

An outlook for robotics (in industry and service)

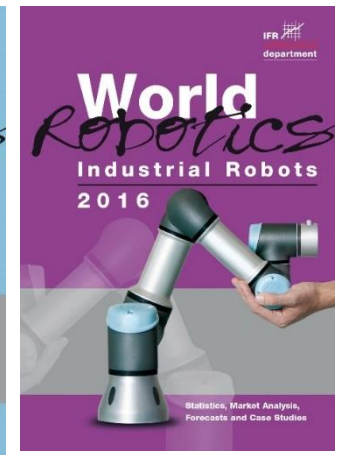
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Oct 13, 2016

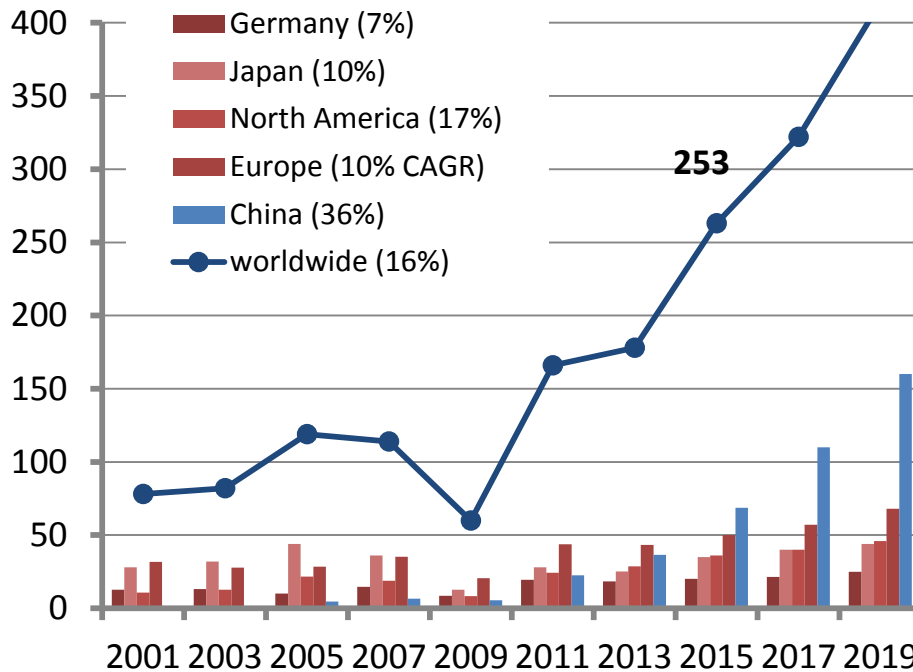
International Federation of Robotics IFR

- Represents the global robotics industry
 - Turn-over 2015 industrial robotics ~ US\$35bn
 - >50 members:
 - National robot associations
 - R&D institutes
 - Robot suppliers
 - Integrators
 - World (Industrial and Service) robotics Yearbooks; www.ifr.org; www.worldrobotics.org
- Look for downloads. Complete set of data or DB access subject to fee.

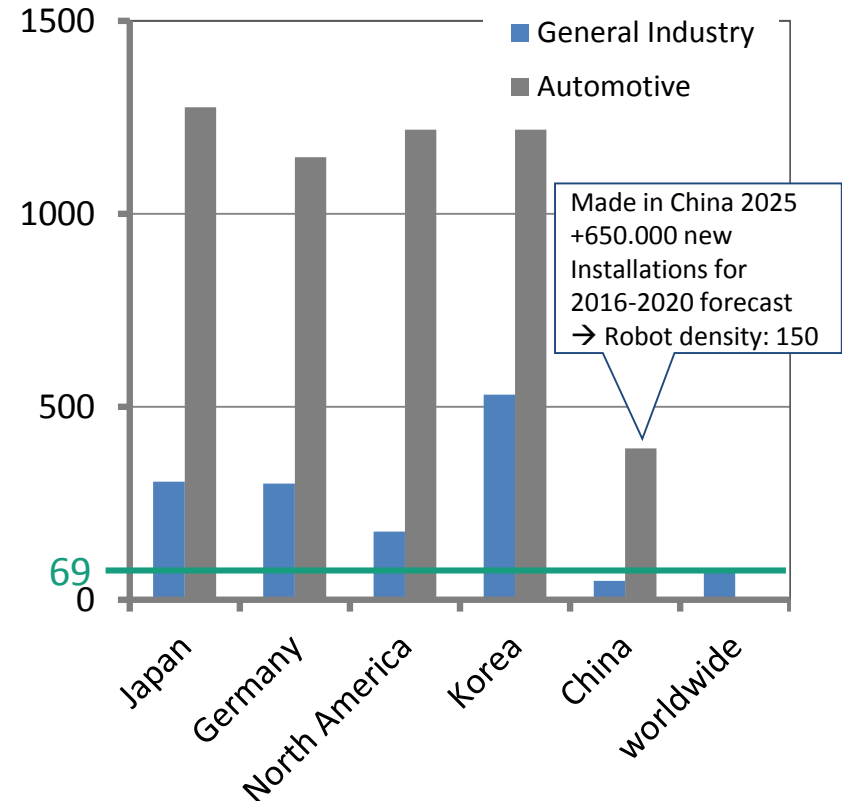


Industrial Robotics on the rise in a globalized economy; some basic statistics

Industrial robot shipments worldwide in thousands of units (2016+ estimated) 414



Industrial robot density worldwide In selected regions (in 2015)

