

**UNECE**United Nations Economic Commission for Europe

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**Worldwide investment in industrial robots up 19% in 2003**  
**In first half of 2004, orders for robots were up another 18% to the highest level ever recorded**

**Worldwide growth in the period 2004-2007 forecast**  
**at an average annual rate of about 7%**

**Over 600,000 household robots in use – several millions**  
**in the next few years**

***UNECE issues its 2004 World Robotics survey***

Below are some of the many questions answered by the newly released survey ***World Robotics 2004*** produced by the United Nations Economic Commission for Europe (UNECE) in cooperation with the International Federation of Robotics (IFR). The following questions and answers provide an executive summary of this 414 page in-depth analysis:

- **Double digit growth in the robot business** *In 2003, the robot market in North America surged by 28%, by close to 25% in Japan and by 4% in the European Union, says Jan Karlsson, responsible for the UNECE/IFR publication. The modest growth in the European Union market should, however, be seen in the light of the fact that with the exception of 1997 and 2001-2002, the European Union has had double-digit market growth since 1994.*
- **What about the trends in 2004 and the forecast for 2004-2007?** The UNECE/IFR quarterly survey on order intake of industrial robots, which includes most of the world's largest companies, showed that worldwide order intake increased by 18% in the first half of 2004, compared with the same period in 2003. It was the highest order intake of industrial robots ever recorded, worldwide and in all regions, except in Europe where it was the second best half year recorded. The order intake, by regions, were as follows:

**North America +18%, Europe -3%, Asia +57%, Other regions 0%**

Worldwide sales are forecasted to increase from 81,800 units in 2003 to over 106,000 units by 2007, or an average of close to 7% per year.

**How many robots are now working out there in industry?** Worldwide at least 800,000 units (possibly the real stock could be well over one million units), of which 350,000 in Japan, close to 250,000 in the European Union and about 112,000 in North America. In Europe, Germany is in the lead with 112,700 units, followed by Italy with 50,000, France with 26,000, Spain with 20,000 and the United Kingdom with 14,000.

- **What is the forecast for 2007?** A conservative forecast points about one million units worldwide, of which 350,000 in Japan, 326,000 in the European Union and 145,000 in North America.

.../

- **Is Japan's lead position in automation eroding?** Robot business was booming in Japan in the 1980s and early 1990s. The optimism was unlimited. It seemed as if everything that could be robotized was robotized. Since the middle of the 1990s, the momentum in the robot business has moved to Europe and North America. In 2003, their robot stocks increased by 7% and 9%, respectively. In Japan it has steadily been falling since 1998 but shows now sign of recovering.
- **Why invest in robots?** In the last decade the performance of robots has increased enormously while at the same time their prices have been plummeting. A robot sold in 2003 would have cost about a fourth of what a robot with the same performance would have cost in 1990. In the last few years the price decrease of robots has, however, started to level off. Profitability studies have shown that it is not unusual for robots to have a pay-back period as short as 1-2 years.
- **And not hire people?** In Germany, for instance, the prices of robots relative to labour costs have fallen from 100 in 1990 to 35 in 2003 and to 15 when taking into account the radically improved performance of robots. In North America, the relative price dropped to 28 and to about 12 if quality improvements are taken into consideration. *"Falling or stable robot prices, increasing labour costs and continuously improved technology are major driving forces which speak for continued massive robot investment in industry"*, says Jan Karlsson. Even in developing countries like Brazil, Mexico and China, robot investments are starting to take off at an impressive rate. *"As robots are used both for increasing capacity and for rationalizing production, robots investments are made also during periods of economic recession. When the economy recovers, production can then to a large extent be increased without necessarily hiring new labour"*, concludes Jan Karlsson.
- **If robots are so profitable why is there not an even stronger rush to invest?** Robots are not products to be acquired "over the counter". In order to reap the benefits of robots, potential user companies must have sufficient in-house technological know-how as well as a thorough comprehension of their production processes.
- **How many robots per employee in the manufacturing industry?** About 320 per 10,000 employees in Japan, 148 in Germany, 116 in Italy, 99 in Sweden and between 80 and 50 in Finland, Spain, France, United States, Austria, Benelux and Denmark (the figure for Japan includes all types of robots while for all the other countries only multipurpose industrial robots are included. The figures are therefore not comparable). In the United Kingdom the density amounted to about 40.
- **In the car industry?** In Japan, Italy and Germany there is more than 1 robot per 10 production workers.
- **Are we seeing any service robots in our homes?** At the end of 2003, about 610,000 autonomous vacuum cleaners and lawn-mowing robots were in operation. In 2004- 2007, more than 4 million new units are forecasted to be added.
- **How are service robots for professional use doing?** Medical robots, underwater robots, surveillance robots, demolition robots and many other types of robots for carrying out a multitude of tasks are doing very well. A stock of some 21,000 units was estimated at the end of 2003. In the period 2004-2007, another 54,000 units are projected to be added to the stock.
- **In the long run service robots will be everyday tools for mankind.** They will not only clean our floors, mow our lawns and guard our homes but they will also assist old and handicapped people with sophisticated interactive equipment, carry out surgery, inspect pipes and sites that are hazardous to people, fight fire and bombs and be used in many other applications described in the present issue of *World Robotics 2004*. **Huge military investment in service robots will give spin-off effects both for the market of professional service robots and for the market of consumer products.**

**Details of the market development for industrial robots in France, Germany, Italy, Spain, United Kingdom and United States are presented in a separate press release for each of those countries.**

## The facts

### ***World market surged by 19% in 2003...***

Worldwide sales of multipurpose industrial robots peaked in 1990 when they reached over 80,000 units. Following the recession in 1991-1993, worldwide sales of industrial robots fell to about 53,000 units in 1993. The world robot market then started a period of strong recovery, which peaked in 1997 when it reached a level of 82,000 units. In 1998, however, sales plunged by 16% to just under 69,000 units. The market recovered sharply in 1999 with sales of nearly 80,000 units, an increase of almost 15% over 1998. In 2000, growth accelerated to 24%, attaining a record of almost 99,000 units. In 2001 and 2002, however, the world market fell by 21% and 12%, respectively, reaching 68,600 units. **A strong recovery was recorded in 2003. The world market grew by 19% to 81,800 units.**

