EXECUTIVE SUMMARY

2006 World Robot Market

Total world-wide sales:

- **112,200 units, down 11% on 2005**

World total stock of operational industrial robots:

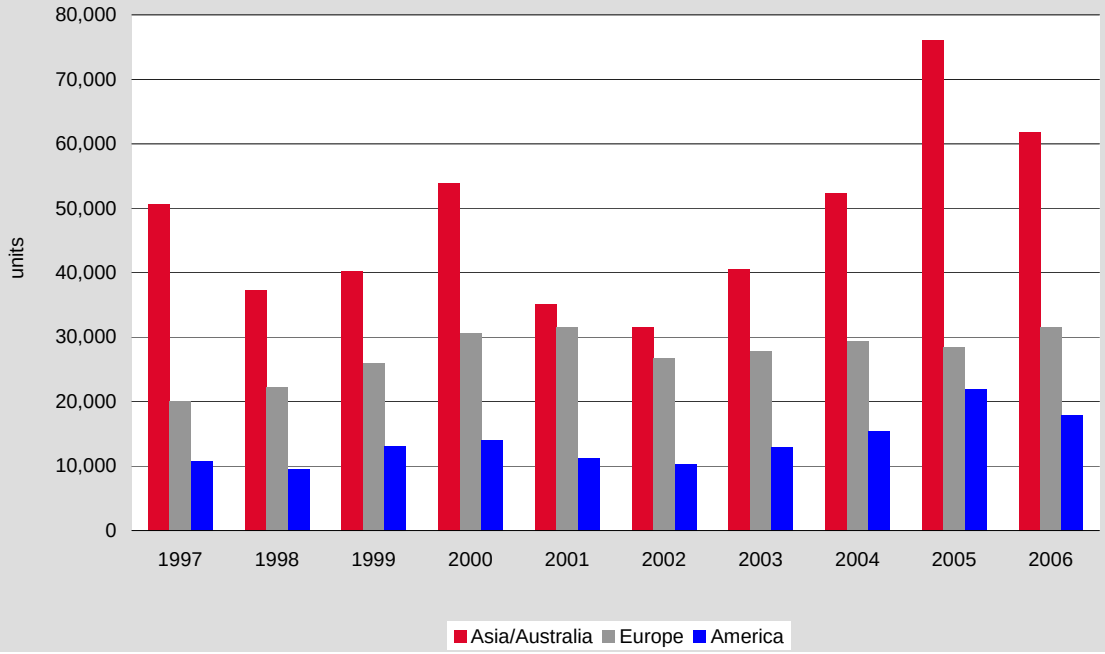
- **951,000 units,3% greater than 2005**

The world market decreased by 11% in 2006.....

After the peak in 2005, the world market was down by 11% in 2006, at 112,203 newly supplied industrial robots. Nevertheless, developments were quite dissimilar in the three large industrial regions of Europe, America and Asia. After huge investments in the previous year, robot sales in Asia and America plummeted in 2006. Europe recovered after a weak year in 2005. In 2006, world-wide shipments to the **automotive industry** decreased by 17% compared to 2005. Across the total **electrical/ electronics industry** (including office and computing machinery and equipment, radio, TV and communication devices and equipment, and medical, precision and optical instruments), installations surged by 88% in 2005, to 28,600 units. This was the second year in a row that has seen huge increases in robot installations in these industries. Thus it is not surprising that in 2006, investment slowed down.

Robot sales to the **fabricated metal products industry,** the **chemical industry** and **the food industry** increased substantially.

Figure 1 Estimated yearly shipments of industrial robots



In 2006, more than 61,700 robots were supplied to **Asian** countries (including Australia and New Zealand), about 19% fewer than in 2005. The electrical/electronics industry in Asia, which invested very

heavily in 2005, cut robot purchases by half. Supplies to the automotive industry also decreased slightly. Supplies to all other industries – in particular the metal products and machinery industry, the chemical industry and the food industry – surged.

In Japan, supplies fell by 26%, to about 37,400 units. After the substantial investments within the automotive and electrical/electronics industry in 2005, purchases in both sectors were down in 2006. The sharp fall was compensated by increased sales to the machinery and metal industry as well as to the chemical industry.

In 2006, about 10,800 industrial robots were ordered for destinations in the Republic of Korea, down 17% from 2005. In 2005, the supply was about 13,000 units, which was largely the result of strong demand from the electronic components industry and more complete reporting on robots in this particular industry. In 2006, this sector cut investments by almost 70%. This sharp fall has been somewhat offset by a huge increase in robot supplies to the automotive industry and the communications industry.