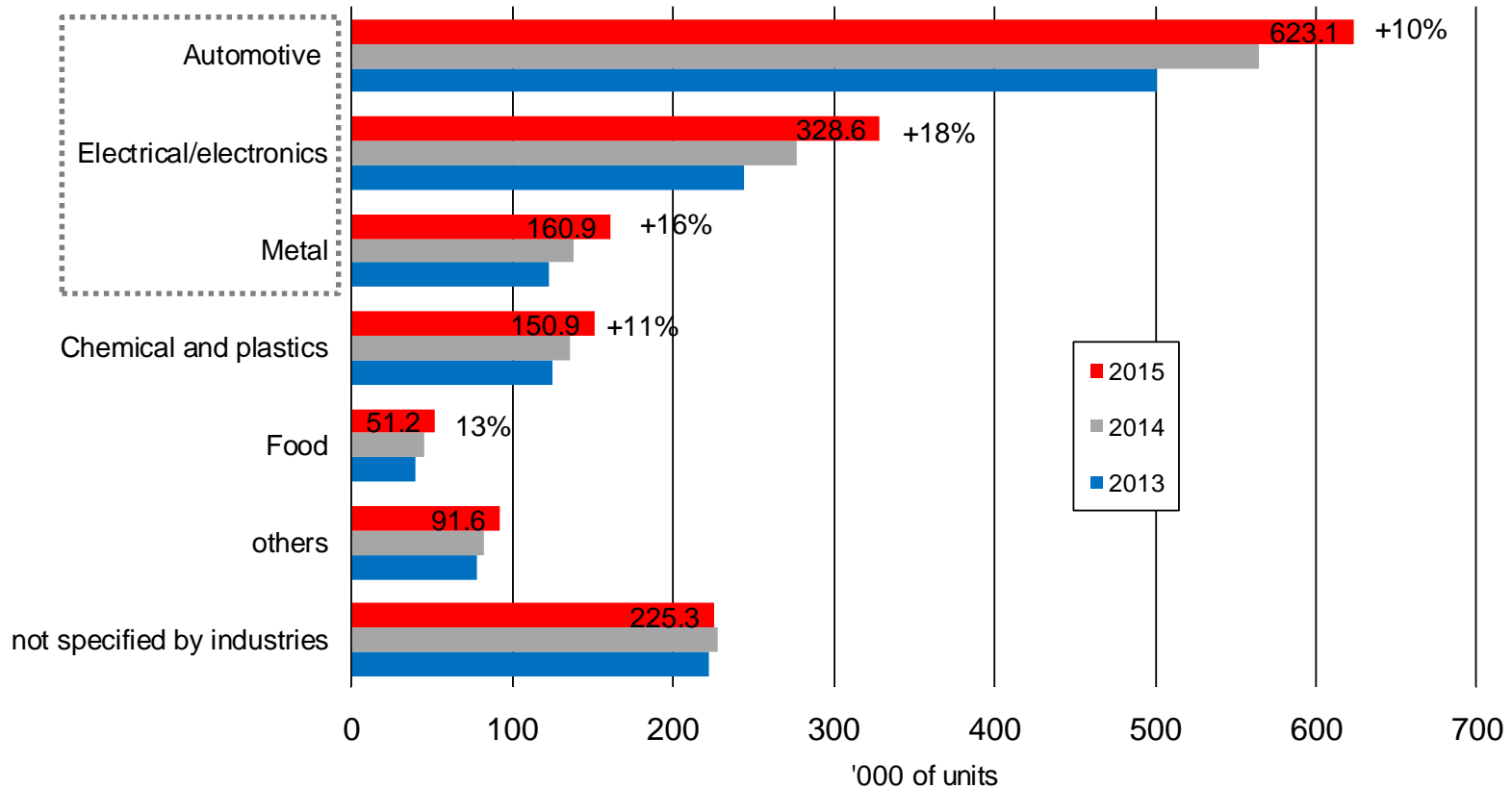


www.worldrobotics.org, September 2016

- Global turn over in industrial robotics ~US\$35b (+15.5%); 2015: 253k, 2019: 414k units
- In 2019, estimated 2.6m industrial robots in factories worldwide; 1 million more than in 2015
- Total Industrial Robotics market worldwide estimated US\$25bn.
- Strong growth in Asia (China) will impact technology, cost, supply chain of industrial robotics

Industrial Robotics: Almost 70% of systems installed in three main industries

Estimated worldwide operational stock of industrial robots at year-end by main industries 2013 - 2015



Source: IFR World Robotics 2016

- Share of robot sales into automotive industries in 2015 → some 40%
- Robots for **electrical/electronics industry** (3C industries incl. medical equipment, precision/optical devices) were up **41% in 2015 to 64,600 units**

Some major technological trends in IR

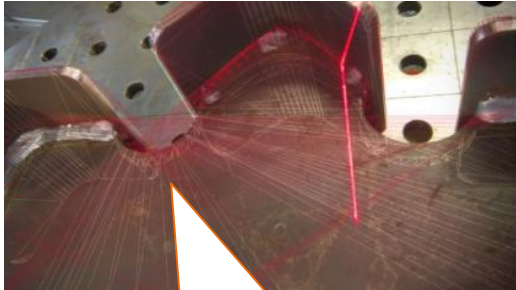
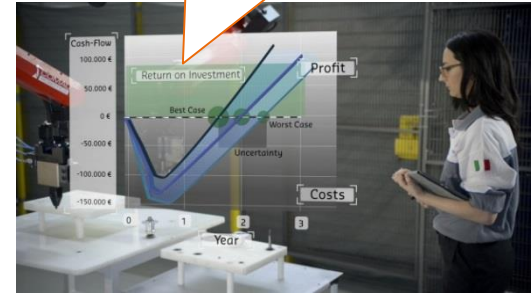
Safe human
robot collaboration



