

The Robotics & Automation Industry in Germany

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Germany's robotics and automation (R&A) industry has enjoyed unprecedented success over the last decade. With a workforce of more than 52 thousand employees, the industry's turnover has more than quadrupled since the mid-1990s.

Global Market Growth

According to the most recent industrial robots statistics from the International Federation of Robotics (IFR), global robot sales in 2015 increased to the highest level ever recorded – with the international market value for robot systems estimated to be around USD 35 billion. The IFR forecasts that robot installations will have a compound annual growth rate (CAGR) of at least 13 percent during the period 2017 to 2019. It is also estimated that more than 1.4 million new industrial robots will be installed in factories around the world between 2017 and 2019. The main drivers for this growth are expanding production capacities and the trend towards setting up automated manufacturing lines (e.g. by installing robot production assemblies). This development is confirmed by the findings of the KPMG Global Manufacturing Outlook study, with the majority of respondents identifying robotics as their number one R&D investment priority over the next two years.

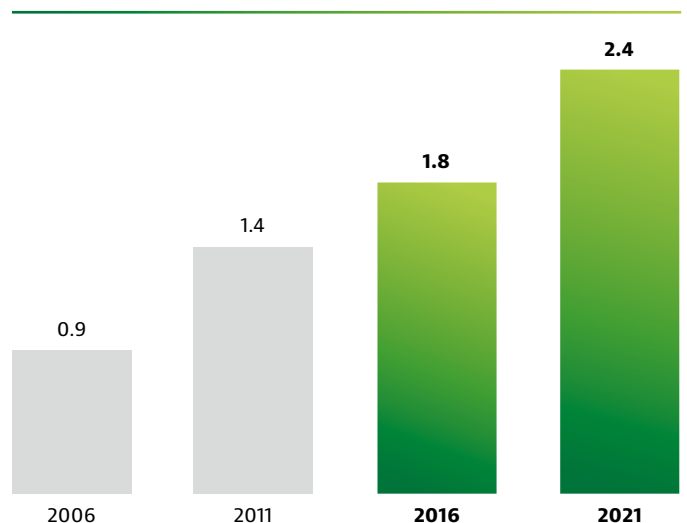
Europe's Robotics and Automation Technology Hub

With a robot density level of 301 industrial robots per 10 thousand employees, Germany has the highest density level in Europe and ranks fourth in global comparison (global average of 69 robots per 10 thousand employees). Demand for industrial robots for the period 2006 to 2021 is forecast to increase by more than 250 percent. A study conducted by PricewaterhouseCoopers reveals the factors for Germany's success in the robotics and automation technology sector as being close ties between R&D and application in the industry clusters; logistic proximity to important sales markets; demographic development in the companies; and the digitalization of the value chain (often referred to as "INDUSTRIE 4.0").

Machine Vision – Leading Technology

As a global robotics hub, Germany is home to leading players from all market segments. Particular strengths are seen in machine vision (MV) technologies and human-machine collaboration. Germany is the most important sales market for the European image processing industry, with more than 30 percent of total industry turnover generated domestically. Automation and the implementation of MV technology help make consistently high quality, permanent traceability and 100 percent production accuracy a reality. High levels of production flexibility can be achieved and product changes quickly realized using efficient automation solutions. This has helped establish the industry as a major driver of Germany's INDUSTRIE 4.0 advanced manufacturing initiative.

Industrial Robot Demand in Germany in USD billion



Source: Freedonia 2013

Innovative Application Areas

Although Germany already boasts a comparatively high robot density level, annual sales remain high. During the period 2010 to 2015, annual sales recorded a CAGR of seven percent. In 2016, record turnover of EUR 12.8 billion was generated in the R&A industry (five percent increase compared to 2015) with turnover of EUR 13.7 billion expected for 2017 (seven percent increase). According to the VDMA (German Mechanical Engineering Industry Association), the sector has an export share of 57 percent. Thirty percent of the exports went to Europe, followed by China (10 percent export share), representing the largest single overseas market.

VDMA Classification

According to VDMA classification, the industry can be divided into three innovative sectors.

- **Robotics**

The robotics industry can be divided into two categories: industrial robots and service robots. Industrial robots represent the core of automation in production technologies. However, service robots are also gaining increasing importance in the market.

- **Integrated Assembly Solutions**

The integrated assembly solutions sector mainly focuses on the creation of new hardware and components needed for tasks such as forming, measuring and testing. With 25 thousand employees, integrated assembly solutions describe the biggest sector within this industry.

