



RockEU2
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**Market and Supplier Study on
European Robotics, Service Robotics -
Update**

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Deliverable D1.8

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Executive summary

During the previous years, the service robotics statistics has been continuously developed into a world-wide recognized report on the service robotics industry.

While the statistical data, published in the World Robotics Yearbook has found wide interest among media, funding agencies, investors and technology scouts, it was felt that for effective policy making some facets are missing such as data for the characterization of the supply side economics.

Since many of these service robotics companies are start-ups it is of particular interest to statistically monitor this innovation-driven industry in terms of growth, size, job creation etc. in order to define measures to effectively fuel sustainable start-up creations and general industrial innovation for economic growth and quality jobs. Currently, Fraunhofer IPA is monitoring an ever-increasing number of now more than 700 service robotics suppliers worldwide. These include about a third categorized as start-up which means the company is not older than five years and technology-driven.

The objective of this continuous activity in RockEU2 “D1.8 Market and Supplier Study on European Robotics, Service Robotics” is to provide a solid basis of data from a European perspective regarding robotics market data, basic business structural data of European robot suppliers. In particular the fragmented service robotics domain should be analysed in depth for fuelling the RockEU2 activities in its road-mapping, entrepreneurial and tech-transfer-related aspects. Furthermore, this task is dedicated to providing this information to stakeholder groups and media in regular updates. This extension of service robotics statistics will primarily build on the existing and established work of market observation and surveys, statistics and forecasts provided by the annual World Robotics Report (particularly the service robotics section), but will also be complemented by other public and commercial data sources.

After the elaboration of a revised statistical scheme described in previous deliverables (e.g. RockEU2 Deliverable D1.7 of February 2017) this deliverable D1.8 adds recent developments and data especially on company size. Furthermore, it is intended to continue and develop the “Market and Supplier Study on European Robotics, Service Robotics” beyond the runtime of RockEU2.

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1. Introduction

Coordination of research and development, technology transfer and entrepreneurial activities in robotics should be based on current market developments, reliable forecasts and solid long-term trends. These data should be completed with data characterizing the supply side of service robotics (SR) through structural business statistics.

This will be of particular relevance for the road-mapping process (see WP1 of RockEU2) with respect to the prioritization of measures and policies related to technologies, innovation, public procurement, ELS-issues, and standardization. Furthermore, consistent and comparable statistical material on market data and forecasts, as well as on critical demands and trends is not only valuable for any type of communication (from scientific/technical publications to dissemination and PR), but very much in demand by any stakeholder group and the media in particular.

During the previous years, service robotics statistics has been well developed through the International Federation of Robotics IFR, particularly through its Statistical Department; www.worldrobotics.org. The continuous development of the statistics base has been an important asset to strategic planning in euRobotics.

While the statistical data, published in the World Robotics Yearbook, has been well received by media, funding agencies, investors and technology scouts, it was felt that for effective policy making some facets are missing, such as data for the categorization of the supply side, i.e. service robot manufacturers. Since many of these companies are start-ups it is of particular interest to statistically monitor these in terms of growth, job creation etc. to define measures to effectively fuel sustainable start-up creations. Within the last months, Fraunhofer IPA has widened its data basis: currently, the institute is monitoring more than 700 robotics companies worldwide. These include about a third categorized as start-up which means the company is not older than five years and technology-driven.

The objective of “market and society observations” is to provide a solid basis of data from a European perspective regarding robotics market data and major trends, basic business structural data of European robot suppliers, particularly in the fragmented service robotics domain (professional and domestic) and overall opportunities and trends for the activities in RockEU2. Furthermore, this task is dedicated to providing this information to stakeholder groups and media in regular updates.

This extension of service robotics statistics will not only build on the existing and established work of market observation and surveys, statistics and forecasts provided by the annual World Robotics Report (particularly the service robotics section), but will also be complemented by other public and commercial data sources (e. g. Eurostat, UNECE/OECD) where appropriate.

After the elaboration and introduction of a revised statistical scheme it is planned to extend the IFR questionnaire by additional items and carry out a structural business survey. First efforts address company demographics (age, size etc.) as well as innovation characteristics (i.e. number and characterization of patents) by economies. The result is and will be an annual report including an executive summary for immediate communication to the robotics community, interested media or other interested audiences (e.g., as a download).

2. Service Robotics; definitions

Service robotics has been receiving continued mainstream media coverage therefore bringing this new robotics area to a wider public audience. Robots are clearly on the rise: in manufacturing and increasingly in everyday environments. The growing interest in service robotics is partly due to the variety and number of new start-ups which now account for almost 30% of all robot companies. Furthermore, large companies are increasingly investing into robotics, increasingly through acquisition of start-ups.

