

## EXECUTIVE SUMMARY

### 2005 World Robot Market

#### Total world-wide sales:

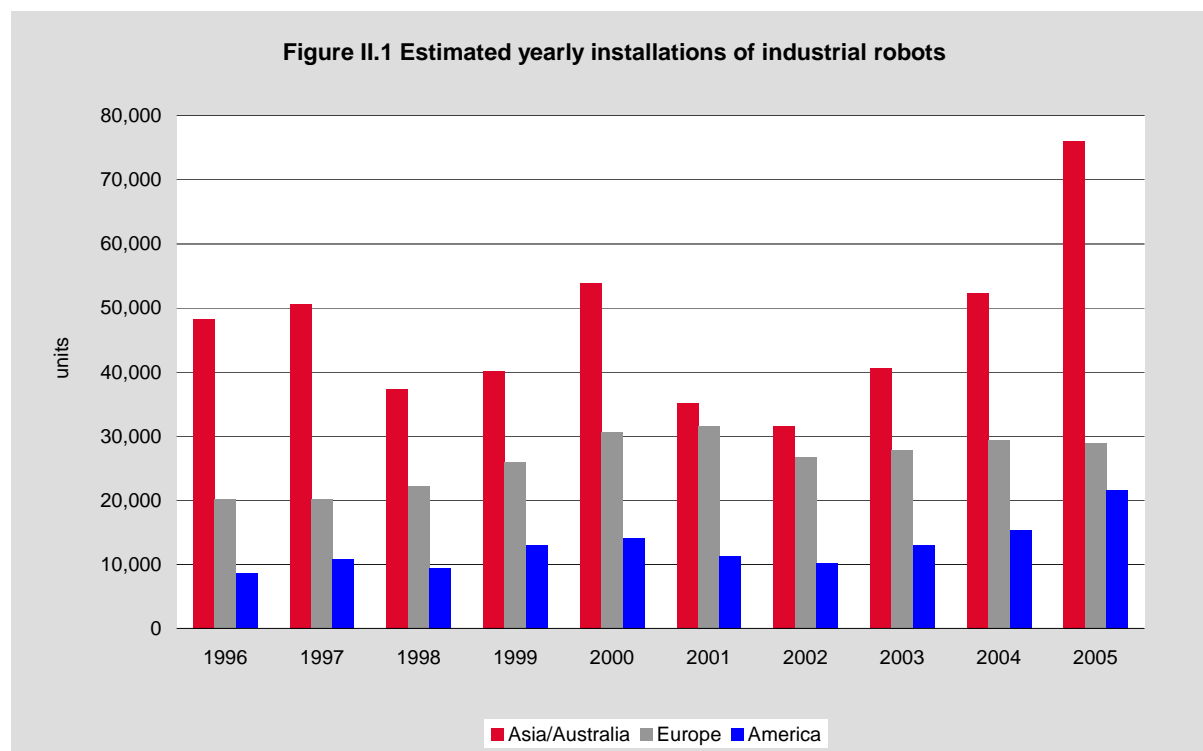
- 126,700 units, up 30% on 2004

#### World total stock of operational industrial robots:

- 923,000 units, 9% greater than 2004

#### *World market surged by 30% in 2005...*

The world market peaked in 2005, reaching about 126,700 newly installed industrial robots, 30% more than in 2004. This is the highest number ever recorded for one year. Nevertheless, developments were quite dissimilar in the three large industrial regions of Europe, America and Asia. While robotics investment boomed in Asia and America, order intakes in Europe were far more moderated. The automotive industry affected the results in all three regions. In Asia, in addition to the automotive sector, strong demand from the electronic components industry, the communication equipment industry and the computer industry reinforced the gain in market share already seen in 2004.



In 2005, more than 76,000 robots were supplied to **Asian** countries (including Australia and New Zealand), about 45% more than in 2004, as a result of **strong investment within the automotive industry and the electrical/electronics industry**. The increase seen in the electrical/electronics industry was influenced by a more accurate coverage of industrial robots in general, and in particular of those employed in these industries.

**In Japan, installations skyrocketed to the highest number since 1991, 50,500 units, 36% more than in 2004.** This was not only the result of replacement investments by the automotive industry and the electric machinery and components (incl. semiconductors and LCD) industry: supplies to the communication equipment industry and the metal and machinery industry also rose remarkably.