China was the third largest robot market in Asia, with 5,800 newly installed robots, about 29% more than in 2005. The automotive industry is still the predominant user of industrial robots, but the rubber and plastics industry and the electrical/electronics industry are gaining in importance. **In 2006, the number of industrial robots supplied in India almost doubled**, to about 850 robots. At the moment, The actual numbers are quite small, but this escalation in the supply of robots testifies to the dynamism of the Indian market.

Total supplies in all other Asian markets, including**, Indonesia, Malaysia, the Philippines, Singapore, Taiwan (Province of China), Thailand and Vietnam**, decreased by 7%.

In the Americas, robotics investments were down by 18 percent, to about 17,900 units. Although robot sales to the chemical industry, including the rubber and plastic products industry, increased remarkably in 2006, these increases were not sufficient to offset the sharp cyclical decline in sales to the automotive sector. After the extraordinarily high investments seen in 2005, robotics purchases by automotive companies and their suppliers slowed in 2006 in the highly competitive U.S. and Canadian markets. Sales and production volumes of cars have stagnated or even declined over the last few years, which have also witnessed changes in the respective market shares of the individual manufacturers. American suppliers have reduced capacity and will continue to do so. Nevertheless, the decrease of robot supplies in 2006 is likely to be only temporary, since their Asian and European competitors have announced additional investments in production facilities. In 2007, increasing demand for robots has already been registered. In the first half of 2007, North American orders rose by 39% according to the RIA (Robotics Industry Association), USA. The intense competition in the biggest and most saturated market is set to continue. .

An increasing demand of industrial robots has been registered in **Mexico, Argentina and Brazil**. The deliveries to these countries increased by 10%.

Sales of industrial robots in Europe were up by 11%, to about 31,500 units. This was the result of substantially increasing industrial robot investment by the metal products industry, the rubber and plastics industry and the food and beverages industry. The motor vehicle industry and the automotive parts industry again reduced their purchases in Europe. In **Germany** – the biggest market for industrial robots in Europe – supplies increased by 13% to about 11,400 units. This was the result of surging investments in general industry – all industries except the automotive. Here as well, supply to the automotive industry slightly decreased. It seems that the peak of yearly robot investment within the automotive industry was reached in 2004: Germany as a production site for motor vehicles serves an almost saturated market in Western Europe.

Italy – the second largest market, recovered by 15% to almost 6,300 units. The rubber and plastics industry and the fabricated metal products industry invested very heavily in industrial robots. Sales to all other industries, including the automotive industry, decreased

The yearly supply of industrial robots in **France** has been fairly stable over the last five years, at around 3,000 units. The reason for this similar figure has been the largely stagnant investment climate in the automotive industry and the machinery industry, which has been somewhat compensated by a

significant increase of robot supplies to the metal industry and a remarkable increase of robot supplies to the chemical and food industries.

Sales to **Spain**, the **United Kingdom** and **Sweden** were down. Of the **Eastern European** countries, only the **Czech Republic and Poland** saw a significant increase in robot supplies. Compared to the established robot markets in Western Europe, the Turkish one is still quite minor, with 370 robots supplied in 2006, but it is growing in importance. **Turkey** is becoming an attractive production site for the international automotive industry, along with China, India, Malaysia, the Czech Republic, Slovakia and Iran. Exports of motor vehicles and automotive parts are increasing rapidly: more motor vehicles are now assembled in Turkey than in the United Kingdom or Sweden.

Table 1

Shipments and operational stock of multipurpose industrial robots in 2005 and 2006 and forecasts for 2007-2010.
Number of units