In professional applications, service robots are already having a significant impact in areas such as agriculture, surgery, logistics and underwater applications and are growing in economic importance. Driven by evolving security threats, there is a growing need to monitor everyday environments, which results in increased and difficult-to-manage workloads and data flows. To help meet this need, robots will play an even greater role in the maintenance, security and rescue market.

Robotics in personal and domestic applications has experienced strong global growth with relatively few mass-market products: floor cleaning robots, robo-mowers and robots for edutainment. Future product visions point to domestic robots of higher sophistication, capability and value, such as assistive robots for supporting the elderly, for helping out with household chores and for entertainment.

In a joint effort started in 1995, the United Nations Economic Commission for Europe (UNECE) and IFR engaged in working out a first service robot definition and classification scheme which has been absorbed by the current ISO Technical Committee TC 299 (formerly TC 184 / Subcommittee 2) resulting in a novel ISO-Standard 8373 which had become effective in 2012.

This international standard specifies vocabulary used in relation with robots and robotic devices operating in both industrial and non-industrial environments. It provides definitions and explanations of the most commonly used terms, which are grouped into clauses by main topics of robotics. Its vocabulary definitions relate to industrial as well as to service robotics. Relevant robotics related definitions are:¹

- A robot is an actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks. Autonomy in this context means the ability to perform intended tasks based on current state and sensing, without human intervention.
- A service robot is a robot that performs useful tasks for humans or equipment excluding industrial automation application. Note: The classification of a robot into industrial robot or service robot is done according to its intended application.
- A personal service robot or a service robot for personal use is a service robot used for a non-commercial task, usually by laypersons. Examples are domestic servant robot, automated wheelchair, and personal mobility assist robot.
- A professional service robot or a service robot for professional use is a service robot used for a commercial task, usually operated by a properly trained operator. Examples are cleaning robot for public places, delivery robot in offices or hospitals, fire-fighting robot, rehabilitation robot and surgery robot in hospitals. In this context,

¹ ISO 8373:2012 Robots and robotic devices - Vocabulary;
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=55890.

an operator is a person designated to start, monitor and stop the intended operation of a robot or a robot system.

- A robot system is a system comprising 1 robot(s), end-effector(s) and any machinery, equipment, devices, or sensors supporting the robot performing its task.

Service Robots fall into two classes: (1) Service robots for professional use and for (2) domestic use, which are subdivided into application areas with a further refinement of robot types.

I	Personal/Domestic Robots
1-6	Robots for domestic tasks
1	Robot companions / assistants / humanoids
2	Vacuuming, floor cleaning
3	Lawn mowing
4	Pool cleaning
5	Window cleaning
6	Home security & surveillance
7	Others
8-11	Entertainment robots
8	Toy/hobby robots
9	Multimedia
10	Education and research
11	Others
12-14	Elderly and handicap assistance
12	Robotized wheelchairs
13	Personal aids and assistive devices
14	Other assistance functions
16	Other personal/domestic robots
II	Professional service robots
17-22	Field robotics
17	Agriculture (broad acre, greenhouse, fruit-growing, vineyard)
18	Milking robots
19	other robots for livestock farming
20	Mining robots
21	Space robots
22	Others
23-27	Professional cleaning
23	Floor cleaning
24	Window and wall cleaning (including wall climbing robots)
25	Tank, tube and pipe cleaning
26	Hull cleaning (aircraft, vehicles, etc.)
27	Other cleaning tasks
28-30	Inspection and maintenance systems
28	Facilities, plants
29	Tank, tubes, pipes and sewers
30	Other inspection and maintenance systems
31-34	Construction and demolition

31	Nuclear demolition & dismantling
32	Building construction
33	Robots for heavy/civil construction
34	Other construction and demolition systems
35-39	Logistic systems
35	Autonomous guided (AGV) vehicles in manufacturing environments
36	AGVs in non-manufacturing environments (indoor)
37	Cargo handling, outdoor logistics
38	Personal transportation (AGV for persons)
39	Other logistics
40-43	Medical robotics
40	Diagnostic systems
41	Robot assisted surgery or therapy
42	Rehabilitation systems
43	Other medical robots
44-46	Rescue und security applications
44	Fire and disaster fighting robots
45	Surveillance/security robots without UAV
46	Other rescue and security robots
47-51	Defense applications
47	Demining robots
48	Unmanned aerial vehicles
49	Unmanned ground based vehicles (e.g. bomb fighting)
50	Unmanned underwater vehicles
51	Other defense applications
52	Underwater systems (civil/general use)
53	Powered Human Exoskeletons
54	Unmanned aerial vehicles (general use)
55	Mobile Platforms (general use)
56-60	Public relation robots and joy rides
56	Hotel and restaurant robots
57	Mobile guidance, information robots, telepresence robots
58	Robots in marketing
59	Robot joy rides
60	Others (i.e. library robots)
61	Other professional service robots not specified above