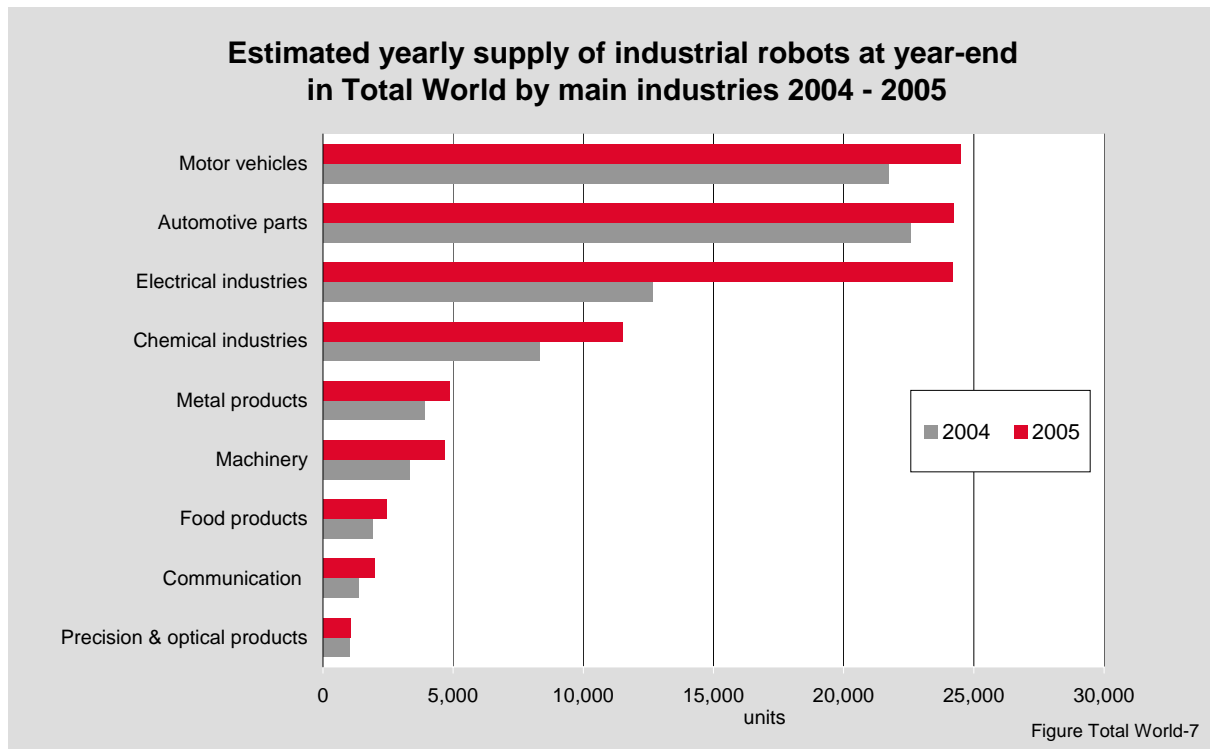
**In 2005, about 13,000 industrial robots were ordered for the Republic of Korea, about 138% more than in 2004.** This was the result of strong demand from the *electrical machinery and electronic components industry* and more complete reporting on robots used in this particular sector. **China** became the third largest robot market in Asia, with 4,500 newly installed robots, about 28% more than in 2004. Growth was slower than in 2004. In China, the automotive industry is still the predominant user of industrial robots. Installations in the other Asian markets, including, **India, Indonesia, Malaysia, the Philippines, Singapore, Taiwan (Province of China), Thailand and Vietnam**, increased by about 58% on average. Most of these markets are still relatively small, but are gaining in importance as a result of expanding **investments by the automotive industry.**

In the **Americas**, robotics investments sky-rocketed by 40 percent, to 21,555 units. Asian car makers, in particular, have made significant investments to enlarge and improve their US and Canadian production sites. However, this was also emulated by their US and European competitors within the automotive industry, who sought to preserve their respective shares of the North American market.

When deliveries to Mexico, Argentina and Brazil are included, the automotive industry in the Americas installed **47% more industrial robots in 2005 than in 2004. However, other industries also increased their orders of robots remarkably.** Demand from the **metal industry** (including machinery, metal products and basic metals) increased by 52%, the **chemical industry** by 41%, the **electrical/electronics industry** by 34%.