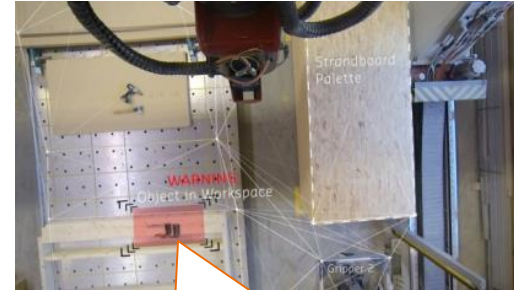
Interfacing with
production data



Cost effectiveness



Sensors



Cognitive capabilities



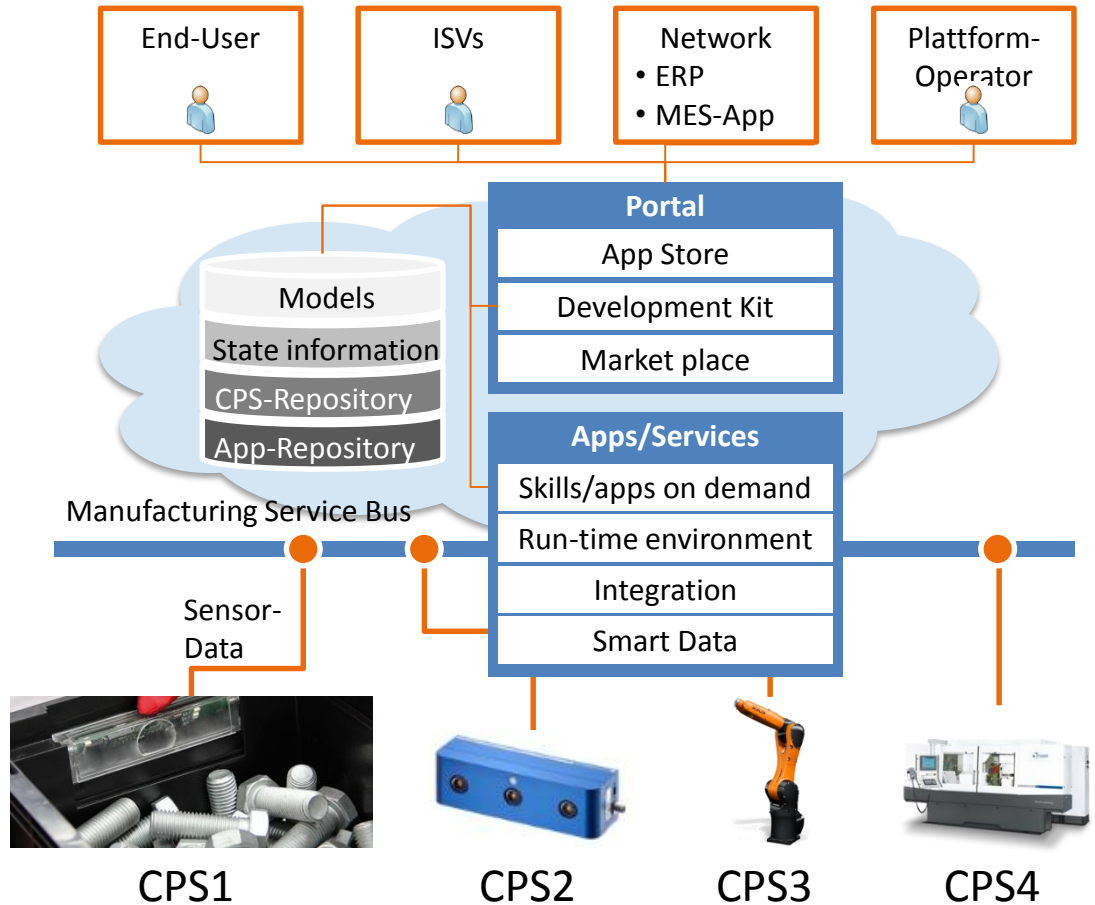
Intuitive instruction
(skills), error recovery

- Industrie4.0/Industrial Internet will have strong impact on technological progress
- Still, incremental/evolutionary innovation process in industry
- Role of human operator shifting → knowledge worker on the shopfloor
- Example: SMERobotics in 100 sec; www.smerobotics.org

Industrial Robotics in Industrie4.0-environments

Basic architecture of I4.0 platforms

- Portal
- Platform
- Services
- Cyber-physical systems



ISV: Independent Software Vendor
 ERP: Enterprise Resource Planning Software
 MES: Manufacturing Execution System