	Yearly installations				Operational stock at year-end			
Country	**2005**	**2006**	**2007**	**2010**	**2005**	**2006**	**2007**	**2010**
America	**21,986**	**17,910**	**21,400**	**24,400**	**143,634**	**154,680**	**167,100**	**209,000**
North America (Canada, Mexico, USA)	21,567	17,417	20,500	23,000	139,984	150,725	162,400	200,900
Central and South America	419	493	900	1,400	3,650	3,955	4,700	8,100
Asia/Australia	**76,047**	**61,748**	**66,000**	**75,000**	**481,652**	**479,027**	**500,500**	**579,900**
China	4,461	5,770	6,600	7,900	11,557	17,327	23,900	47,000
India	450	836	1,600	4,500	1,069	1,905	3,500	14,100
Japan	50,501	37,393	39,900	42,300	373,481	351,658	355,000	362,900
Republic of Korea	13,005	10,756	10,700	11,800	61,576	68,420	73,600	94,000
Taiwan, Province of China	4,096	4,307			15,464	19,204		
Thailand	1,458	1,102			2,472	3,574		
Other Asia	1,163	812			11,095	11,385		
Australia/New Zealand	913	772			4,938	5,554		
Europe	**28,432**	**31,536**	**35,000**	**39,000**	**296,918**	**315,624**	**329,800**	**380,000**
Austria	485	498			4,148	4,382		
Benelux	1,097	1,459			9,362	10,128		
Denmark	354	417			2,661	3,013		
Finland	556	321			4,159	4,349		
France	3,077	3,071	3,300	3,200	30,236	32,110	34,000	38,800
Germany	10,075	11,425	12,700	13,000	126,294	132,594	137,900	147,400
Italy	5,425	6,259	6,900	6,400	56,198	60,049	63,800	72,000
Norway	115	181			811	960		
Portugal	144	268			1,542	1,710		
Spain	2,709	2,409			24,141	26,008		
Sweden	939	865			8,028	8,245		
Switzerland	442	458			3,732	3,940		
Turkey	207	368			403	771		
United Kingdom	1,363	1,220	1,000	800	14,948	15,082	15,300	13,800
Central/Eastern European countries	1,287	1,322			9,446	10,781		
other Europe	157	995			809	1,502		
Africa	**204**	**426**	**700**	**900**	**634**	**1,060**	**1,700**	**4,400**
Total	**126,669**	**112,203**	**123,100**	**139,300**	**922,838**	**950,974**	**999,100**	**1,173,300**

Source: IFR, national robot associations and UNECE (up to 2004)

Total accumulated yearly sales, measured since industrial robots started to be introduced in industry at the end of the 1960s, amounted to more than **1,750,000 units** at the **end of 2006, including, as mentioned before, the dedicated industrial robots installed in Japan up to and including 2000** (see the tables in annex B). Many of the early robots, however, have by now been taken out of service. The stock of industrial robots in actual operation is therefore lower. Based on the assumptions made in chapter I, UNECE and IFR estimate the

total worldwide stock of operational industrial robots
at the end of 2006 between a minimum of 951,000 units
and a possible maximum of 1,200,000 units

The minimum figure above is, as was discussed in chapter I, derived on the assumption that the average length of **service life is 12 years**. A UNECE/IFR pilot study has indicated that the average service life might in fact be as long as **15 years**, which would result in a **worldwide stock of 1,200,000 units**.

When the minimum 2006 stock of 951,000 units is compared with the 923,000 units at the end of 2005, it represents an increase of 3%.