2005 saw installations of industrial robots in **Europe** decline by 2% when compared to 2004. This can be largely attributed to a lull in investments by the automotive industry and its suppliers in Germany, Italy, Spain, Portugal and Sweden. In contrast, sales augmented in Eastern European countries and Great Britain. The figures here, however, are still somewhat low when compared to the major European locations. Only in France was a slight increase in installations within the automotive industry achieved. **Car makers' purchases of industrial robots fell by 28 percent in Europe as a whole.**

Outside the automotive sector (including parts suppliers), demand for industrial robots is steadily increasing: **Plastics and rubber, food and packaging, household appliances, wood and furniture, glass and ceramic products are all areas where expansion has been seen.** The figures here do not yet outweigh demand from the automotive industry and were therefore unable to compensate for the sharp fall in this industry. These areas experienced a combined growth rate of 17 percent in 2005. **In Europe, about 30% more robots were installed in the food industry than in both America and Asia.** In general, robot systems in industries other than the automotive industry and the electrical/electronics industry are more established in Europe than in all other regions.



**Total accumulated yearly sales**, measured since industrial robots started to be introduced in industry at the end of the 1960s, amounted to more than **1,600,000 units** at the **end of 2005, including, as mentioned before, the dedicated industrial robots installed in Japan up to and including 2000.** 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, IFR estimate the

**total worldwide stock of operational industrial robots  
at the end of 2005 between a minimum of 923,000 units  
and a possible maximum of 1,120,000 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 2005 stock of almost 923,000 units is compared with the 850,000 units at the end of 2004, it represents an increase of 9%.

Table 1

Installations and operational stock of multipurpose industrial robots in 2004 and 2005 and forecasts for 2006-2009.  
Number of units

Country	Yearly installations				Operational stock at year-end			
	2004	2005	2006	2009	2004	2005	2006	2009
<b>America</b>	<b>15,400</b>	<b>21,555</b>	<b>17,200</b>	<b>20,100</b>	<b>126,961</b>	<b>143,203</b>	<b>153,500</b>	<b>182,500</b>
Brazil	208	320			2,352	2,672		
North America (Canada, Mexico, USA)	15,170	21,136	16,500	19,100	123,663	139,553	149,400	176,000
Other America a/	22	99			946	978		
<b>Asia/Australia</b>	<b>52,311</b>	<b>76,047</b>	<b>65,000</b>	<b>76,000</b>	<b>443,193</b>	<b>481,664</b>	<b>502,000</b>	<b>583,000</b>
China	3,493	4,461			7,096	11,557		
India	369	450			619	1,069		
Indonesia	74	193			121	314		
Japan (see note below)	37,086	50,501	40,000	46,000	356,483	373,481	372,000	388,500
Malaysia	250	243			1,452	1,695		
Philippines	65	80			93	173		
Republic of Korea (all types of industries)	5,457	13,005			51,302	61,576		
Singapore a/	244	424			5,443	5,463		
Taiwan, Province of China a/	3,680	4,096			11,881	15,464		
Thailand	757	1,458			1,014	2,472		
Vietnam	14	99			14	113		
Other Asia a/	170	124			3,505	3,349		
Australia/New Zealand a/	652	913			4,170	4,938		
<b>Europe</b>	<b>29,409</b>	<b>28,863</b>	<b>28,200</b>	<b>33,800</b>	<b>279,019</b>	<b>297,374</b>	<b>307,700</b>	<b>345,400</b>
Austria a/	545	485			3,907	4,148		
Benelux a/	536	1,097			8,749	9,362		
Denmark	296	354			2,342	2,661		
Finland	401	556			3,712	4,159		
France	3,009	3,275	3,000	3,700	28,133	30,434	32,200	37,900
Germany	13,401	10,506	10,700	13,000	120,544	126,725	132,300	142,700
Italy	5,679	5,425	5,100	6,200	53,244	56,198	58,900	66,400
Norway	61	115			724	811		
Portugal	211	144			1,488	1,542		
Spain	2,826	2,649			21,893	24,081		
Sweden	833	939			7,341	8,028		
Switzerland a/	310	442			3,539	3,732		
Turkey	24	207			196	403		
United Kingdom	785	1,363	800	1,200	14,176	14,948	14,700	14,300
Central/Eastern European countries a/	419	1,149			8,372	9,337		
other Europe a/	73	157			659	805		
<b>Africa</b>	<b>87</b>	<b>204</b>	<b>220</b>	<b>250</b>	<b>430</b>	<b>634</b>	<b>900</b>	<b>1,600</b>
<b>Total</b>	<b>97,207</b>	<b>126,669</b>	<b>110,620</b>	<b>130,150</b>	<b>849,603</b>	<b>922,875</b>	<b>964,100</b>	<b>1,112,500</b>

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

a/ Estimated by UNECE and IFR for some or for all the years.