- **Machine Vision Technologies**

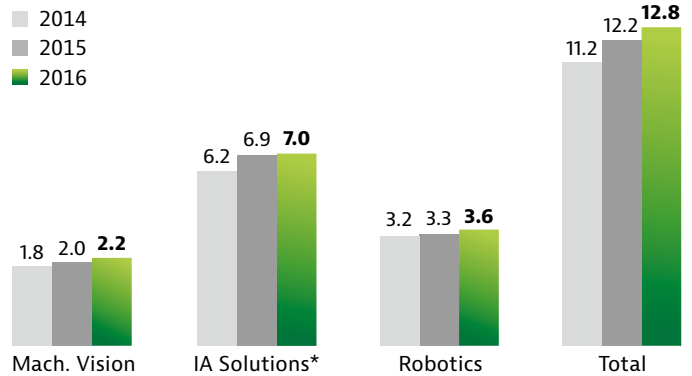
Machine vision systems allow machines to see and comprehend. Application fields are diverse and include areas such as components identification, quality control and data collection.

Machine Vision

Machine vision counts as one of the major growth sectors in the R&A industry and has become the key technology for the automation industry worldwide. In just a decade, MV industry turnover has more than doubled. Record turnover of EUR 2.4 billion is forecast for 2017 (10 percent increase), with dynamic market development set to be maintained in 2018. Germany is the major sales market for the European MV industry: 33 percent of turnover in 2015 was generated in Germany. Major client sectors include the automotive and electrical and electronics (including semiconductors) industries. The automotive industry accounts for 20 percent of overall turnover. Other sectors – including the metal, food, packaging, and even non-manufacturing industries (e.g. intelligent traffic technology, medical diagnostic equipment and surgical technologies) – are increasingly making use of MV technology for a range of application areas.

Robotics and Automation Turnover Development in Germany

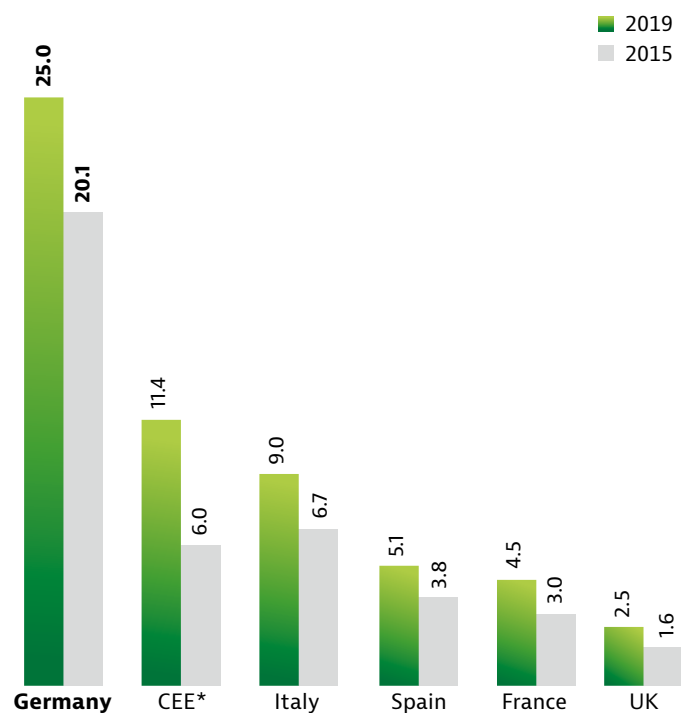
in EUR billion



*IA Solutions: Integrated Assembly Solutions
Source: VDMA, Statista 2017

Estimated Yearly Shipments of Multipurpose Industrial Robots in Selected Countries

number in thousand units



*CEE: Central/Eastern Europe
Source: IFR 2016, national robot associations

INDUSTRIE 4.0 and Human-Robot Collaboration

R&A technology provides the core elements for the development towards INDUSTRIE 4.0. The increasing application level of human-robot collaboration (HRC) represents a perfect example of the move towards connectivity within INDUSTRIE 4.0. Through its innovations, the German R&A industry contributes to further developments in machine learning, so that opportunities for HRC have significantly increased. Robotic assistance systems support human labor, with repetitive and physically demanding tasks increasingly being automated. It is expected that more than EUR 2.6 billion will be invested in INDUSTRIE 4.0 in Germany through to 2020.

