Industrie 4.0
Germany Market Report and Outlook
**INDUSTRIE 4.0 – GERMANY MARKET REPORT AND OUTLOOK**

**From Concept to New Reality**

Germany is the world’s leading Industrie 4.0 nation. This is a significant achievement when considering the fact that, until a few years ago, “Industrie 4.0” was a still unproven catch-all term created to denote digitalization in the production space. Since 2011, Industrie 4.0 has made the leap from abstract concept to tangible reality; leaving the test lab for the factory floor. In doing so, Industrie 4.0 has become an international by-word for intelligent, networked production – with Germany consolidating its reputation as the world’s factory outfitter and a country capable of meeting the challenges of the digital age.

In the shortest of times, Germany has established itself as the world’s Industrie 4.0 hotspot, with “Industrie 4.0” likewise being firmly positioned as a strong international brand. Intelligent production is a global development. This development is itself a response to the digital transformation of the economy and society that affects not only Germany, but the world as a whole. That is why the country is working with a number of international partners to develop interoperable standards, IT security measures and a level global playing field for the digital platform economy.

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Industrie 4.0 is the name given to the initiative to establish Germany as a lead market and provider of advanced manufacturing solutions.

www.gtai.com/industrie4.0
Industrie 4.0 – Germany’s Growing Market

Germany’s market for Industrie 4.0 solutions (software, IT services, and hardware) increased from EUR 4 billion in 2015 to almost EUR 6 billion in 2017 according to the Bitkom digital association. This is forecast to rise to more than EUR 7 billion in 2018, with the upward trajectory expected to continue for the immediate future.

Major Application Industries
Domestically, Industrie 4.0 is already creating real added value. Industrie 4.0 hardware, software and IT Services all recorded double digit growth in the year 2016/17, recording cumulated growth of more than 20 percent. More than 65 percent of German companies are already using or plan to use special Industrie 4.0 applications. Continued double digit growth is forecast in the respective software, IT services, and hardware segments that, taken together, constitute Industrie 4.0 solutions. In Germany alone, extra value added potential of up to EUR 425 billion has been forecast for the period up to 2025. The main application industries driving Industrie 4.0 solution uptake are the automotive, mechanical and plant engineering, and electronics and high-tech sectors.

Industrie 4.0 Solution Segments
Increased domestic demand for Industrie 4.0 solutions is driving growth in the Industrie 4.0 segment markets. Broken down into their constituent parts, Industrie 4.0 solutions growth is strongest in the software sector (in overall market second place behind IT services), followed by IT services (biggest market) and hardware (smallest market). Software market growth of 24 percent to EUR 1.5 billion is forecast for 2018, with the current largest segment being IT services (including consultancy, system integration and the development of individual software solutions).

Digital Leader
Digitalization and the use of digital technologies in German industry are advanced in international comparison. Eighty-three percent of domestic companies believe that their value chains will be marked by a high level of digitalization by 2020. More than 65 percent of German companies use or plan to use special Industrie 4.0 applications. Two thirds of companies, according to the Staufen German Industrie 4.0 Index 2017, already deploy predictive maintenance applications – in-house or as a purchased service. In the manufacturing sector, three in four companies use cloud computing solutions; one third of which analyze large amounts of data using big data analytics solutions. Technological leadership and vision in the fields of manufacturing, automation and software-based embedded systems, as well as historically strong industrial networks, lay the cornerstone for the long-term success of the Industrie 4.0 project.

Industrie 4.0 Solutions* Market by Industry Sector 2016-2017
in EUR million

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Processing</td>
<td>424</td>
<td></td>
</tr>
<tr>
<td>Electronics and High Tech</td>
<td>817</td>
<td></td>
</tr>
<tr>
<td>Automotive Industry</td>
<td>1,244</td>
<td>1,454</td>
</tr>
<tr>
<td>Mechanical and Plant Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of Manufacturing</td>
<td></td>
<td>1,930</td>
</tr>
</tbody>
</table>

Industrie 4.0 Solutions* Turnover and Segment Growth 2016-2017

Source: Pierre Audoin Consultants (PAC) 2017
* Industrie 4.0 solutions: software, IT services, and hardware
Automotive and Lightweight Technologies Sector

**Market Overview**
The automotive industry is the largest industry sector in Germany, generating turnover of EUR 404 billion in 2016 alone. Internationally, the sector is the acknowledged world export leader, with export volume of more than EUR 256 billion. With innovation spending of more than EUR 21 billion in 2016, the automotive sector is responsible for around 35 percent of total domestic research and development (R&D) expenditure.