Table 2-1: Classification of service robotics into application areas and types

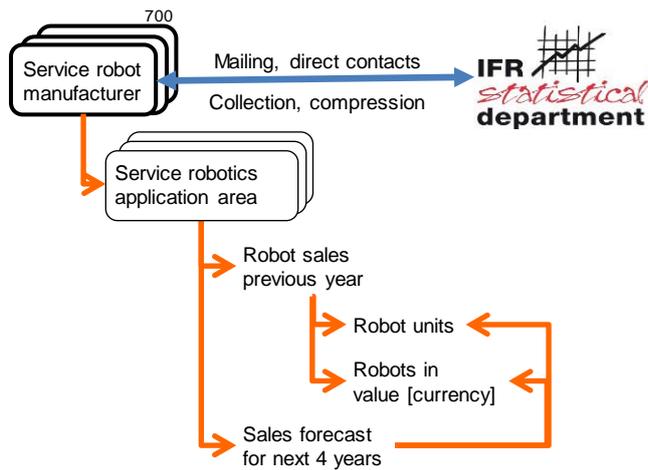


Figure 2-1: Method for collecting data; value and numbers from the previous year (here 2016) and forecasts (value, units) for the next four years are collected from SR industries by email questionnaire

3. Market and Supplier Study

3.1. Service robot sales units and values in regions

Sales in service robots for professional use will increase 12 percent by the end of 2017 to a new record of 5.2 billion U.S. dollars, see Figure 3-1. And the long-term forecast is positive too, with an expected average growth rate of 20 to 25 percent in the period 2018 - 2020.

European service robot manufacturers play an important role in the global market: about 290 out of the 700 registered companies supplying service robots come from Europe, North America ranks second with about 240 manufacturers and Asia third with about 130 (Figure 3-1, right).

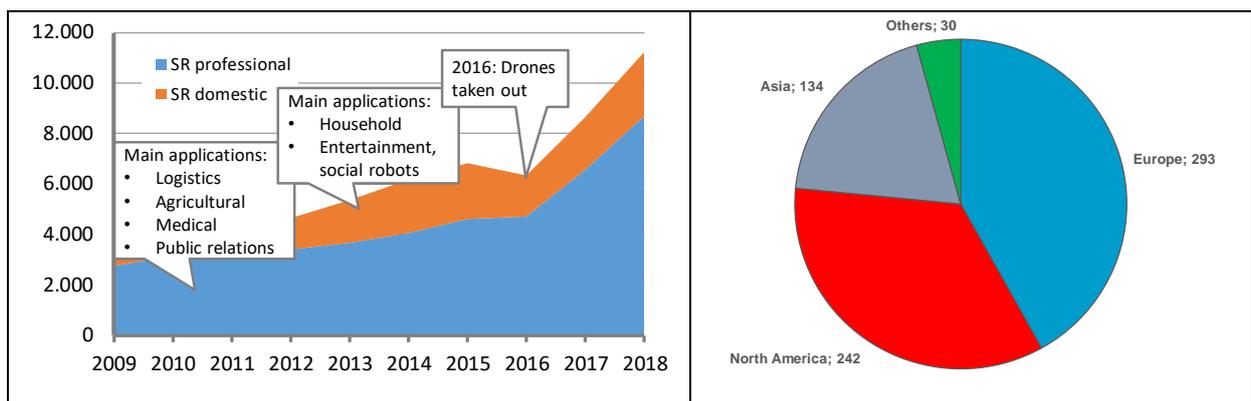


Figure 3-1: Left: Annual sales volume of service robotics SR for domestic, professional domains worldwide in Mio US\$, since 2007 including compound annual growth rates in that period. Right: Current number of service robot suppliers world wide

The distribution of personal/domestic robots by region of origin results in the figures given in Table 3-1 and Figure 3-2. In 2016 American companies had an overwhelming share of

domestic service robots (vacuum and floor cleaners, lawn mowers and other domestic robots). Sales increased by 24% compared to 2015. The total number of domestic service robots reported by Asian/Australian companies increased by 22%, accounting for a share 32% of total sales in 2016. Only 4% of personal/domestic robots came from Europe but increased considerably, by 29%. The major share of 60% of all reported entertainment robots are supplied by Asian/Australian companies, some 39% came from Europe.

