

## INDUSTRIAL ROBOTS AND SERVICE WORLDWIDE

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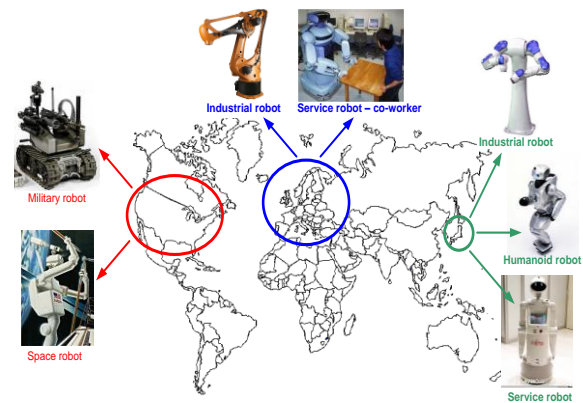


Fig.1 World Center of Robotics

### Abstract

The article deal about the development in the field of robotic research. The year 2010 was a break-through and since that year the production of industrial robots has increased each year and the estimated number of produced robots in 2015 is 200 000. The paper also points out the increasing trend of use of service robots as well as mentions main producers and countries with high potential deployment of robots.

**Key words:** Industrial, robots, service robotics

### INTRODUCTION

Major manufacturers of robots in a period of decline deployment of industrial robots to industry mainly to the automotive industry started to invest more in to the development of robotics for service field, service activities and today also to personal robots. The world's leading robotics development as Japan, USA, Europe and South Korea (Fig. 1). USA dominate in service robotics for militarypurpose mobile robots off-road. They are unique in robots Space and the development of interplanetary robots. In Japan and South Korea are widely developed research activities manufacturing and service robotics, which category includes humanoid robots. They are mainly designed for domestic robots, for fun or rescue. It turns out that it will be in the next 10 years one of most traded goods. Japan and South Korea see the next great potential in the development of robots for elderly care.

Japan has traditionally been strong in industrial robotics. In Europe, dominated by industrial robots and in the service robotics predominant focus on mobile robotics, and transport and logistics mainly outdoors (in urban environment). The second area are robots to work with humans.

The history of deployments of robots, characterized by the permanent growth, recorded in years 1992 – 1994 declines in sales of industrial robots. It was caused mainly due to the reduction of their deployment particularly in the automotive industry. The major manufacturer of robots in fear from the market saturation in the field of industrial robots, started to invest more in the development of robots for area of service activities and various other non-industrial activities. Experience to date shows that non-industrial field of robotics opens wide scope of activity. This trend has technical support in the development of control and communications technology as well as sensors and actuators. . Service robots are developed for many applications, are able to refuel the fuel for cars, airplanes, clean the windows on tall buildings, penetrate to work under the water, and are an invaluable aid in various disasters for firefighters, police and army. They assist to the doctors and know to operate. The emerging new category of robots is called personal robots for fun, sport, and disabled people and so on.

### Development of industrial robots

The period around the year 1985 is called golden age of industrial robots. It was the period of the expansion of robots into the automotive and electronic industry. During this period the number of installed robots stood increase at twice the previous three years. However in years 1992 – 1994 was stagnation and statistics recorded up to 30% decrease in production of industrial robots compared to the estimated forecasts. The reason was the saturation in traditional fields of industry. The fields of new application were dynamically expanded in the following period. The robots application is transferred from classical engineering field to non-engineering and even non-industrial fields and services. The year 2010 is

known as the year of the comeback in the production of industrial robots. It follows from the fact that in 2009 there were a decline in the annual installaHowever, in 2010 the number of installed industrial robots reached number 140 000 and from that of year there is increasing number of installed robots every year. In the year 2014 it was more than 220 000 installed robots according of IFR (International Federation of Robotics). The assumption for year 2017 is to achieve a magical value of 300 000 installed industrial robots, see fig. 2. The annual number of installed robots in the period 2011- 2014, according to industry sectors shown in fig. 3 robots expectations increase for the years 2017 and 2018 in Europe, Asia and America, shown in fig. 4.