**Industrie 4.0 Opportunities**
Germany’s automotive sector is being transformed by Industrie 4.0. The domestic market for Industrie 4.0 solutions grew by more than 20 percent to over EUR 1.2 billion in 2016/17. According to the Staufen German Industrie 4.0 Index 2017, almost all auto sector companies already make use of "smart" concepts or intend to in the immediate future (compared to 85 percent of respondents in the broader production sector). Internal efficiency increases were the motivating factor for 97 percent of auto sector companies’ decision to implement Industrie 4.0 and digital measures, followed by cost reductions (89 percent) and transparent processes (86 percent). Predictive maintenance, in particular, is expected to play a significant role in automotive production in the next two to five years. According to McKinsey, vehicle manufacturers will need to increase lightweight component levels from 30 percent to 70 percent by 2030 in order to compensate for electric drive weight increases and more efficient engine technology. Annual value added potential of 1.5 percent – or EUR 15 billion – through to 2025 is forecast by Bitkom as a result of the integration of real-time data at the design-production interface and the use of more versatile production systems (real-time data, man-machine interfaces and flexible automation).

**Industrie 4.0 in Practice**
ARENA2036 – “Active Research Environment for the Next Generation of Automobiles” is the largest and leading research platform for mobility in Germany. Looking towards the 150th anniversary of the motor vehicle in 2036, the program envisions lightweight design with integrated functionality in the versatile factory of the future. ARENA2036 sees itself as the pacemaker for sustainable automotive engineering for the next generation of cars. The entire value chain of tomorrow’s fully digitalized vehicles is being rethought and implemented as part of the initiative.

Since the project launch in 2013, the research campus has focused its activities in core projects in four research project areas of intelligent lightweight design with functional integration (LeiFu); new materials and processes (DigitPro); production of the future (ForschLab); and creativity, cooperation and competence transfer (Khoch3). Partner competences are anchored in a number of disciplines that range from simulation and lightweight construction to production technology and ergonomics. ARENA2036 is supported by the Federal Ministry of Education and Research “Research Campus – Public-Private Partnership for Innovation” initiative.
**Machinery and Equipment Sector**

**Market Overview**
The machinery and equipment (M&E) sector is the second largest and one of the most innovative industry branches in Germany. In 2016, mechanical engineering production volume reached EUR 204 billion in nominal terms – a new record according to the VDMA industry association. Exports for the same period rose to almost EUR 156 billion. Germany is home to Europe’s best-performing M&E sector, and enjoys a deserved reputation as the world’s leading exporter of machinery with more than 15 percent global share (ahead of China and the USA in that order). German manufacturers belong to the global top three in 23 of 31 M&E sectors (occupying top spot in 14 sectors).

**Industrie 4.0 Opportunities**
Industrie 4.0 represents a major growth opportunity for Germany’s M&E sector. Gross value added in the sector amounted to around EUR 77 billion in 2013 according to the Bitkom digital association and the Fraunhofer Institute for Industrial Engineering IAO. This is expected to rise to around EUR 100 billion by 2025 – a direct effect of the Internet of Things and cyber-physical systems entering the factory space. The robotics and automation (R&A) industry is one of the most innovative in the M&E sector, with R&A technology providing the core elements for Industrie 4.0 development. Advanced robotics and human-robot collaboration (HRC) technologies are a perfect example of increased automation and connectivity levels, with automation and electrification linked to intelligent control systems directing new product development in many M&E segments – creating enormous market potential for the future.

**Industrie 4.0 in Practice**

**Speedfactory**
Situated in the Bavarian city of Ansbach, the Adidas “speedfactory” is an agile model for shoe production that, according to Adidas and industry partner OECHLSER Motion, can effectively be relocated anywhere around the world. Automated manufacturing processes allow the sporting goods manufacturer to design and produce high performance running shoes in a process that privileges customized, local fabrication over offshore mass production. Digital design, product personalization and localized, automated production dramatically reduce the typical 18-month design-to-retail-outlet waiting time associated with mass overseas production. Man (“upskilled” factory workers) and machine (3D printing and industrial robots) work together in the speed factory to create bespoke, premium-priced products on a scalable production site capable of fitting into a cargo container. A second Adidas speedfactory has already been built in Atlanta, USA.

An official project in the Federal Ministry for Economic Affairs and Energy’s “Autonomics for Industrie 4.0” technology program, Speedfactory was developed in partnership with other manufacturers (Johnson Controls and KSL Keilmann) and research institutes (Fortis Institute and the Institute of Textile Technology at RWTH Aachen University).