All sales figures in [1000 units]		Europe		Americas		Asia		World	
I	Personal/Domestic Robots	2015	2016	2015	2016	2015	2016	2015	2016
1-6	Robots for domestic tasks	108	182	2.395	2.972	1.225	1.500	3.728	4.654
8-11	Entertainment	707	807	6	7	983	1.260	1.696	2.074
12-14	Elderly and handicap assistance	69	133	144	172	4.500	5.000	4.713	5.305
Total number of units of personal / domestic service robots [in 1000]		884	1.122	2.545	3.151	6.708	7.760	10.137	12.033

Table 3-1: Estimated number of sold personal/domestic service robots 2015 and 2016 by region of origin.

In total, 54% of all units of professional service robots came from America, 27% from Europe and a minor part (19%) of professional service robots is produced in Asia. 81% of all logistic systems are produced in America (9% in Europe and 10% in Asia). Most field robots are produced in Europe (about 91% of the global supply in 2016), as well as most construction and demolition robots (90%), most defence applications (53%) and most underwater systems (67%). In the field of medical robotics, Europe (with 52%) and America (with 46%) are almost equal. However, 64% of the inspection and maintenance systems and 67% of the rescue and security systems came from Asia. Sales of professional service robots from Europe increased by 2% and from the Americas by 25%. Asian sales increased by 72% compared to 2015. For more details refer to Table 3-2 and Figure 3-3.

In units sold		Europe		Americas		Asia		World	
II	Professional SR	2015	2016	2015	2016	2015	2016	2015	2016
17-23	Field robotics	6.085	5.502	224	243	304	300	6.613	6.045
24-28	Professional cleaning	120	150	334	371	8		462	521
29-31	Inspection maintenance	37	42	68	70	170	200	275	312
32-35	Construction, demolition	505	606			63	64	568	670
36-39	Logistic systems	1.560	2.279	15.422	20.633	2.036	2.532	19.018	25.444
40-43	Medical robotics	635	856	681	751	8	16	1.324	1.623
44-46	Rescue, security	11	9	0		18	18	29	27
47-50	Defense applications	6.258	5.921	4.935	5.187	14		11.207	11.108
51	Underwater systems	60	55	51	27			111	82
52	Powered Exoskeletons	178	277	4.099	4.670	693	1.071	4.970	6.018
53	Mobile Platforms	87	170	5		15	100	107	270
54-58	Public relation robots	21	24	7	470	3.186	6.994	3.214	7.488
59	Other professional SR		1	70	97	50		120	98
Total number of units of professional service robots		15.557	15.892	25.896	32.519	6.565	11.295	48.018	59.706

Table 3-2: Estimated number of sold professional service robots 2015 and 2016 by region of origin.

