IFR International Federation of Robotics

BI MU 12th October 2018

INDUSTRIAL AND SERVICE ROBOTICS: STATE OF THE ART AND FUTURE TRENDS

Arturo Baroncelli
Past President IFR
SIRI Board Member

International Federation of Robotics

Representing the global robotics industry

- Robotics turnover 2017: about $50 billion
- More than 50 members:
  - National robot associations
  - R&D institutes
  - Robot suppliers
  - Integrators

- Sponsor of the annual International Symposium on Robotics (ISR)
- Co-sponsor of the IERA Award
- Primary resource for world-wide data on use of robotics – IFR Statistical Department

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Source data August 2018

Structure of Presentation

- Industrial Robots
- Service Robots

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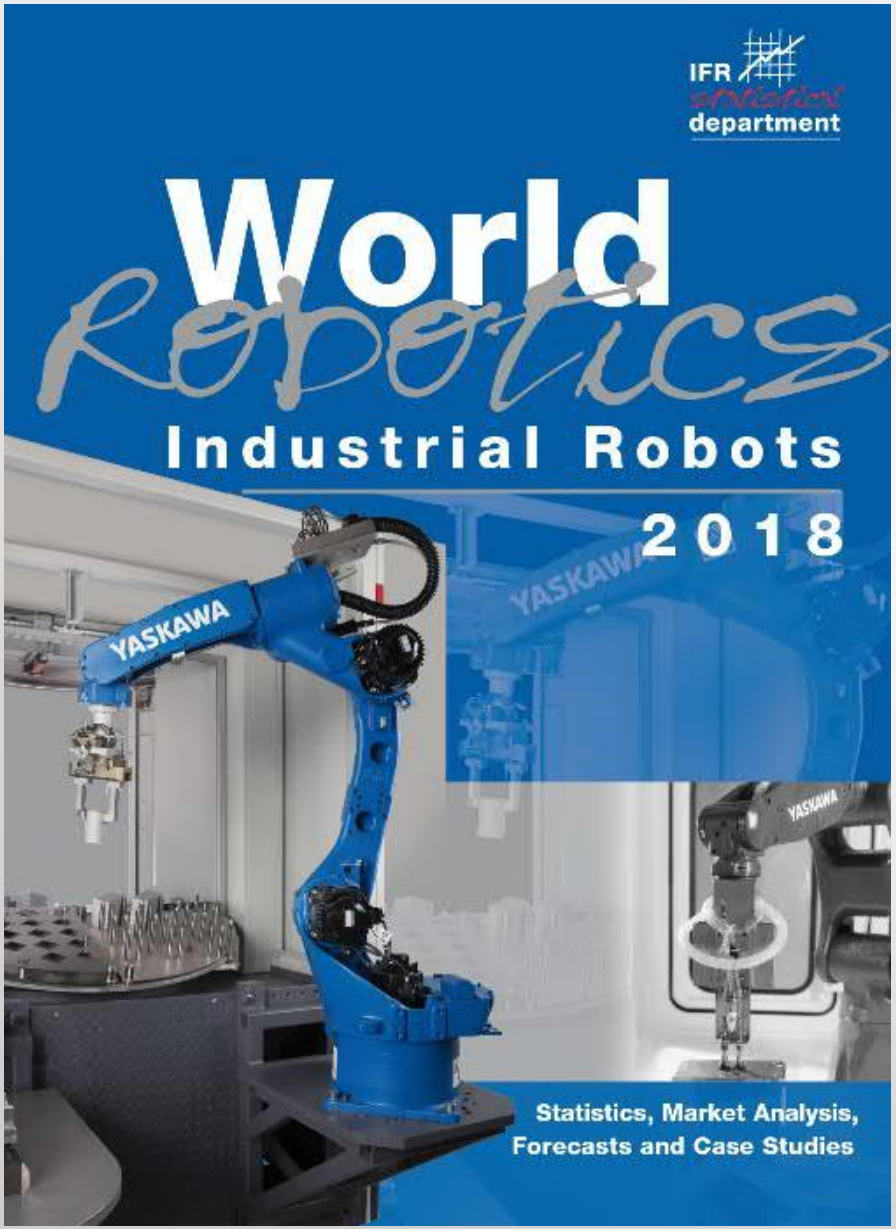

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Preview on World Robotics 2018

- Industrial Robots 2017
  - Global installations
  - Regions
  - Main Markets
  - Main Customers
  - Challenges of the Robotics Industry

Some figures of the presentation were taken from previous edition of World Robotics

The Birth of Real Industrial Robotics

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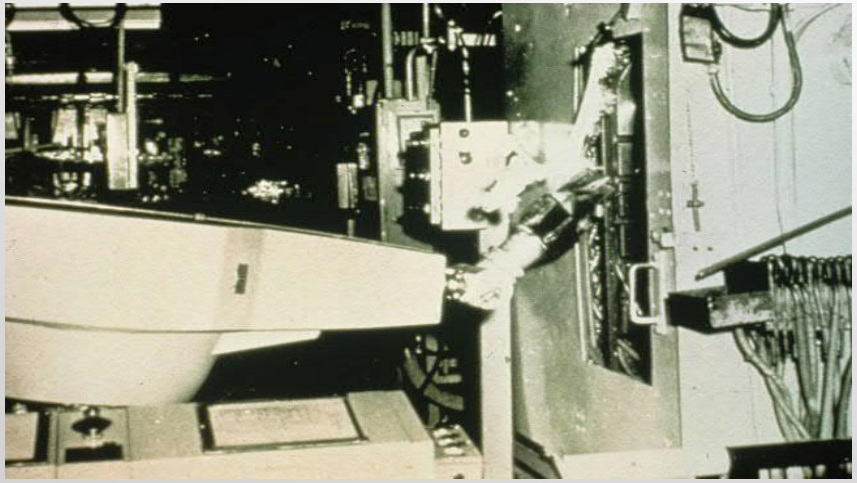

- First robot installed
- 1961 in GM plant, Trenton NJ
- Handled various hot pieces of diecast metal and stacked them
- Weight 2 tons
- Hydraulically driven
- Controlled by a program on magnetic drums
- Developed by George Devol and Joe Engelberger, 2 pioneers of Robotics

2017: record growth of industrial robots

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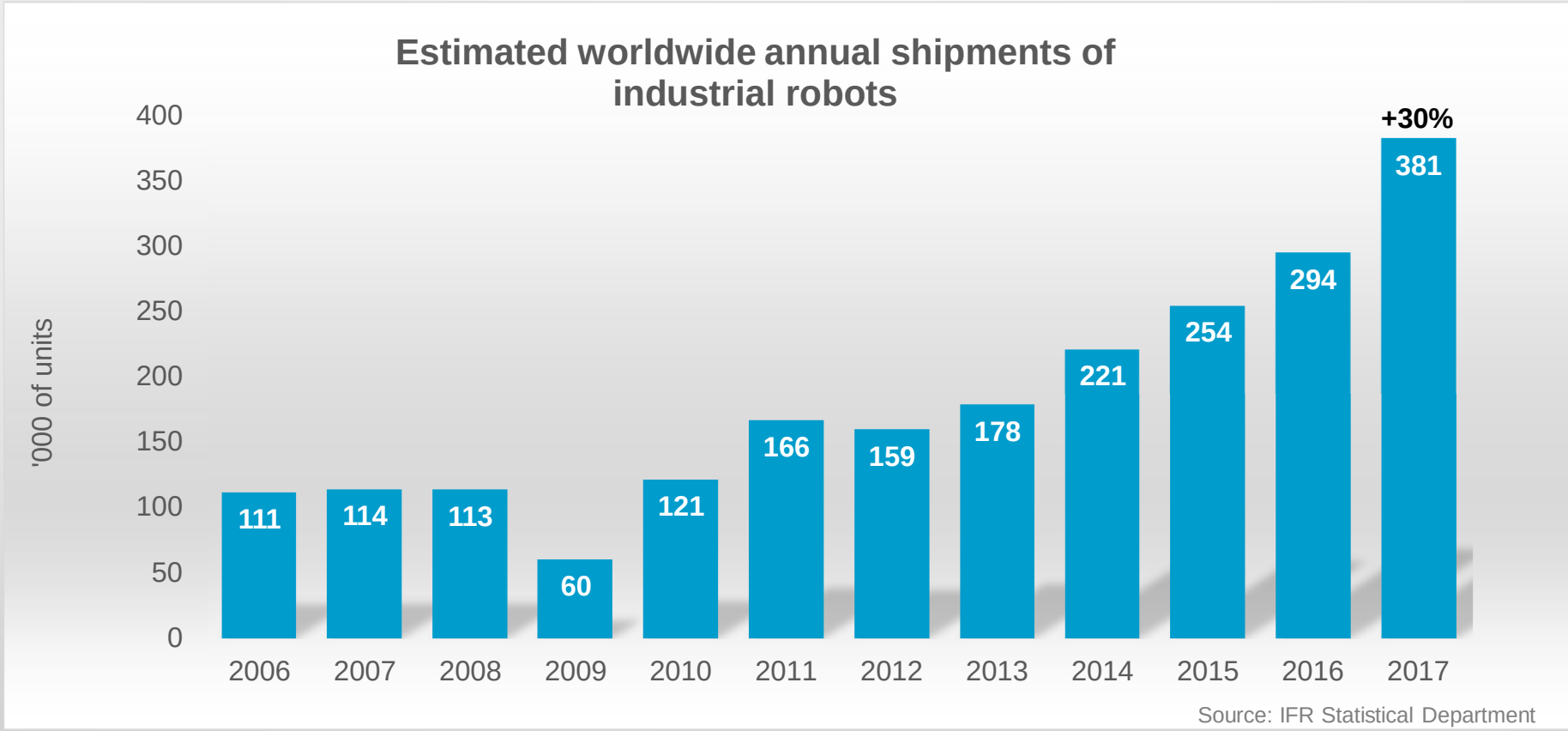

N.1 1961

2020: 3 million industrial robots in operation

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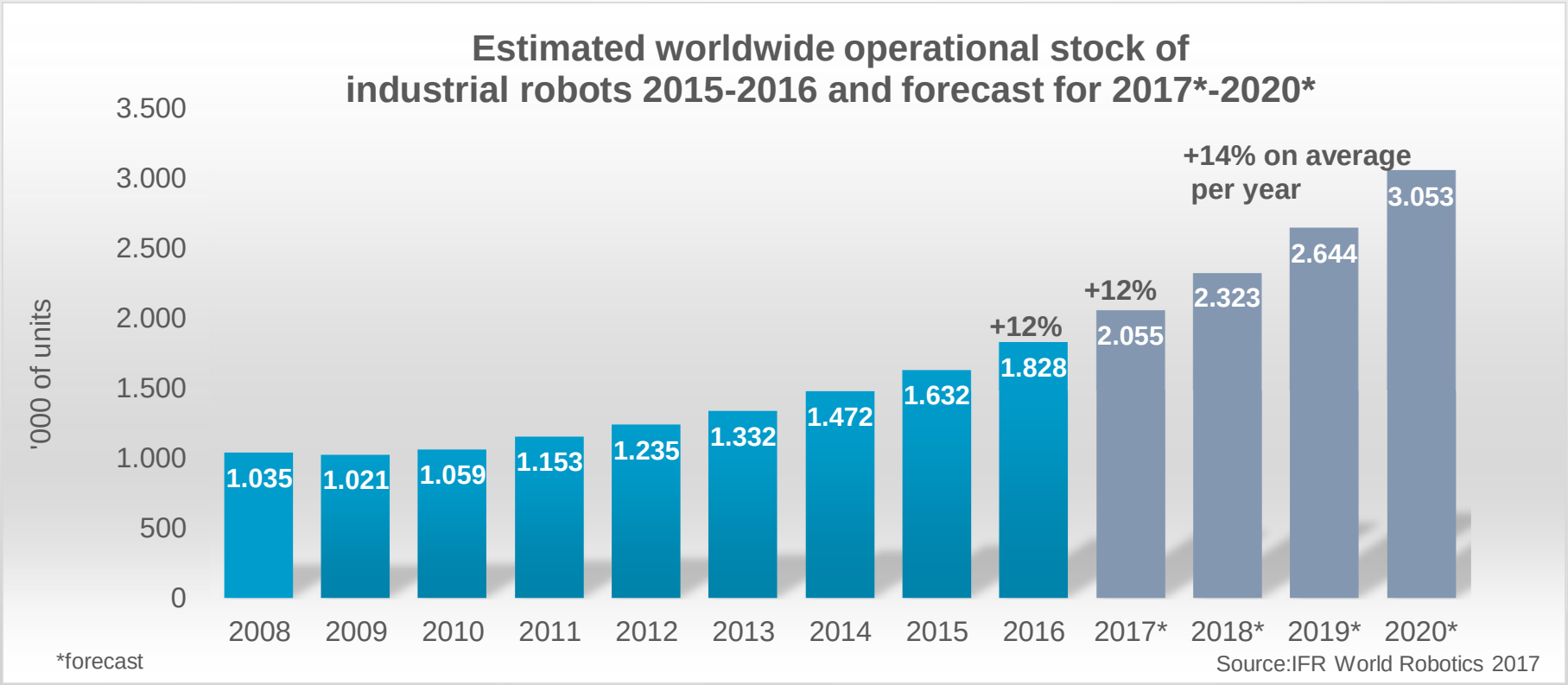
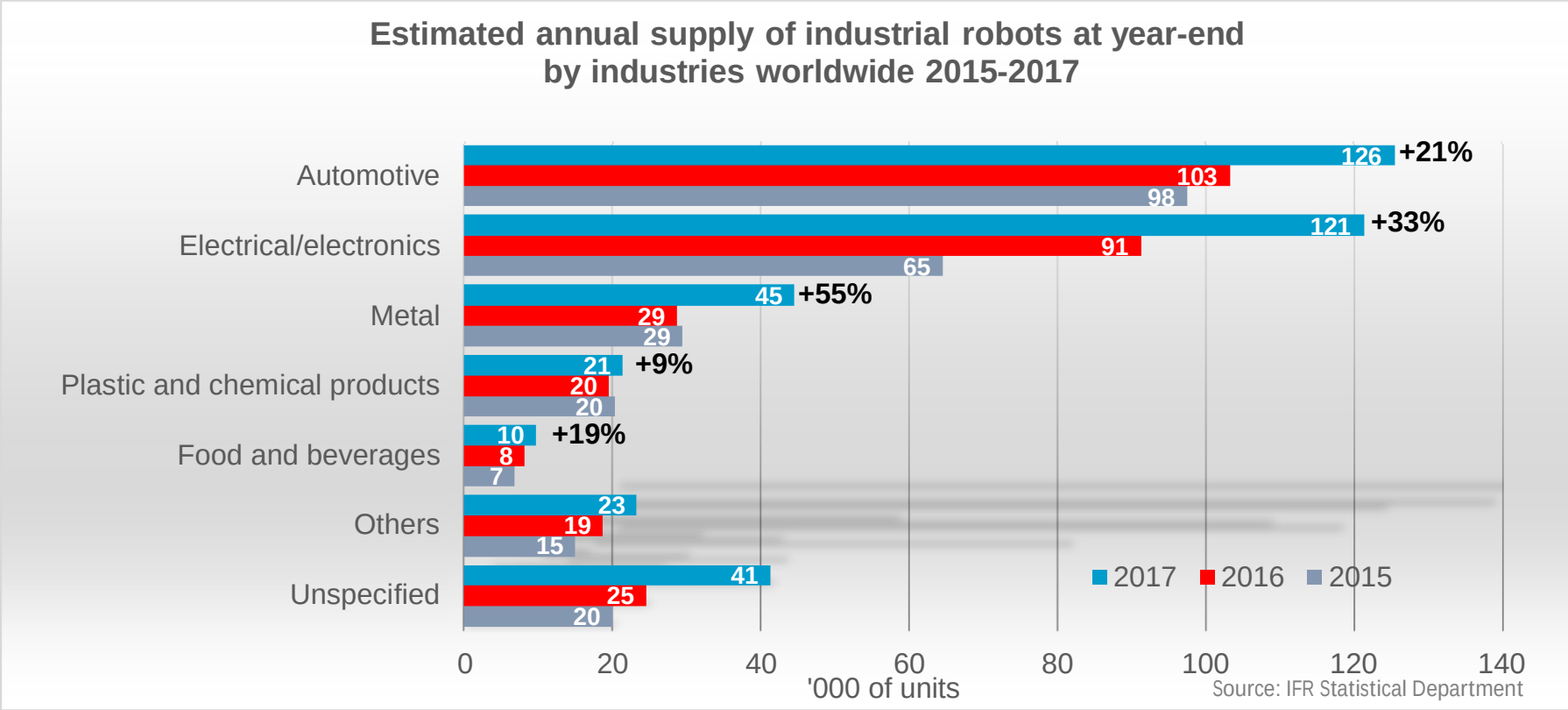
N.1 1961