“Robots are the most flexible automation tool – which is why they are at the heart of Industrie 4.0. They are becoming more autonomous, can sense their environment and their ubiquity in digital networks is leading to “cloud robotics.” More and more we are seeing that people will work hand-in-hand with robots.”

Patrick Schwarzkopf, Managing Director VDMA Robotics + Automation Association

**Robotics and Automation Industry Turnover in Germany 2010-2017**
in EUR billion

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>10.2</td>
</tr>
<tr>
<td>2013</td>
<td>10.4</td>
</tr>
<tr>
<td>2015</td>
<td>12.2</td>
</tr>
<tr>
<td>2017*</td>
<td>13.7</td>
</tr>
</tbody>
</table>

Source: VDMA 2017
* forecast
ICT and Software Sector

Market Overview
Germany is home to the single largest software market in Europe, recording year-on-year growth of 6.3 percent and turnover of more than EUR 23 billion in 2017 according to the European IT Observatory (EITO). Software growth is being driven by infrastructure optimization demand for big data analytics solutions, particularly in the country’s manufacturing base. Conventional software segments – including enterprise resource planning – are increasingly moving to the cloud. Germany belongs to the international leaders in terms of outsourcing market potential – only the USA, UK and Finland generate more per capita turnover. Growing demand for cloud services is intrinsically linked to the country’s digital transformation, with two out of three companies having implemented cloud services in 2016 according to national digital association Bitkom. The country recorded ICT market turnover of EUR 160 billion in 2017 according to Bitkom, making Germany the fifth biggest ICT market in the world. The country’s IT sector is the main driver of growth, with turnover of more than EUR 85 billion. According to EITO, domestic spending on IT equipment, services and software helped the market grow faster than GDP in 2017, with a year-on-year increase of 3.1 percent. The trend is set to continue in 2018, with IT spending expected to rise by 2.9 percent over the year.

Industrie 4.0 Opportunities
Industrie 4.0 provides significant market potential for ICT providers whose products support new business and service models on the basis of intelligent networking of objects and actors in a value chain. Around 90 percent of all industrial production processes are supported by ICT, with ICT share set to rise in the future as production processes and underlying ICT hardware merge with each other in the Internet of Things. Industrie 4.0 solutions growth is strongest in the software sector (in overall market second place behind IT services), followed by IT services (biggest market) and hardware (smallest market) in that order. According to an IDC study conducted for the European Commission, European Union (EU) data economy value is forecast to grow to EUR 430 billion in 2020 – with Germany accounting for more than one quarter of market volume. Real opportunities exist for business models that tap into the data protection, security and compliance concerns of companies active in the data economy.

Industrie 4.0 in Practice
IBM Watson IoT Headquarters
IBM has invested USD 200 million to establish its global Watson IoT headquarters in Munich. The headquarters house the first ever cognitive IoT collaboratories – hands-on industry labs where clients and partners can work together with the company’s 1,000 Munich-based researchers, engineers, developers and business experts to drive collaborative innovation in the automotive, electronics, manufacturing, healthcare, and insurance industries. IBM’s Watson platform technologies use machine learning and natural language processing to reveal insights from IoT data.

“Software and connected machinery have led to information-enabled manufacturing. Data analytics and the Internet of Things have sparked an information-driven industry. Platform-like manufacturing stacks, offering third party services on top of standard-compliant automation hardware, will be key to Industrie 4.0 success.”
Dr. Mirko Bordignon, Group Manager, Software Engineering and System Integration, Fraunhofer IPA
Microelectronics Sector

Market Overview
Germany has established itself as an international microelectronics force; accounting for more than half of European microelectronics production. The country is also home to one of the world’s most thriving and innovative electronics sectors. The industry is forecast to record turnover of EUR 191 billion for 2017, equivalent to an increase of more than seven percent. With a workforce of 85 thousand people, it is also Germany’s second biggest manufacturing industry by number of employees. It is also the country’s strongest manufacturing sector in terms of value added.