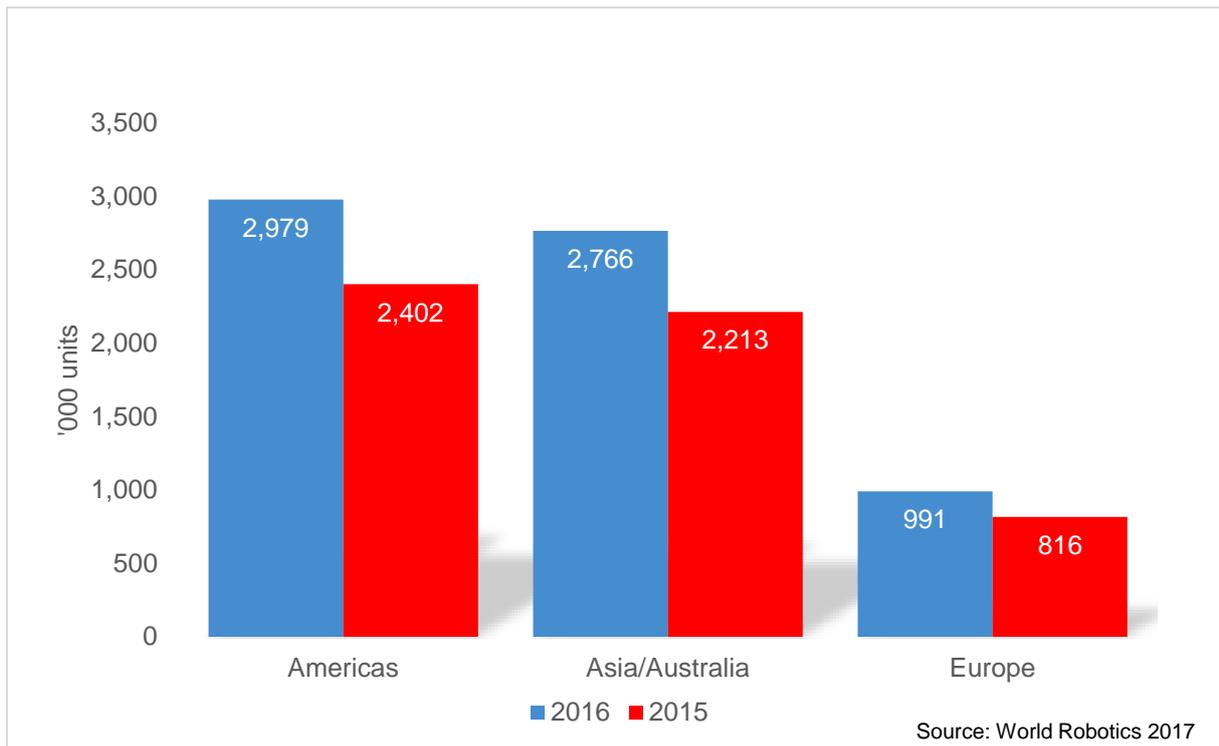


Figure 3-2: Service robots personal/domestic use: Unit sales 2015 and 2016 by region of origin

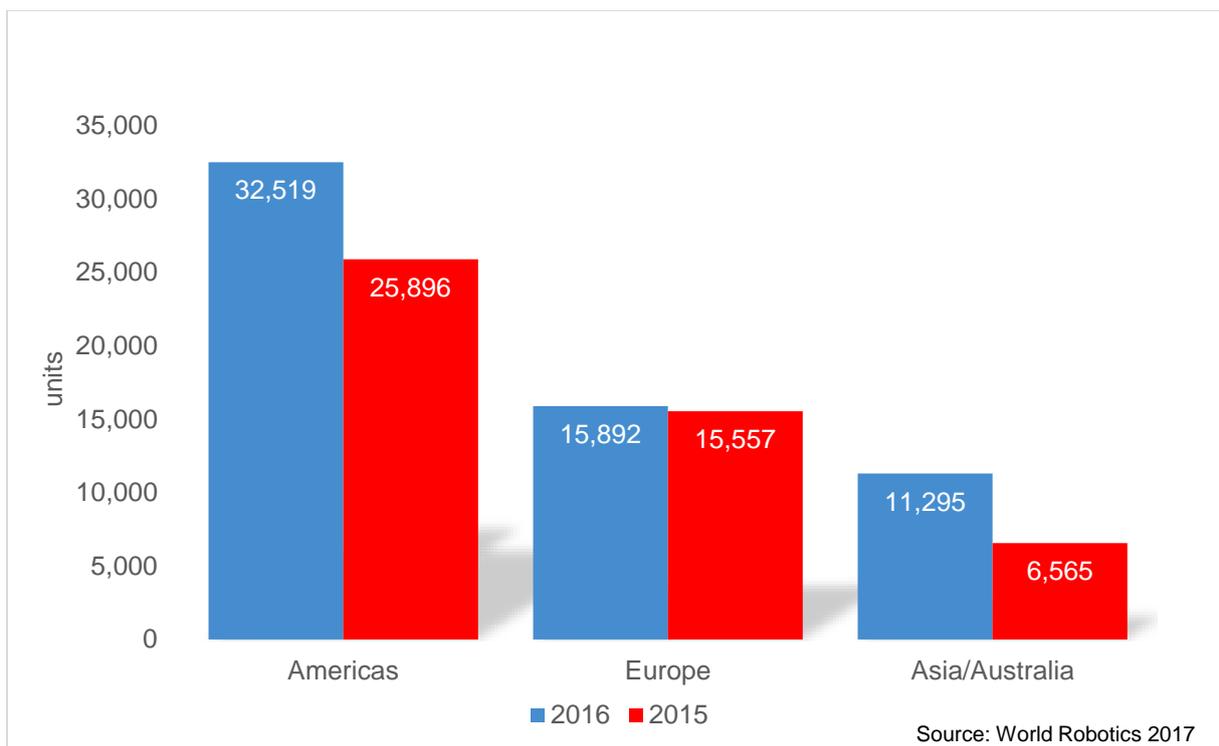


Figure 3-3: Service robots for professional use: Unit sales 2015 and 2016 by region of origin

3.2. Number of service robot suppliers in regions

Even with a documented number of 700 companies, Figure 3-4 and Figure 3-5 may still be too conservative with respect to manufacturers in their respective application areas/types of robots. Overviews and numbers of suppliers from North America and Europe should be

reliable. Uncertainties are expected with companies located in Russia, China and India however are considered to decrease, as the statistical exercise will develop over the years.