### ***...as a result of increased demand in all major markets: Japan +25% and North America +28%***

After two years of falling or stagnant sales, there was a sharp recovery in Japan in 2000. Sales of all types of industrial robots surged by 32% over 1999, reaching almost 47,000 units. As from 2001, data for Japan exclude almost all dedicated robots (only dedicated robots for machining are included). Data for 2000 and 2001 are thus not comparable. Between 2001 and 2002, however, sales in Japan fell by almost 11% to about 25,400 units. **A buoyant recovery started in 2003 when the market grew by almost 25% to 31,600 units.**

From 1995 to 2000, the robot market in the United States was booming every second year and, in the years between, it was flat or falling. In 1995, 1997 and 1999 it increased by 32%, 28% and 37%, respectively. By contrast, in 1996 and 1998, the market dropped by 5% and 13%, respectively, while in 2000 it was almost flat (+1%). However, the highest sale of multipurpose industrial robots, in their strict definition, ever recorded was in 2000 when it reached nearly 13,000 units. In 2001, the market fell by nearly 17% to 10,800 units followed by another drop of 8% in 2002 to just under 10,000 units. **In 2003, however, there was a sharp recovery. The market expanded by 28% to about 12,700 units.**

### ***The market in the European Union rose by 4% ...***

In the European Union, sales of multipurpose industrial robots rose by 18% in 2000 to 29,800 units. In 2001, sales continued to grow but by a modest 3%, reaching 30,800 units. With the exception of 1997, when the market fell by 1%, the European Union has had market growth since 1994 and, except for 2001, double digit growth. This came to a halt in 2002, when the market fell by 15% to 26,100 units. **In 2003, there was a slight recovery of 4% to 27,100 units. There were, however, large variations between countries – from an increase of 48% in the United Kingdom to a decrease of 46% in Austria.**

### ***Europe and the United States are rapidly catching up with Japan...***

In the early 1990s, installations of multipurpose industrial robots in the European Union and the United States only amounted to about 20% and 7%, respectively, of Japan's installations of (all types of) industrial robots. Following the more restrictive reporting by Japan, data show that in 2001-2002 **more multipurpose industrial robots were installed in the European Union than in Japan. In 2003, however, the market in Japan was again larger than that of the European Union.**

Looking at the operational stock of industrial robots, again relating Japan's stock (to which all types of robots were added up to and including 2000) to those of multipurpose robots in the European Union and the United States, the same pattern prevails. **The EU stock rose from 23% of that of Japan in 1990 to almost 72% in 2003. The corresponding figures for the United States were 12% and 32%, respectively.** Again, if separate data had been available for multipurpose industrial robots

in Japan, they might very well have shown a stock of a magnitude between that of the United States and that of the European Union.

### ***Robots do much better than most other investment goods...***

While in 2002 the value of market for industrial robots fell by 8% in the United States, the market for machine tools fell by as much as 36%. In Japan and Germany the same pattern was prevailing. Machine tools fell by 32% and 20%, respectively, while robots “only” fell by 11% and 7%.

In 2003, growth in robot investment again largely surpassed machine-tool investment.

### ***Estimate of the worldwide operational stock of industrial robots***

**Total accumulated yearly sales**, measured since industrial robots started to be introduced in industry at the end of the 1960s, amounted at the **end of 2003** to some **1,410,000 units**. 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. UNECE and IFR estimate the

**total worldwide stock of operational industrial robots  
at the end of 2003 between a minimum of 800,000 units  
and a possible maximum of 1,090,000 units**

The minimum figure above is 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 1,090,000 units.

The minimum 2003 stock of just over 800,000 units can be compared with 770,000 units at the end of 2002, representing an increase of 4%. As can be seen from table 1 and figure 2, **Japan accounts for just under half the world robot stock - largely because the Japanese figures include all types of robots**. Its share is, however, rapidly diminishing.

### ***Forecasts for 2004-2007***

**The world market for industrial robots is projected to increase from 81,800 units in 2003 to 106,000 in 2007** or by a yearly average of 6.8% (see table 1 and figure 1).

#### **Sales in Japan expected to show continued strong recovery...**

Growth in robot investment in Japan will be spurred by an increasing demand for replacement investment. Between 2003 and 2007, sales are projected to increase from 31,600 units to some 41,000 units.

In 2003, just as in the previous five years, more industrial robots were taken out of operation in Japan than new robots installed. The robot stock fell by just over 1,000 units compared with 11,000 units in 2002. In the late 1980s and early 1990s, before the economic slump of 1992/1993, a large number of industrial robots were installed in Japan. The peak occurred in 1990 with over 60,000 robots installed. During the forecasting period, these robots are most likely to be replaced. For this reason, a recovery of the robot market can be expected for the period under review.

#### **The operational stock of industrial robots continues to grow, except in Japan**

In terms of units, it is estimated that the worldwide stock of operational industrial robots will increase from about 800,000 units at the end of 2003 to 1,000,000 at the end of 2007, representing an average annual growth of 5.7% (see table 1 and figure 2). It is interesting to note that the operational stock of robots in Japan decreased for the first time in 1998. In 1999-2001, the decrease accelerated. In 2002-2003, however, the rate of decrease slowed down significantly.

Table 1

Installations and operational stock of multipurpose industrial robots in 2002 and 2003 and forecasts for 2004-2007. Number of units