Main application areas of Service Robots

Professional Use

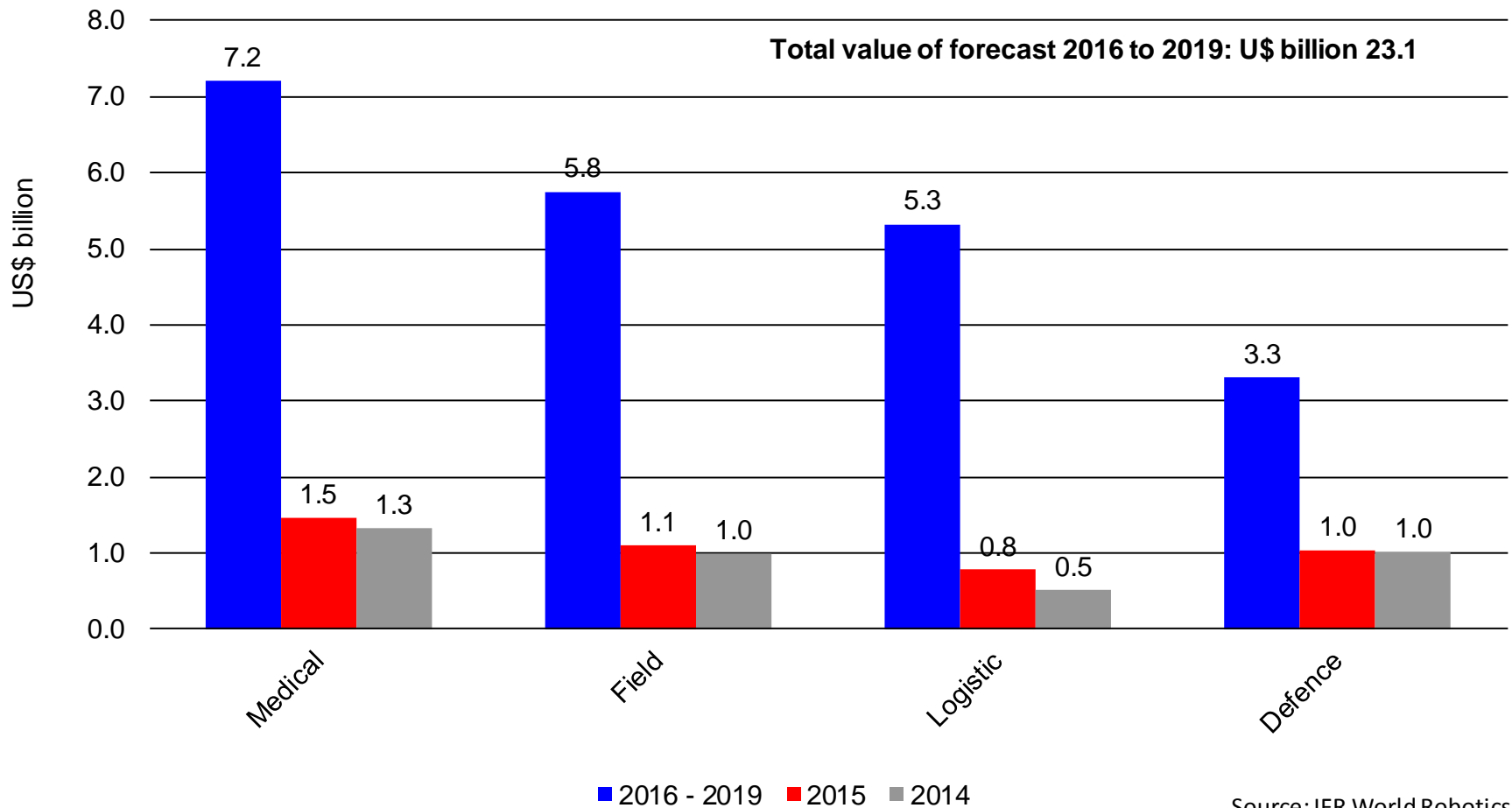
- 17-23 Field robotics
- 24-28 Professional cleaning
- 29-31 Inspection and maintenance systems
- 32-35 Construction and demolition
- 36-39 Logistic systems
- 40-43 Medical robotics
- 44-46 Rescue & security applications
- 47-51 Defense applications
- 52 Underwater systems (civil / general use)
- 53 Powered Human Exoskeletons
- 54 Unmanned aerial vehicles (general use)
- 55 Mobile Platforms in general use
- 56-60 Underwater systems (civil / general use)
- 61 Other

Personal/domestic use

- 1-6 Robots for domestic tasks
- 7-10 Entertainment robots
- 11-13 Elderly and handicap assistance
- 14 Personal transportation (AGV for persons)
- 15 Home security & surveillance
- 16 Other Personal / domestic robots