Industrie 4.0 Opportunities
Microelectronics and microsystems are central to the implementation of the broad array of Industrie 4.0 scenarios. Modern electronic and microelectronic components and systems provide an essential toolkit for making Industrie 4.0 objectives of flexibility, increased productivity and reduced costs possible. As key enablers in industrial automation, electronics and sensors help transform production systems and products into cyber-physical systems (CPS). New microelectromechanical systems (including sensors and actuators) building blocks (particularly for 3D motion tracking and technical monitoring systems) need to be developed for deployment in future cyber-physical production systems (CPPS). Twenty percent of companies in the domestic automotive sector already use self-controlling production facilities. Increased vehicle automation levels are creating extra demand for advanced electronics and sensor technologies from the microelectronics sector. According to the ZVEI electrical industry trade association, the automotive semiconductor segment recorded a rise in growth from 7.7 percent to 11.6 percent during the period 2011 to 2016. Internationally, demand for semiconductors and vehicle electronics rose to almost USD 35 billion by 2014, and is forecast to grow by around 4.5 percent annually through to 2021.

Industrie 4.0 in Practice
Research Fab Microelectronics Germany
Eleven institutes within the Fraunhofer Group for Microelectronics and two institutes from the Leibniz Association have developed a concept for a cross-location micro- and nanoelectronics research factory. The *Research Fab Microelectronics Germany* initiative will consolidate the country’s global position in semiconductors and electronics in four future-relevant technology areas ("silicon-based technologies," "compound semiconductors and special substrates," "heterointegration," and "design, testing and reliability"). Industry clients, SMEs and research institutes alike will enjoy access to the complete micro- and nanoelectronics value chain from a single source. As the world’s largest pool for smart system technologies and intellectual property rights, the initiative will strengthen German and European competitiveness in the field. The research fab concept was designed jointly by Fraunhofer and Leibniz to combine their respective competences in a pool for technologies. The Federal Ministry of Education and Research has made total funding of EUR 350 million through to 2020 available for the project.

### German Semiconductor Market 2015

<table>
<thead>
<tr>
<th>Sector</th>
<th>2015</th>
</tr>
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<tbody>
<tr>
<td>Automotive Electronics</td>
<td>24.0</td>
</tr>
<tr>
<td>Data Processing Tech.</td>
<td>6.5</td>
</tr>
<tr>
<td>Industrial Electronics</td>
<td>22.0</td>
</tr>
<tr>
<td>Consumer Electronics</td>
<td>2.5</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>45.0</td>
</tr>
</tbody>
</table>

Source: ZVEI 2016

### Internet of Things Turnover Forecast Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover (EUR billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>9.2</td>
</tr>
<tr>
<td>2016</td>
<td>13.7</td>
</tr>
<tr>
<td>2018</td>
<td>24.5</td>
</tr>
<tr>
<td>2020</td>
<td>50.1</td>
</tr>
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</table>

Source: Statista (Technavio, Deloitte) 2017
Investing in Industrie 4.0 Innovation

Companies can count on generous Industrie 4.0 research support in Germany. The European Union supports technological innovation through the Horizon 2020 R&D program – the biggest of its kind in the world. Germany has established a comprehensive package of complementary innovation policy measures and funding programs in order to consolidate its status as an Industrie 4.0 leader.

Horizon 2020
Horizon 2020 is the European Union’s Framework Programme for Research and Innovation for the period 2014 to 2020. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation. By coupling research and innovation, Horizon 2020 is helping achieve sustainable growth with its emphasis on excellent science, industrial leadership and the tackling of societal challenges. During the period 2014 to 2016, 55 percent of funding applicants were newcomers, with the share of funding awarded to SMEs surpassing the 20 percent target. With funding of almost EUR 80 billion, it is the biggest EU R&D funding initiative to date and the biggest initiative of its kind in the world. More than 27 percent (EUR 6.7 billion) of EU contribution attributed to signed grants were made in the area of ICT research and innovation as part of the digital agenda for Europe.

→ ec.europa.eu/programmes/horizon2020

Central Innovation Programme for SMEs – ZIM
The “Central Innovation Programme for SMEs” (ZIM) provides research and development funding to companies located in Germany that are engaged in market-driven technology-based R&D work. Funding is not restricted to any particular field of technology or specific field of application. The overarching objective of ZIM is to sustainably increase the innovative capacity and competitiveness of SMEs including craft businesses and independent professions. Public and private non-profit research and technology organizations (RTO) acting as a cooperation partner of a SME are also eligible for ZIM funding. Applications can be submitted continuously until December 31, 2019. Applications for cooperation networks with international partners can be submitted from 2018 onwards.

→ www.zim-bmwi.de

Microelectronics from Germany – Driver of Innovation for the Digital Economy
The Federal Ministry of Education and Research “Microelectronics from Germany – Driver of Innovation for the Digital Economy” initiative (part of the German Federal Government’s Framework Programme for Research and Innovation 2016-2020) will see public funding in the region of EUR 1 billion invested in the country’s chip industry through to 2020. This is expected to trigger project volume of EUR 4.4 billion from microelectronics companies in the following years.