Country	Yearly installations				Operational stock at year-end			
	2002	2003	2004	2007	2002	2003	2004	2007
<b>Japan</b>	<b>25,373</b>	<b>31,588</b>	<b>33,200</b>	<b>41,300</b>	<b>350,169</b>	<b>348,734</b>	<b>352,200</b>	<b>349,400</b>
<b>United States</b>	<b>9,955</b>	<b>12,693</b>	<b>12,800</b>	<b>15,900</b>	<b>103,515</b>	<b>112,390</b>	<b>121,300</b>	<b>145,100</b>
<b>European Union</b>	<b>26,096</b>	<b>27,114</b>	<b>28,800</b>	<b>34,400</b>	<b>233,769</b>	<b>249,200</b>	<b>266,100</b>	<b>325,900</b>
Germany	11,862	13,381	14,100	16,300	105,212	112,693	121,500	151,400
Italy	5,470	5,198	5,500	6,400	46,881	50,043	53,100	63,400
France	3,012	3,117	3,300	3,900	24,277	26,137	28,400	35,900
United Kingdom	750	1,111	1,200	1,500	13,651	14,015	14,600	16,300
Austria a/	670	365			3,521	3,602		
Benelux a/	654	715			8,708	9,052		
Denmark	249	288			1,853	2,078		
Finland	376	387			3,151	3,407		
Portugal	138	135			1,282	1,367		
Spain	2,420	2,031			18,352	19,847		
Sweden	495	386			6,881	6,959		
<b>Other Europe</b>	<b>582</b>	<b>922</b>	<b>1,000</b>	<b>1,300</b>	<b>11,009</b>	<b>11,409</b>	<b>11,900</b>	<b>14,200</b>
Czech Rep. a/	87	498			1,022	1,445		
Hungary	61	35			211	216		
Norway	80	48			664	684		
Poland	128	60			622	584		
Russian Fed. a/	21	9			5,000	5,000		
Slovakia b/	24	1						
Slovenia b/	25	31						
Switzerland a/	156	240			3,490	3,480		
<b>Asia/Australia</b>	<b>5,123</b>	<b>6,695</b>	<b>7,200</b>	<b>8,900</b>	<b>60,427</b>	<b>65,419</b>	<b>69,900</b>	<b>78,500</b>
Australia	392	533			3,192	3,571		
Rep. of Korea (all types of industrial robots)	3,998	4,660			44,265	47,845		
Singapore a/	53	48			5,299	5,273		
Taiwan, Province of China	680	1,454			7,671	8,730		
<b>Other countries a/</b>	<b>1,466</b>	<b>2,764</b>	<b>3,200</b>	<b>4,500</b>	<b>11,216</b>	<b>13,620</b>	<b>16,500</b>	<b>27,200</b>
<b>Subtotal, excl. Japan and Rep. of Korea</b>	<b>39,224</b>	<b>45,528</b>	<b>47,900</b>	<b>58,700</b>	<b>375,671</b>	<b>404,193</b>	<b>485,700</b>	<b>590,900</b>
<b>Total, including Japan and Rep. of Korea</b>	<b>68,595</b>	<b>81,776</b>	<b>86,200</b>	<b>106,300</b>	<b>770,105</b>	<b>800,772</b>	<b>886,200</b>	<b>997,700</b>

Sources: UNECE, IFR and national robot associations.

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

b/ In the period 1999-2001, included in the aggregate "Other countries".

### Steady growth in Europe and in North America

The robot market in the **European Union** is expected to grow from **27,100 units in 2003 to over 34,000 units in 2007**, representing an annual average growth of 6.1%. In **North America**, the market is estimated to grow by an average annual rate of 5.8%, which implies that the market will reach about 16,000 units in 2007. In view of a somewhat optimistic economic forecast by OECD of a recovery, these forecasts for robotics, mainly based on the opinions of robotics experts, might be somewhat too conservative.

Figure 1. Yearly installations of industrial robots, 2002-2003 and forecast for 2004-2007

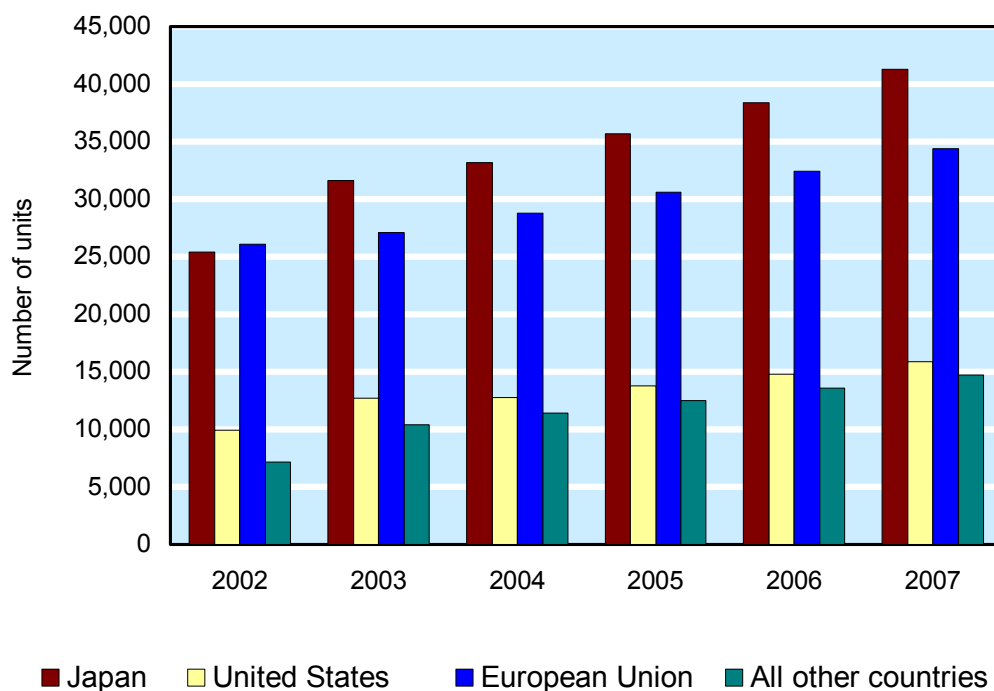
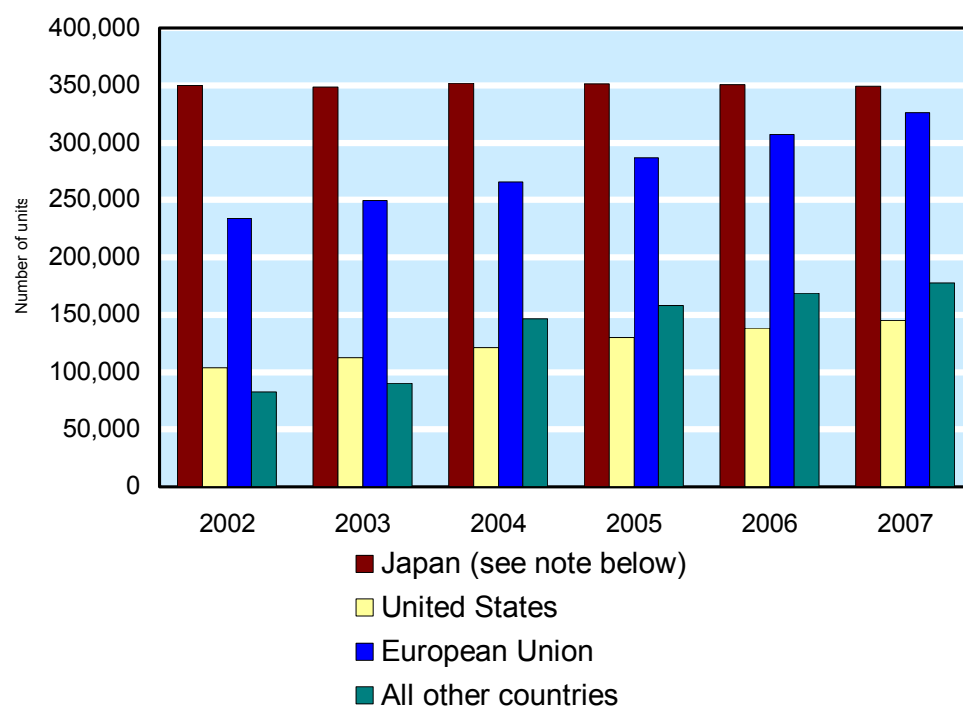