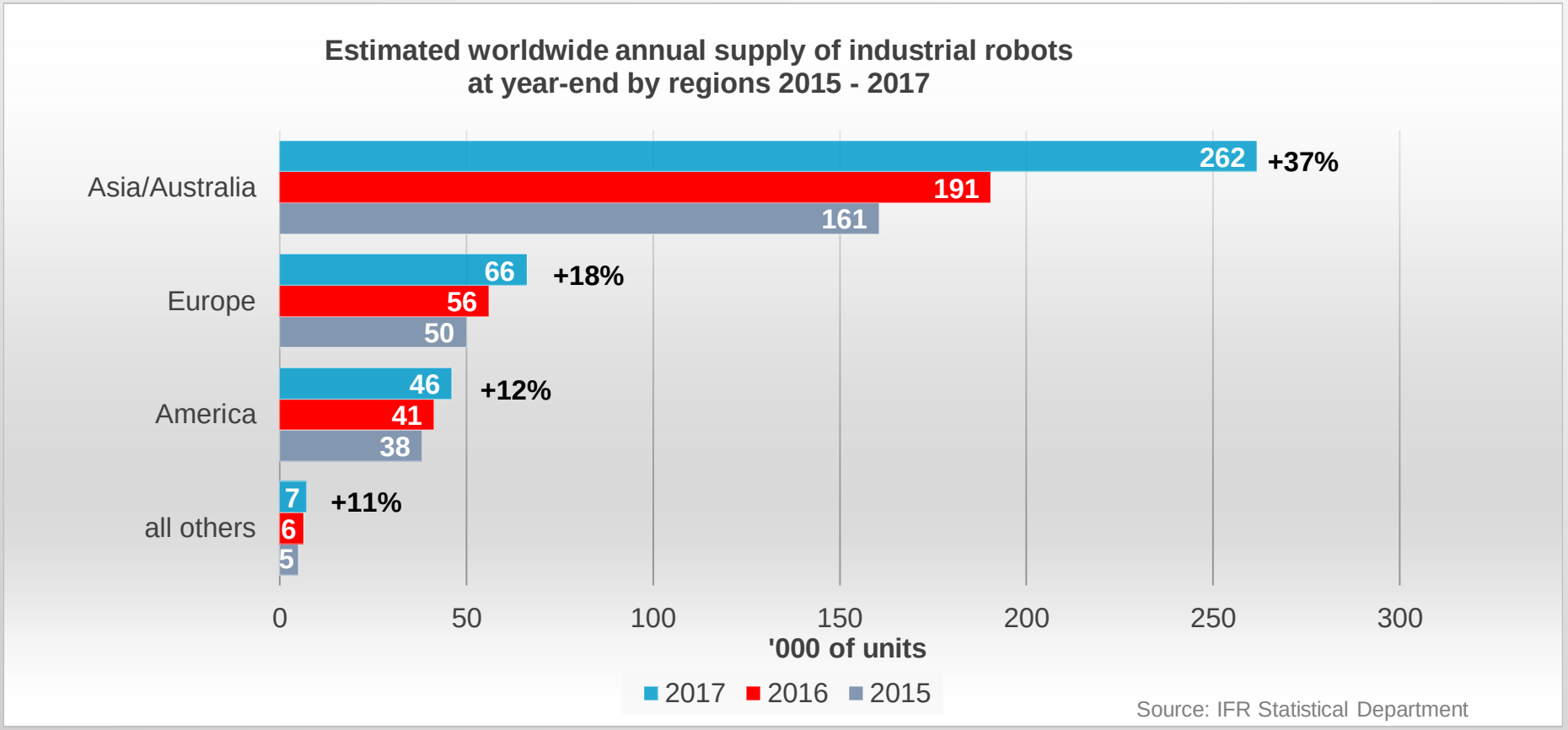


2017: electronics, automotive and metal industry are main drivers



Source data August 2018

2017: considerable increase in all regions



Source data August 2018

Top 5 countries represent 73% of total sales in 2017

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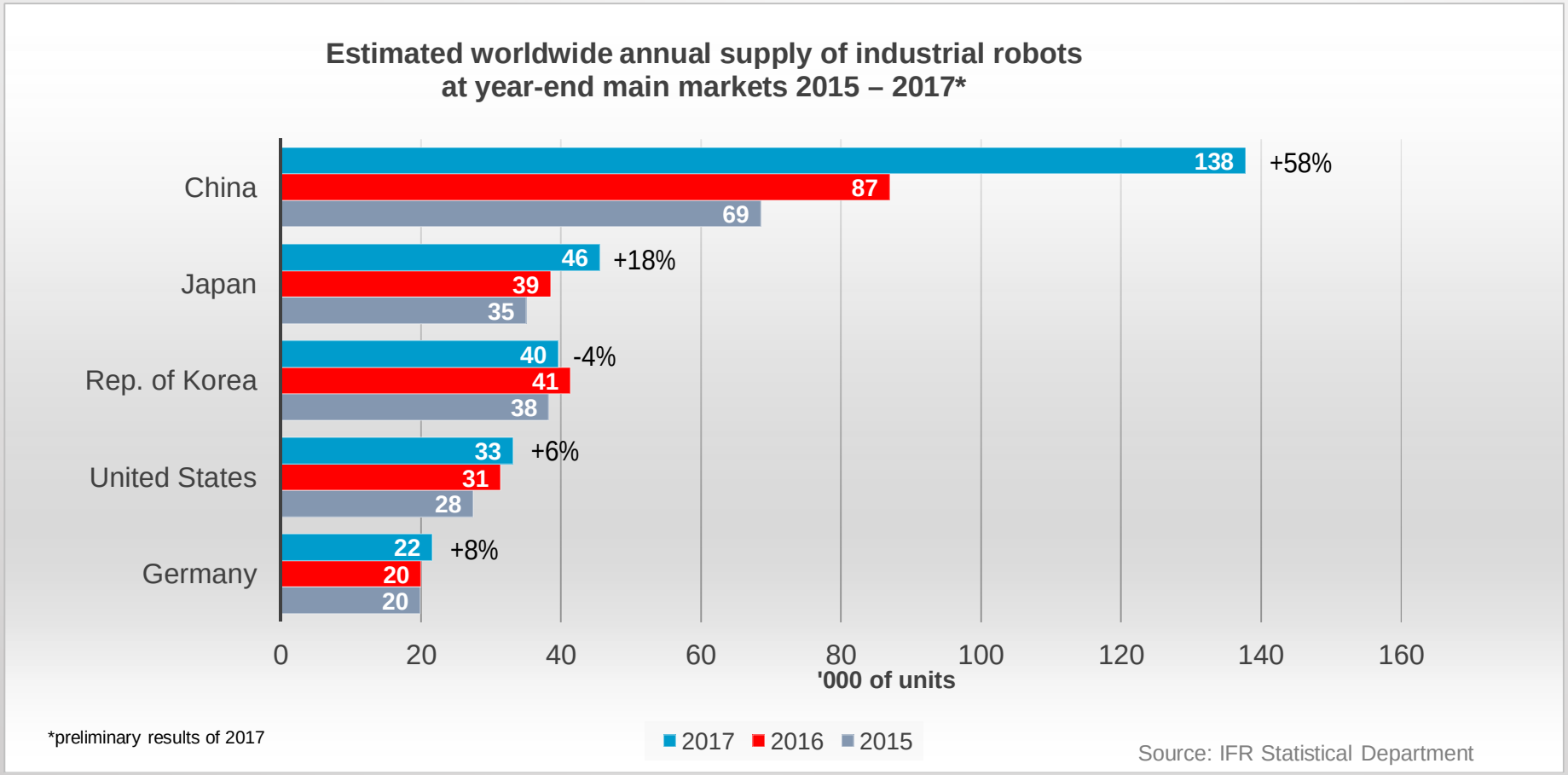
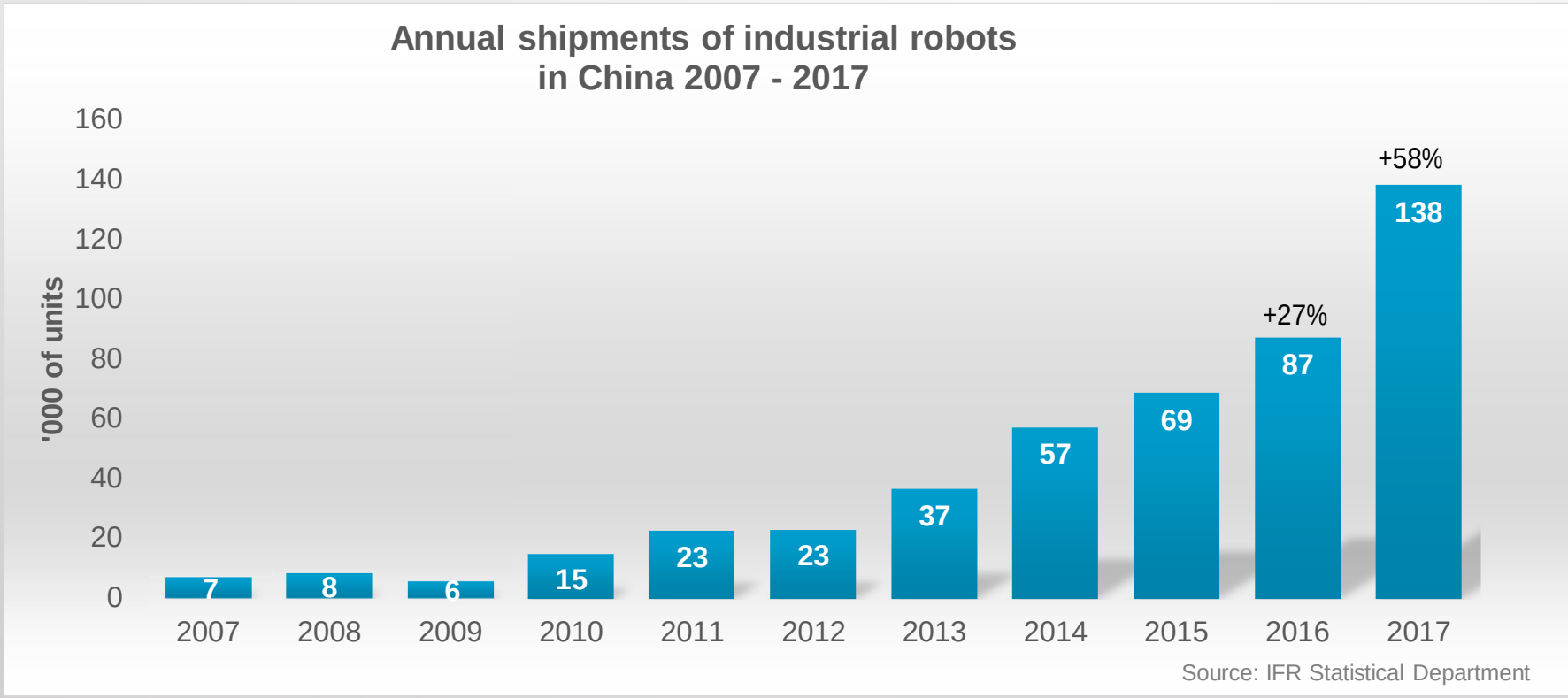


China: Main driver of growth in 2017



Source data August 2018

Italy: double digit growth 2017 vs 2016 (IFR data) and first half 2108 vs first half 2017 (SIRI UCIMU data)

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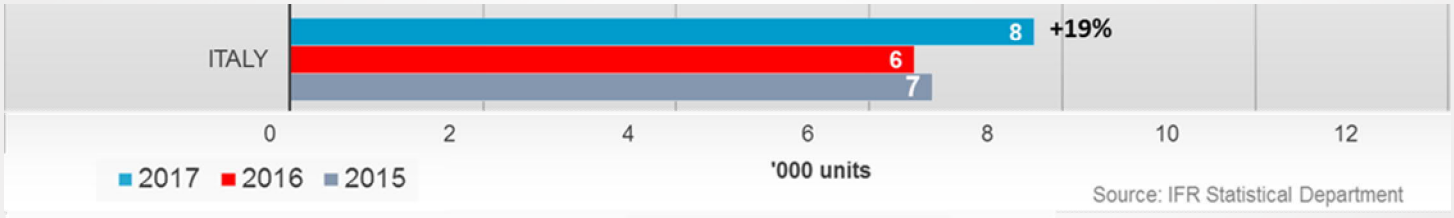
IFR data 2017 vs 2016 2015



SIRI UCIMU data 1st half 2018 vs 1st half 2017

Stima del mercato di robot articolati, scara, cinematica parallela, cartesiani, collaborativi e altri.

