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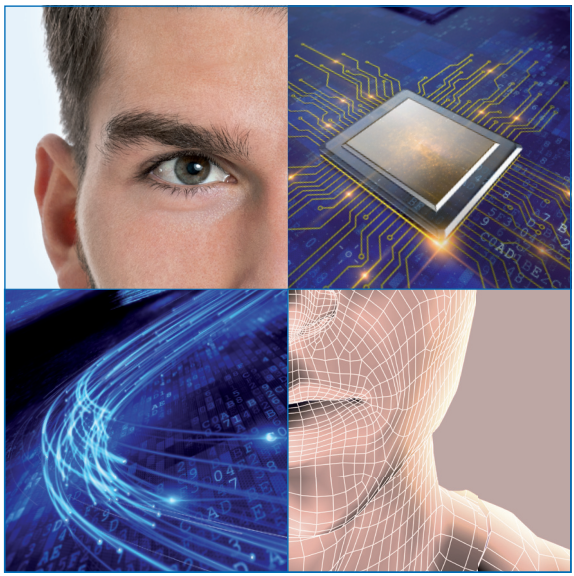
Fraunhofer ISI

Abstract of the Study

The Electrical and Electronic Industry as the Leading Sector of Digitisation

Seizing Chances for Innovations, Reducing Barriers for Innovations



German Electrical and Electronic Manufacturers' Association

Michael Ziesemer
President of ZVEI

Shaping Digitisation

Digital Transformation is a major challenge of our time. Companies, industrial sectors and national economies need to go through major changes. At this stage, we do not yet know the actors and locations that will be able to make use of the new potentials for more value added that digital transformation carries along.

With a high performance in manufacturing and knowledge intensive as well as highly globalised companies, Germany is one of the most successful national economies worldwide. The current challenge is to transfer this model of success into the digitised economy of the 21st Century to maintain Germany's economic strength.

This study analyses the input of the Electrical and Electronic Industry within the process of digitisation in its five key markets: Industry 4.0, Energy, Health, Mobility and Buildings. Referring to a comprehensive body of data, it is the first methodological study in this field. It finds that the Electrical and Electronic Industry is a central industrial sector that enables the digitisation of the economy: its technologies and products are core requirements in the process.

At the same time, the study analyses the extent of digitisation within the Electrical and Electronic Industry. It finds that, compared to other industrial sectors, the Electrical and Electronic Industry is well advanced as a provider as well as a user of digital products. It does, however, also indicate that in many companies of the Electrical and Electronic Industry and other industrial sectors, digitisation is still at the beginning of the process. When it comes to new

business models, the potentials in gaining value added often remain unused. This means that these companies need to catch up. Moreover, the study shows that there is a risk of a digital divide between small, medium and large companies. But not only do companies need to take action, just as essential are offers of public support.

The analyses of the survey show that companies cannot accomplish the process of digital transformation on their own. Designing it successfully requires determination not only within the companies but also within society, politics and science.

We will need to take these steps together in order to find ways to apply the recommendations of this study. Succeeding in this challenge will enable the Electrical and Electronic Industry to maintain its enabling role in the process of digital transformation. It can thereby contribute to the economic success of Germany and to the digital economy of the 21st Century.

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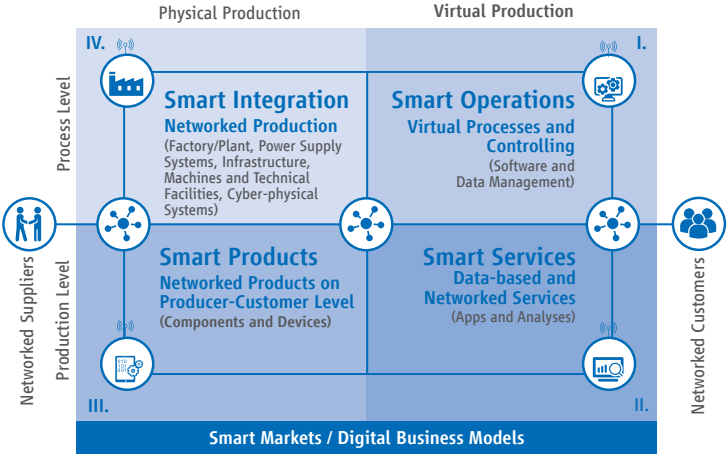
President of ZVEI