Note 1: Addition to the stock data for Japan included dedicated robots up to and including 2000. Stock data shown here are therefore not fully comparable with those of other countries.

### Forecasts for 2006-2009

**The world market for industrial robots is projected to decrease from 126,700 units in 2005 to 110,600 in 2006. From 2007, it will rise by a yearly average of 5.6.% to 130,150 in 2009.**

Demand from the automotive industry will plummet in 2006 in North America, Japan and the Rep. of Korea because of the high investments made in 2005. In Western Europe, investments by the automotive industry already decelerated in 2004 and 2005. In 2006 a further slight decrease can be expected. The decrease in 2006 will be offset to some extent by orders from the non-automotive industry and investments by the automotive industry in most emerging markets.

Robust growth in robot installations world-wide can be expected between 2007 and 2009. The automotive industry is set to begin production of new model cycles, investments in emerging markets will

continue, and installations in general industry - especially the packaging industry, the food industry, the rubber and plastics industry and the machinery industry- will grow all over the world as a result of technical developments. Improvements in robot technology, such as new control systems and safety systems to permit interactive operations of man and machine, as well as improved sensor technology and robot-vision applications, will promote further robot installations.

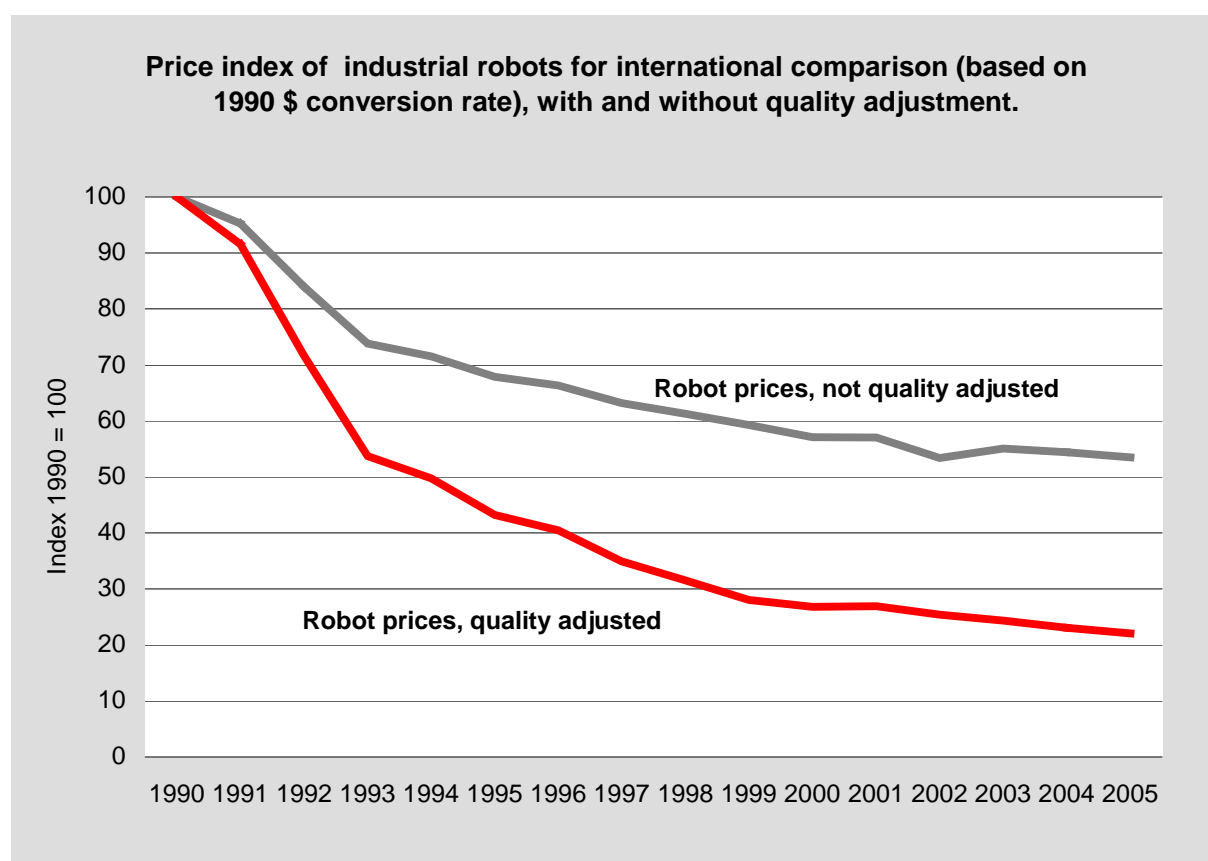
In terms of units, it is estimated that the **worldwide stock of operational industrial robots** will increase **from about 922,900 units at the end of 2005 to 1,112,500 at the end of 2009**, representing an average annual growth rate of 4.9%