	1° sem. 2017	1° sem. 2018	Var. 18/17
TOTALE ROBOT ORDINATI Stima del mercato	3.870	5.072	*31,1%*

Italy: focus on first half 2108 vs first half 2017
Source: Deformazione - PubliTec Ottobre 2018 on SIRI UCIMU data

Stima del mercato di robot articolati, scara, cinematica parallela, cartesiani, collaborativi e altri.

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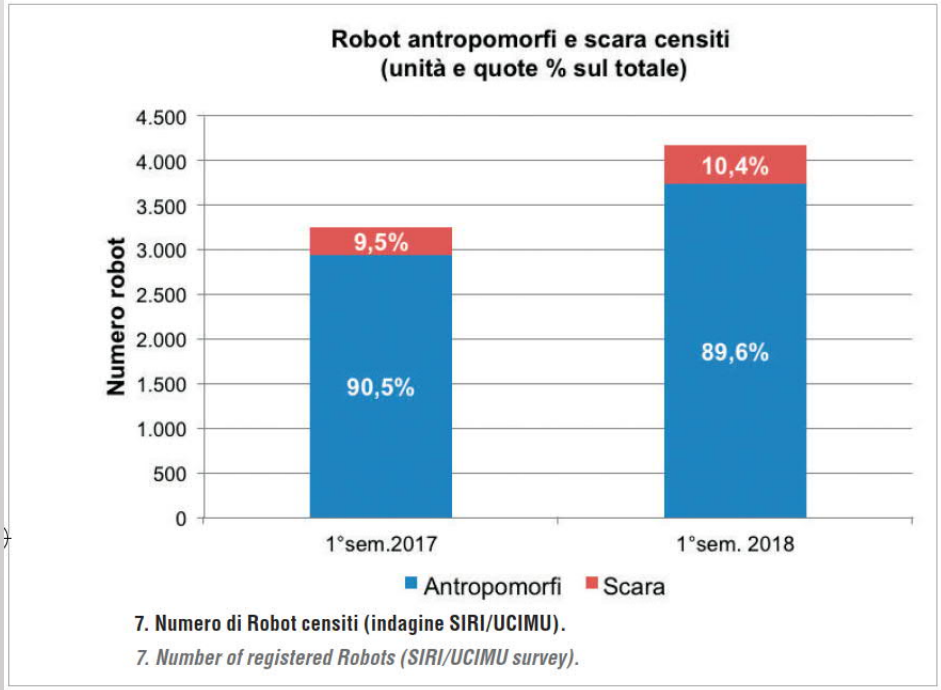
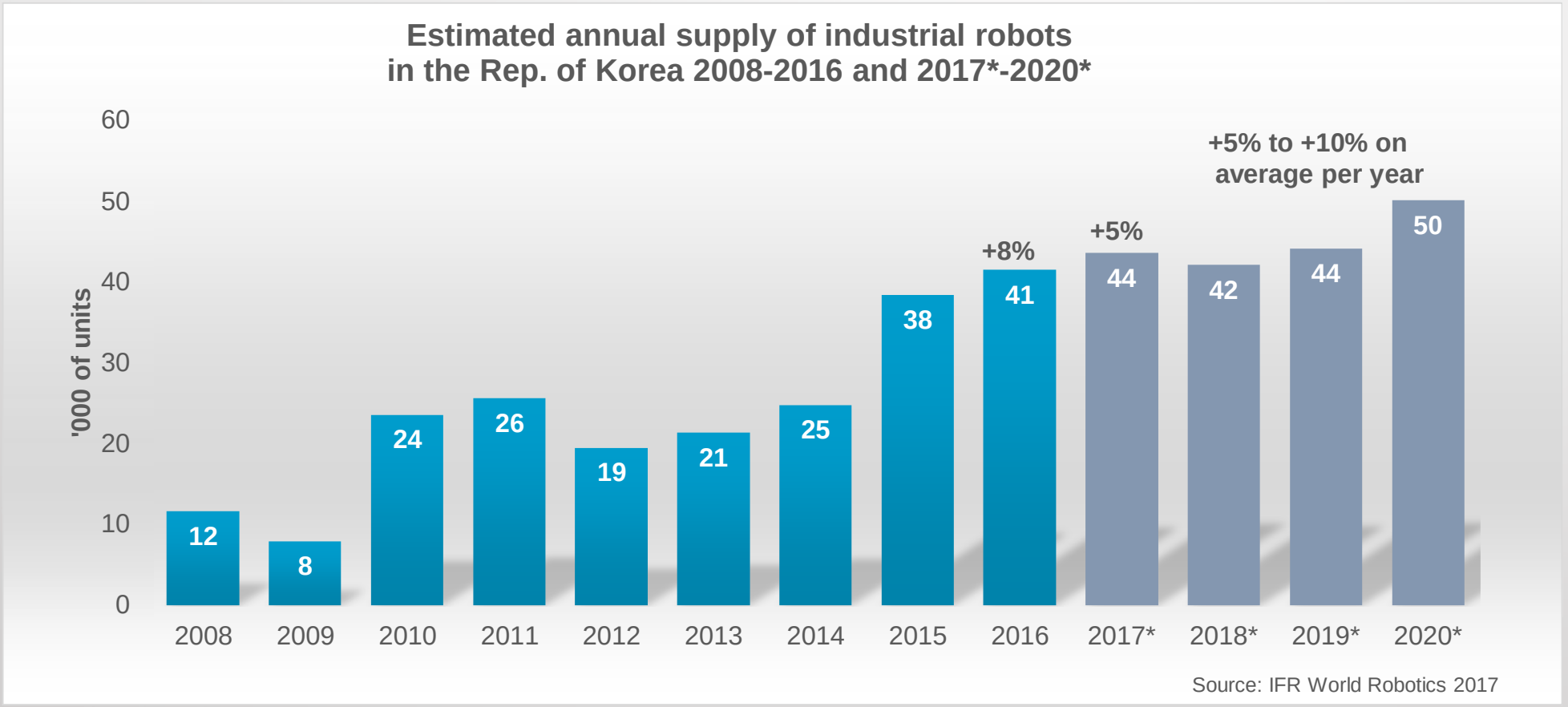


7. Numero di Robot censiti (indagine SIRI/UCIMU).

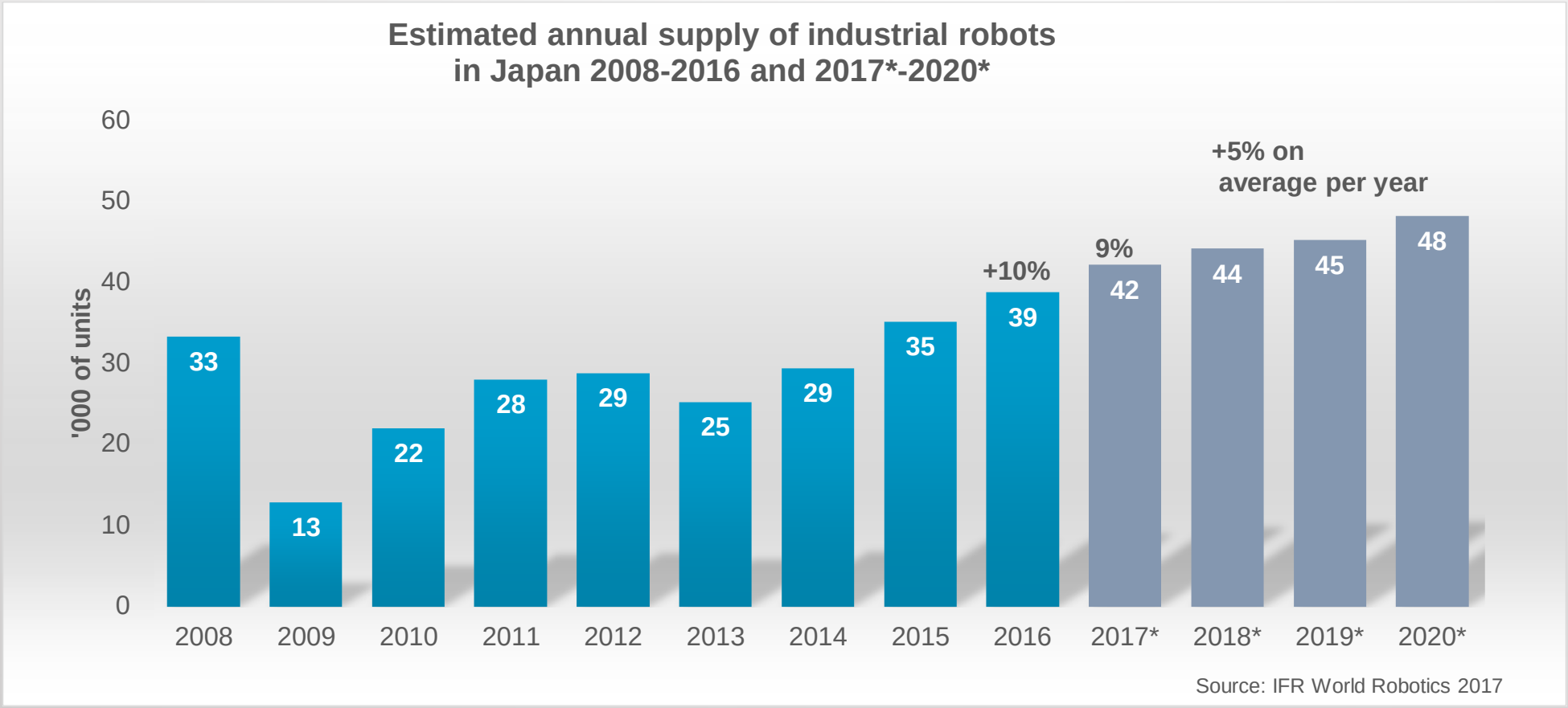
7. Number of registered Robots (SIRI/UCIMU survey).

	1° sem. 2017	1° sem. 2018	*Var. 18/17*
Robot ordinati direttamente	**794**	**906**	***14,1%***
Auto	54	59	*9,3%*
Tier1/Tier2	231	283	*22,5%*
General Industry	509	564	*10,8%*
Robot ordinati tramite terzi	**2.462**	**3.264**	***32,6%***
Automotive/ Tier 1/ Tier 2	309	431	*39,5%*
General Industry	2.153	2.833	*31,6%*
TOTALE ROBOT ORDINATI	3.256	4.170	*28,1%*
Robot per AW	145	243	*67,6%*
Robot per SW	58	72	*24,1%*
Robot per MH	1.675	2.024	*20,8%*
Robot asservimento MU	359	480	*33,7%*
Robot in fonderia	244	236	*-3,3%*
Robot per appl. di processo/sbavatura	72	109	*51,4%*
Robot per verniciatura	38	45	*18,4%*
Robot per pallettizzazione	328	622	*89,6%*
Robot di montaggio	322	339	*5,3%*
Robot altri	15	0	*n.s.*
TOTALE ROBOT ORDINATI	3.256	4.170	*28,1%*