Figure 2. Estimated operational stock of industrial robots 2002-2003 and forecast for 2004-2007



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.

The year 1997 was the peak one for the Japanese robot stock, when it reached 413,000 units, including all types of industrial robots. By end 2003, it had fallen to 349,000 units and is projected to remain at that level also in 2007.

In the United States, the operational stock of multipurpose industrial robots is forecast to reach **145,000 units in 2007**. The projection for the **European Union is 326,000 units**, of which 151,000 in Germany, 63,000 in Italy, 36,000 in France and 16,000 in the United Kingdom.

These estimates of stock data are **minimum figures**. Assuming a longer average service life of robots (15 years instead of 12 years) would significantly increase the estimated stock.

### ***Results in the first half of 2004 – robot sales continue to surge***

Looking at the **first half of 2004**, the UNECE/IFR quarterly survey on order intake of industrial robots, which includes most of the world's largest companies, showed that worldwide order intake **increased by 18%**, compared with the same period in 2003. It was the highest order intake of industrial robots ever recorded, worldwide and in all regions, except for Europe where it was the second best half year recorded.

#### **Order intake of industrial robots, first half of 2004 compared with the same period in 2003**

North America	+18%	Asia	+57%
Europe	-3%	Other regions	0%

### ***Growth in robot investment is spurred by plummeting robot prices but price decreases are starting to level off...***

In the 1990s, prices of industrial robots were plummeting while at the same time their performance, measured both for mechanical and electronic characteristics, was improving continuously. A UNECE/IFR survey, which covered the period 1990-2000, showed the following results:

♦ List price of one robot unit .....	-43%
♦ Number of units delivered .....	+782%
♦ Number of product variants that can be supplied to customers .....	+400%
♦ Total handling capacity (including gripper module) .....	+26%
♦ Repetition accuracy .....	+61%
♦ Speed of the 6 axes .....	+39%
♦ Maximum reach .....	+36%
♦ Mean time between failures .....	+137%
♦ RAM in Mbytes .....	over 400 times
♦ Bit-size of the processor .....	+117%
♦ Maximum number of axes that can be controlled .....	+45%

Prices of industrial robots, expressed in constant 1990 US dollars, have fallen from an index 100 to 59 in the period 1990-2003, without taking into account that robots installed in 2003 had a much higher performance than those installed in 1990 (see figure 3). When taking into account quality changes, it was estimated that the index would have fallen to 25. In other words, an average robot sold in 2003 would have cost only a fourth of what a robot, with the same performance, would have cost in 1990, if it ever had been possible to produce such a robot in that year.

In the same time, the index of labour compensation in, for instance, the American business sector increased from 100 to 156 (see table 2). This implies that the **relative prices of robots in the United States fell from 100 in 1990 to 28 in 2003**, without taking into consideration the enormous improvements in robotics during this period, and to only **12** when taking such improvements into consideration. 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 figure 4, five groups of countries can be distinguished with respect to robot densities, expressed as the number of robots per 10,000 persons employed in the manufacturing industry (ISIC rev.3: D). The **first group** includes **Japan** and the **Republic of Korea**, whose robot stock includes all types of industrial robots and is therefore not comparable with other countries. In 2003, these two countries had robot densities of about 320 and 140, respectively. While the density in the Republic of Korea is increasing rapidly, it has fallen in Japan since the peak in 1998.

The **second group** is topped by **Germany**, which in 2003 had a density of 148, followed by **Italy** with 116 and **Sweden** with 99 robots per 10,000 employed in the manufacturing industry. The **third group** of countries includes **Finland** with 78, **Spain** with 72, and **France** with 71 robots per 10,000 employed in the manufacturing industry. In the **fourth group**, the densities ranged between 63 and 39 in the **United States**, **Benelux**, **Denmark**, **Austria** and the **United Kingdom**. In **Norway** and **Australia**, the density amounted to 24 and 36, respectively, while at the bottom was **Portugal** with 15. Countries in Central and Eastern Europe, with the exception of the Czech Republic, have even significantly lower densities.

Despite this large range in the robot densities of European countries, it is interesting to note that **the robot density in the European Union is about 50% higher than that of the United States**.

### ***Robot densities - 1 robot per 10 workers in the motor vehicle industry***

Figure 5 shows data on the number of multipurpose industrial robots per 10,000 production workers in the motor vehicle industry. Japan and Italy are in the lead with 1,400 robots 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 1,000, France 910, Spain 800, United States 740, United Kingdom 660 and Sweden 560. 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 with 5 axes or more***

When countries collect data, they do not always include the same types of robots - some countries concentrate on the more sophisticated robots while others, e.g. Rep. of Korea, collect data on all types of robots that satisfy the IFR definition. For this reason, country data are not always comparable. Looking only at the subset of **robots with 5 axes or more**, the comparability between countries is significantly improved (see table 3).

### ***Diffusion of service robots***

Table 4 gives details about the results of the UNECE/IFR survey of sales of service robots, broken down by application areas. As many companies did not provide market data, the figures reported here probably underestimate significantly the true sales amounts as well as the installed base of robots.