### ***Robot prices are falling at a lower rate...***

The **price of industrial robots** and even more so their **relative price**, i.e. the price of industrial robots for a given set of performance indicators in relation to labour costs, have fallen sharply between 1990 and 2000. After 2000, nominal prices stopped falling. Although quality adjusted prices and relative prices will continue to fall, they are falling at a lower rate than before. This is the result of the expansion in applications for industrial robots in sectors other than the automotive industry. Bespoke solutions for particular operations will stabilise robot prices, and may even result in higher returns.

Prices of industrial robots, expressed in constant 1990 US dollars, have fallen from an index 100 to 54 in the period 1990-2005, without taking into account that robots installed in 2005 had a much higher performance than those installed in 1990. When taking into account quality changes, it was estimated that the index would have fallen to 22.

In the same period (1990-2005), the **index of labour compensation** in the American business sector increased **from 100 to 179**. This implies that the **relative prices of robots** fell **from 100 in 1990 to 23 in 2005** without quality adjustment, and **to 10** when taking into account quality improvements in robots. Other major robot using countries had similar developments in their relative robot prices.



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

In 2001-2005, employment stagnated while the stock of robots continued to increase, except in Japan, resulting in a further boost to robot density.

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 2005, **352** robots in Japan and **173** robots in the Rep. of Korea were in operation per 10,000 persons employed in the manufacturing industry.

With 171 robots per 10,000 employed in the manufacturing industry **Germany** is the country with highest robot density in Europe, followed by **Italy** with 130 and **Sweden** with 117. In **Finland** the density amounted to 99, followed by the **United States** with 90, **Spain** with 89, and **France** with 84 robots per 10,000 employed in the manufacturing industry. The densities ranged between 67 and 44 in the **Austria**, **Benelux**, **Denmark**, **Switzerland** and the **United Kingdom**. In **Norway** the density amounted to 29 and in **Portugal** to 17. 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 1,710 robots and 1,600, 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 1,180, France 1,120, Spain 950, United States 770, United Kingdom 610 and Sweden 630. 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 2005, **59%** of the installed robots were **articulated robots**, down from 61% in 2004, 20% were **linear/cartesian/gantry robots**, up from 17% in 2004, 12% were **cylindrical robots**, up from 8% in 2004, and **8% were Scara robots**, down from 13% in 2004. In table II.16 and II.17 the distribution by countries and by types can be seen. **74,400 articulated robots were installed in 2005, up 25% on 2004, 25,200 linear/cartesian/gantry robots, up 55% on 2004, 15,400 cylindrical robots, up 103% on 2004 and 10,100 Scara robots, 18% fewer than 2004.** The high increase in the number of cylindrical robots is partly the result of better coverage of this type of robot.

## ***Distribution of service robots***

### ***Service robots for professional use: 31,600 units installed up to the end of 2005***

With 5,680 units, underwater systems accounted for 18% of the total number of service robots for professional use installed up to the end of 2005 (see table VII.1 and figure VII.6a). Thereafter followed cleaning robots with 17%, defense, rescue and security applications with 16% and construction and demolition robots, milking robots and medical robots and mobile robot platforms for general use, accounting for 11%, each. . Minor installation numbers were counted for logistic systems (1,130 units), inspection systems (275 units) and public relations robots (30 units).

### ***Service robots for personal and private use: about 1.9 million units for domestic use and more than 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 2005, accumulated sales of vacuum cleaning robots resulted in 1.8 million units. At the end of 2005, the stock of lawn mowing robots amounted to 79,000 units.

### ***Projections for the period 2006-2009: 34,000 new service robots for professional use to be installed***

Turning to the projections for the period 2006-2009), the stock of service robots for professional use is forecast to increase by some 34,000 units (see table 4 and figure 6). Application areas with strong growth are underwater systems, defence, rescue and security applications, laboratory robots, professional cleaning robots, medical robots and mobile robot platforms for multiple use.

### ***Projections for the period 2006-2009: about 5.6 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 2006-2009 could reach some 3.9 million units.

The market for entertainment and leisure robots, which includes toy robots, is forecast at about 1.6 million units, most of which, of course, are very low cost.