Rep. of Korea: considerable increase since 2010



Japan: significant recovery and continued growth



USA: considerable increase since 2010

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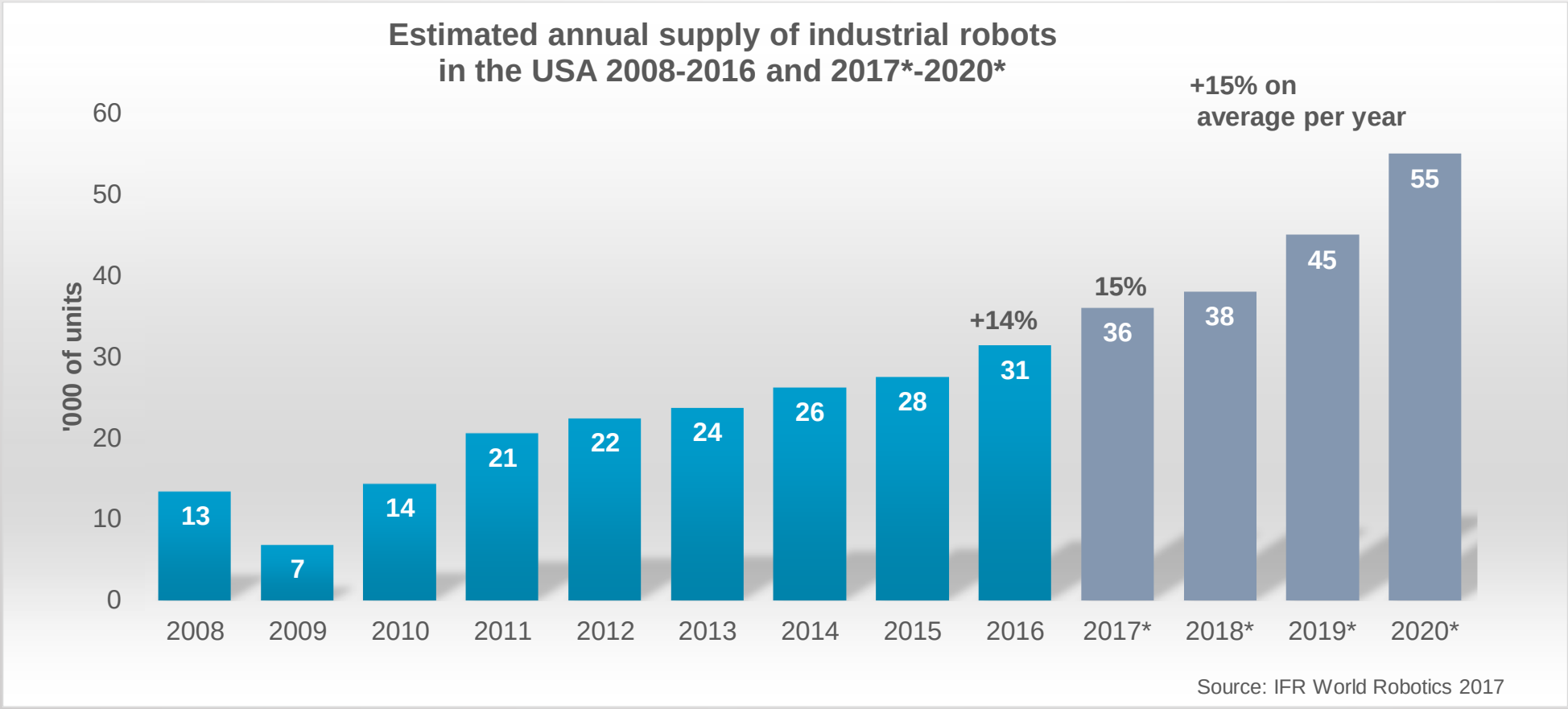
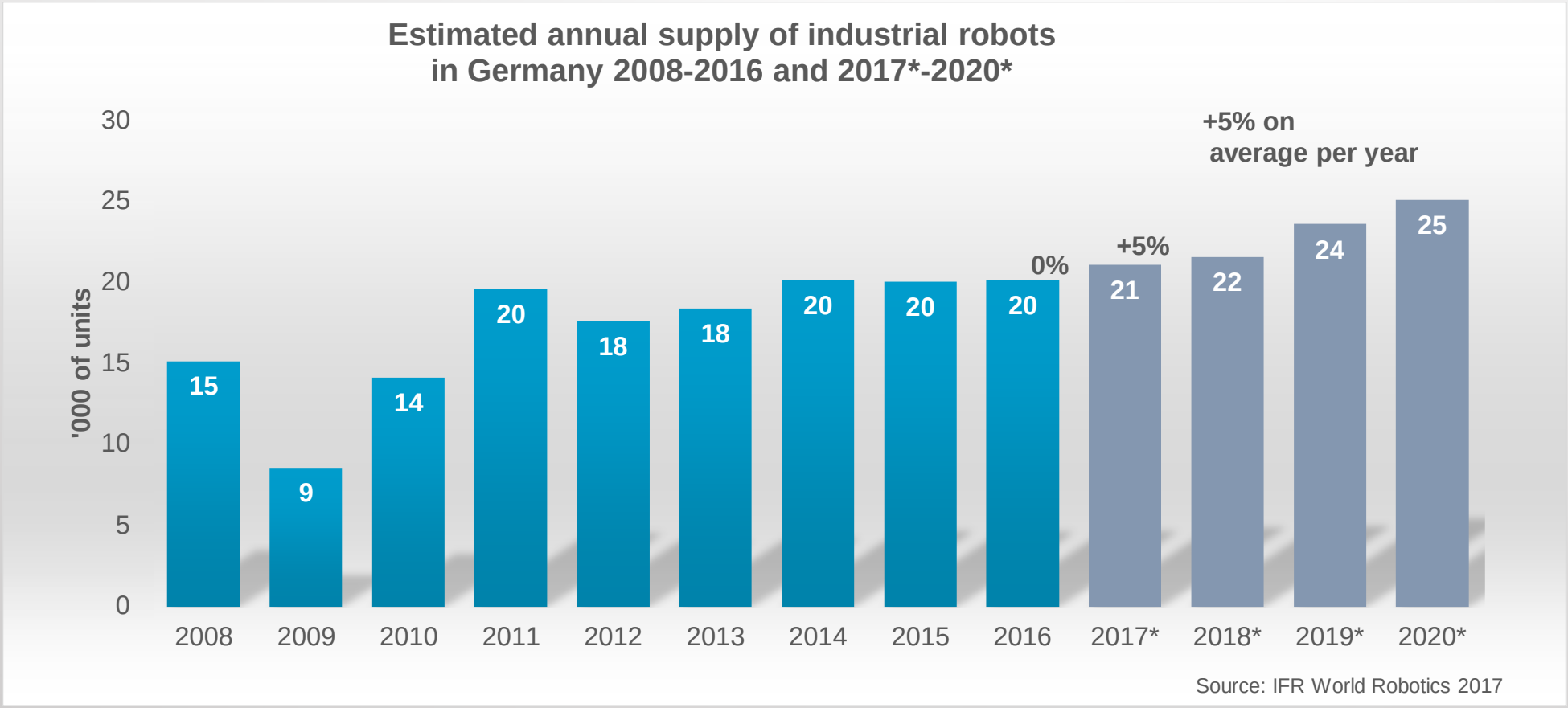


Germany: moderate increase at record levels



2020: 1.9 million operating in Asian factories

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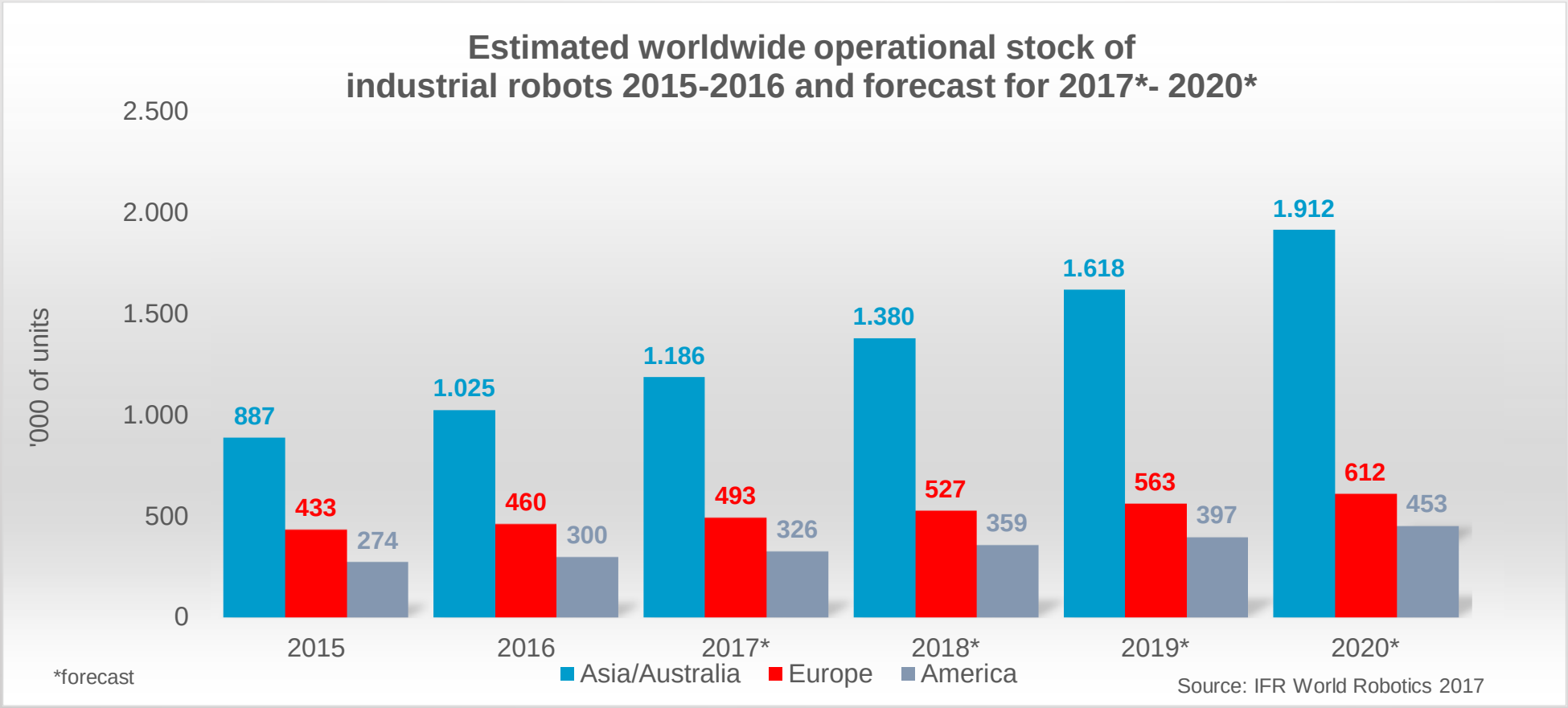

2020: 950,000 robots operating in China

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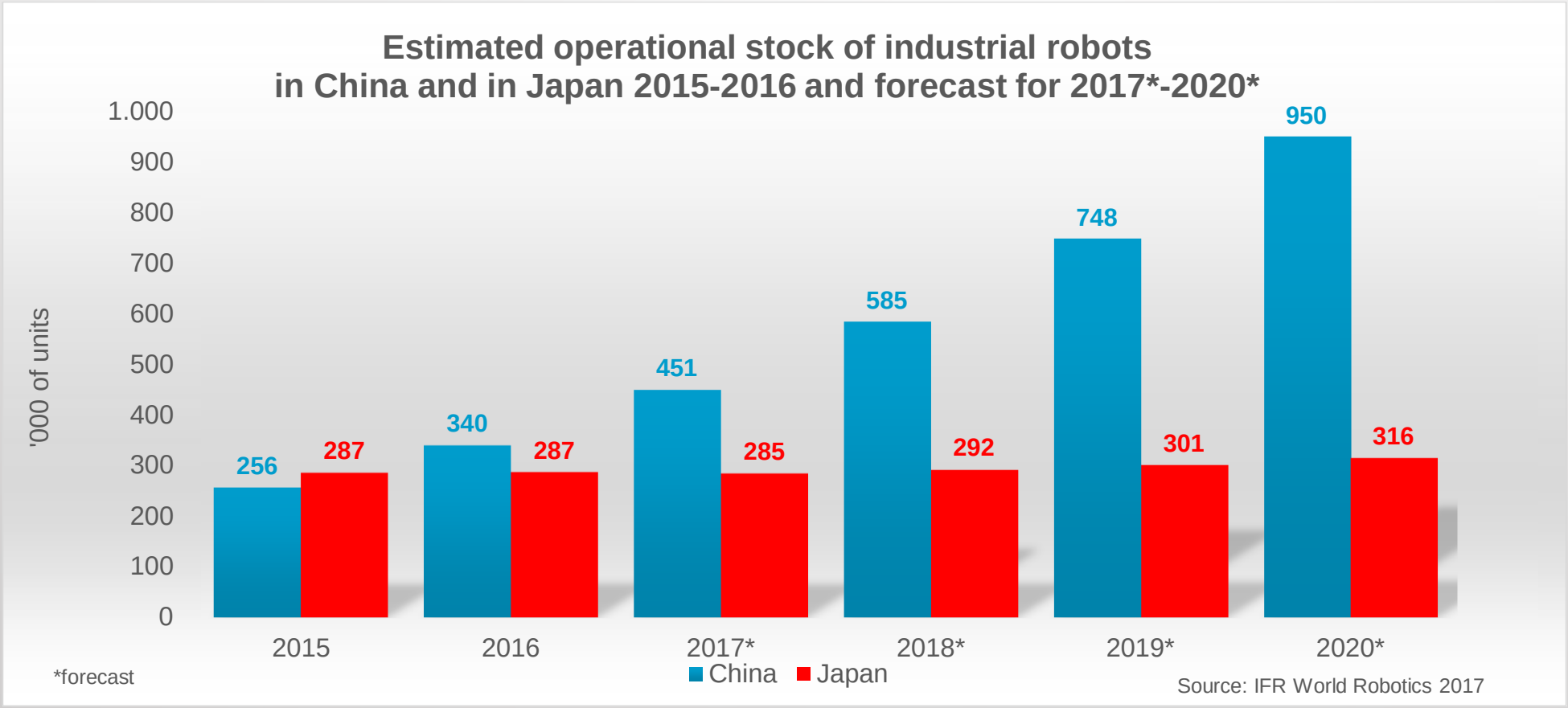

Density of Robots

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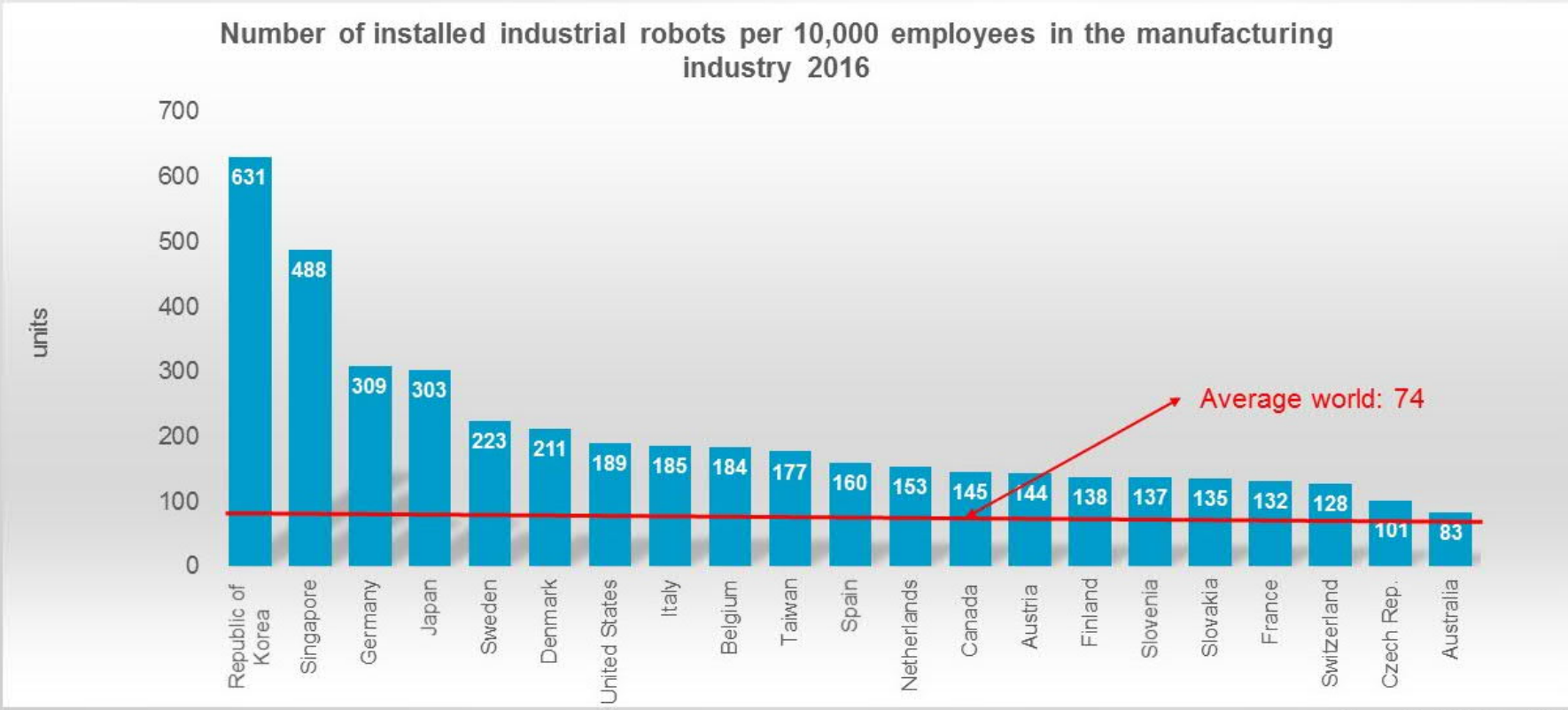
Density of Robots = Robots / 10.000 Manufacturing Employees

World average = 74

Republic of Korea at the top = 631

China = 49 . Enormous potential to further growth.