Table 2

Price index of industrial robots in the United States, with and without quality adjustment. Index of labour compensation per employee and hourly wages, excluding social costs, in selected industry branches

Year	Index of robot prices, 1990=100		Index of labour compensation		Hourly wages, excluding social costs, production workers, \$		
	without quality adjustment	with quality adjustment	Business sector a/	Manufact. industry (ISIC rev.3:D) b/	Manufact. industry (ISIC rev.3:D) c/	Food industry (ISIC rev.3: 15+16) c/	Motor veh. industry (ISIC rev.3: 34) c/, d/
1990	100.0	100.0	100.0	100.0	10.83	9.62	14.56
1991	95.7	94.1	103.9	100.9	11.18	9.90	15.23
1992	69.5	58.6	109.8	115.3	11.46	10.20	15.45
1993	53.1	36.3	112.9	120.0	11.74	10.45	16.10
1994	56.9	41.4	115.5	123.5	12.07	10.66	17.02
1995	59.7	45.3	117.7	126.3	12.37	10.93	17.34
1996	55.9	40.1	120.6	129.8	12.77	11.20	17.74
1997	46.3	27.1	124.5	133.1	13.17	11.49	18.35
1998	45.7	26.2	130.7	136.4	13.49	11.80	18.19
1999	40.9	19.7	136.3	140.1	13.85	11.40	18.45
2000	37.3	17.8	145.2	146.1	14.32	11.77	19.07
2001	31.5	15.1	148.8	150.8	14.76	12.18	19.62
2002	37.5	18.0	152.5	156.4	15.29	12.55	21.03
2003	43.9	19.0	156.2	163.4	15.74	12.80	21.66

Sources: United Nations Economic Commission for Europe (UNECE) and International Federation of Robotics (IFR).

a/ Source: OECD Economic Outlook, December 2003. Data for 2003 are estimated.

b/ Total compensation, blue-collar occupations. Source: U.S. Bureau of Labor Statistics. Data for 2003 are provisional.

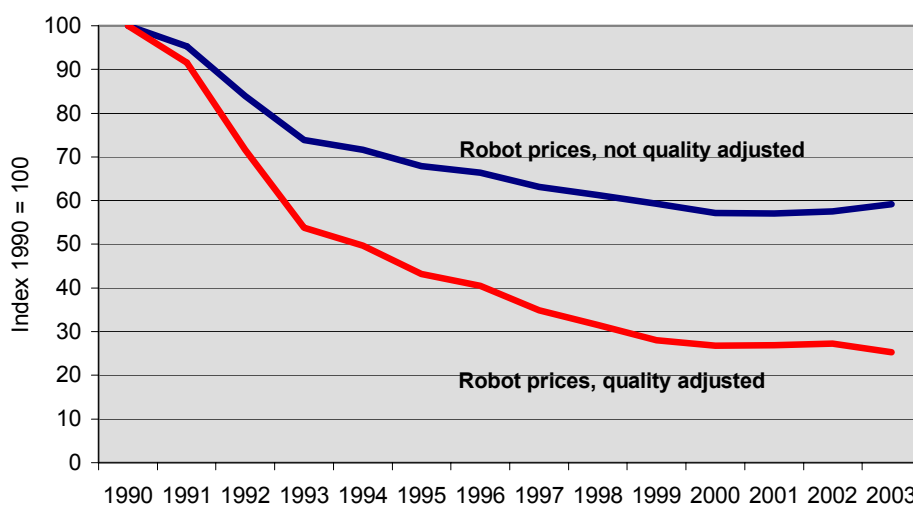
c/ Source: U.S. Bureau of Labor Statistics. Data for 2002 are provisional.

d/ Comprises three sub-industries which in 2003 had the following average hourly wages: motor vehicles **\$28.03**, motor vehicles bodies & trailers **\$15.89** and motor vehicle parts **\$20.42**.

General note: The robot price indices calculated for individual countries are always based on prices of the same seven robot models supplied by four major international robot companies with large market shares in Europe and the United States.

Figure 3

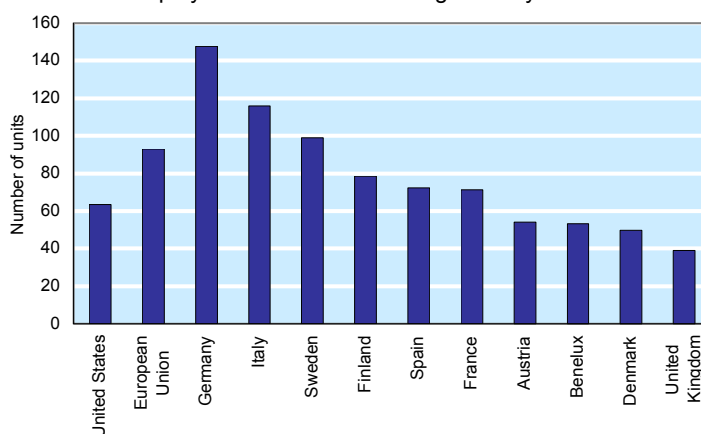
Price index of industrial robots for international comparison (based on 1990 \$ conversion rate), with and without quality adjustment.



	2003
Japan a/	322
Rep. of Korea b/	138
<b>United States</b>	<b>63</b>
<b>European Union</b>	<b>93</b>
Germany	148
Italy	116
Sweden	99
Finland	78
Spain	72
France	71
Austria	54
Benelux	53
Denmark	50
United Kingdom	39
Australia	36
Norway	24
Portugal	15
Czech Rep. a/	12

Sources: UNECE and IFR.

Figure 4 Number of robots per 10,000 persons employed in the manufacturing industry in 2003



	2001	2003
France	720	910
Germany	760	1,000
Italy	1,040	1,400
Japan	1,300	1,400
Spain	650	800
Sweden	560	560
United Kingdom	580	660
United States	640	740

Sources: UNECE and IFR.