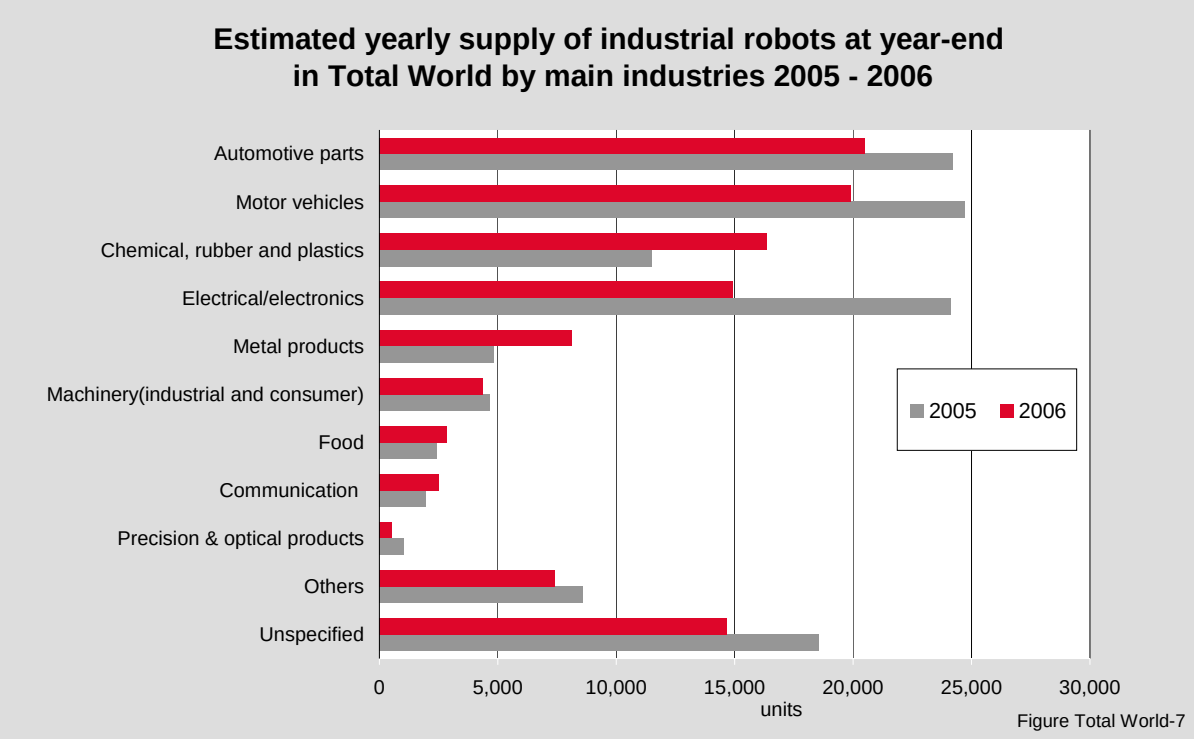


Figure Total World-7

Forecasts for 2007-2010

The world market for industrial robots is projected to increase from 112,200 units in 2006 to 123,100 in 2007. From 2008, it will rise by a yearly average of 4.2.% to 139,300 in 2010.

In 2007, the worldwide supply of industrial robots will increase by 10%. Investments by the automotive industry will be more buoyant than in 2006: In **Europe,** increasing demand has already been registered, especially in **Central/Eastern Europe, Italy, Sweden and Germany**. In **North America**, competition within the automotive industry will cause robot purchases to rise again. Asian car suppliers boosted their investment in the home market as well as overseas. Demand in **China** will grow more moderately. In **India, ASEAN, Central/Eastern Europe and South America** the robot supply will again increase at an above-trend rate. Robot supplies will stagnate in the **Republic of Korea**, while in **Japan** growth of about 7% can be expected. The optimistic view for 2007 in all three regions is partly a result of encouraging robot supplies to 'general industry' – all industries except the automotive. After the decrease in 2006, demand from the electrical/electronics industry also should be higher in 2007.

Robust growth in robot shipments world-wide can be expected between 2008 and 2010. Stagnating or only slowly growing investments by motor vehicle suppliers world-wide will be compensated – to a certain degree - by more vigourous demand across all other industries.

In terms of units, it is estimated that the **worldwide stock of operational industrial robots** will increase from about 951,000 units at the end of 2006 to 1,173,300 at the end of 2010, representing an

average annual growth rate of 5.5%

Measurements of robot density based on the total number of persons employed

In 2001-2006, employment slightly decreased in most of the countries surveyed, while the stock of robots continued to increase. In Japan, the stock of operating robots as well as employment within the sector fell in the period 2001 to 2006.

In **Japan** and in the **Republic of Korea**, which collect data on all types of industrial robots and are therefore not comparable with other countries, have a quite high density of robot installations. In 2006, **349** robots in Japan and **187** robots in the Rep. of Korea were in operation per 10,000 persons employed in the manufacturing industry.

With 186 robots per 10,000 employed in the manufacturing industry **Germany** is the country with highest robot density in Europe, followed by **Italy** with 138 and **Sweden** with 123. In **Finland** the density amounted to 101, followed by the **United States** with 99, **France** with 92, and **Spain** with 79 robots per 10,000 employed in the manufacturing industry. The densities in **Denmark**, **Austria,** the **Benelux, Switzerland, Australia** and the **United Kingdom** ranged between 50 and 75. In **Norway,** the density was 33 and in **Portugal** 19. Countries in central and eastern Europe, with the exception of the **Czech Republic**, have even lower densities.

Despite this large range in the robot densities of the European countries mentioned, it is interesting to note that **the robot density in Germany is about 90% higher than that of the United States**.

Robot densities – 1 robot per 10 workers in the motor vehicle industry

Japan and Italy are in the lead with 1,820 robots and 1,630, respectively per 10,000 workers, but, bearing in mind that Japan includes all types of robots (up to and including 2000), it is not comparable with the densities of other countries. Thereafter follows Germany with a density of 1,220, France 1,160, Spain 970, United States 830, United Kingdom 600 and Sweden 590. The technological level with respect to robotics is thus rather homogeneous in the motor vehicle industry in most of the above-mentioned countries.