Source: World Robotics 2017

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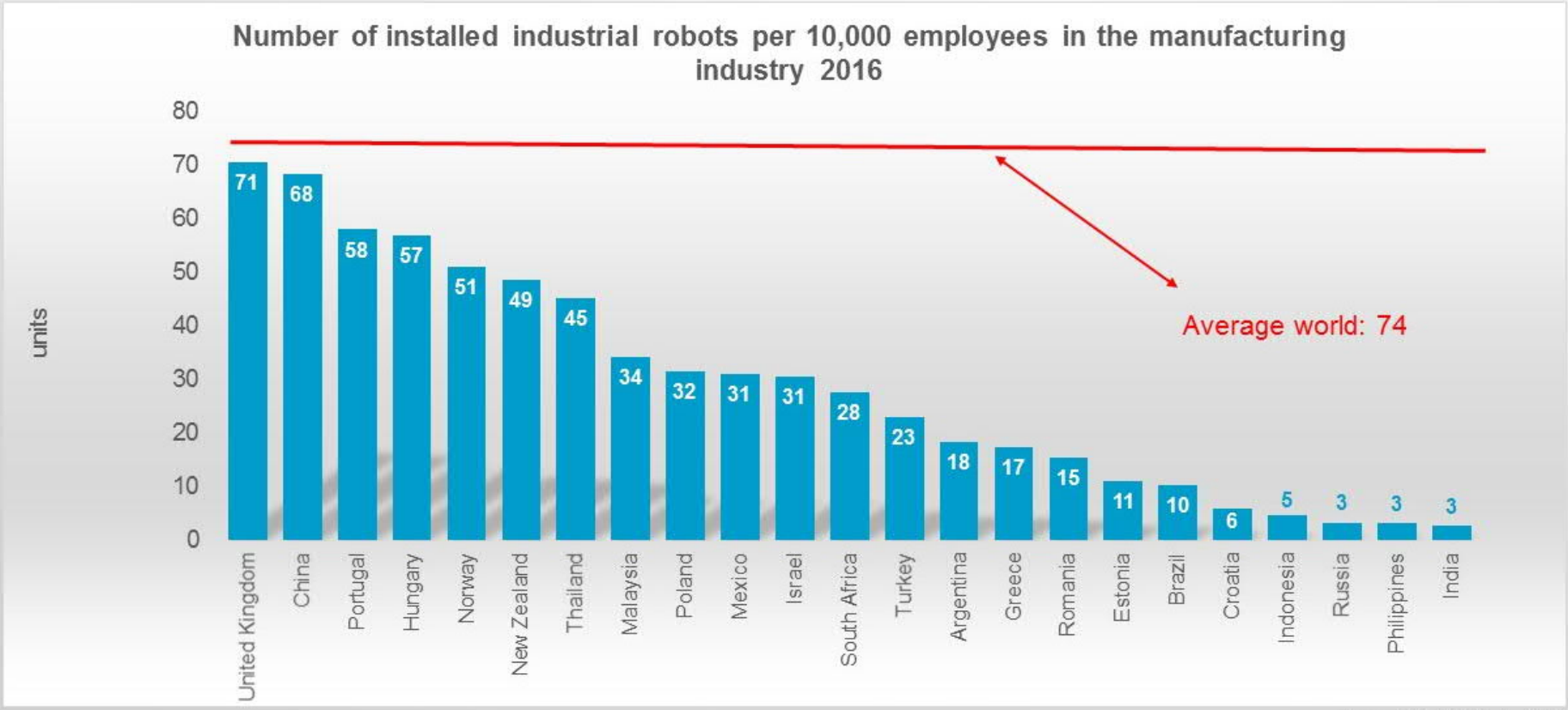

Source: World Robotics 2017

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Today's trends, tomorrow's robots!

The Changing Nature of Manufacturing & Work

- Shift from high volume/low mix to low volume/high mix is having a profound impact on manufacturing.
- Many industries facing acute shortages of skilled labor.
- Quicker automation ROIs and rising wages bringing an end to labour arbitrage.
- Increasing focus on workplace safety.

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Today's Digital Generation doesn't do "4D" Jobs!

Addressing these Realities : a Huge Opportunity

	The Trends	The Challenges	The Enablers
	Low volume high mix	Automation complexity and unpredictability	**Collaborative automation for greater flexibility**
	Shorter cycles, faster launches	Shop floor disruptions and high engineering costs	**Better software for engineering efficiency**
	Increased need for automation and scalability in SMEs	Lack of robot integration and programming expertise	**Easier to use robots with more intuitive programming**
	Rising cost of downtime	Higher lifetime TCO due to increase in planned downtime	**Advanced analytics and services for greater reliability**
	Increased and sporadic human intervention	Lost productivity to maintain safety	**Collaborative automation to maintain safety and productivity**

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The Answers to these challenges lie in Simplification, Digitalisation and Collaboration

Simplification

- Robots which are easier to install, program and operate will unlock entry barriers to the large, untapped market of small and medium enterprises (SMEs).
- Trend towards having production closer to the end consumer driving the importance of standardisation & consistency across global brands.

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Simplification critical to SMEs, but also important for large Global Manufacturers

Digitalisation

- Industry 4.0, linking the real-life factory with a virtual one, will play an increasingly important role in global manufacturing.
- Vision and sensing devices, coupled with analytics platforms, will pave the way for new industry business models.
- Machine Learning will drive many robotics developments over the coming years.

Big Data allowing People to make better Decisions about Factory Operations

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Collaboration

- Collaborative robots are shifting the traditional limits of “what can be automated?”
- Collaborative robots increase manufacturing flexibility as ‘low volume high mix’ becomes the new normal
- Collaboration is also about productivity with increased human/robot interaction

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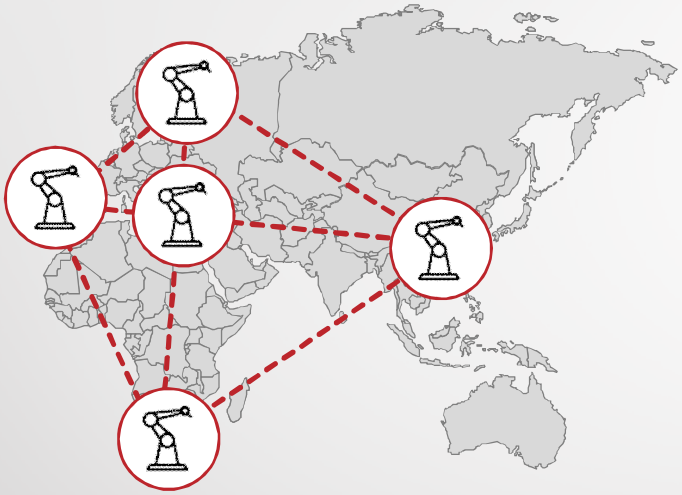
Collaboration means different Things to Different People, but is changing the Face of Manufacturing

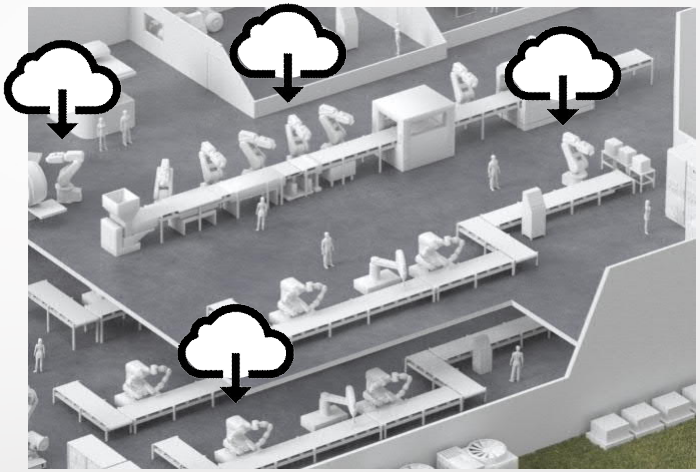
Robotics : the Connected Future

Self-optimising Production



Robots doing the same task connect across all global locations so performance can be compared and improved at the click of a button.

Self-programming Robots



Robots automatically download what they need to get started from a cloud library and then start to optimise through “self-learning”.

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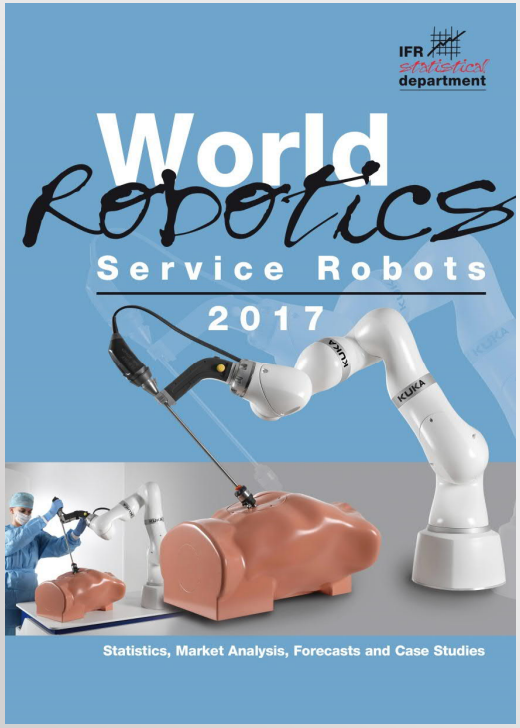
Connected & Collaborative Robots enable SMART Manufacturing for both SMEs & Global Enterprises

Structure Of Presentation



- Industrial Robots
- **Service Robots**

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Definitions of Service Robots

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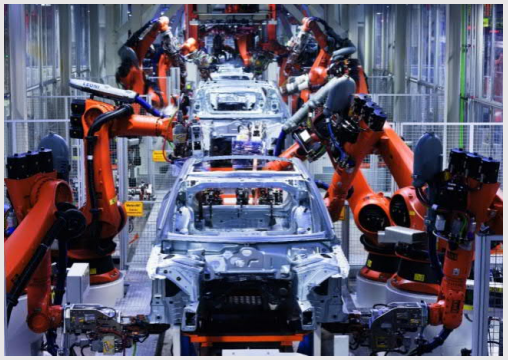
A **service robot** is a robot that performs useful tasks for humans or equipment excluding industrial automation application.
Note: The classification of a robot into industrial robot or service robot is done according to its intended application.

• A **personal service robot** or a service robot for personal use is a service robot used for a non-commercial task, usually by lay persons.
Examples are domestic servant robot, automated wheelchair, personal mobility assist robot, and pet exercising 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 an operator is a person designated to start, monitor and stop the intended operation of a robot or a robot system.

What is a service robot?

Industrial Robots



Industrial environments

Service Robots

Professional Use

Personal/domestic

Non-industrial environments

Picture source: Goldbeck, ;KUKA AG, Bosch Bonirob, Hetwin, SMP Robotics, Omron, International Submarine Engineering , Robert Bosch Hausgeräte , Wonder Workshop

Professional Service Robots

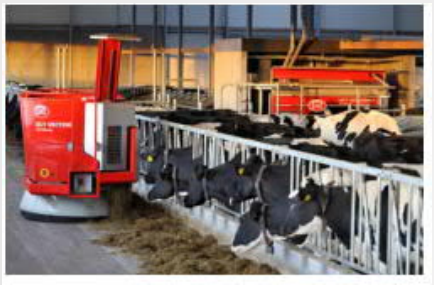
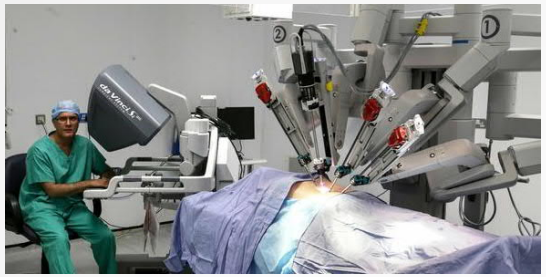


Image credit
Lely



Source: Intuitive Surgical

Source: Rewalk

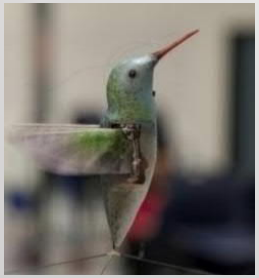


Image credit
AeroVironment

Image credit
Cobham

Image credit
Schilling Robotics

Source: BA Systemes

Source: IFR World Robotics

Professional service robots: significant growth

- 2016: almost 60,000 units, +24%
- Forecast 2017: +17% -almost 79,000 units
- Forecast 2018 -2020: about 400,000 units
  20% to 25% on average per year

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Professional service robots: increasing turnover

2016: 4.7 US$bn, +2%

Forecast 2017: +12% - 5.2 US$bn

Forecast 2018 -2020: 26.8 US$bn
20% to 25% on average per year

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Main drivers: logistic systems