Tomorrow's Robotics and Automation Technologies

The R&A industry is one of the most innovative in the mechanical engineering sector. German OEMs in the field of robotics and automation count among the globally leading companies in the industry. According to a recent McKinsey study, German R&A companies believe that customer-specific system and integration solutions as well as after-sales and service represent the most promising market growth fields. Advanced robotics and HRC are also considered amongst the major technological trends in the country's R&A industry. In contrast to the rest of the mechanical engineering sector, R&A companies consider technological developments as being more important than trends; a position strongly underpinned by the high level of innovation within the industry.

Main Application Industries

The automotive industry is the leading client sector for industrial robotics in Germany. This is due to the fact that, in terms of turnover, the automotive industry is the largest industry in the country. A number of automotive OEMs and suppliers operate production facilities in Germany, thereby creating increased demand for industrial robots. The second largest customer is the electrical and electronics industry. However, the metal processing and machinery, plastics and chemicals as well as food industries also represent major R&A application sectors.

Growth Application Industries

Service and assistance robots are widely considered to be one of the major growth sectors in the automation industry. Industry analysts expect great sales prospects for the further automation of services and the respective product range. Service robots can carry out maintenance and inspection tasks, house work or the management of agricultural zones. Professionals expect that from 2020 to 2025, sales of service robots could reach the same level as that of industrial robots. German robot manufacturers in particular are among the world's service robotics pioneers.

Stable Supplier Network

The German R&A industry is characterized by a strong industrial network, with a stable and reliable supplier network also among the success factors for the sector: Robot manufacturers, suppliers and application industries have their operations based in Germany as they are heavily dependent on electrical, mechanical and optical components for their products. High-technology component manufacturers can benefit from this industry infrastructure. In the MV industry, component turnover increased by more than 18 percent during the period 2014 to 2015 alone.

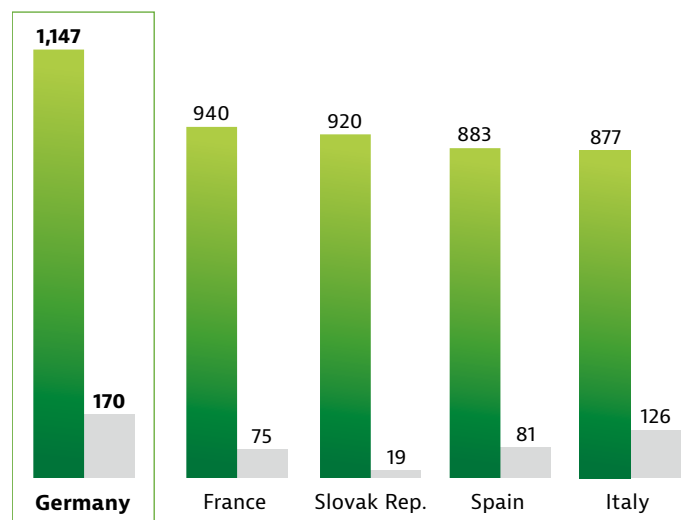
Value Chain Excellence

The sustained success of the German manufacturing industry is driven by complete value chain coverage. Numerous research institutions, close proximity to key supplier industries – including robotics, electronics, materials and software – and a strong industry base guarantee a pooling of resources of all actors within the value chain for optimal innovation and R&D excellence. This environment offers numerous business opportunities across multiple technology segments for international investors. Particular location strengths are seen in the industrial image processing, embedded vision and integrated assembly industries.

Robot Density in Selected European Countries

number of robots per 10,000 employees

■ Automotive Industry
■ Other Industries



Source: IFR 2016

Supporting Business Success

A Tradition of Engineering Quality

German R&A industry strength is driven by a combination of Germany's proven engineering tradition, its position as a leader in technological development, and its highly diversified industrial base. The machinery and equipment (M&E) industry is one of the technological motors that drive Germany as a high-tech nation combining all of the key future technologies, such as materials, electronics, software, and robotics: Researchers, companies and employees active in the R&A industry profit from the country's reputation and global know-how. The "Made in Germany" quality seal has long been recognized as a sign of engineering excellence and precision across the globe.

Dual Education System

In order to secure the economy's demand for highly qualified personnel, Germany developed a dual system in vocational training – combining the benefits of classroom-based and on-the-job training over a period of two to three years. In close cooperation with the German government, the German Chambers of Industry and Commerce (IHKs) and the German Confederation of Skilled Crafts (ZDH) ensure that exacting standards are rigidly adhered to, guaranteeing the quality of training provided across Germany. One in five German companies take part in the dual vocational training system, thereby turning apprentices into specialists who fit each company's individual needs. Most apprentices receive an employment contract after training. In production-based industries more than 70 percent are taken on as employees, underlining the importance of the training system for companies. More than 1.3 million young people are currently in vocational training in Germany.