Installations of advanced multipurpose industrial robots by types

In 2006, **60%** of the robots installed were **articulated robots**, up from 59% in 2005, 22% were **linear/cartesian/gantry robots**, up from 20% in 2005, 4% were **cylindrical robots,** down from 12% in 2005, and **13% were SCARA robots**, up from 8% in 2005. In table II.15 and II.16 the distribution by countries and by types can be seen. In terms of absolute numbers, the following figures for installations by types of robots were recorded: **67,478 articulated robots installed in 2006, 9% fewer than 2005, 24,148 linear/cartesian/gantry robots, 4% fewer than 2005, 15,509 cylindrical robots, down 71% on 2005** and **1,867 SCARA robots, up 48% on 2005**.

Distribution of service robots

Service robots for professional use: 39,900 units installed up to the end of 2006

With 9,095 units the service robots in **defense, rescue and security applications**, accounted for 23% of the total number of service robots for professional use installed up to the end of 2006 (see table VII.1 and figure VII.1a). Thereafter follow field robots (mainly **milking robots**) with 16%, **cleaning robots** and **underwater systems** with 14%, each. **Construction and demolition robots** (10%), **medical robots** (9%) and **mobile robot platforms for general use** (8.4%) come in the next ranges. Minor installation numbers were counted for logistic systems (1,550 units), inspection systems (nearly 600 units) and public relation robots (about 100 units).

Service robots for personal and private use: about 2.44 million units for domestic use and about 1.1million units for entertainment and leisure sold up to end 2005

Service robots for personal and domestic use are recorded separately, as their unit value is 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 marketing channels.

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

The market for **robots for handicap assistance** is still small, but is expected to double in the next four years. Robots for **personal transportation** and **home security and surveillance robots** will also increase in importance in the future.

Up to the end of 2006, accumulated sales of **vacuum cleaning robots** resulted in 2.35 million units. At the end of 2006, the stock of **lawn mowing robots** amounted to 91,000 units.

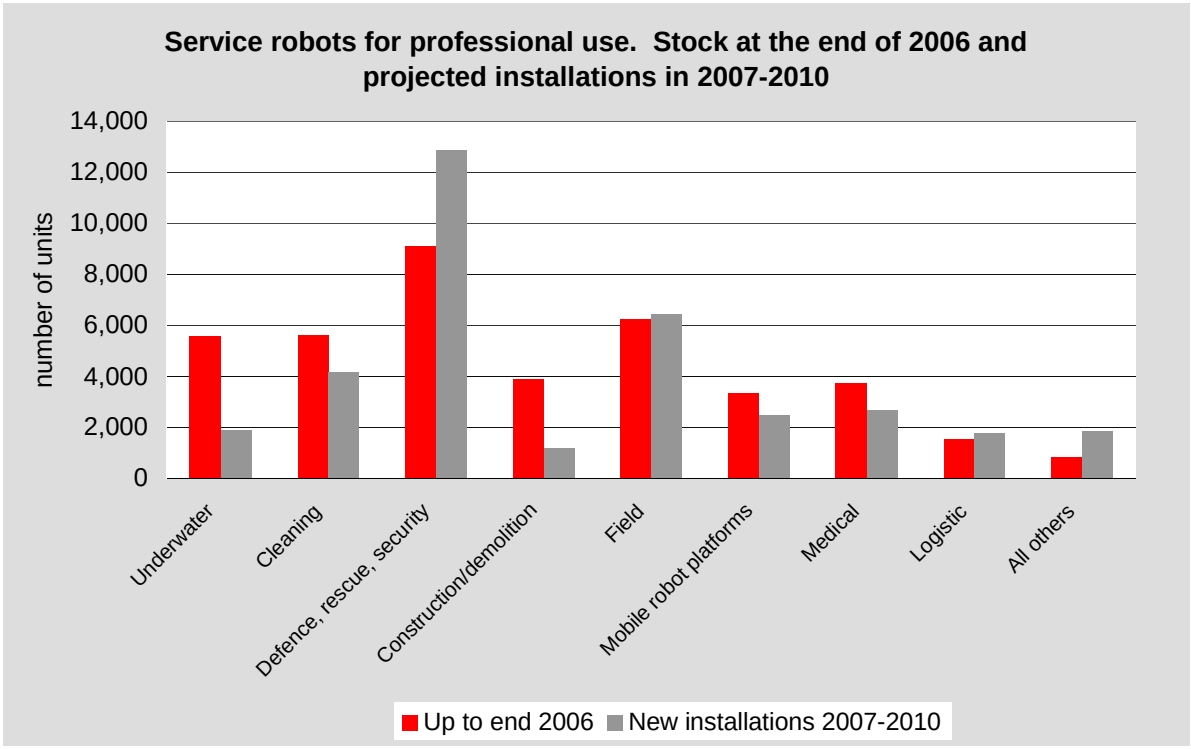
Projections for the period 2007-2010: 35,500 new service robots for professional use to be installed