1. Enabling-Function of the Electrical and Electronic Industry

Value chains become value networks. The very basic form of industrial sectors is changing. Up to this day it is not clear what players at what locations will unlock the potentials of value added that come with digitisation.

Figure 1: Dimensions of Digitisation



Source: IW Consult; adaptation by authors

Digitisation is not self-propelling but has highly disruptive potential. We need to be aware of the chances it carries along and ponder possible effects carefully in order to seize the chances as much as possible. The companies of the Electrical and Electronic Industry have done more to prepare themselves for facing these challenges than most companies in the manufacturing sector.

Figure 2: Degree of Adjustment of Business Strategies to Digital Transformation

	Electrical and Electronic Industry in Percent	Other Sectors[1] in Percent
To a high degree	33.1	21.3
To a medium degree	41.5	38.6
To a low degree	21.5	32.4
No adjustment	3.8	7.7
Total	100.0	100.0

[1] Industry and closely industry-oriented services from "IW-Zukunftspanel"

Source: ZVEI-survey (2016), IW-Zukunftspanel (2016)

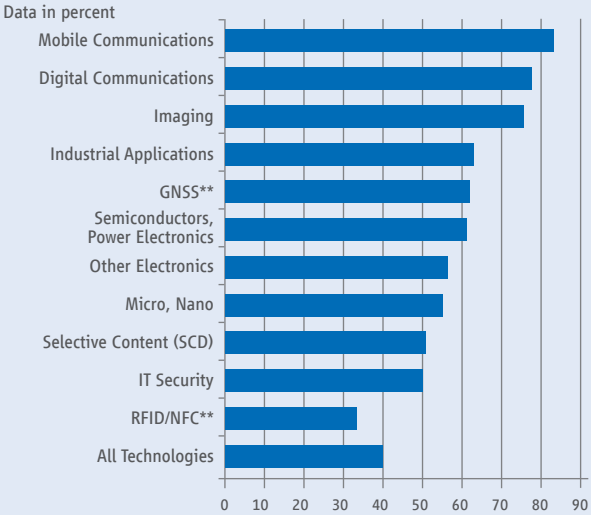
The Electrical and Electronic Industry. The Leading Sector of Digitisation – Providing the Highest Amount of Intermediate Goods to Other Industrial Sectors

The technologies of the Electrical and Electronic Industry are networked with other fields of technology to a higher degree than that of any other industrial sector in the world.

Other industrial sectors benefit significantly from the innovations of the Electrical and Electronic Industry. This concerns innovations in the field of digitisation in particular (figure 3).

As an enabling sector and core industry, the Electrical and Electronic Industry delivers complex intermediate goods into other industrial sectors. Exchanges with the Electrical and Electronic Industry make their products and services knowledge intensive: the Electrical and Electronic Industry functions as a technology generator for all other industrial sectors, with exceptions of the Chemical Industry as well as the Data Processing Sector (figure 4).