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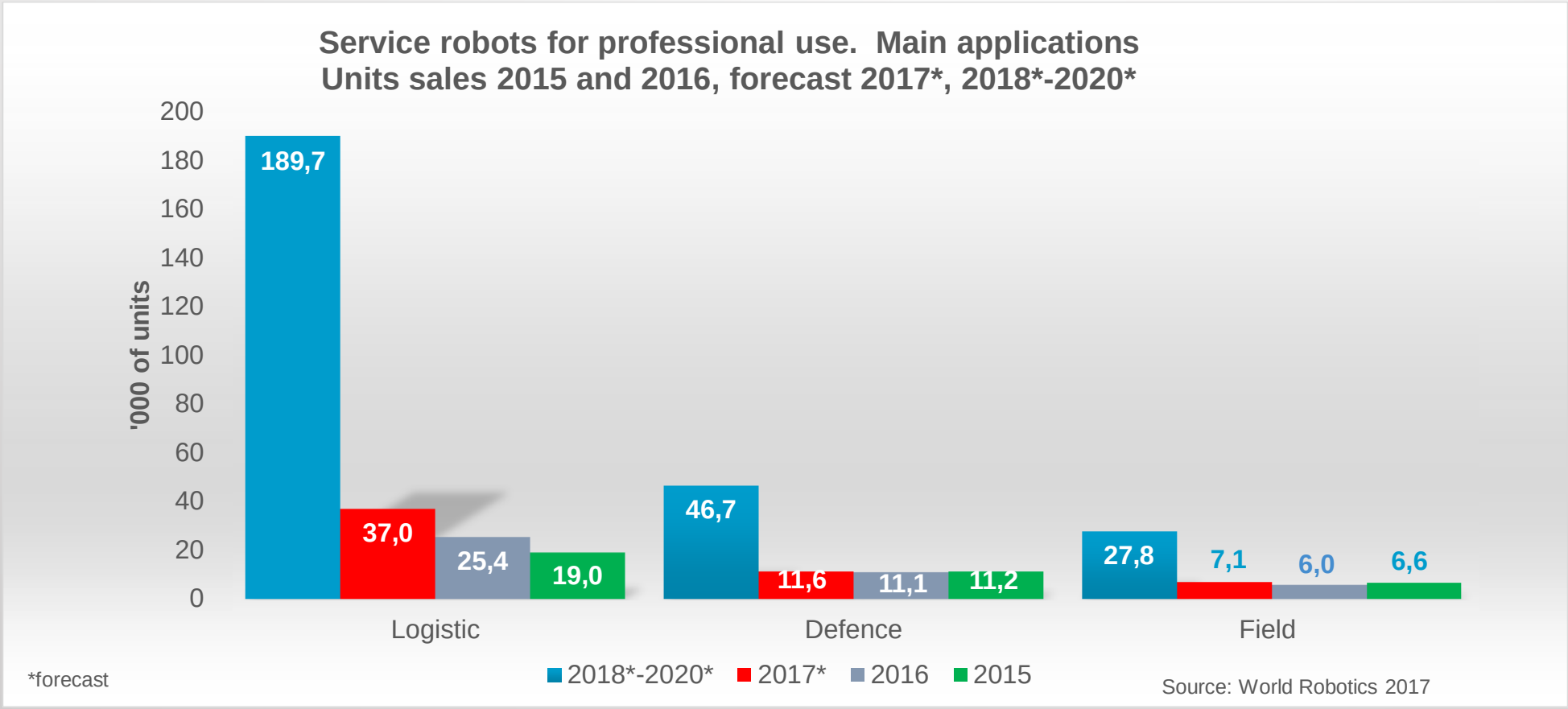

Public relation robots and exoskeletons on the rise

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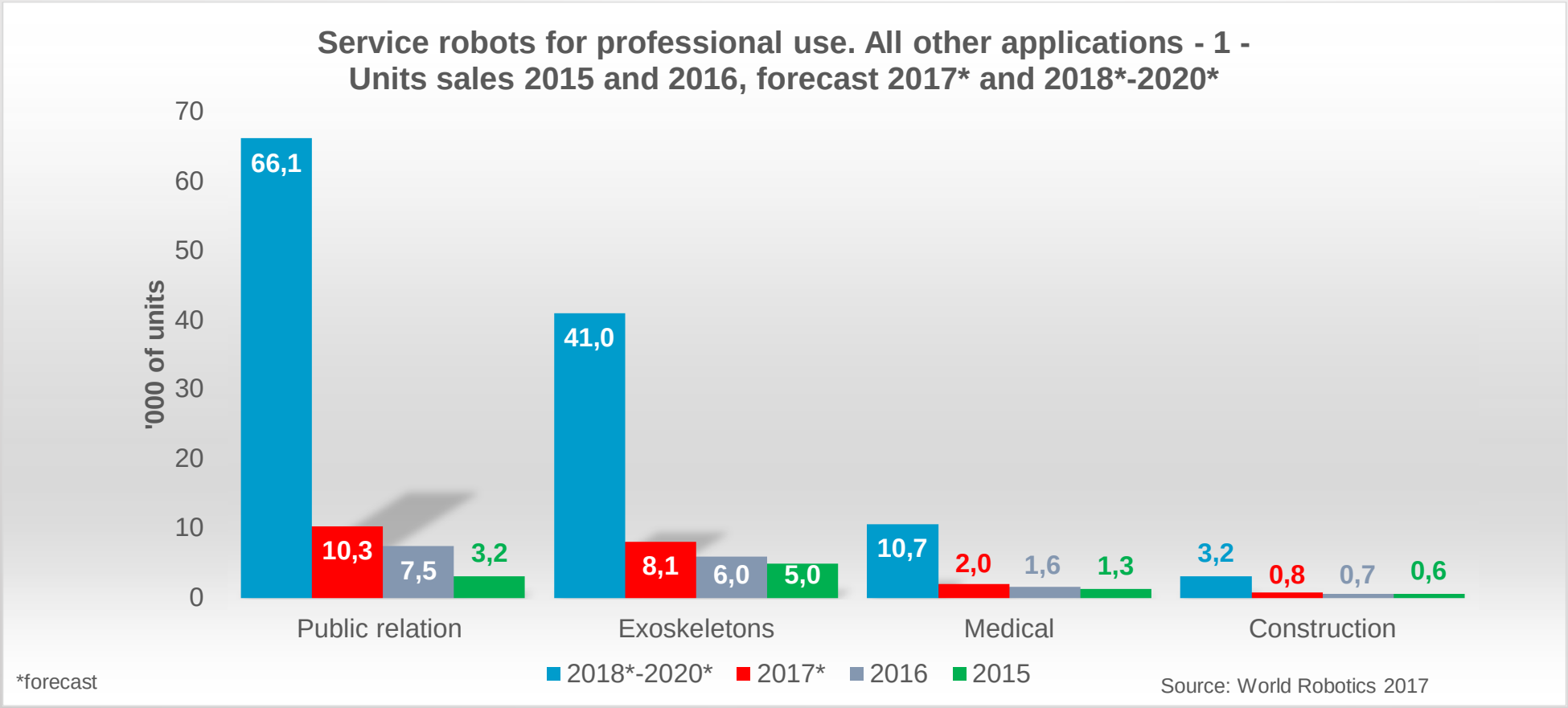

Good prospects for cleaning robots

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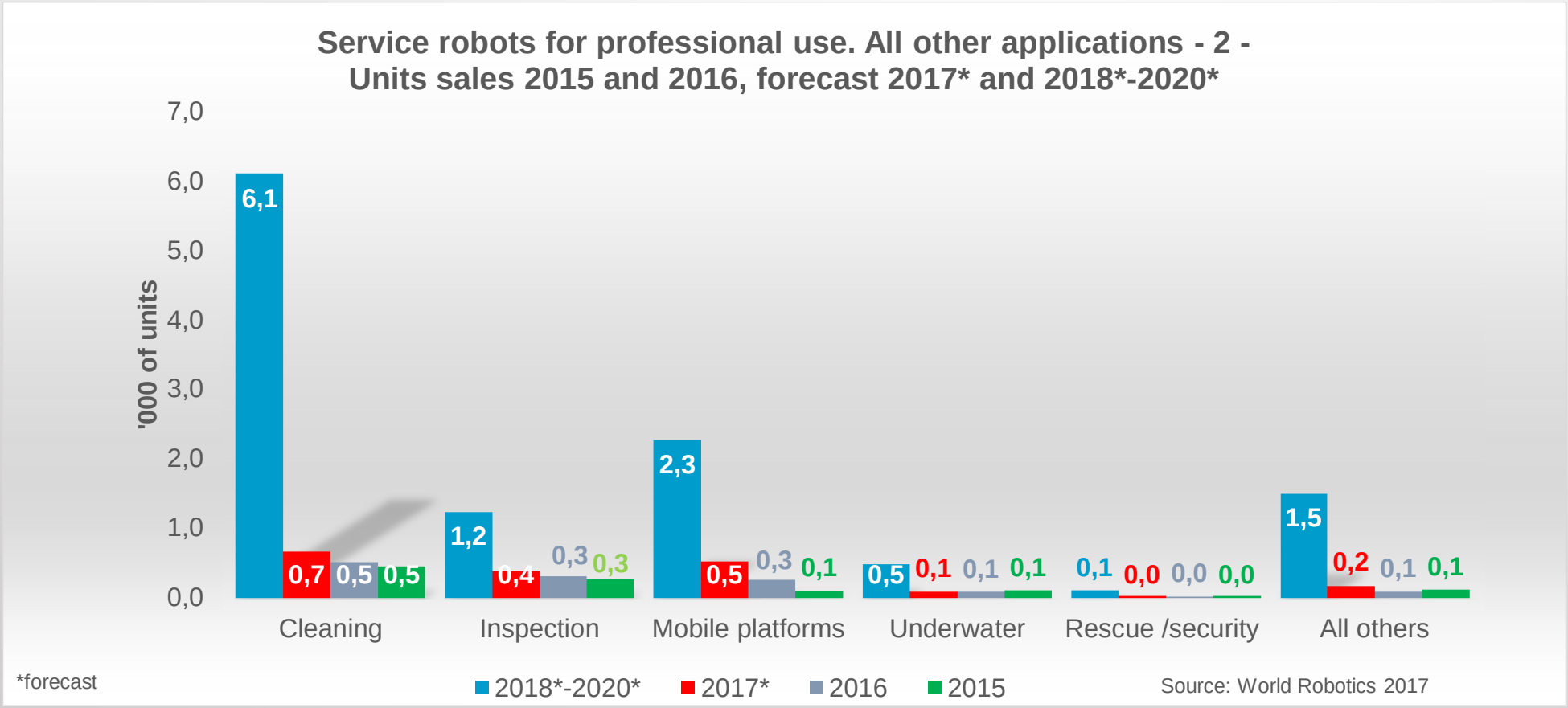

Medical robots: most valuable

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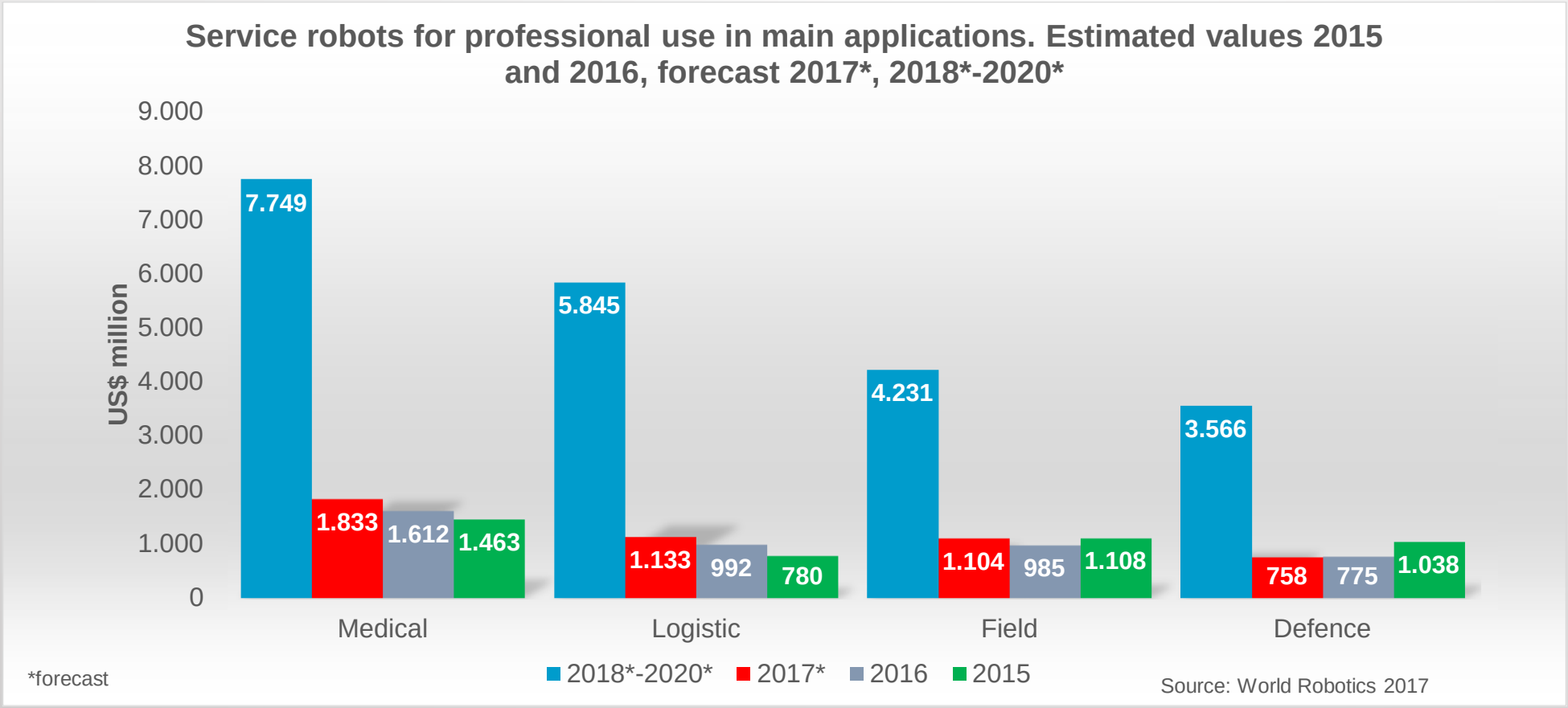