Competitive Labor Costs

High productivity rates and steady wage levels make Germany an extremely attractive investment location. Since 2005, wages in the manufacturing sector have risen in most European countries (EU-28), with the growth rate averaging 2.7 percent. While some countries – particularly those in Eastern Europe – experienced a rise of more than five percent, Germany recorded one of the lowest labor cost growth rates (2.1 percent) in the manufacturing sector within the EU. Highly flexible working practices such as fixed-term contracts, shift systems, and 24/7 operating permits contribute to enhance Germany's international competitiveness as a suitable investment location for internationally active businesses.

Public Incentives and R&D Programs

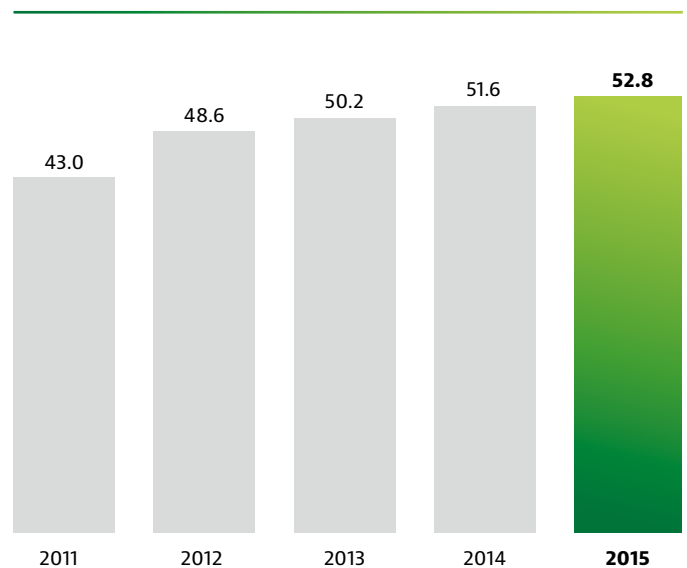
Germany offers numerous incentives for all investors – regardless of country of provenance. There is a large selection of programs designed to support a wide variety of business activities at different stages of the investment process. These

range from cash incentives for the reimbursement of direct investment costs to support for research and development and labor incentives for the reimbursement of direct investment costs. The highly innovative character of the robotics industry makes it an important part of Germany's High-Tech Strategy. This is complemented by other government R&D support programs that provide public grants – either as a reimbursable advance or in the form of a non-refundable cash grant. As part of the research program on human-technology interaction, the federal government will support companies, research institutes and academics with non-refundable cash grants of around EUR 70 million each year during the period 2016 to 2020.

Academic Study Programs

Germany provides access to a network of universities highly active in the field of mechanical engineering with a special range of robotics and automation study programs. Around 300 automation and robotics-related study programs are currently available. German industry also enjoys a global reputation for its high R&D activity. In 2015, machinery and equipment companies invested EUR 5.9 billion in R&D activities. Germany also has an internationally leading intellectual property role in terms of industrial robot patents.

Employees in the Robotics and Automation Industry in thousand



Source: VDMA 2017

World-Class Robotics and Automation R&D

Europe's Leading R&D Nation

Germany is Europe's leading R&D investment nation. Total R&D expenditure of almost EUR 80 billion in 2013 makes the country Europe's biggest research spender. Internationally, only the US, Japan, and China have bigger domestic R&D budgets. Germany is also one of the European leaders in terms of R&D investment as share of GDP – with a figure of almost three percent outperforming the EU-28 2013 average of just two percent. According to Ernst & Young's European Attractiveness Survey 2015, R&D activity is also a major source of future inward investment – 58 percent of those surveyed plan R&D investment projects.