Figure 3: Percentage of Patents* of the Electrical and Electronic Industry for German Patent Applications for Key Technologies of Digitisation

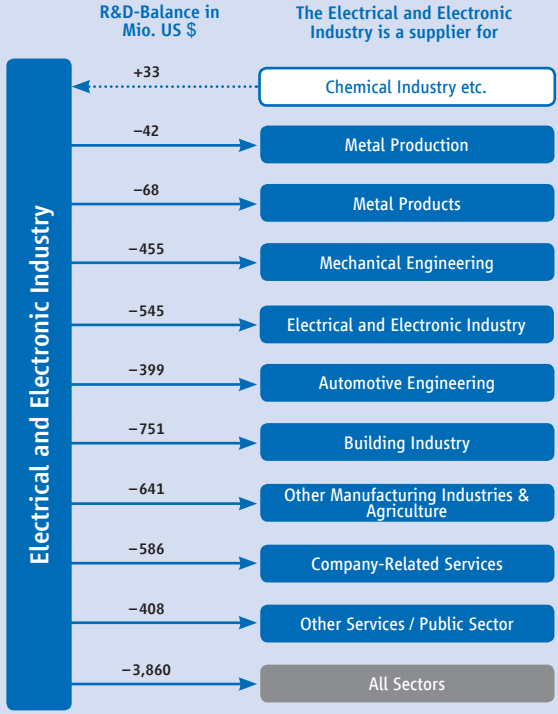


* Only patent families with at least one EPO or PCT application within the priority years from 2011-2013 were considered; only patent applications with information on the industrial sector were considered.

** (RFID) Radio Frequency Identification, (NFC) Near Field Communication, (GNSS) Global Navigation Satellite System

Source: EPO Patstat; BvD – Orbis; calculations and presentation by Fraunhofer ISI

Figure 4: The International R&D-Network of the German Electrical and Electronic Industry of 2011



Source: calculations IW consult, data: OECD (2015; 2016)

This, together with its high innovation drive, makes the Electrical and Electronic Industry one of the most important impulse generators when it comes to knowledge and technology for the entire economy. In proportion to its turnover, its investments in product and process developments are twice as high as those in the manufacturing sector and more than three times as high as those in the German national economy.

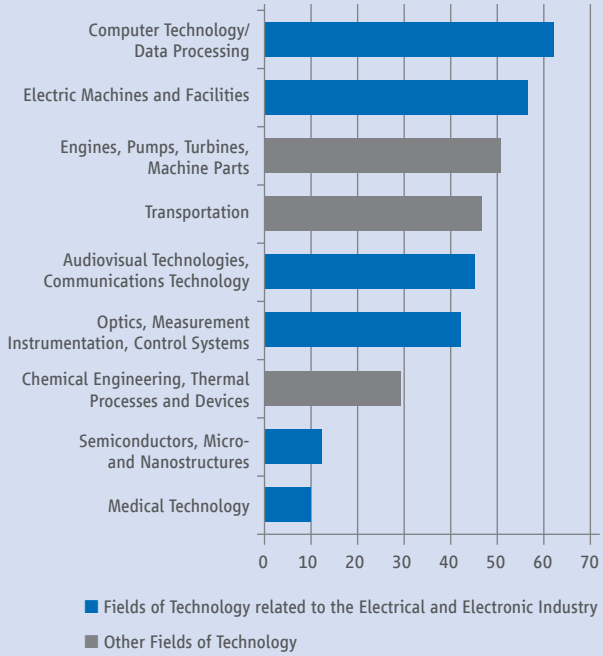
When looking at the digitisation of the economy, the Electrical and Electronic Industry contributes particularly with the research-intensive divisions of semiconductors, sensors or actuators and embedded software to the further development of Germany as an industrial location. With

15.5 Billion Euros in Germany in 2015, 25 percent of all investments in R&D made by the industry and 20 Percent of private investments were carried out by the Electrical and Electronic Industry. This makes the Electrical and Electronic Industry the sector with the second highest investments in R&D in Germany.

A survey of the manufacturing sector that did not include the Electrical and Electronic Industry illustrates the high level of importance of the fields of technology of the Electrical and Electronic Industry for business operations within the manufacturing sector (figure 5).

