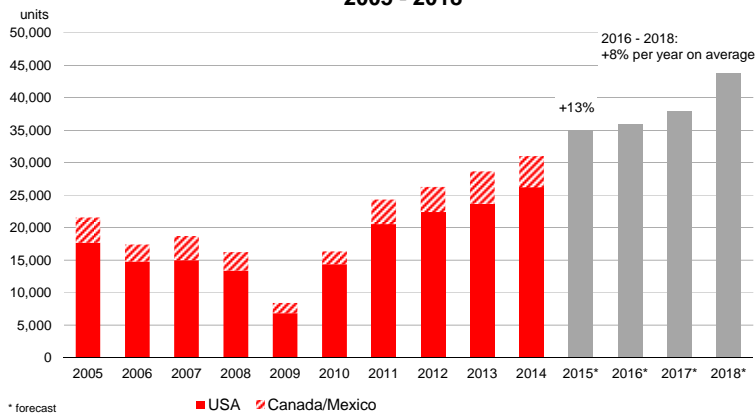
Source: IFR World Robotics 2015

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North America: continued growth

Annual supply of industrial robots to North America
2005 - 2018*



Source: IFR World Robotics 2015

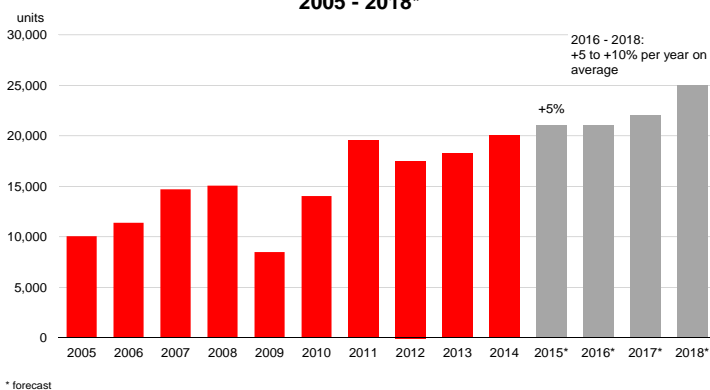
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Germany: general industry will gain in importance

Annual supply of industrial robots to Germany
2005 - 2018*



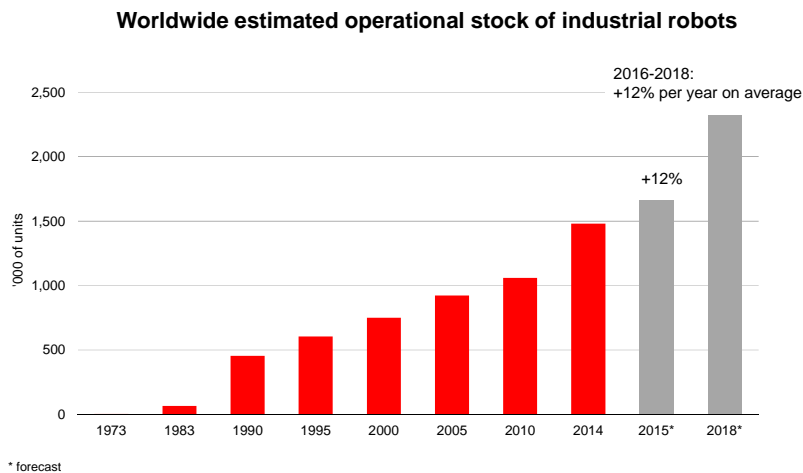
Source: IFR World Robotics 2015

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2018: 2.3 million robots in operation