→ www.elektronikforscung.de

Productive 4.0
Productive 4.0 is a European co-funded digital industry innovation and lighthouse project for the semiconductor industry. More than 100 partners from 19 European countries have signed up to the Infineon-led research project to strengthen Industrie 4.0 microelectronics competences for the international market. Alongside industry partners, research institutes – including the Karlsruhe Institute of Technology, Fraunhofer-Gesellschaft and TU Dresden – are involved in the EUR 106 million project schedule to run until 2020.

→ www.productive40.eu
Supporting Work in a Digital World

Industrie 4.0 promises to transform the world of work as we know it – bringing as many challenges as opportunities. Knowledge management and lifelong learning become essential in the digital workplace as demand for highly trained and qualified employees grows.

From Work 1.0 to Work 4.0
Just as the first Industrial Revolution represented a radical shift away from an agrarian economy to one defined by the introduction of mechanical production methods ("Work 1.0"), it also revolutionized the workplace. And now, as then, there are legitimate concerns about the effects automation will have on jobs and labor practice. But instead of the doomsday "rise of the robots" scenario envisioned by some, Industrie 4.0 is creating increased demand for a skilled workforce to implement digital goals ("Work 4.0"). Industrie 4.0 gives rise to new work and value chain processes through the intelligent networking of machines and materials, automated work processes, and innovative software solutions in the Internet of Things. In doing so, the Work 4.0 world creates new job function profiles and responsibilities across the complete value chain: from incoming product and service order through to delivery.

The Future of Work
The Federal Ministry of Education and Research Zukunft der Arbeit ("The Future of Work") program supports the joint development and balance of technological, economic and social work factors through the funding of R&D projects. New concepts and tools for the workplace will be developed in pilot activities for operational practice. The program results should provide design possibilities that can become standard for the future of work. The initiative is co-financed by the European Social Fund of the European Commission.

Innovations for the Production, Service and Work of Tomorrow
The Federal Ministry of Education and Research "Innovations for the Production, Service and Work of Tomorrow" research program provides support to cooperative precompetitive research projects that demonstrate how Industrie 4.0 technologies can be integrated in practice. Launched in 2014 within the framework of the new High-Tech Strategy, the program aims to develop new concepts and tools for organizing work in the digital workplace through research, practically oriented development projects and transfer activities in nine thematic areas. The program, which enjoys funding of approximately EUR 1 billion, will run through to 2020.

Mittelstand 4.0 – Digital Production and Work Processes
The Federal Ministry for Economic Affairs and Energy Mittelstand 4.0 - Digitale Produktions- und Arbeitsprozesse ("SME 4.0 – Digital Production and Work Processes") initiative supports SMEs and craft trade companies in the digitalization, networking and implementation of Industrie 4.0 applications. Mittelstand 4.0 Competence Centers raise awareness about digitalization among companies and provide information, training, and the opportunity to view and test new solutions in practice across the country.

Work 4.0 in Practice – Future Work Lab
The Future Work Lab in Stuttgart is a factory of the future where the interaction between man and modern technology is being researched today. The center allows the new employment opportunities created by digitalization to be demonstrated, discussed and evaluated for the mutual benefit of both industry and society as a whole. The innovation lab pools the Industrie 4.0 know-how of the Fraunhofer Institute for Industrial Engineering IAO and its research and cooperation partners to provide an invaluable resource for manufacturing companies seeking information about the digitalization of the industrial value chain. Competence development and training services address the needs of industry, trade unions, policy makers, academics and, above all, the production staff themselves. Established in 2017, the Future Work Lab is funded by the Federal Ministry of Education and Research as part of the Program "Innovations for Tomorrow's Production, Services, and Work" program and managed by the Project Management Agency Karlsruhe (PTKA).
Industrie 4.0 Actors, Associations and Initiatives

Plattform Industrie 4.0 is the central network to advance digital transformation in production in Germany. The initiative seeks to consolidate Germany’s leading Industrie 4.0 role by engaging in ongoing dialogue with partners and developing action recommendations for all stakeholders that serve as the basis for a common framework.

Plattform Industrie 4.0

Plattform Industrie 4.0 brings together more than 300 stakeholders from over 150 companies, associations, trade unions and academic and political institutions so that all stakeholders can drive their mission at many levels. Five working groups set up to address the central challenges of Industrie 4.0 draw up basic concepts, recommendations for action and guidelines in the areas of standardization, security, legal framework, and work and business models.