Figure 5 Number of robots per 10,000 production workers in the motor vehicle industry, 2001 and 2003

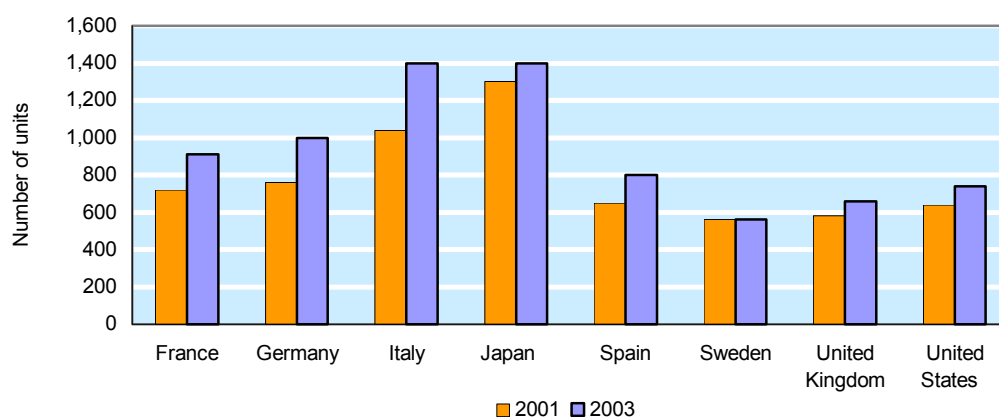


Table 3

Number of multipurpose industrial robots with 5 axes or more compared with the total number of multipurpose industrial robots in 2003. Ranking according to number of robots with 5 axes or more

	All robots	Robots with >= 5 axes	% share
USA	12,693	11,754	92.6
Germany	13,381	9,261	69.2
Italy	5,198	4,599	88.5
Rep. of Korea a/	4,660	2,819	60.5
France	3,117	2,566	82.3
Spain	2,031	1,708	84.1
United Kingdom	1,111	1,037	93.3
Sweden	386	378	97.9
Austria	365	269	73.7
Finland	387	267	69.0
Denmark	288	205	71.2
Norway	48	42	87.5
<b>Subtotal</b>	<b>43,665</b>	<b>34,906</b>	<b>79.9</b>
Japan	31,588		
All other countries	6,523		
<b>Total</b>	<b>81,776</b>		

Sources: UNECE, IFR and national robot associations.

a/ All types of industrial robots. About 16% of the robots are not classified by number of axes.

### ***Service robots for professional use: 21,000 units installed up to the end of 2003***

With 4,785 units, underwater systems accounted for 23% of the total number of service robots for professional use installed up to the end of 2003 (see table 4 and figure 6). Thereafter followed cleaning robots with 16%, laboratory robots with 15% and demolition and construction robots with 14%. Medical robots had a share of 12% and mobile robot platforms for general use accounted for 9%. Defense, rescue and security applications had a share of nearly 5% and field robotics, e.g. milking robots and forestry robots, 4%. The value of the stock of professional service robots is estimated at \$2.4 billion.

The unit prices for professional service robots differ significantly – from less than \$10,000 to more than \$300,000, depending on type of application. The most expensive robots are the underwater systems (\$300,000), followed by milking robots (\$200,000). The average price of a medical robot is about \$150,000.

### ***Service robots for personal and private use: about 610,000 units for domestic use and almost 700,000 units for entertainment and leisure sold up to end 2003***

Service robots for personal and private 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 private use are mainly in the areas of domestic (household) robots, which include vacuum cleaning and lawn-mowing robots, and entertainment robots, including toy and hobby robots (see table 4 and figure 7). Sales of lawn-mowing robots have started to take off very strongly, with sales in excess of 40,000 units, and should continue to boom. The market potential is very large. Vacuum cleaning robots were introduced on the market at end of 2001. The market expanded rapidly in 2002-2003 and now counts at least 570,000 units.

Of the 610,000 robots for domestic household robots that were in use at end 2003 almost 400,000 were installed in 2003 (see table 4 and figure 7).

### ***Projections for the period 2004-2007: 54,000 new service robots for professional use to be installed***

Turning to the projections for the period 2004-2007, the stock of service robots for professional use is forecasted to increase by some 54,000 units (see table 4 and figure 6). Application areas with strong growth are humanoid robots, robots in public relation, laboratory robots, underwater systems, defense, rescue and security applications, professional cleaning robots and mobile robot platforms for multiple use. Medical robots, on the other hand, are not expected to do as well as was previously forecasted.

### ***Projections for the period 2004-2007: about 6.6 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 2004-2007 can reach some 4.1 million units with an estimated value at \$2.7 billion (see table 4 and figure 7).

The market for entertainment and leisure robots, which includes toy robots, is forecasted at about 2.5 million units, most of which, of course, are very low cost. The sales value is estimated at over \$4 billion.

Table 4

Estimated number and value of service robots installed up to the end of 2003,  
by application areas, and forecasts for the period 2004-2007

Types of robots	Stock at end 2003	Installations 2004-2007	Sales in 2003	Stock at end 2003	Installations 2004-2007
	No. of units	No. of units	No. of units	\$ million	\$ million
<b>SERVICE ROBOTS FOR PROFESSIONAL USE:</b>					
<b>Field robotics</b>	885	1,345	110	177	271
Agriculture					
Milking robots	830	1,300	100		
Forestry					
Mining systems					
Space robots					
Others	55	45	10		
<b>Professional cleaning</b>	3,370	2,310	212	68	54
Floor cleaning	340	340	2		
Window and wall cleaning (including wall climbing robots)					
Tank, tube and pipe cleaning					
Pool cleaning	3,000	1,000	200		
Other cleaning tasks	30	970	10		
<b>Inspection systems</b>	185	290	18	21	17
Sewer robots	85	160	7		
Tank, tubes and pipes*					
Other inspection systems	100	130	11		
<b>Construction and demolition</b>	3,030	1,250	225	195	96
Demolition systems:					
nuclear demolition & dismantling	70	45	7		
other demolition systems	2,900	1,110	202		
Construction support robots:					
maintenance or construction	60	95	16		
other types of construction					
<b>Logistic systems</b>	225	1,375	28	12	68
Courier systems					
Mail delivery *					
Factory logistics					
Other logistics*					
<b>Medical robotics</b>	2,440	1,910	218	352	413
Diagnostic systems*					
Robot assisted surgery of therapy	2,440	1,910	218	352	413
Rehabilitation systems*					
Other medical robots *					
<b>Defence, rescue &amp; security applications</b>	1,010	2,740	319	76	360
Demining robots					
Fire and bomb fighting robots	410	430	61		
Surveillance/security robots (incl. UAV-surveillance systems)	600	2,310	258		
Unmanned aerial vehicles:					
surveillance systems					
armed systems *					
Others					
<b>Underwater systems</b>	4,785	2,960	496	1,467	937
<b>Mobile platforms in general use</b>	1,990	1,900	262	33	57
<b>Laboratory robots</b>	3,060	3,150	400	37	68
General material handling					
Clean room robots					
Others					
<b>Public relation robots</b>	15	10,000	6		50
Hotel & restaurant robots *					
Guide robots					
Robots in marketing					
Others (i.e. library robots)*					

Sources: UNECE and IFR.