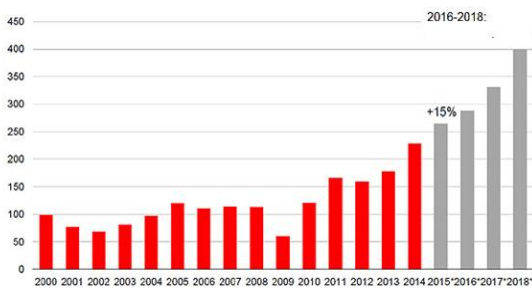


Fig.2 Global annual demand for industrial robots

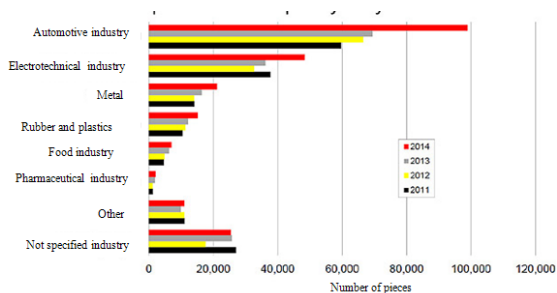


Fig. 3 Global annual demand of industrial robots by main industries 2011 – 2014

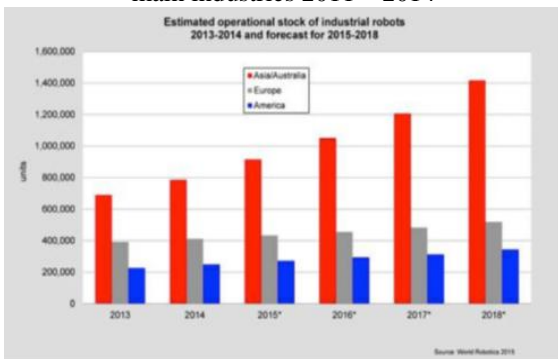


Fig.4 Estimated operation stock of industrial robots 2013 – 2014 and forecast for 2015 - 2018

A next trend in development of industrial robots is to equip with two arms, so called collaborative robots, Fig.5.



Fig. 5 Colaborative robots

This robots construction copied function of human arms, it has 15- teen and more DoF. They are predetermined for complicated assembly and manipulating operations. For the increasing demands on accuracy, movement speed, but also for reliability, these concepts are no longer able to move its technical capabilities and the respond is the introduce of robots based on the concept of parallel kinematic structures, (tripod, hexapod,...).

Advantages of this robots approach include, for example accuracy to 0.0025 mm, greater speed (up to three times) at high accelerations, the ratio of load to tare is 1:1.7 (in traditional articulated robots is the ratio 1:10) and so on.

**Service robotics**

The service robots differ principally from the industrial robots not only in their construction but also in the set of their utility properties. Difference is mainly in the fact that the service robots are fully autonomous devices, which do not have their activity programmed in details in advance as industrial robots. They conduct their activity step by step and according to the situation development at their working scene and related surroundings. Information needed for such devices are obtained from various types of sensors, for examples for the working area monitoring exploited are the ultrasonic sensors, laser scanners and camera systems.

The main differences between service and industrial robots are:

- Construction: architecture and modular structure,
- Mobility: function of movements in the operating area,
- Control: they are navigated to achieve the goal,
- Collision situation solution: detection of obstacles and objects within the space, ways to overcome barriers
- Furnishing with the sensors: sensor of vision, touch,
- Safety: in relation to the interface human-device, to own safety and to the objects existing within the zone of activity.

The total number of professional service robots sold in 2015 rose considerably by 25% to 41,060 units up from 32,939 in 2014. The sales value increased by 14% to US\$ 4.6 billion. Since 1998, a total of about 220,000 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 life time of 12 years in industrial robotics).

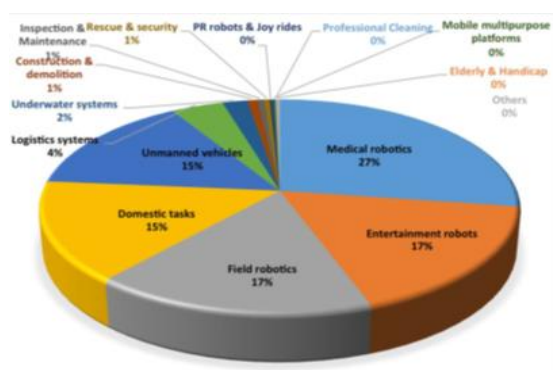


Fig. 6 Area of service robots are deployed in fig. 6

In 2015, about 5.4 million service robots for personal and domestic use were sold, 16% more than in 2014. The value of sales increased by 4% to US\$2.2 billion. About 333,200 new service robots for professional use to be installed for the period 2016-2019.

Significant results were obtained in the development of the field of humanoid robotics. Humanoid robotics integrates the knowledge and constructions of the industrial and service robots with latest knowledge in the field of cognitive science. The result is the robot with high similarity to human. New field of the development, along with the construction solutions of the humanoid robots, is their interaction with the human. Actually research and experiments in the field of construction of humanoid robots are aimed to achieve human movements.

Other fields are research and experiments are:

- Equipment with the sensors for the environment recognition,
- Development of new generation of control,
- Implementation of methods of the artificial intelligence for decision making,
- Speaking and understanding of the human speech.

We can see two directions in the development of the humanoid robots. The first direction is to develop humanoid robot as a

personal assistant to human – “robot partner”. The second direction is to develop humanoid robot to replace humans in certain activities.

## CONCLUSION

Robotics represents one of the most dynamically developing fields. Robot represents the complex product, which includes the field of research and also applications. But robot is also the product, which appears not only as a “worker” in servicing the machines, but also as a “surgeon”, “cleaner”, “nurse”, “actor”, “football player”, “bricklayer”, “toy”, “alive animal”. Although these robots are still far from the actual reality of the beings which represents, the development technologies reduce this shortage.

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Projekt č. 059TUKE-4/2014