A number of online tools provide optimal orientation for small and medium-sized enterprises looking to identify potential Industrie 4.0 partners and opportunities. The interactive Industrie 4.0 Use Case Map showcases more than 340 Industrie 4.0 innovations already in practice across Germany; thereby providing an invaluable resource to companies seeking information, advisory services and access to national testbed sites. An online library also provides ready access to all results produced by the Plattform Industrie 4.0 and its partners. The Compass Industrie 4.0 serves as a platform for more than 100 cost-free Industrie 4.0 support services available in Germany. International in outlook, Plattform Industrie 4.0 has entered into a number of national and international partnerships to take on overarching challenges – like standardization and IT security. The Plattform Industrie 4.0 is headed by the Minister for Economic Affairs and Energy and the Minister of Education and Research, together with high-level representatives from business, sciences, and trade unions. A steering group of business representatives coordinates all the activities of the working groups. A strategy group, made up of representatives from politics, trade unions and the academic community, provides advice on strategic issues.

www.plattform-i40.de

Standardization Council Industrie 4.0

The Standardization Council Industrie 4.0 (SCI 4.0) was established in 2016 from Plattform Industrie 4.0. It pursues the goal of initiating digital production standards in Germany and of coordinating these nationally and internationally. The initiative accelerates standardization processes and organizes and shapes the German standardization roadmap Industrie 4.0. The SCI 4.0 also identifies the need for new projects and organizes their international implementation.

Labs Network Industrie 4.0 e.V.

Government policy actions are accompanied by an initiative created by companies and associations from Plattform Industrie 4.0 to provide appropriate information to interested parties in as many industries and manufacturing technology fields as possible. The Labs Network Industrie 4.0 e.V. association was founded as a one-stop shop for the coordination of different approaches. It supports companies in the initiation of Industrie 4.0 projects, pools results from the testbeds and forwards them to relevant competitive structures, e.g. in the field of standardization and international cooperation.

Reference Architecture Model Industrie 4.0 – RAMI 4.0

The Plattform Industrie 4.0 working group on reference architectures, standards and norms has developed the "Reference Architectural Model Industrie 4.0" (RAMI 4.0) guideline. RAMI 4.0 brings together all of the essential technological elements of Industrie 4.0 together in a uniform model – providing companies from different sectors with a standard orientation framework. RAMI 4.0 is a service-oriented architecture that combines all elements and IT components in a layer and life cycle model. Complex processes are broken down into easy to understand packages including data privacy and IT security. The RAMI 4.0 standard creates a shared understanding of norms, standards and case studies for all parties working on Industrie 4.0 standards. It provides a guideline to identifying relevant standards and is used internationally to standardize approaches with other reference architecture models.
Industry Associations

**acatech – the National Academy of Science and Engineering**

acatech – the National Academy of Science and Engineering – represents the interests of the German scientific and technological communities, at home and abroad. It is autonomous, independent and a non-profit organization. As a working academy, acatech supports policy-makers and society, providing qualified technical evaluations and forward looking recommendations. Moreover, acatech is determined to support knowledge transfer between science and industry, and encourage the next generation of engineers. acatech works to promote sustainable growth through innovation. Its work focuses on four core areas of scientific recommendations; transfer of expertise; promotion of young scientists and engineers; and providing a voice for science and engineering. [www.acatech.de](http://www.acatech.de)

**Bitkom**

Bitkom is Germany’s digital association. Founded in 1999 as a merger of individual industry associations in Berlin, it represents more than 2,500 companies in the digital economy – among them 1,000 SMEs, 400 start-ups and almost all global players. These companies offer a range of software and IT, telecommunications and Internet services; manufacture hardware and consumer electronics; operate in the digital media and Internet industries and otherwise play a role in the digital economy. Bitkom mainly advocates for innovative economic policies, the modernization of the educational system and future-oriented network policies. [www.bitkom.org](http://www.bitkom.org)

**VDMA**

The Verband Deutscher Maschinen- und Anlagenbau e.V. (VDMA – “Association of German Machinery and Plant Manufacturers”) represents more than 3,200 member companies in the SME-dominated mechanical and systems engineering industry in Germany and Europe. VDMA is the largest network organization for mechanical engineering in Europe. The association represents the common economic, technological and scientific interests of this diverse industry. The VDMA successfully accompanies its members in global markets.