Figure 5: Relevance of Different Fields of Technology for Business Operations

Data in percent / arranged by level of turnover



Source: IW-Zukunftspanel (2016)

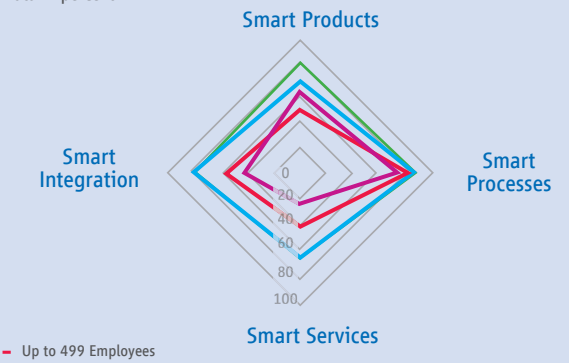
2. Realisation Status of Digitisation: The Electrical and Electronic Industry as a User – Digital Index Twice as High as That of the National Economy

The status of realisation as well as strategic concepts of digitisation within the Electrical and Electronic Industry is developed to a higher degree than within the average German economy. As a user of digitisation, the digital index of the Electrical and Electronic Industry is twice as high (10.2 points) as that of the German national economy (4.8 points). With regard to digital technologies and business models, the Electrical and Electronic Industry has a high percentage of users and is one of the leading sectors within the manufacturing industries. This means that 90 percent of the companies use smart processes, 75 percent use smart products and 50 percent use smart services.

Figure 6: Digital Products and Services of the Electrical and Electronic Industry – User

The Electrical and Electronic Industry's own use of digital products and services for the optimisation of processes

Data in percent



Source: ZVEI-survey (2016)

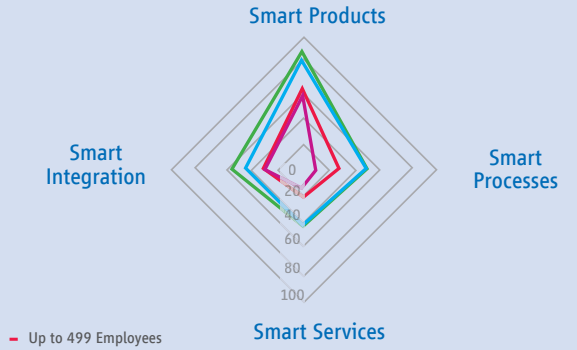
The Electrical and Electronic Industry as a Supplier of Digital Products and Services with Potential for Development

As a supplier of digital products and services the Electrical and Electronic Industry clearly has potential for further development. Currently, the sector produces approximately 20 percent of its turnovers with digital or digitally enhanced products and the corresponding services. 15 percent thereof are Smart Products, which make up the main section of digital supplies of the Electrical and Electronic Industry. New Business models and services, which are likely to have very high potentials to gain Value Added, are just at their very beginning.

Figure 7: Digital Products and Services of the Electrical and Electronic Industry – Supplier

Sale of Digital Products and Services

Data in percent



Source: ZVEI-survey (2016)

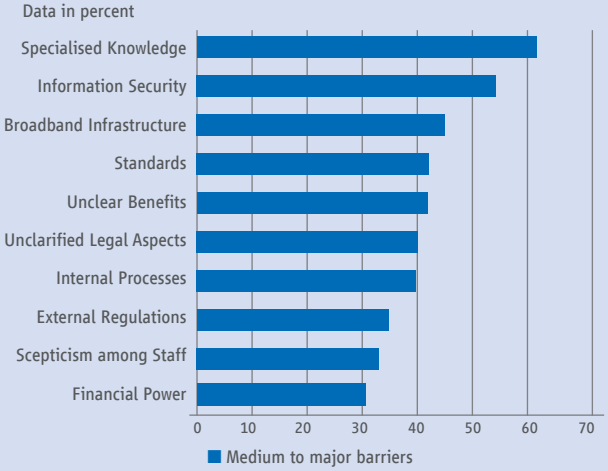
The example of Industry 4.0 shows that about 20 percent of all industrial enterprises are still in the process of introducing it. A major reason for this is that companies can only make limited progress if their partners in the supply chain or their customers do not support them in the process. Similar problems arise if the infrastructure does not meet the requirements or if legal aspects remain unclear.