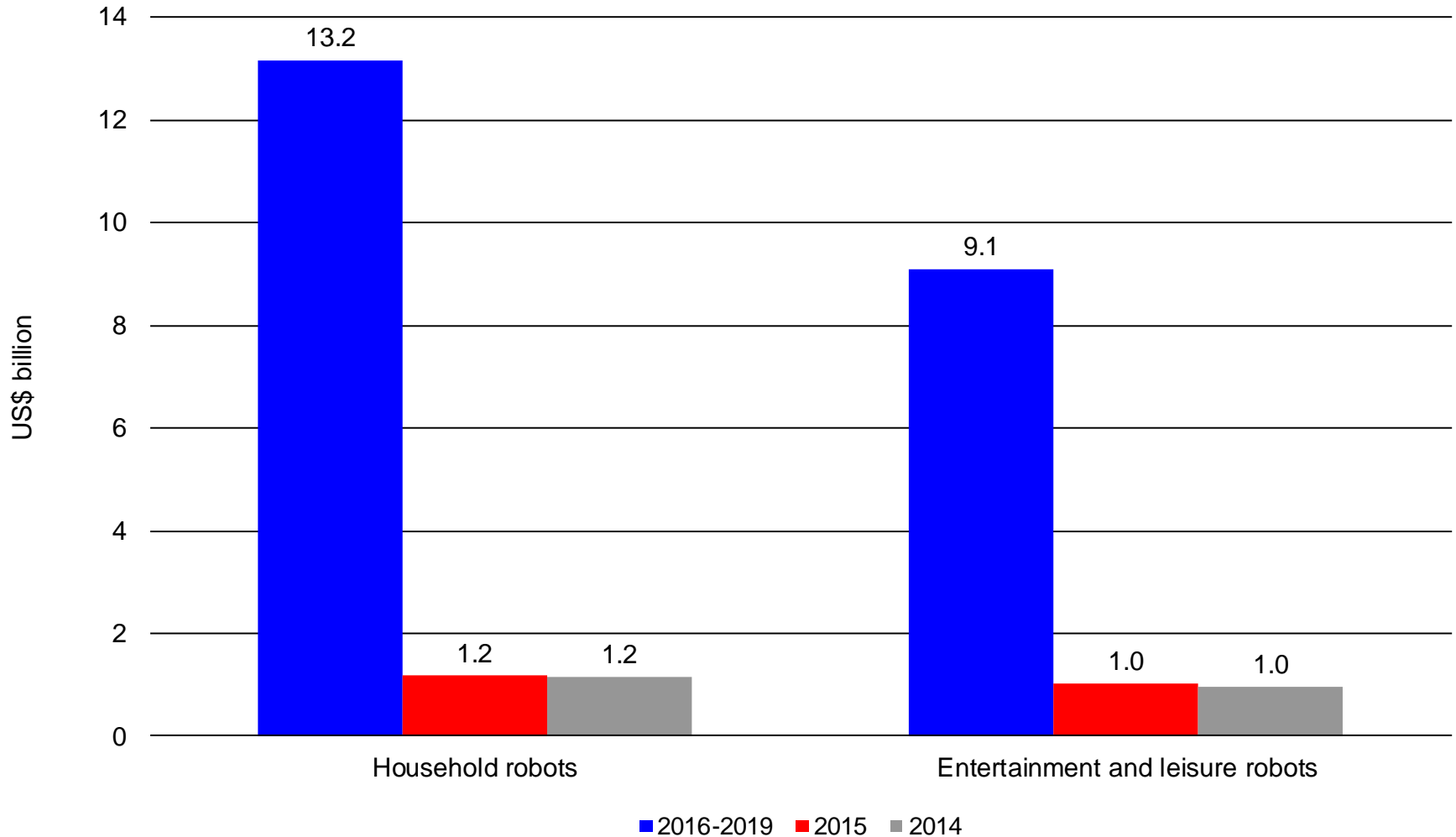
Service Robotics for Professional Use

Service robots for professional use. Estimated value of sales 2014 and 2015 and estimated value of forecast 2016 - 2019 (main applications)