**ZVEI – German Electrical and Electronic Manufacturers’ Association**

ZVEI – German Electrical and Electronic Manufacturers’ Association represents the common interests of the electrical industry in Germany and at the international level. This commitment is supported by the involvement of around 160 employees in the main office and around five thousand employees of the member companies in an honorary capacity. The basis of the association’s work is the exchange of experience and views between the members about current technical, economic, legal and socio-political topics in the field of the electrical industry. From this exchange, common positions are drawn up. With proposals on research, technology, environmental protection, education, and science policy, the ZVEI is a pacemaker of technological progress. It supports market-related international standardization work. Over 1,600 companies have opted for membership of the ZVEI. They employ around 90 percent of the employees and staff of the electrical industry in Germany. Its members include global players, medium-sized and family-owned companies. [www.zvei.org](http://www.zvei.org)

Its technical expertise, industry knowledge and straightforward positioning make it a recognized and valued point of contact for companies as well as the general public, science, administration and policy makers. [www.vdma.org](http://www.vdma.org)
Industrie 4.0 Best Practice

Germany’s highly diversified Industrie 4.0 landscape is generating success stories along the value chain – from SMEs and industry giants to innovative research clusters.

Investment Success Story
Omni-ID

Omni-ID began in the 1990s as a research and development team within QinetiQ, an international defense and security technology company. Omni-ID is a global leader in the manufacture and supply of passive, active and e-paper RFID solutions. RFID applications supported by Omni-ID RFID tags for Industrie 4.0 solutions include visual tagging, RFID mapping, and material flow enhancement. Company activities are largely focused in the manufacturing sector, with major manufacturing partners including Siemens, Daimler, IBM Germany, and Bosch. The company’s products are used to establish cost-effective and reliable connected environments that allow end-to-end asset management, in-process visibility and real-time control management.

Industry Innovation
Infineon Technologies

Production facilities in the semiconductor industry are very capital intensive. For that reason, a key industry goal is increased capacity utilization while maintaining the highest of quality standards (in the area of automotive products for example). Only by implementing Industrie 4.0 can Infineon meet these exacting requirements and continue to be successful in the highly competitive semiconductor sector.

Infineon has extensively automated and networked its existing 200 mm production site in Dresden in cooperation with partners from the Silicon Saxony cluster. Wafer transportation, equipment operation and production control are interlinked and controlled by IT systems. The 200 mm Infineon Dresden factory is one of the world’s most highly automated manufacturing facilities. Automation is an essential requirement for a “smart factory,” the basis for this being standardized processes. The networked factory provides information about machine process conditions, for example, bottlenecks or disruptions, and communicates in real time with other sites worldwide to continuously control and optimize production.

Infineon has planned, tested, and introduced a comprehensive solution step by step. Equipment is linked to production management (“MES”) software as well as the transport system and the integrated robots connected with the equipment “nervous system.” Planning tools and control from the control center accompany these processes. Up to one thousand process steps are interlinked: Optimization algorithms control efficient robots, machine, transport systems and batches. Industrie 4.0 standards are implemented internationally and the factories – partially involving clients and suppliers – form a “global virtual factory” network.

“Germany has long been a thought leader in manufacturing and automation. Most recently, the vision and investment in Industrie 4.0 has started bringing together some very interesting vendors and concepts that we are convinced will play a big part of the future of the plant floor. Being an engaged part of this ecosystem was a major factor in founding our new German subsidiary.”

Ed Nabrotzky, CSO Omni-ID

Germany Trade & Invest (GTAI) helped the US-based company identify a suitable site for sales and marketing as well as local adaptation activities in Germany. Comprehensive site selection analyses and tax and legal information services were provided free of charge to the Rochester, New York-based company. From initial contact through to office opening, Omni-ID was able to set up its new operations in a period of around just seven months.

INDUSTRIE 4.0 OUTLOOK
Research Cluster

it’s OWL

How do we process data from machines to increase productivity and efficiency? How do we develop new services and business models? And how do we use new technology to improve working conditions? At the it’s OWL (Intelligent Technical Systems OstWestfalenLippe) technology network, more than 200 companies and research institutes are working to develop solutions for SMEs to meet these challenges. Awarded Leading-Edge Cluster status by the Federal Ministry of Education and Research, it’s OWL is regarded as one of the most significant Industrie 4.0 initiatives in Germany. Solutions for intelligent products and production processes have been developed in 47 projects. New projects focus on artificial intelligence processes as well as digital platforms and designing the modern workplace.