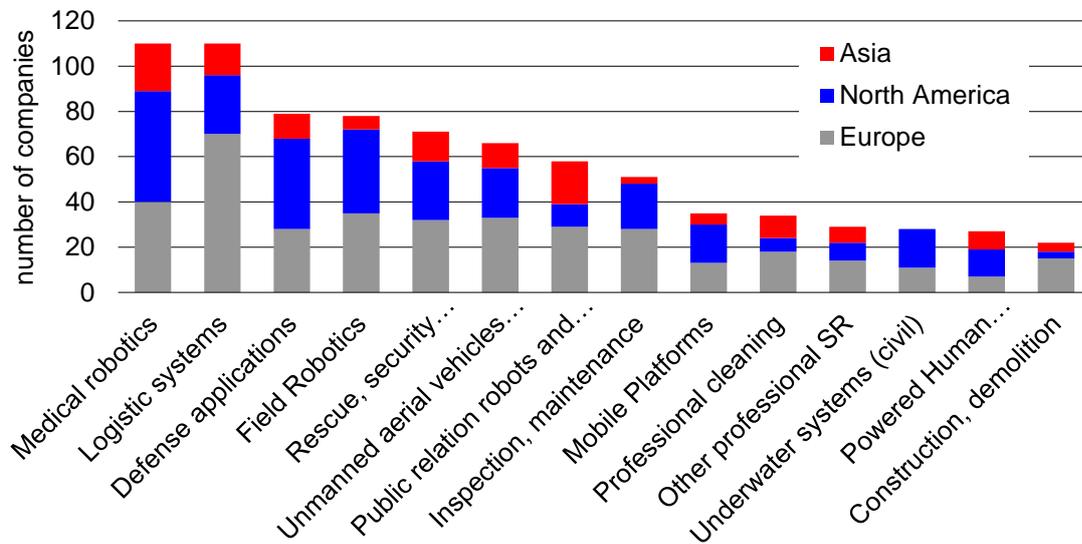


Figure 3-4: Number of service robot manufacturers by application areas (professional use) and by region of origin

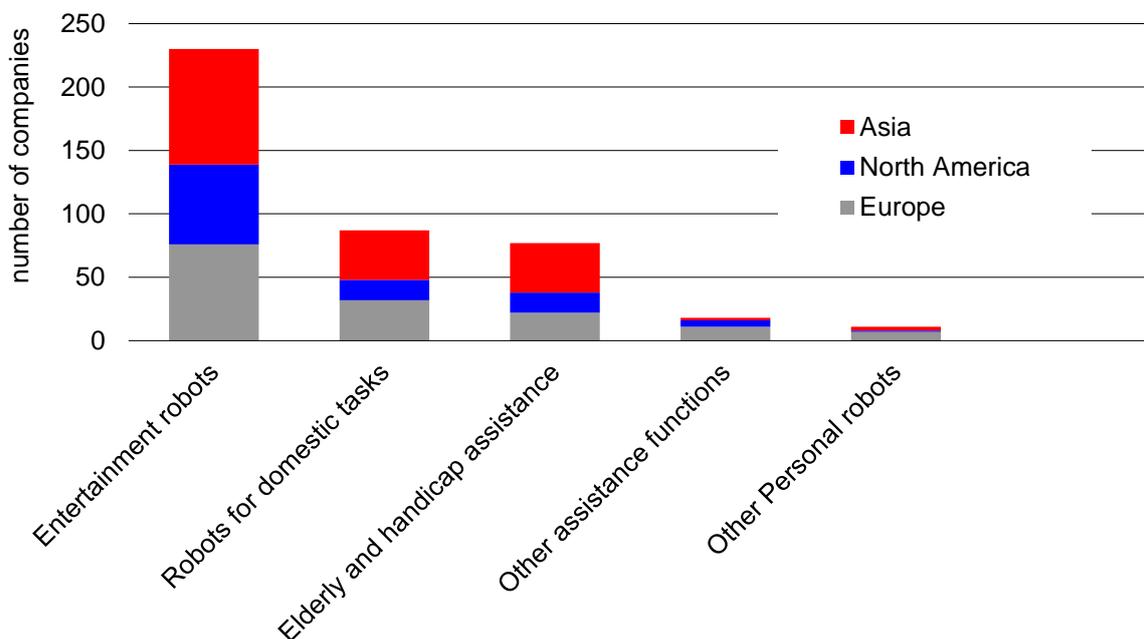


Figure 3-5: Number of service robot manufacturers by application areas (personal/domestic use) and by region of origin

There is a significant interest in the listed company demographics, particularly on the vibrant start-up scene. In this context, a start-up was (arbitrarily) defined as:

- A company with a product on the market or at least a product about to be launched.
- Max 5 years of age (estimated!) and independent of a large company.