Public relation robots: significant increase of turnover

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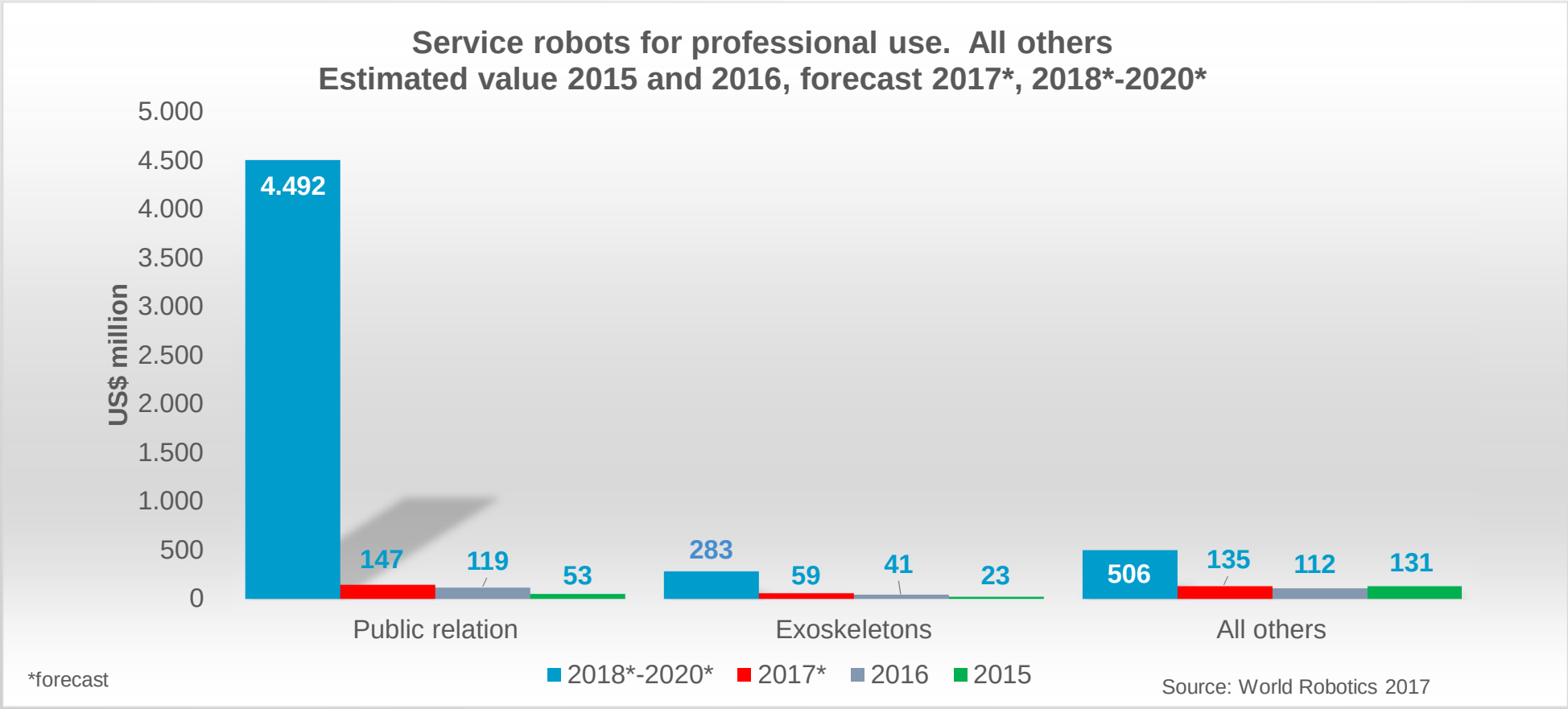

Professional service robots: more than 50% from the Americas

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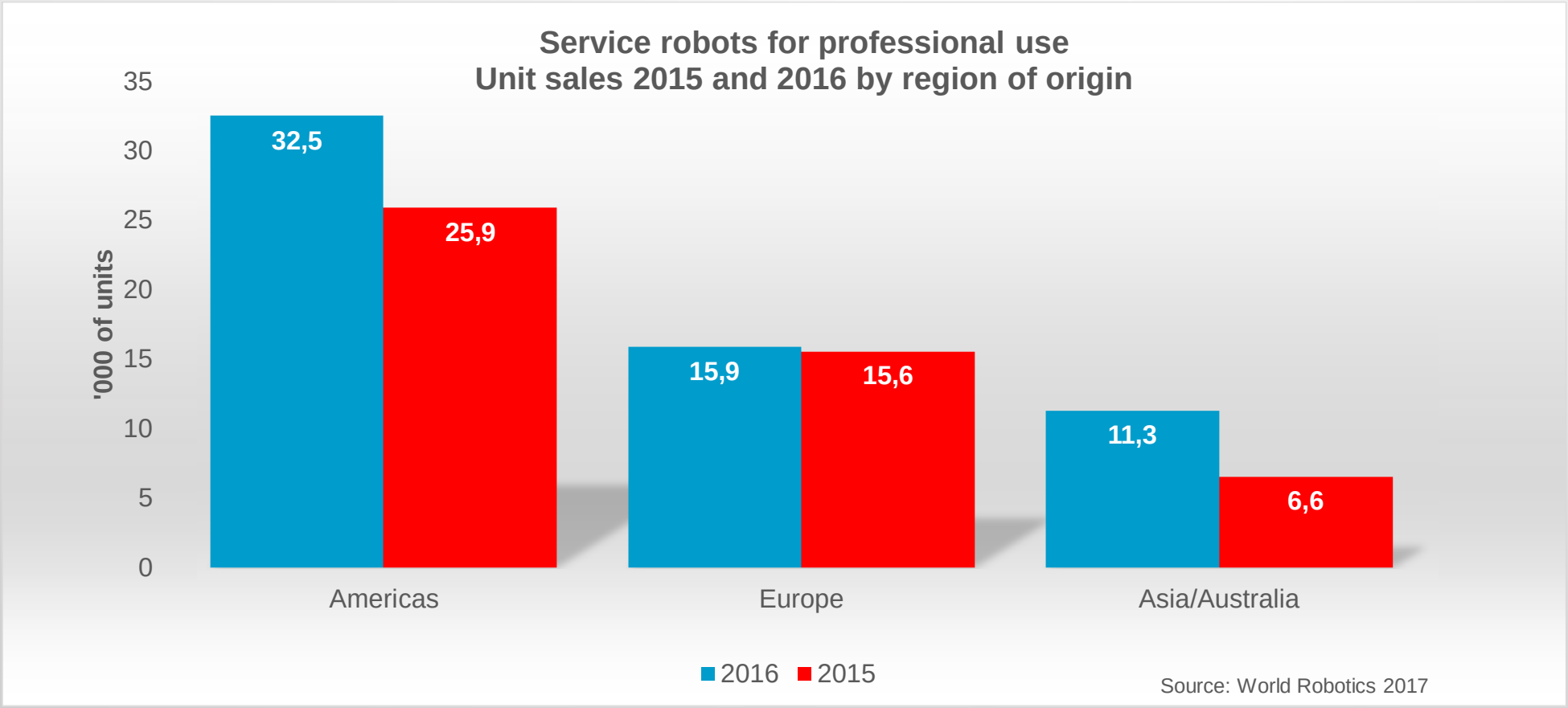

Personal Service Robots

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Main categories:

- Vacuum and floor cleaning
- Lawn-mowing robots
- Entertainment and leisure robots
- Robots for elderly and handicap assistance

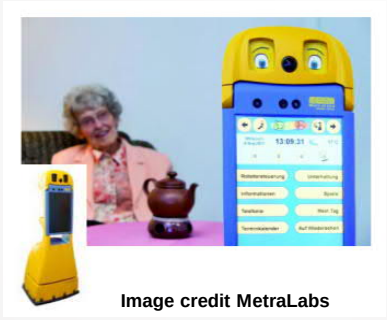


Image credit MetraLabs

Source: Kärcher (Vacuum cleaning)

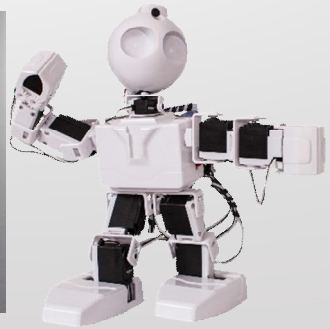
Image credit Kawada

Image credit Vgo Communications

Image credit BlueBotics

Source: Aisoy Robotics S.L

Source: Vorwerk (Vacuum cleaning)



Source: Ezrobot

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Personal/domestic robots on the rise

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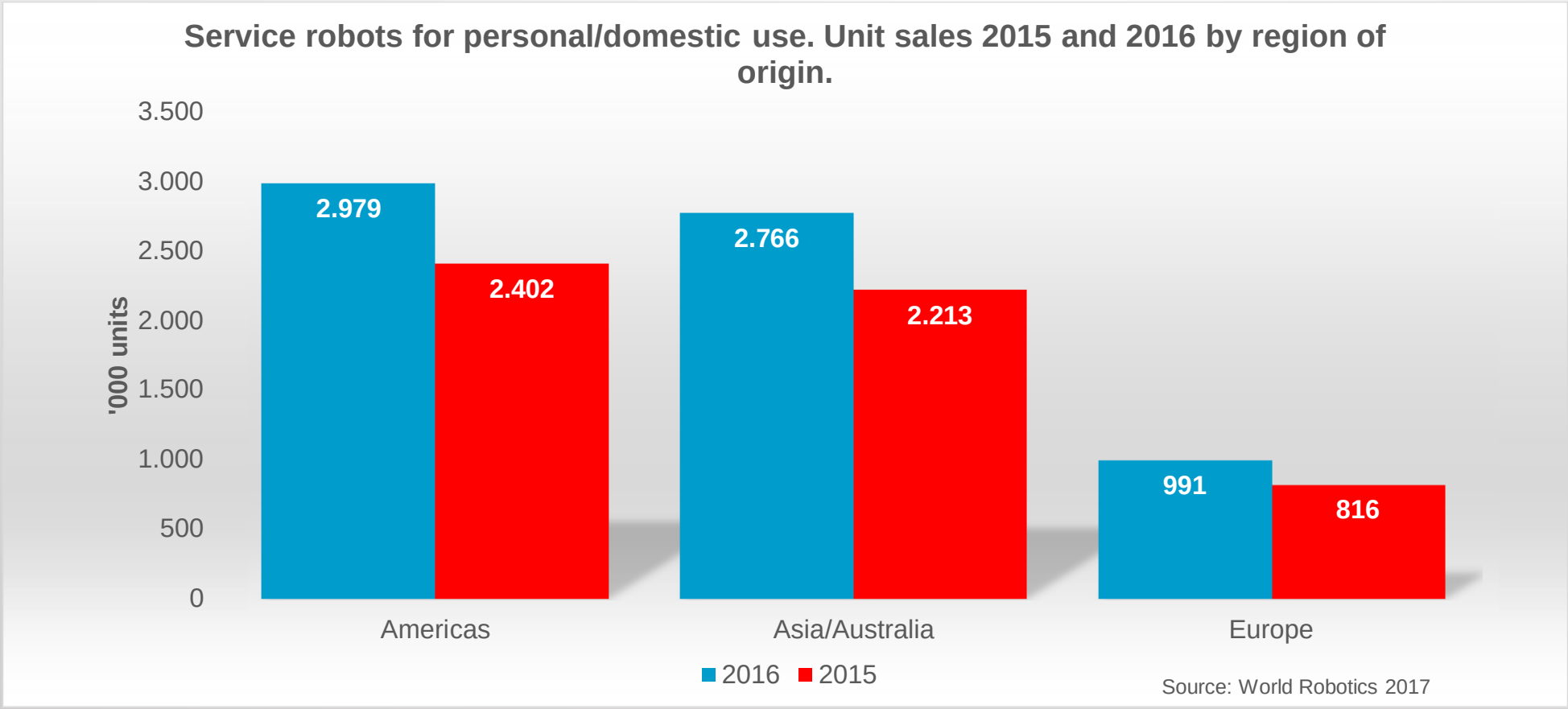
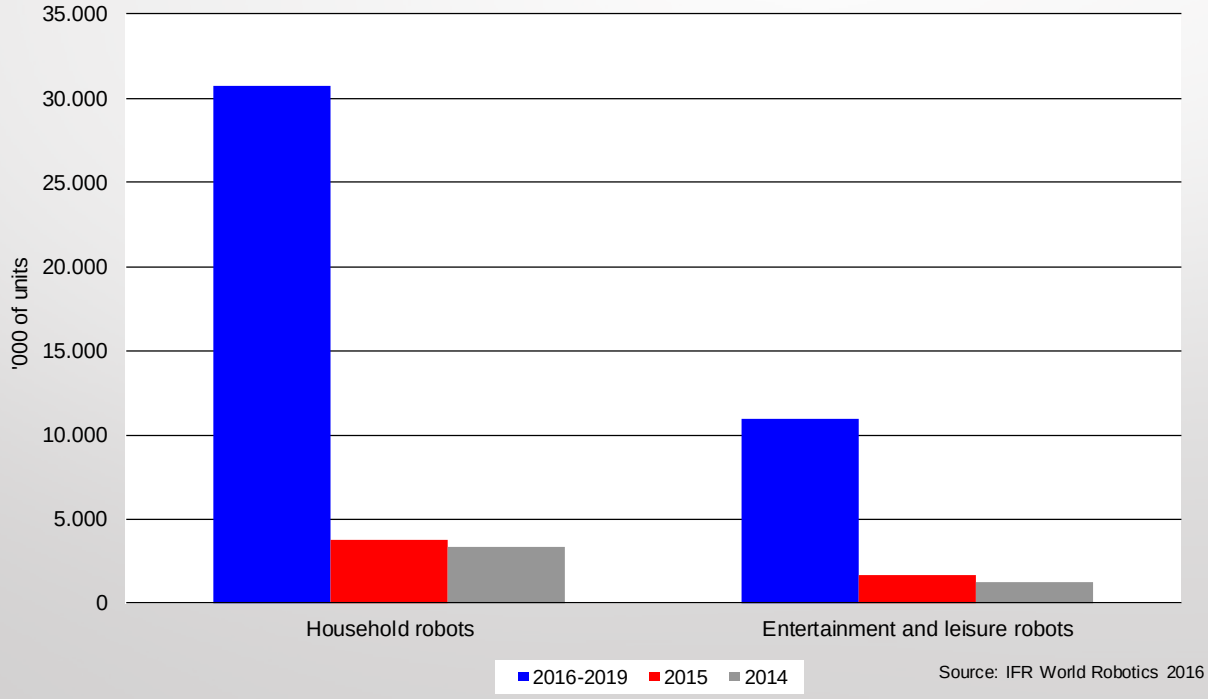


2016 - 2019: 42 million new service robots for personal and domestic use

Total value of forecast :
Household robots: about US$ 13 billion
Entertainment robots: about US$ 9 billion

Figure 2.4 Service robots for personal/domestic use.
Units sales 2014 and 2015, and forecast 2016-2019



Source: IFR World Robotics 2016

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- Dynamics of the service robotics industry
- Technological enablers

Number of service robot manufacturers of all types by region of origin (N=699)