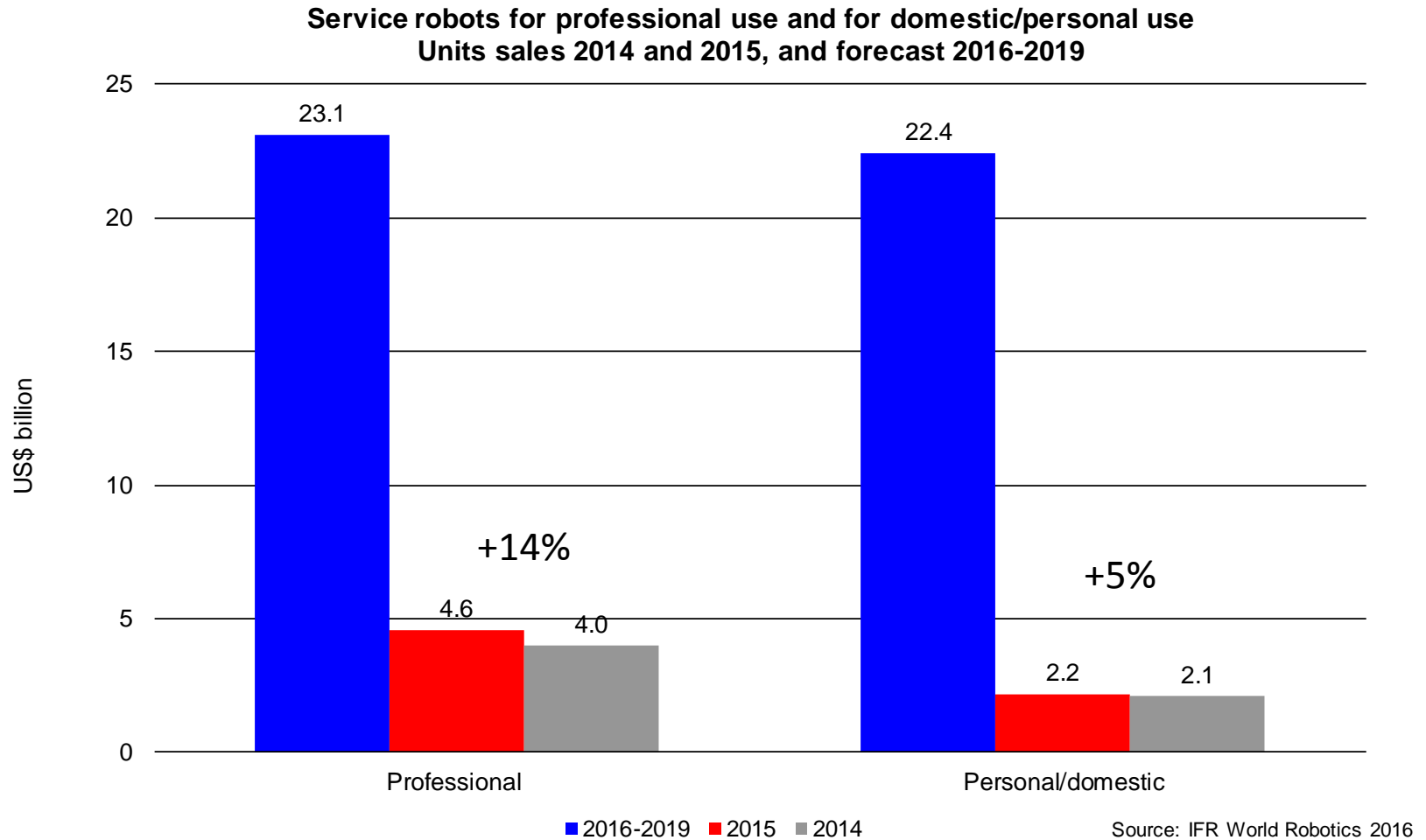


Service Robotics for personal/domestic use

**Service robots for personal/domestic use.
Estimated value of sales 2014 and 2015, forecast 2016-2019**



Service Robotics is taking off

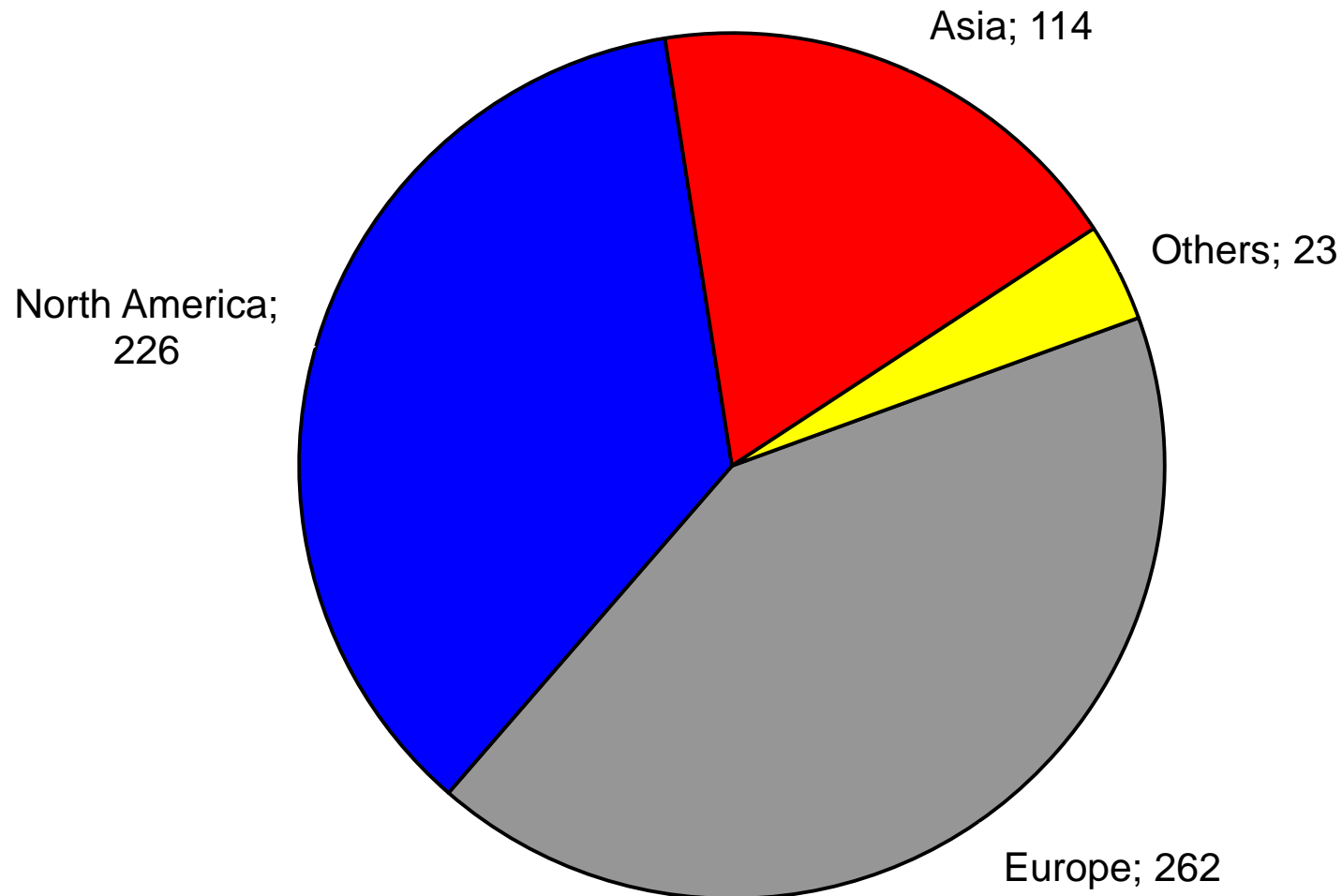


2015: US\$ 6.8bn global turn over globally (corresponds to ~20% of industrial robotics)