A worldwide distribution of start-ups in the service robotics domain is depicted in Figure 3-6.

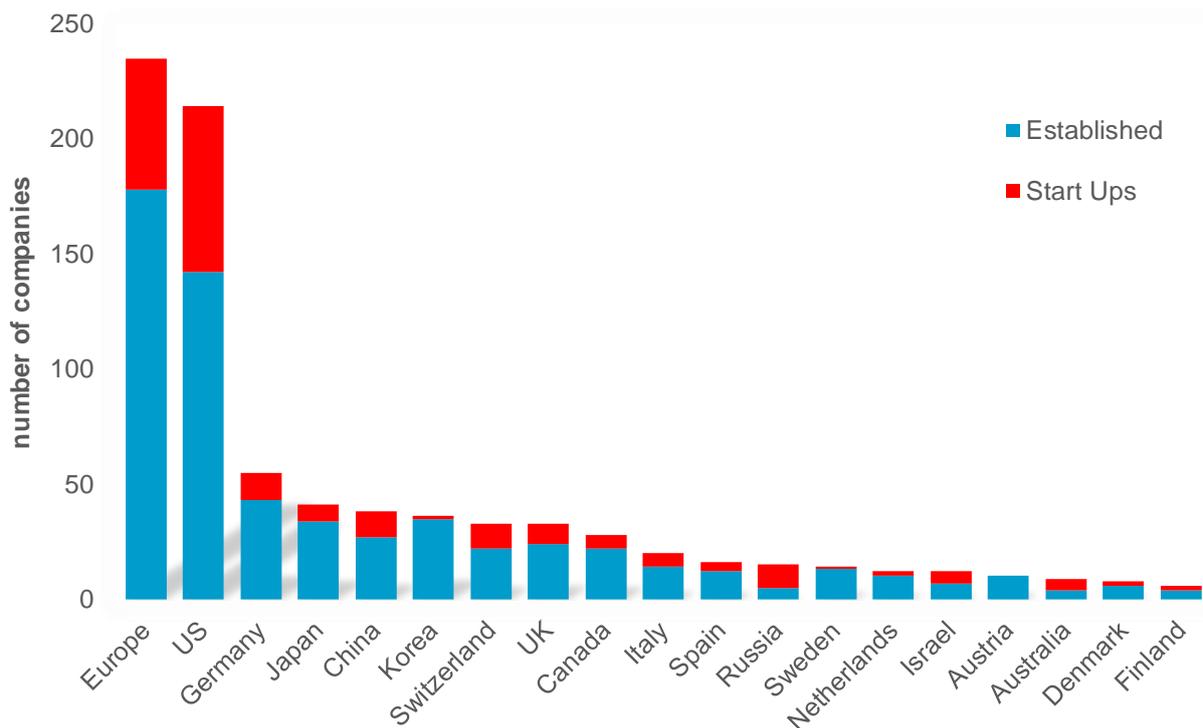


Figure 3-6: Number of service robot suppliers world wide, share of start-ups

3.3. Company size and demographics

The evaluation of the company size is based on the number of employees. The required information was mainly collected from the manufacturers’ websites but also from business oriented networking services, data bases and other public sources (e. g. [LinkedIn](#), [Amadeus](#), [Bloomberg](#)). Figure 3-7 and Figure 3-8 display the distribution of the company size which are active in specific application domains.