\*no information available.

Table 4 (concluded)

Estimated number and value of service robots installed up to the end of 2003, by application areas, and forecasts for the period 2004-2007

Types of robots	Stock at end 2003	Installations 2004-2007	Sales in 2003	Stock at end 2003	Installations 2004-2007
	No. of units	No. of units	No. of units	\$ million	\$ million
<b>SERVICE ROBOTS FOR PROFESSIONAL USE:</b>					
<b>Special Purpose</b>	55	50	5	4	5
Refuelling robots	55	50	5	4	5
Others					
<b>Humanoid robots</b>		24,000			426
<b>Customized robots **</b>					
<b>Other professional service robots not specified above</b>	10	1,000	3	1	32
<b>Total number of units / estimated value of professional service robots</b>	<b>21,060</b>	<b>54,280</b>	<b>2,302</b>	<b>2,443</b>	<b>2,854</b>
<b>SERVICE ROBOTS FOR PERSONAL/DOMESTIC USE:</b>					
<b>Robots for domestic tasks</b>	607,000	4,145,000	397,500	217	2,670
Vacuuming cleaners	570,000	3,445,000	390,000		
Lawn mowing	37,000	200,000	7,500		
Pool cleaning		100,000			
Window cleaning		300,000			
Others		100,000			
<b>Entertainment and leisure robots</b>	691,490	2,497,320	136,968	1,125	4,070
Toy robots	587,000	2,470,000	132,000		
Entertainment	30	70	14		
Hobby systems	1,600	7,000	1,000		
Education and training	12,760	19,700	3,931		
Others	90,100	550	23		
<b>Handicap assistance</b>	260	1,640	65	2	27
Robotized wheelchairs		100			
Other assistance functions	260	1,540	65		
Personal rehabilitation*					
Others					
<b>Personal transportation</b>	205	740	184	7	26
<b>Home security &amp; surveillance</b>		5,000			25
<b>Other Personal/domestic robots</b>					
<b>Total number of units and estimated value of personal/domestic service robots</b>	<b>1,298,955</b>	<b>6,649,700</b>	<b>534,717</b>	<b>1,351</b>	<b>6,818</b>
<b>Total number of units and estimated value of all types of service robots of which robotics R&amp;D***</b>	<b>1,320,015</b>	<b>6,703,980</b>	<b>537,019</b>	<b>3,794</b>	<b>9,672</b>
				<b>90</b>	<b>130</b>

Sources: UNECE and IFR.

\* No information available.

\*\* Included in other professional robots.

\*\*\* Only a few companies provided data.

Figure 6a. Service robots for professional use. Stock at the end of 2003 and projected installations in 2004-2007

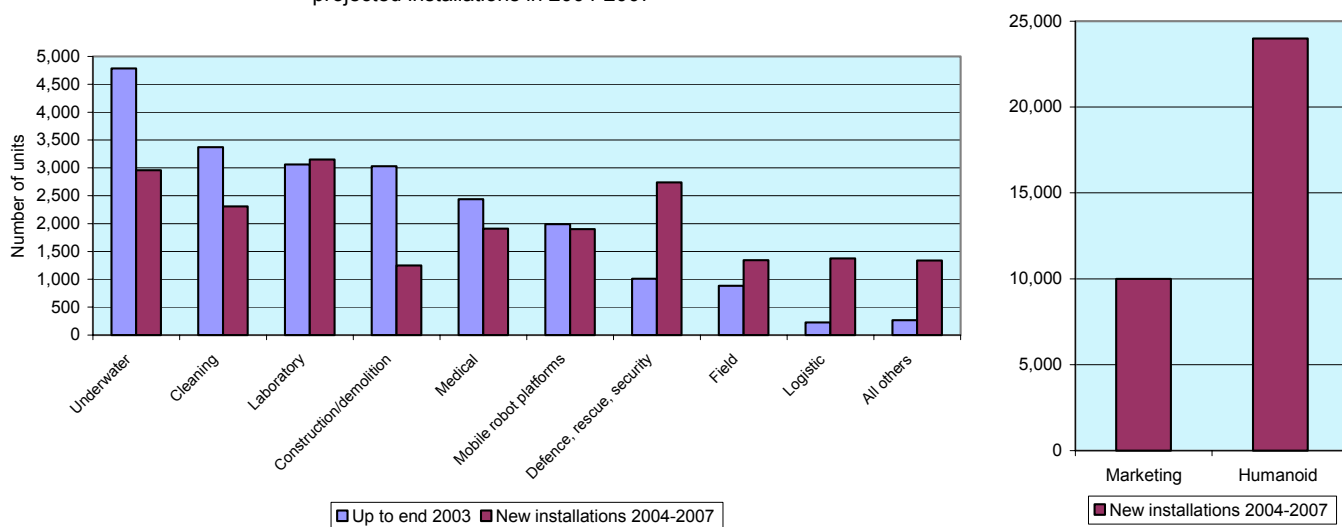


Figure 6b. Service robots for professional use. Value of stock at the end of 2003 and value of projected installations in 2004-2007