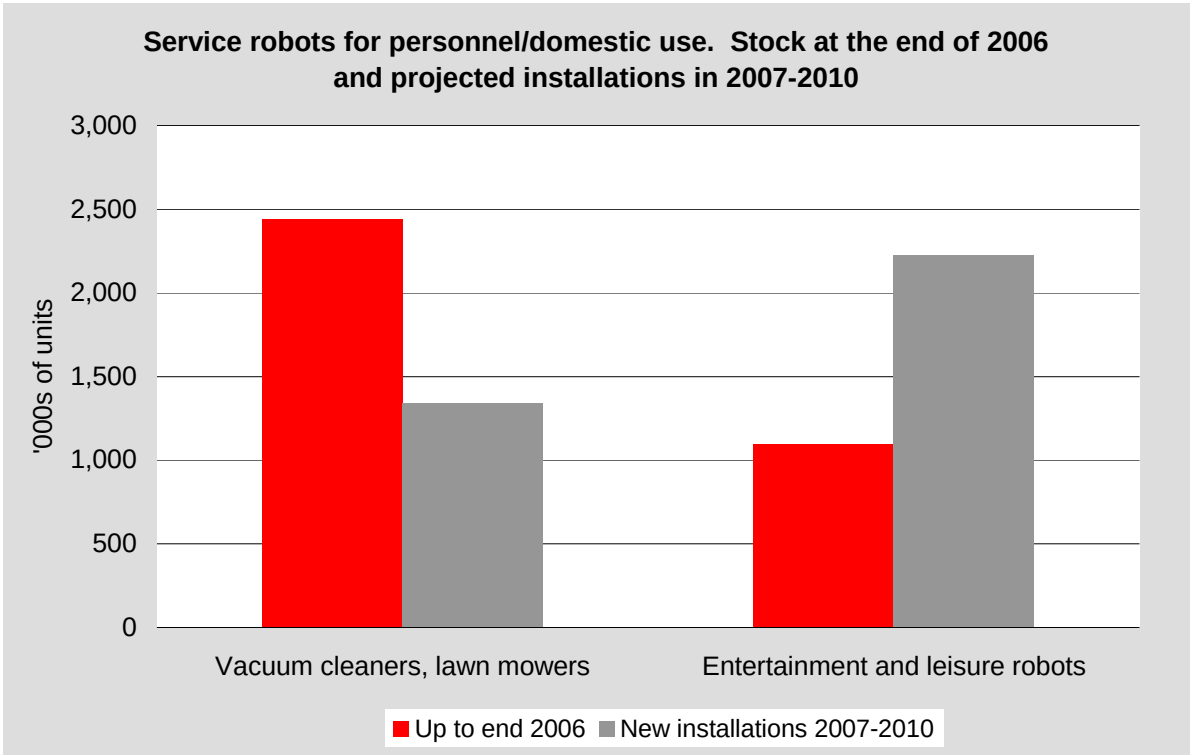
Turning to the projections for the period 2007-2010, the stock of service robots for professional use is forecast to increase by some 35,5 units. Application areas with strong growth are **defence, rescue and security applications**, **field robots**, **cleaning robots, medical robots** and **mobile robot platforms for multiple use**.

Projections for the period 2007-2010: about 3.6 million units of service robots for personal use to be sold

It is projected that sales of **all types of domestic robots** (vacuum cleaning, lawn-mowing, window cleaning and other types) in the period 2007-20010 could reach some **1.34 million units**.

The market for **entertainment and leisure robots**, which includes toy robots, is forecast at about **2.2 million units**, most of which, of course, are very low cost.


Service robots for professional use. Stock at the end of 2006 and projected installations in 2007-2010
number of units
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Underwater
Cleaning
Defence, rescue, security
Construction/demolition
Field
Mobile robot platforms
Medical
Logistic
All others
Up to end 2006
New installations 2007-2010


Service robots for personnel/domestic use. Stock at the end of 2006 and projected installations in 2007-2010
'000s of units
3,000
2,500
2,000
1,500
1,000
500
0
Vacuum cleaners, lawn mowers
Entertainment and leisure robots
Up to end 2006
New installations 2007-2010