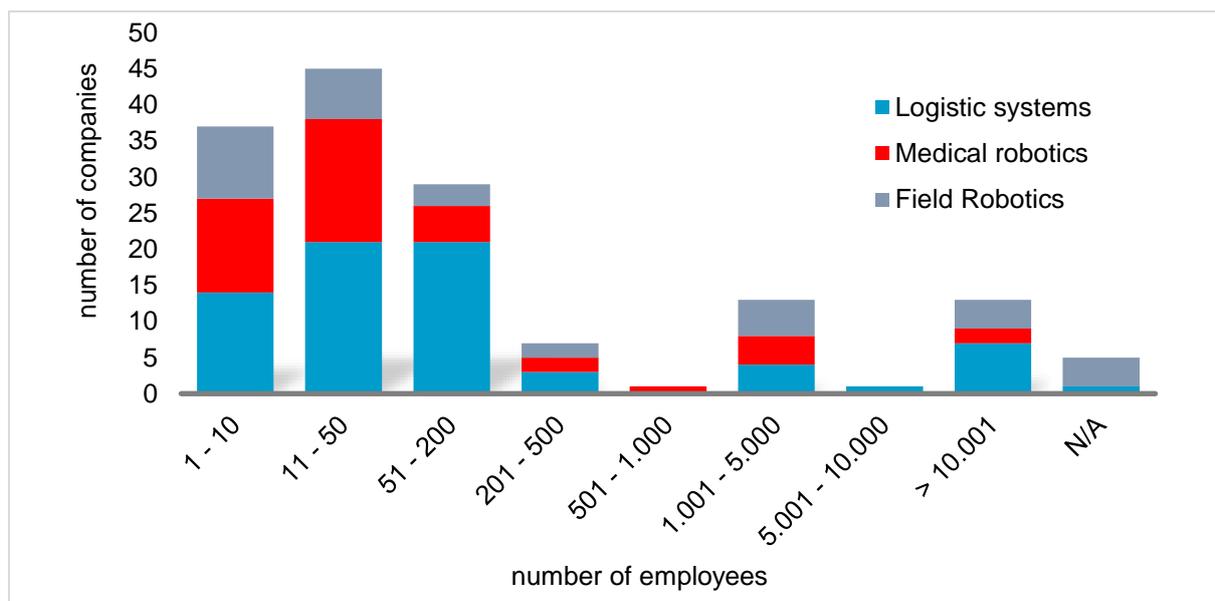


Figure 3-7: Business sizes of service robots for professional use by main applications in numbers of employees (Europe)

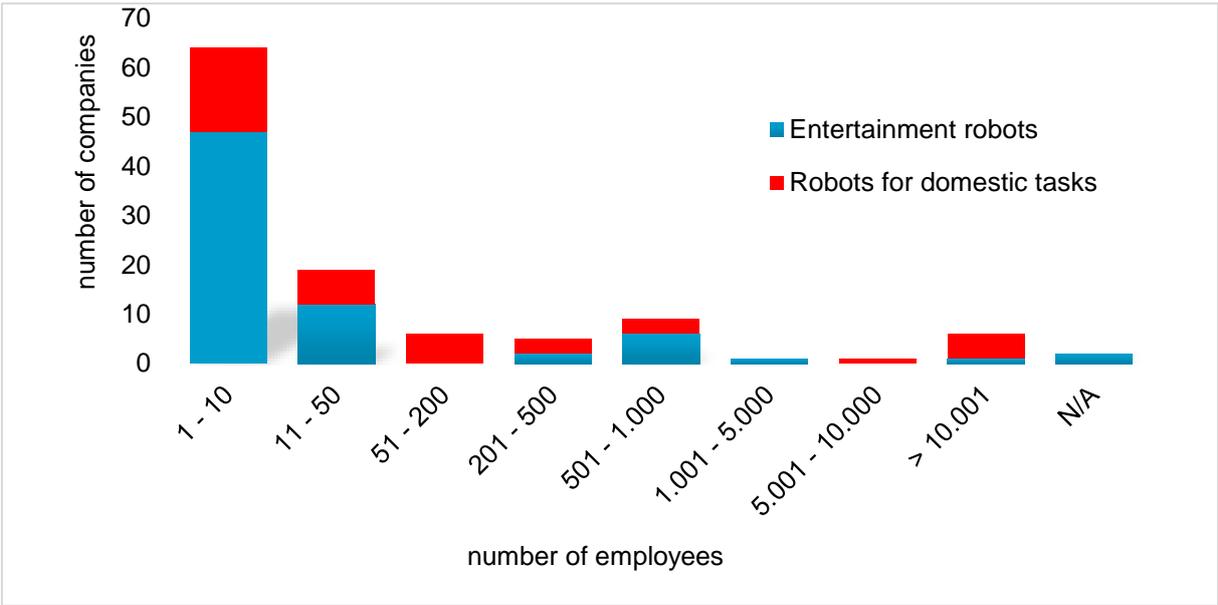


Figure 3-8: Business sizes of service robots personal/domestic use by main applications in numbers of employees (Europe)