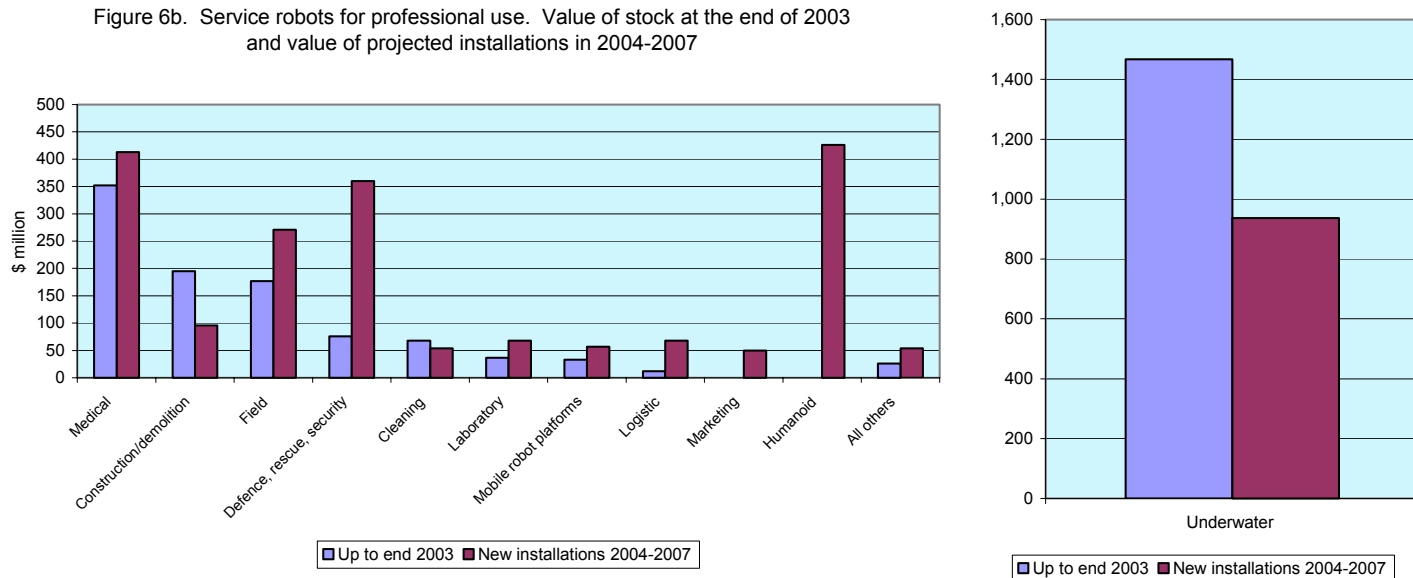


Figure 7a. Service robots for personnel/domestic use. Stock at the end of 2003 and projected installations in 2004-2007

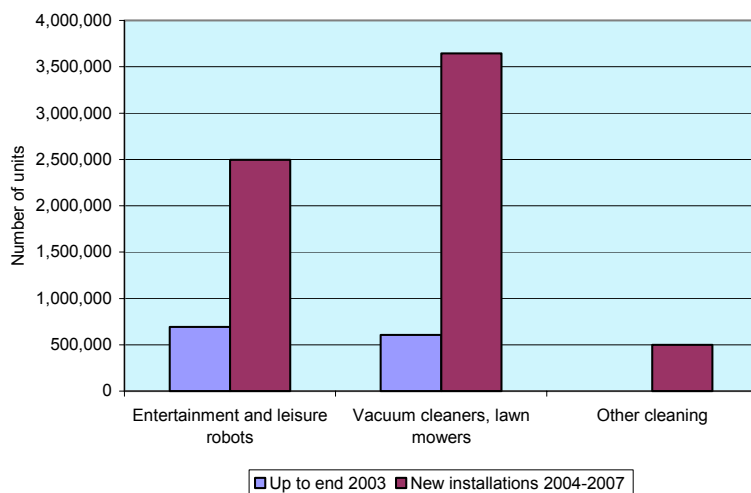
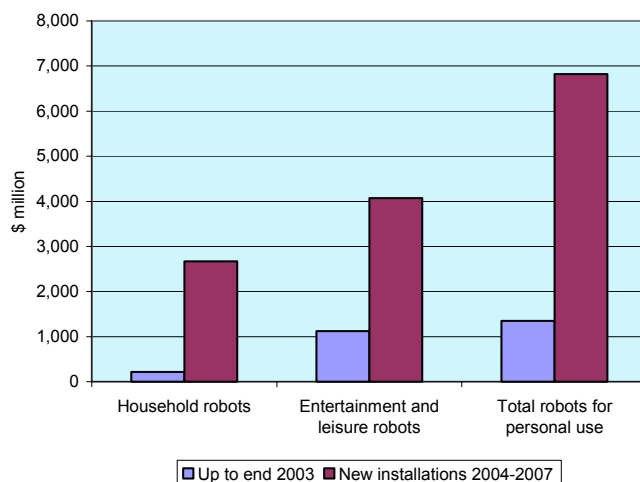
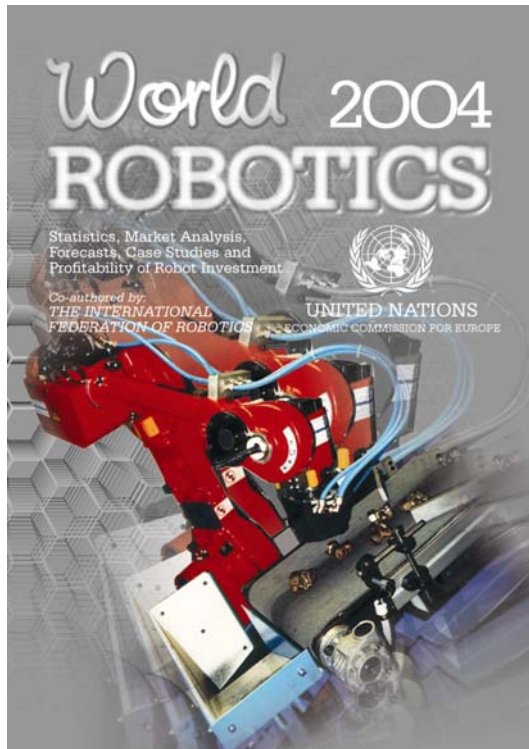


Figure 7b. Service robots for personal/domestic use. Value of the stock at the end of 2003 and of the projected installations in 2004-2007



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**Sales and Marketing Section**  
**United Nations**  
Palais des Nations  
CH - 1211 Geneva 10, Switzerland

Phone: +41(0)22 917 26 00 / 26 14  
Fax: +41(0)22 917 00 27  
E-mail: [unpubli@unog.ch](mailto:unpubli@unog.ch)

For more information about the publication, please contact:

Mr. Jan Karlsson  
Statistical Division  
United Nations Economic Commission  
for Europe (UNECE)  
Palais des Nations  
CH - 1211 Geneva 10, Switzerland

Phone: +41(0)22 917 32 85  
Fax: +41(0)22 917 00 40  
E-mail: [jan.karlsson@unece.org](mailto:jan.karlsson@unece.org)

or: International Federation of Robotics (IFR)  
Statistical Department  
c/o VDMA Robotics+Automation  
Lyoner Str. 18  
D – 60528 Frankfurt am Main  
Germany

Phone: +49 (69) 6603 1502  
Fax: +49 (69) 6603 2502  
E-mail: [gudrun.litzenberger@vdma.org](mailto:gudrun.litzenberger@vdma.org)