Clusters, Networks and Research Institutes

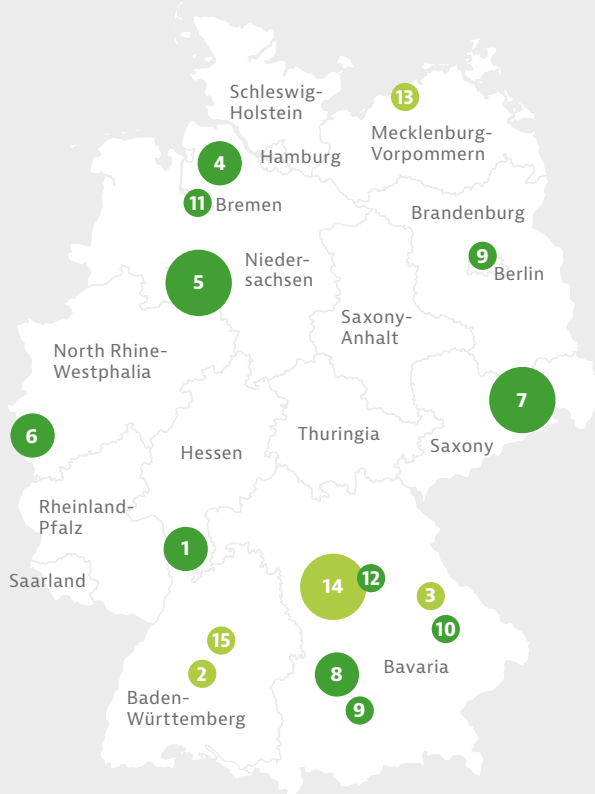
Regional innovation clusters help bridge the gap between science and industry. Stakeholders are organized in multiple regional clusters such as the Automation Valley Northern Bavaria cluster. The country's specific strength in the development and manufacturing of robotics is further illustrated by the existence of specialized clusters such as the Robotics and Mechatronics Center at the German Aerospace Center (DLR). Several Fraunhofer-Gesellschaft research institutes are also

actively conducting research in the areas of automation, robotics and related fields. These include, inter alia, the Institute for Manufacturing Engineering and Automation (IPA); Institute for Production Systems and Design Technology (IPK); Institute for Factory Operation and Automation (IFF); and the Institute for Intelligent Analysis and Information Systems (IAIS).

go-cluster

Launched in 2012, the "go-cluster" excellence program brings together more than 100 innovation clusters from across Germany. The program provides financial stimulus – in the form of support for innovative services and funding for novel solutions – to optimize cluster management allowing German clusters to position themselves as highly effective and visible international clusters. Compliance with go-cluster membership quality criteria also prepares clusters for European Cluster Excellence Initiative silver and gold excellence label certification.

Selected Robotics and Automation Clusters and Networks



Selected Clusters and Networks

- 1* Automatisierungsregion Rhein Main Neckar e.V.
- 2* Intralogistik Netzwerk in Baden Württemberg e.V.
- 3* Kompetenz Netzwerk Mechatronik in Ostbayern
- 4* CFK Valley e.V.
- 5* it's OWL – Intelligente Technische Systeme OstWestfalenLippe
- 6* REGINA e.V. – Regionaler Industrieclub Informatik Aachen
- 7* Silicon Saxony e.V.
- 8* Cluster Mechatronik & Automation e.V.
- 9 Robotics and Mechatronics Center at the DLR
- 10* Strategische Partnerschaft Sensorik e.V.
- 11 I-KON e.V.
- 12* ENERGIEregion Nürnberg e.V.
- 13 Celisca – Center for Life Science Automation
- 14 Automation Valley Nordbayern
- 15 Allianz Industrie 4.0 Baden-Württemberg

Clusters

- Small cluster (<85 member companies)
- Medium-sized cluster (85-200 member companies)
- Large cluster (>200 member companies)

Networks

- Small network (<85 member companies)
- Medium-sized network (85-200 member companies)
- Large network (>200 member companies)

Source: Clusterplattform, GTAI Research 2016, *go-cluster certified

OUR SERVICES

About Us

Germany Trade & Invest (GTAI) is the foreign trade and inward investment agency of the Federal Republic of Germany. The organization advises and supports foreign companies planning to expand into the German market and assists German companies seeking to enter foreign markets.

Investment Location Germany

GTAI provides close-to-market information to international companies looking to enter German markets. Our specialist industry teams prepare all of the relevant information essential to business success in Germany. GTAI's comprehensive range of information services includes:

- Market and industry reports
- Market entry analyses
- Business and tax law information
- Business and labor law information
- Funding and financing information

Business Location Services

GTAI supports international companies from market entry to business start-up in Germany. Expert project teams advise and assist in the business establishment phase. GTAI's range of free services includes:

- Legal and tax-related project support
- Funding and financing advisory services
- Site visit organization
- Local partner and network matchmaking
- Public and private partner coordination

All investment-related services are provided entirely free of charge. Our specialist industry teams have hands-on experience in their respective industries and treat all investor enquiries with the utmost confidentiality.

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Notes

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