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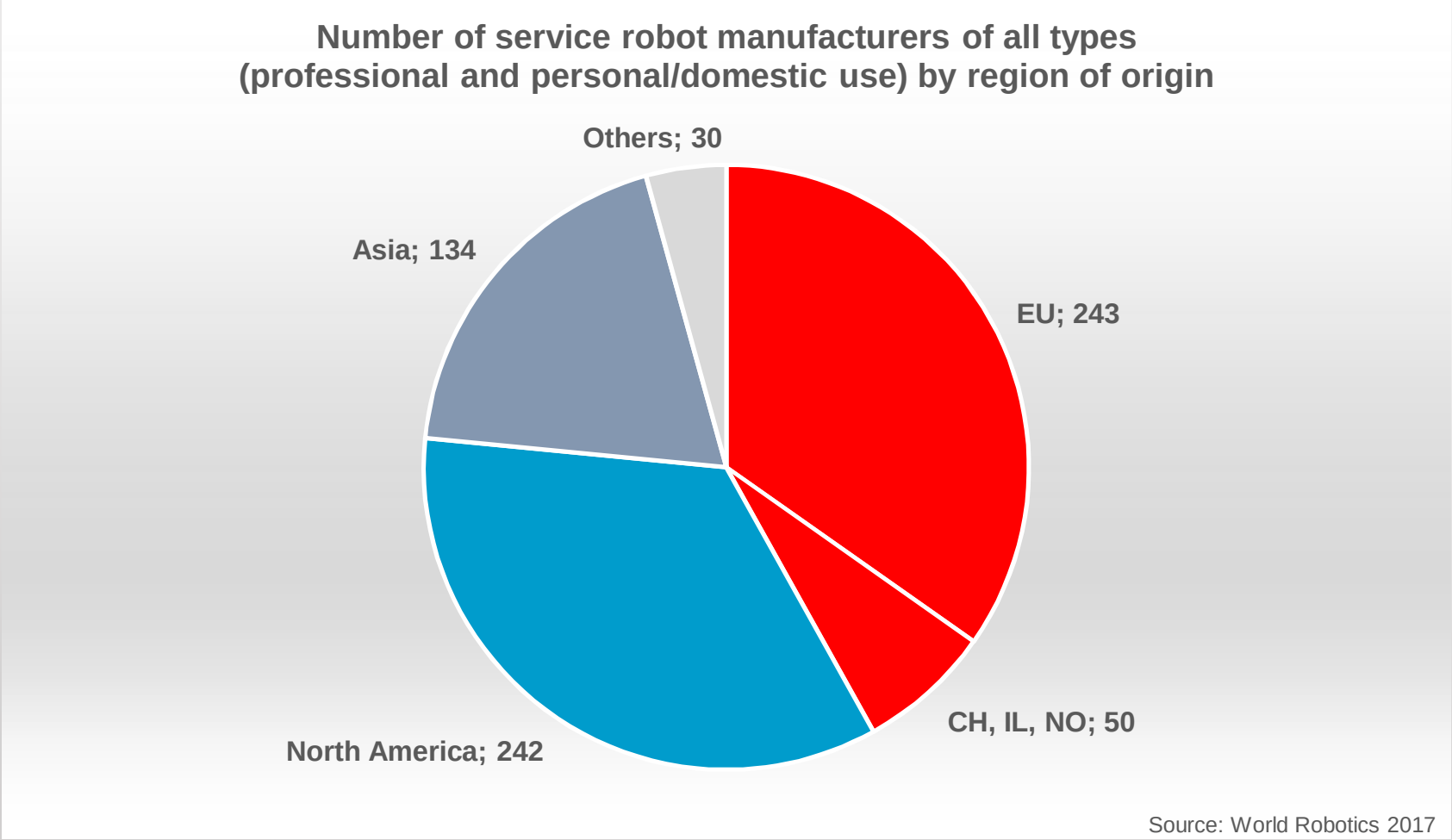

Source: World Robotics 2017

Europe fares well in service robot start-up creation

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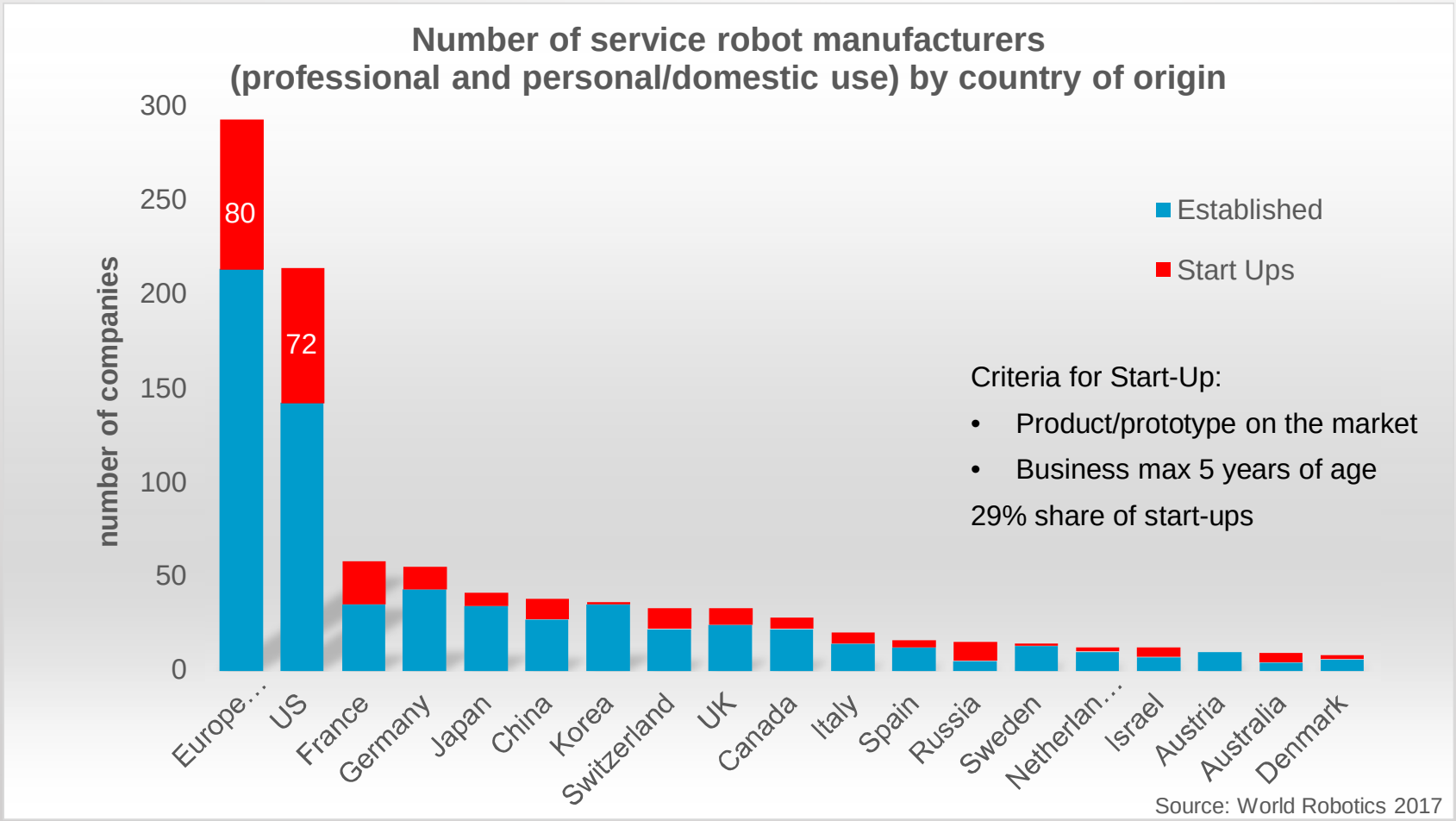

75% of European service robot suppliers are SMEs

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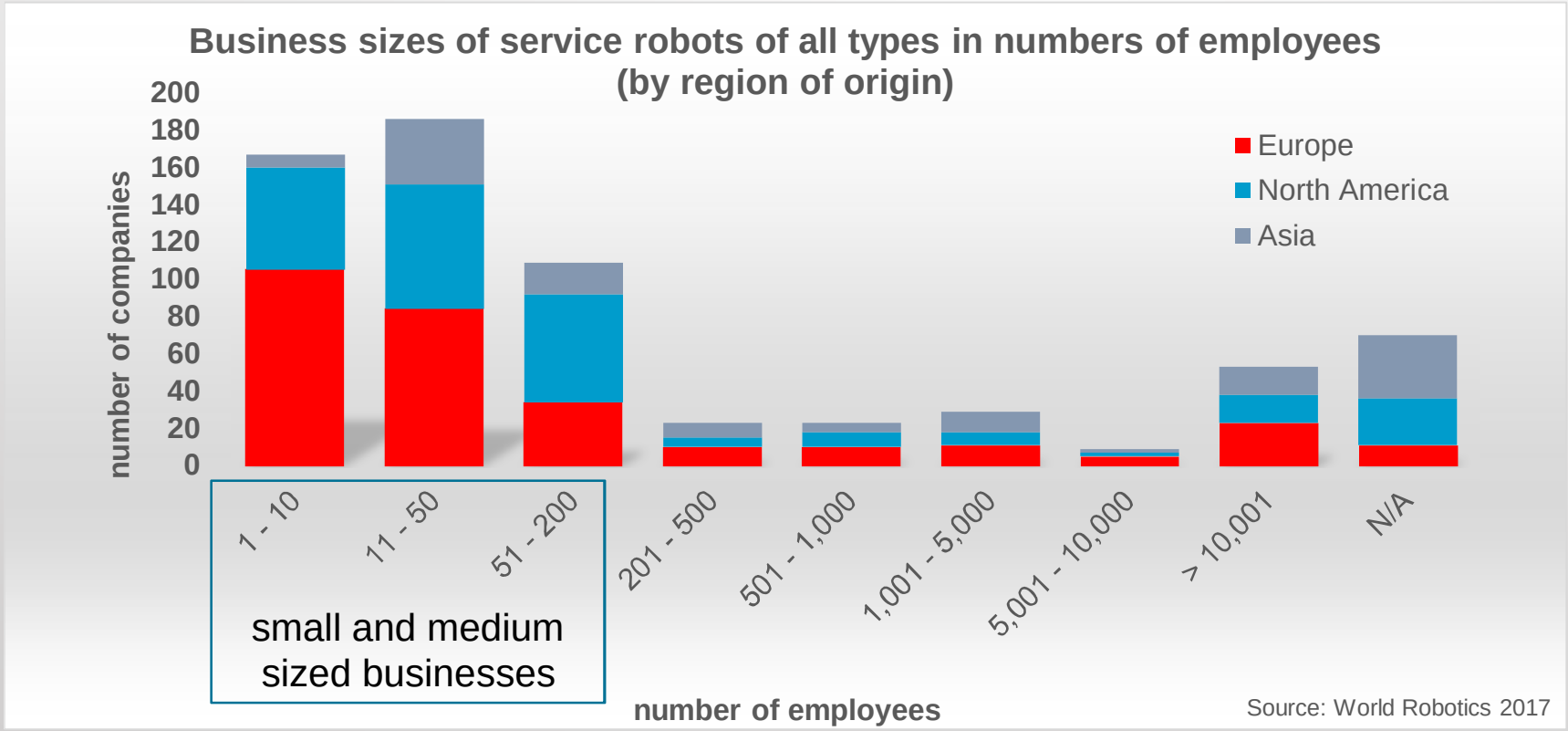

Start-up examples (I): Service robotics in agriculture

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Fresh fruit picking robot

FF Robotics (Israel)

Platform for vineyard maintenance

WALL-YE (France)

Robotic weeder for vegetable farms

Naïo Technologies (France)

Source: FF Robotics, WALL-YE, Naio Technologies

Start-up examples (II): Service robots in public-relations

Unity Robotics (D)

Bots and us (UK)

Promobot (RU)

Source: Unity Robotics, Bots and us, Promobot

Start-up examples (III): Service robots in logistics

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Mobile Industrial Robots MiR (DK)

Fetch Robotics (USA)

Robotnik (ES)

Source: MiR, Fetch Robotics, Robotnik

Creating a European Eco-System in robotics

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- **Robotic key-technologies**: perception, human-machine-interaction, mechatronics, safety, …
- **Software**: Major cost-/performance factor in service robotics, 30+% cost share
- **Supply industry** for robotics key-components, software (computer vision, motion control, mobile navigation etc.) emerges
- **Open Source Software** systems hugely popular; e.g. >2/3 of all service robot suppliers use Robot Operating System ROS (and other OSS)
- With **€700M in funding from EU** 2014 – 2020, **SPARC** is the largest civilian-funded robotics innovation initiative in the world.

Conclusions

- **Both Industrial and Service Robotics are expected to grow in the forthcoming years at double digit rate.**
- **Industrial Robots shows an impressive growth in particular in Asian markets. Simplification, digitalization and collaboration are the key developments.**
- **Service robots are expected to grow in all segments both professional and personal. Most robot producers represented by SME and start ups.**

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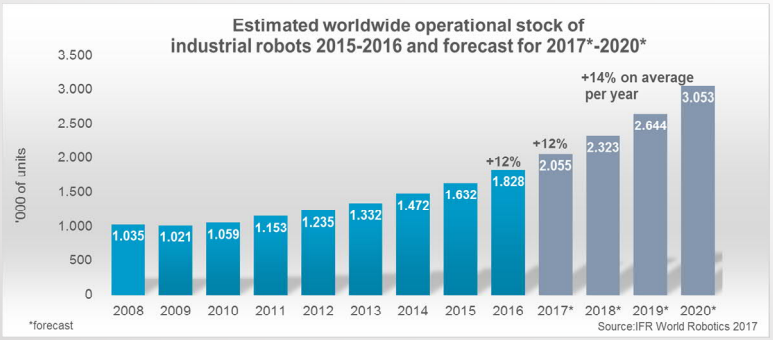

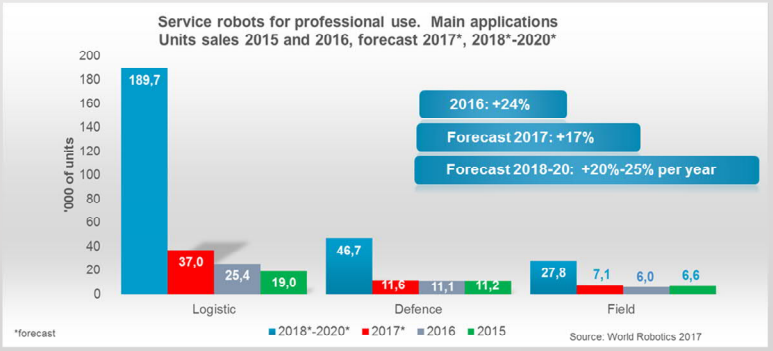

Thanks!

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