Located in the OstWestfalenLippe (OWL) region in northern Germany, it’s OWL belongs to the strongest production clusters in Europe. Four hundred companies in the mechanical engineering and electrical and automotive supply industries generate annual turnover of EUR 17 billion. Family-owned companies and a broad medium-sized industry form the core of the cluster. These include world market leaders (Benteler, Claas, DMG Mori, Hella, Miele, and Diebold Nixdorf) and many hidden champions. In the field of industrial electronics, Beckhoff, Harting, Lenze, Phoenix Contact, Wago, and Weidmüller are setting world standards. Local universities stand for interdisciplinary top-level research in the fields of self-optimization, cognition and industrial automation.

Industrie 4.0 Outlook

Interview with Professor Henning Kagermann
acatech (National Academy of Science and Engineering) President and Global Representative and Advisor of Plattform Industrie 4.0

What needs to be done to drive Industrie 4.0 adoption?
In Germany we have a state-of-the-art production sector and more SME international market leaders than any other country in the world. However, according to our own competence development study, around half of these SMEs are hesitant to embrace digitalization. We need to pick up speed here. In order to be successful in the platform economy, small and large enterprises must cooperate more than ever before – in common business models as well as in education and training. Only through qualification can we avoid a digital gap between large and small enterprises as well as between highly and lower qualified members of the workforce. For fair market access, small and medium-sized enterprises require open digital platforms with interoperable interfaces. Open standards – for numerous applications and users – will in any case win out in the platform economy in the long term.

Germany is not the only industry nation working on the implementation of “Industry 4.0.”
What approaches are there to cooperate across industry sectors and countries?
China is currently carrying out its “China 2025” program which takes Industrie 4.0 as its model. The Japanese government has launched its “Society 5.0” and “Industrial Value Chain Initiative” activities, the latter of which has a strong focus on robotics. South Korea has its own “Smart Factory Initiative” and a broader “Fourth Industrial Revolution” program that is a combination of Industrie 4.0 and Smart Service World. The “Industrial Internet Consortium” established in the USA has a broader focus, but does not go into so much detail in the area of production. The UK and Sweden’s “Catapult” and “Production 2030” programs also pick up on the key themes of Industrie 4.0. These countries are not just looking to see what is happening in Germany – they are already engaged in intensive exchange with us. Common open standards are a matter of real international urgency, a fact confirmed by our “Industrie 4.0 in a Global Context” study.
Our support services for your investment project

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**Project management assistance**

**Location consulting/Site evaluation**

**Support services**

- Facts on incorporation and taxation
- Market intelligence and statistics
- Financing & incentives consultancy
- Information on visa options and labor law
- Contact to financial partners

Germany Trade & Invest’s (GTAI) teams of industry experts will assist you in setting up your operations in Germany. We support your project management activities from the earliest stages of your expansion strategy.

We provide you with all of the industry information you need – covering everything from key markets and related supply and application sectors to the R&D landscape. Foreign companies profit from our rich experience in identifying the business locations which best meet their specific investment criteria. We help turn your requirements into concrete investment site proposals; providing consulting services to ensure you make the right location decision. We coordinate site visits, meetings with potential partners, universities, and other institutes active in the industry.

Our team of consultants is at hand to provide you with the relevant background information on Germany’s tax and legal system, industry regulations, and the domestic labor market. Germany Trade & Invest’s experts help you create the appropriate financial package for your investment and put you in contact with suitable financial partners. Our incentives specialists provide you with detailed information about available incentives, support you with the application process, and arrange contacts with local economic development corporations.

All of our investor-related services are treated with the utmost confidentiality and provided free of charge.
Asha-Maria Sharma and Claudia Grüne are the knowledge and coordination team for Industrie 4.0 at Germany Trade & Invest. Asha-Maria is responsible for all things digital, covering topics including artificial intelligence, big data analytics & IoT, and cloud computing. Claudia covers the hardware side, including robotics and automation, smart machines and sensors. Together, they provide the broad spectrum of information required by potential investors. Both have considerable and lengthy experience in economic development and international management consulting.

Contact us for information on opportunities for your project in Germany:
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For more information about Industrie 4.0 in Germany, please visit our website
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About Us
Germany Trade & Invest (GTAI) is the economic development agency of the Federal Republic of Germany. The company helps create and secure extra employment opportunities, strengthening Germany as a business location. With more than 50 offices in Germany and abroad and its network of partners throughout the world, GTAI supports German companies setting up in foreign markets, promotes Germany as a business location and assists foreign companies setting up in Germany. All investment services and related publications are free of charge.

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