2016-2019: US\$ 45bn accumulated sales value

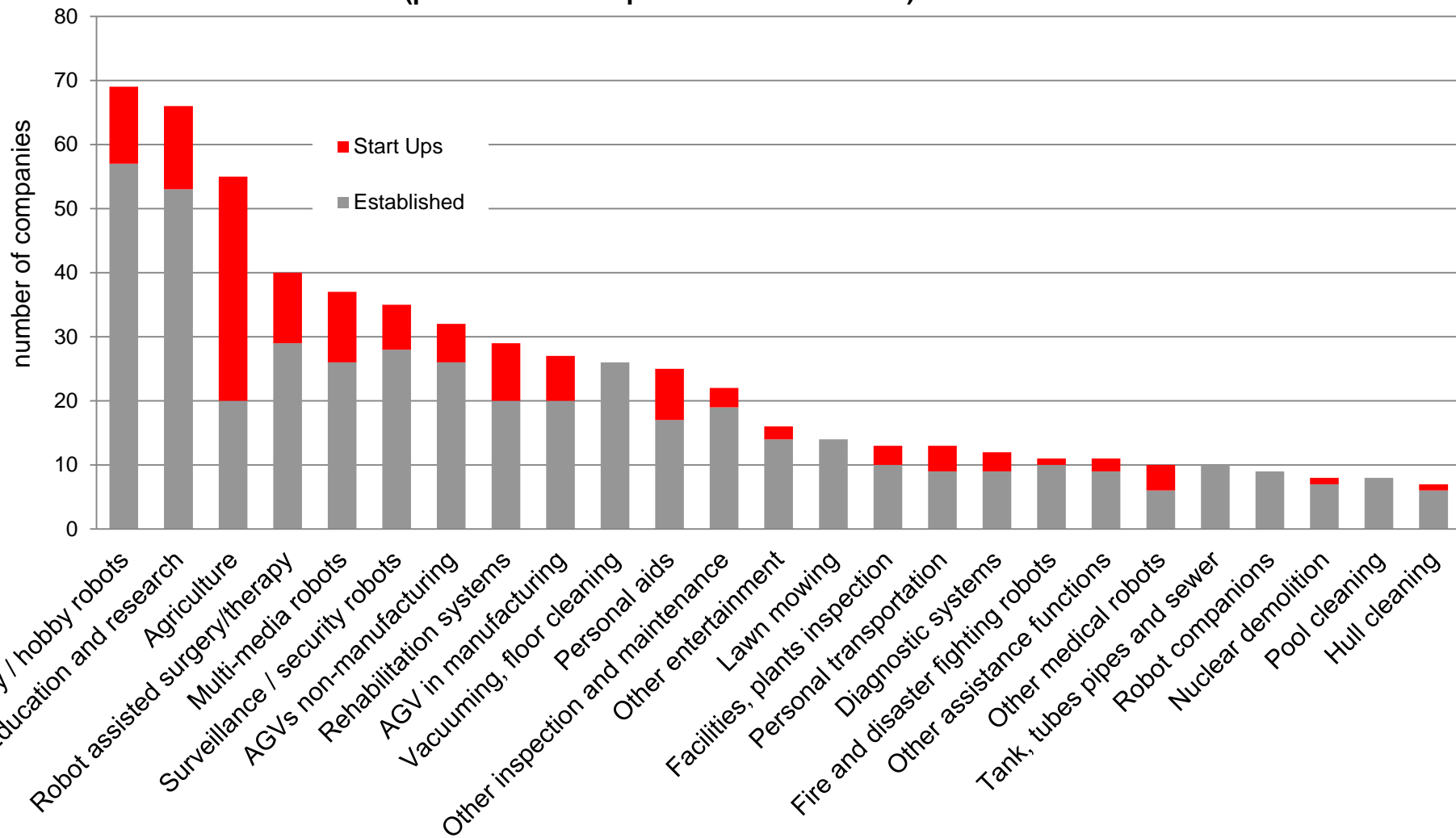
2016 - 2019: US\$ 22.4bn turnover of personal/domestic service robots

Number of service robot manufacturers of all types (professional and personal/domestic use) by region of origin

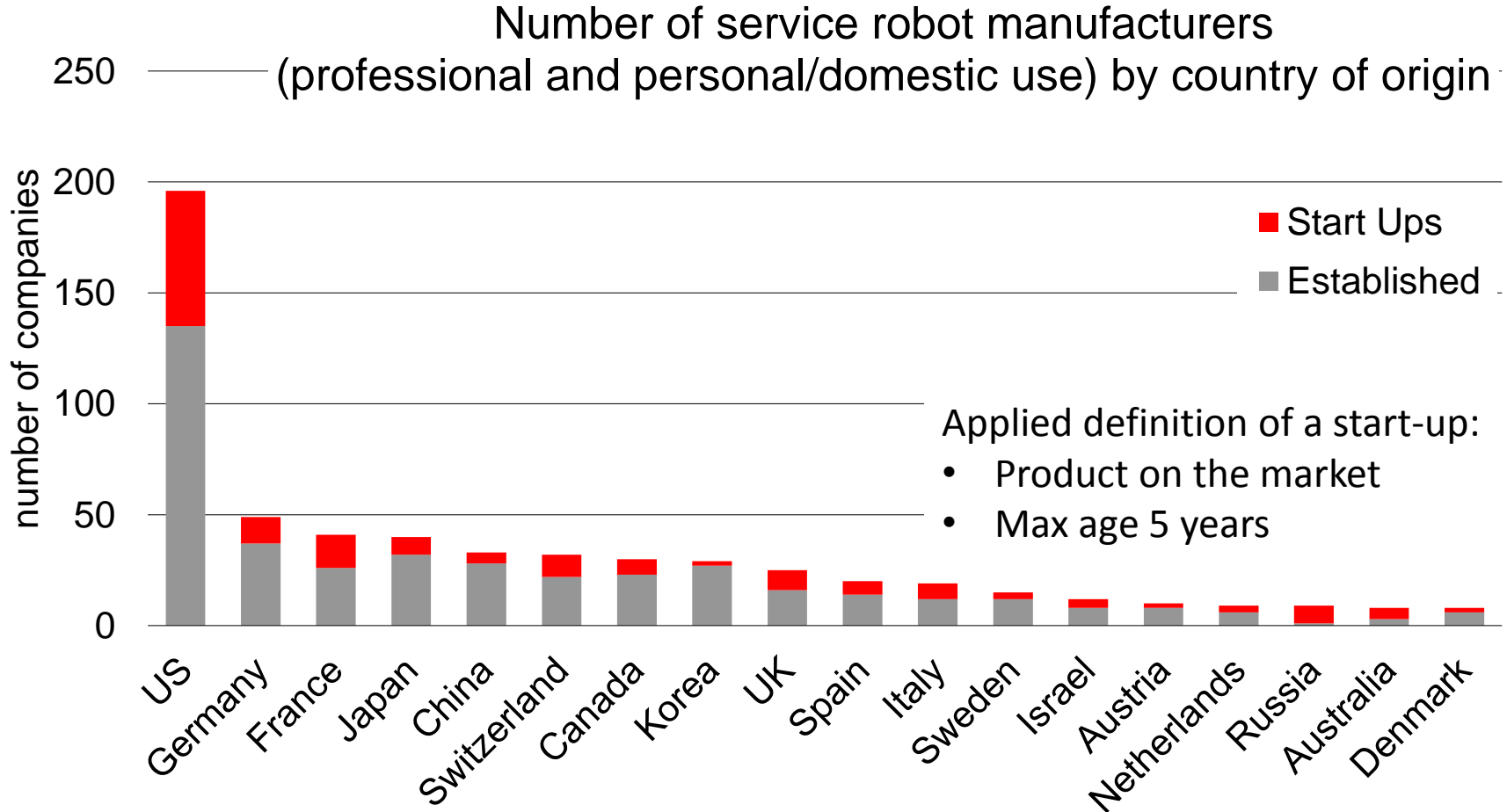


Service Robotics (domestic and professional applications): more than 620 active companies