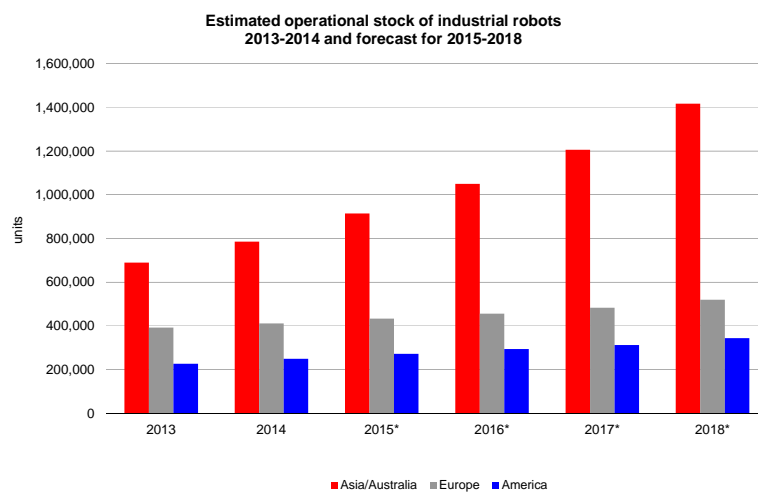


Source: IFR World Robotics 2015

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2018: 1.4 million robots in operation in Asia



Source: IFR World Robotics 2015

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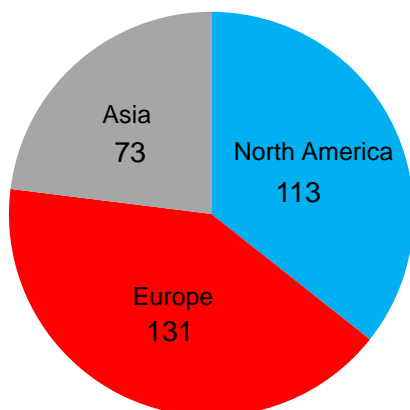


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Number of service robot manufacturers of all types by region of origin



- World Robotics Database: over 300 companies world-wide
- 15% of service robot suppliers are start-ups (criteria: technology-driven, company age under five years)
- „Start-up“-share growing quickly

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By 2018: Sales of service robots for personal and domestic use will increase to 35 million units

■ Main categories:

- Vacuum and floor cleaning
- Lawn-mowing robots
- Entertainment and leisure robots
- Robots for elderly and handicap assistance

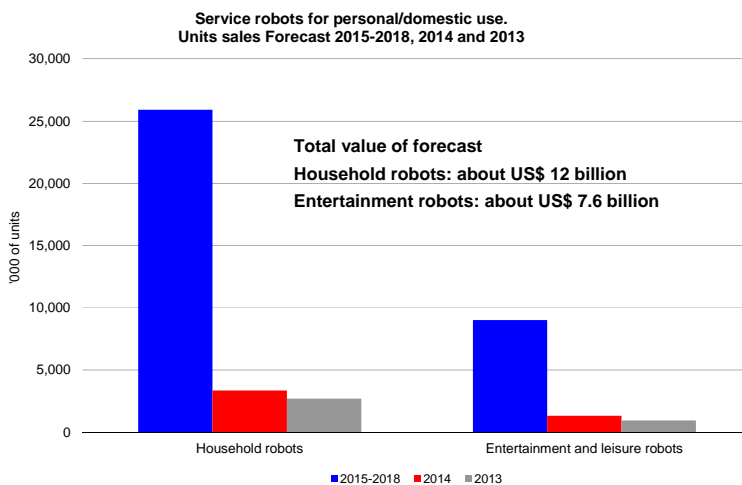


Source: Vorwerk (Vacuum cleaning)



Source: Manon Briod and Maria Beltran

By 2018: about 25 million household robots



Source: IFR World Robotics 2015

Future market for private handicap assistance

- Handicap assistance robots have taken off to the anticipated degree in the past few years.
- Strong increase in 2014
- Rapid longer-term growth expected
- Need for care will increase
 - Increasing number of disabled persons
 - Demographic shift