3. Challenges – Barriers to Digitisation

Naming the barriers that slow down the process of digitisation (exemplary representation in figure 8) has been an objective of this study. For an evaluation, the results of the ZVEI-survey were analysed together with the findings of the IW-Zukunftspanel. In order to achieve this, the companies rated ten aspects on a scale reaching from "major" to "no" barrier.

The future ability of the Electrical and Electronic Industry to compete on an international level as an enabler and leading sector in the process of digitisation will depend to a high degree on economy, society and politics mastering the following challenges together.

Figure 8: Barriers to Digitisation from the Perspective of the Electrical and Electronic Industry



Source: ZVEI-survey (2016)

4. Recommendations for Action

The study shows need for action for companies, politics and science in seven fields:

1. Provide Specialised Knowledge

- More digital competence in all educational sectors
- Higher rating of the digitisation process in educational methodologies and during further training for teachers

2. Ensure Data Security

- Support data security on the basis of a "security by design" approach
- Establish platforms for IT-security in order to back the development of suitable solutions
- Participation in international processes of standardisation

3. Enable High-Performance Broadband Infrastructure Nationwide

- Align the infrastructure for communications with the quality demands of fields of industrial applications (suitable for industry: network latency, symmetry, stability etc.)
- Technologically independent expansions of fixed and wireless networks
- Support additional investment projects as public private partnerships (PPP)

4. Support Key Technologies

- Particularly network communications and data analysis as well as sensor technology, actuators and embedded systems have need for action
- Skills monitoring on a regular basis
- Further development of internationally oriented R&D top priorities, for example in the fields of network communications or data analysis

5. Realise Potential in Gaining Value Added

- Develop digital offers in corporate planning, particularly with new business models and smart services
- More support for data driven innovations: transparent rights for use of data, in order to seize the potentials of data-based services (for example use of machine data); at the same time avoiding regulations that inhibit innovations for data based services

- Resolve regulative contradictions between EU directives, for example between the radio equipment, vehicles, machinery or the low voltage directives
- Build up value added networks and carry along SMEs; adequate raise of R&D investments by companies and government (cf. item 6)

6. Rethink Research and Innovation Policies

- Use a broader definition for innovation that includes digital business development or Smart Services to a larger extent
- More coordination between administration departments when it comes to cross-sectoral or key issues
- Grant tax reliefs on R&D investments to companies
- More coherent and transparent regulations for governmental R&D funding aligned to the high-tech strategy
- Support digital key technologies with critical mass, continuing the processes of establishing clusters of excellence, more emphasis on public support that is not subject to thematic restrictions
- Continue the development of the German funding programme ZIM: promote innovation activities that are close to the market, in particular network-promotion of big business and SMEs
- Augment networks of knowledge: support competence centres following the example of industry 4.0 competence centres for other key markets

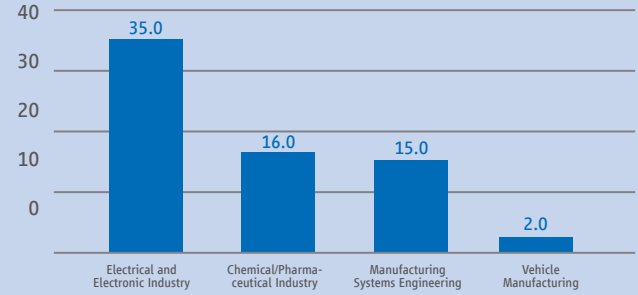
7. Enhance Economic Indicators

- Enhance accounts, indicators and operating figures, so they can still precisely represent the significance of particular sectors of the economy in a digitised age
- Define the concept of "investment" more broadly: apart from the "classical" investments in equipment, the term should include investments in R&D, innovations and education as well as investments in non-tangible assets, such as knowledge intensive/human assets, software, processes etc. ("enhanced definition of investment")

Overview: The Electrical and Electronic Industry as the Leading Sector of the Digitisation Process

The Electrical and Electronic Industry is the most important generator of ideas in the manufacturing sector. It is the sector of origin of one out of three innovations.