Number of service robot manufacturers of main types
(professional and personal/domestic use) worldwide

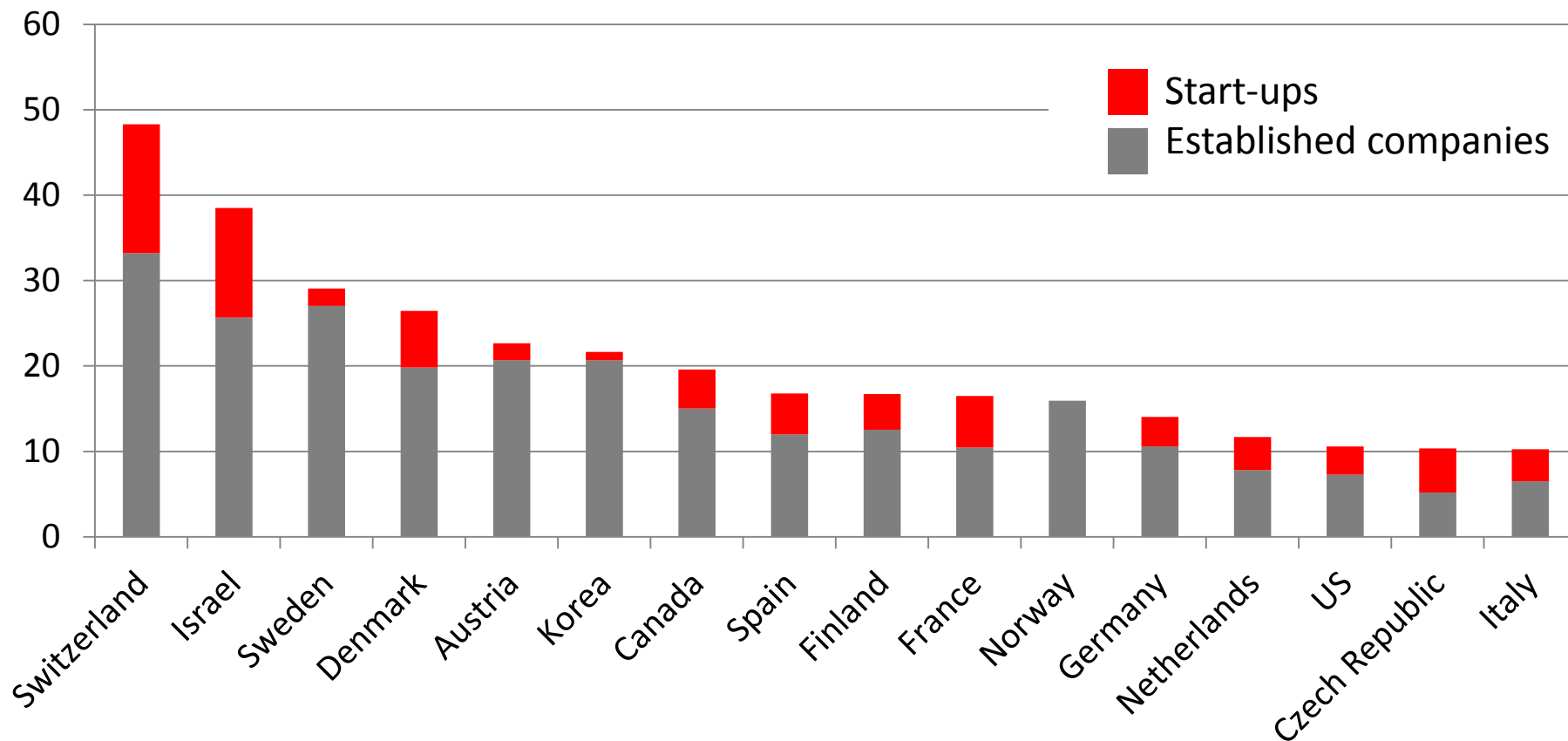


Service Robotics: Opportunities give birth to a new industry worldwide



Service Robotics: Industrial activity in relation to national GDPs

Number of service robot manufacturers;
normalized [per US\$1.000bn in GDP]



2015 GDPs; https://en.wikipedia.org/wiki/List_of_countries_by_GDP_nominal

Service robotics: Some observations

- Service robotics: strong growth and technology burst
- **625 companies** world wide developing/supplying service robots
- Hot field of start-up activities (185/625 → **28%**, >US\$1bn 2015 in VC investment)
- First eco-systems being formed (networks of end-users, suppliers, technology partners, application modules/packages, services, consulting):
 - Mobile robot platforms
 - Unmanned aerial vehicles/multicopter/drones
- Strong facilitators for ecosystems:
 - Mature multi-purpose hardware platforms
 - Open source software-systems → start-ups
- European potential for further growth:
 - Logistics, health, domestic/personal, ...

Robotics and jobs: Image of automation

Automation has a **positive net effect** on labour demand [in Europe]:

- Automation reduces production cost
- Reduced product costs reduce prices
- Reduced product prices increase demand for products
- Increased product demand increases employment.

Main challenge for future work → coping with rising inequality, as technological change creates both winners and losers. Policy makers should focus on the qualifications of the workers to ensure that workers' skills match future skill requirements.

Download ZEW-Study: http://ftp.zew.de/pub/zew-docs/gutachten/Robotics_Employment_2016.pdf