Source: Yujin Robot



Source: Focal Meditech BV, Netherlands

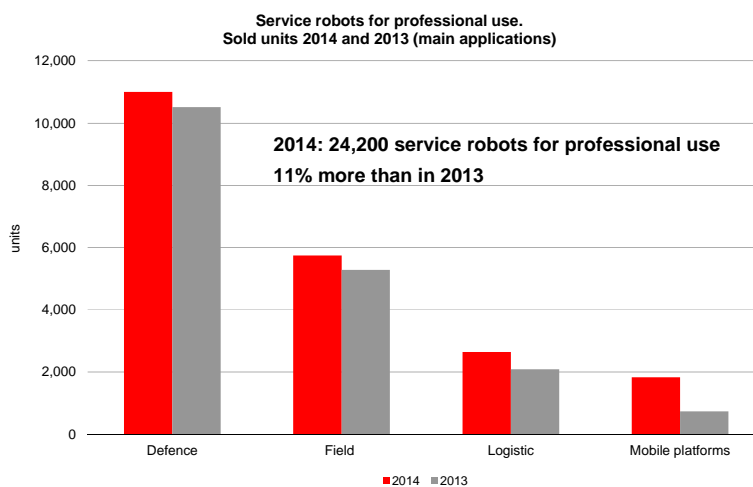
Source: IFR World Robotics 2015

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2014: Increase in all important applications



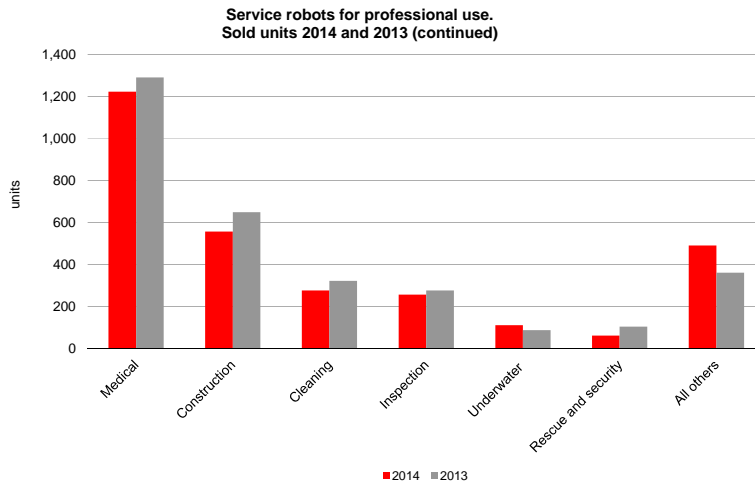
Source: IFR World Robotics 2015

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2014: Unit sales in low volume applications decreased



Source: IFR World Robotics 2015

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Trends in the service robot market

- Exoskeletons on the rise
 - Rehabilitation
 - Ergonomic support for reducing loads



Source: AlterG, USA



Source: Cyberdyne, Japan

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Trends in the service robot market

- Logistic systems on the rise:
 - 2,700 units (mainly AGVs) installed in 2014, +27%
 - At least 14,500 units will be sold 2015-2018
- High growth potential for logistic systems
 - Human-Robot-Collaboration
 - Industrial and non-industrial sectors



Source: Panasonic



Source: Bluebotics

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Other important service robot applications with considerable growth potential

- Medical systems
 - Diagnostic systems
 - Robot assisted surgery or therapy
 - Rehabilitation systems
- Field robots, especially
 - Milking robots
 - Farming and livestock breeding systems
- Mobile platforms in general use



Source: BA Systems



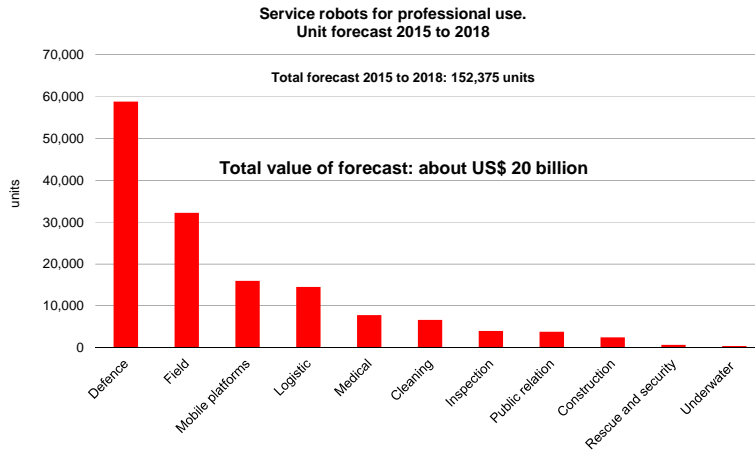
Source: Lely

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2015-2018: about 152,400 new service robots for professional use



Source: IFR World Robotics 2015

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