Figure 9: Initiations for Innovation in the Manufactoring Sector Come out of the Following Sectors (in percent):



Source: ZEW and ZVEI calculations

The Electrical and Electronic Industry has above average degrees for distribution and is among the leading user markets.

Figure 10: Diffusion Rates of Digital Technologies according to Industrial Sectors

The Top-3 sectors with the highest diffusion rate are highlighted		Food and Beverage Industry	Chemical Industry	Rubber-, Plastics- & Ceramic Industry	Metal Processing Industry	Electrical and Electronic Industry	Mechanical Engineering	Vehicle Manufacturing	Other Sectors
Digital Management-Systems	Software System for Production Planning and Regulation	43 %	65 %	74 %	67 %	83 %	75 %	72 %	57 %
	Product-Lifecycle Management Systems	6 %	10 %	14 %	8 %	16 %	16 %	20 %	6 %
Wireless Man-Machine Communication	Devices for the Programming and Use of Facilities and Machines	15 %	15 %	21 %	20 %	13 %	23 %	25 %	19 %
	Digital Visualisation	12 %	21 %	31 %	35 %	50 %	43 %	30 %	27 %
CPS-Related Processes	Near Real-time MES	21 %	34 %	38 %	31 %	22 %	19 %	26 %	30 %
	Digital Data Exchange with Customers/ Suppliers	15 %	26 %	43 %	34 %	32 %	32 %	59 %	24 %
	Technologies for the Automatization and Regulation of the Internal Logistic Processes	22 %	33 %	32 %	27 %	39 %	29 %	40 %	29 %
Man-Machine cooperation	Technologies for a Save Cooperation between Man and Machine	0 %	1 %	5 %	3 %	2 %	3 %	11 %	4 %

Source: Fraunhofer ISI, adaptation by authors

The complete study in German language is available
under the following link:
https://www.zvei.org/presse-medien/publikationen/
die-elektroindustrie-als-leitbranche-der-digitalisierung-innovationsstudie/

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Imprint

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The German Electrical and Electronic Industry Stands for:

Innovations

178.2 Billion Euros Turnover

43 % Highest Proportion of Value Added of All Large Sectors of the German Industry

1/5 of Investments for Innovations in the Manufacturing Sector

7 out of 10 Companies with Regular Product and Process Innovations

1/3 of Revenues with Product Novelties

1/6 of German "Hidden Champions"

23.6 Billion Euros in Investments for Innovations

40 % of Transnational Patent Applications per Year of German Companies

1/5 of Private R&D Investments in Germany

Skilled Workforce

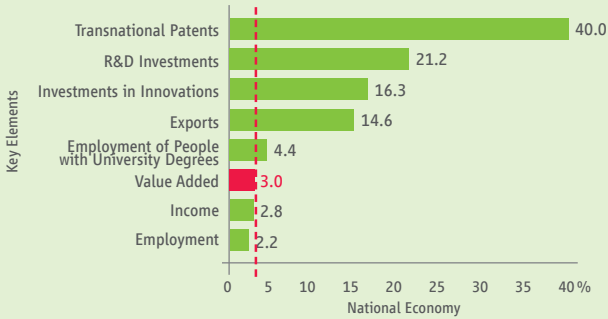
1/4 of Employees in R&D in Germany

about **850,000** 850,000 Employees in Germany (+ 704,000 abroad) Make up …

22 % are Engineers (More than 180,000 = the Highest Proportion in Germany)

Value Added

Contributions of the Electrical and Electronic Industry to the Key Elements of Germany as a Business Model, Figures as of 2015



Source: Destatis (2016), Stifterverband (2016), ZEW (2015), ZVEI (2016), Fraunhofer (2016)