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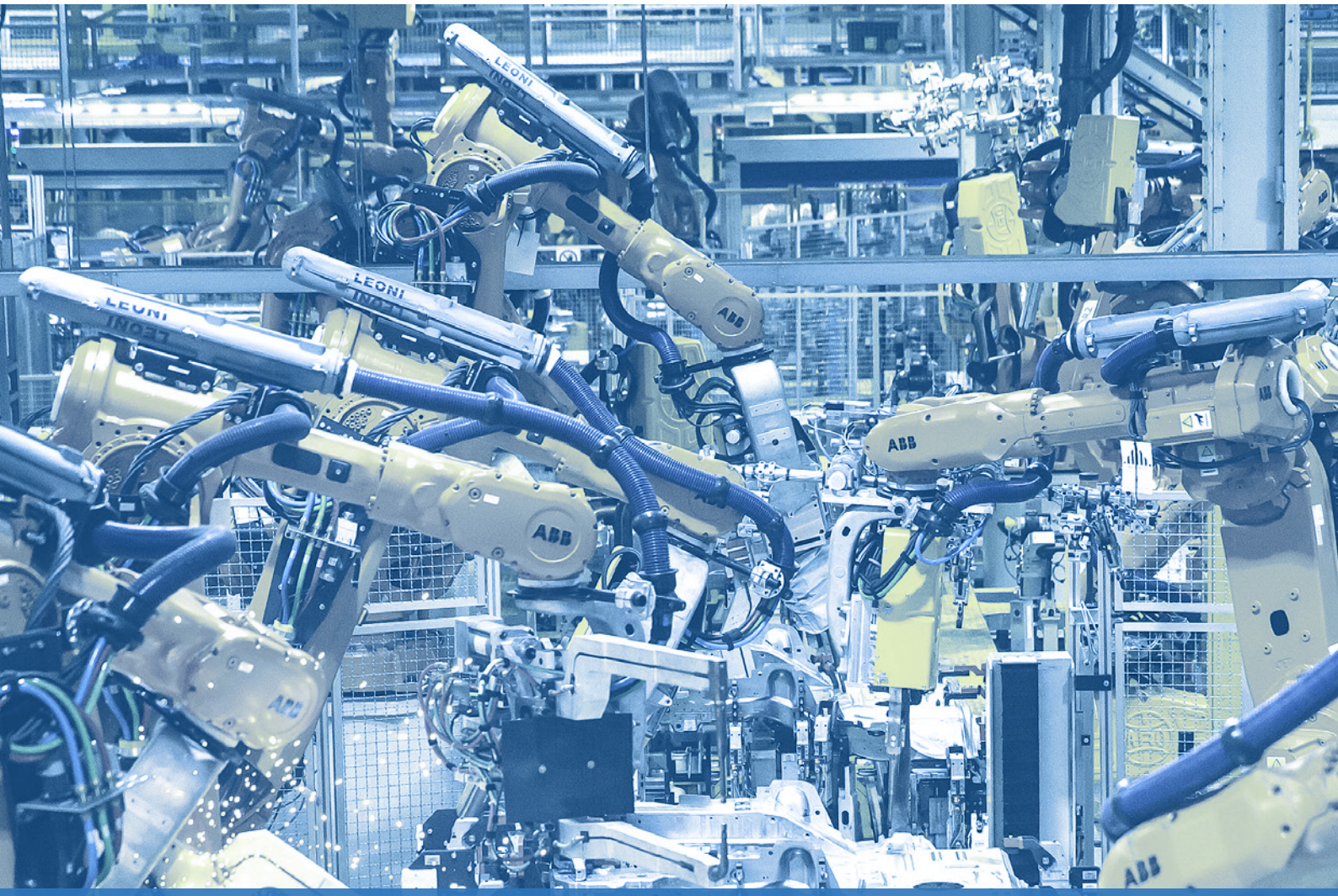
ZUR STÄRKUNG DER FORSCHUNG
ZUR NORMUNG UND
STANDARDISIERUNG E. V.



GERMAN STANDARDIZATION PANEL (DNP)

Standardization Research,
Policy and Promotion

Indicator Report 2017

SUPPORTED BY THE GERMAN SOCIETY FOR THE PROMOTION OF
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GERMAN STANDARDIZATION PANEL 2017

INDICATOR REPORT FOR THE IMPORTANCE OF STANDARDS AND STANDARDIZATION ACTIVITIES OF GERMAN COMPANIES

SUMMARY

Based on representative data of German companies engaged in standardization and, increasingly, companies that only apply standards, this 2017 indicator report of the German Standardization Panel (German: Deutsches Normungspanel, acronym "DNP") provides information on several aspects of standardization. The contribution of innovations to the competitiveness of businesses, as well as to other entrepreneurial dimensions, is undisputed. However, the benefits of standardization and the application of standards have not yet been fully recognized as a significant influencing factor – not least due to a lack of empirical investigations in this area.

For this reason, the German Standardization Panel was set up in autumn 2011 by the German Society for the Promotion of Research on Standardization (FNS). The FNS promotes research on topics and questions related to standardization in order to make qualitative assessments of aspects regarding standardization policy. For the DNP, annual surveys are carried out to collect data on standardization activities and the application of standards by companies, which is then used to examine the impact of standardization and standards on various economic and social dimensions.

Such a systematic analysis requires reliable, detailed data which is collected through surveys carried out among the same economic players (persons or companies) on the same topic and over time. So-called panel data is particularly crucial for the exploration of the complex effects of standardization processes and the application of formal and informal standards on business success. This year, DNP data from four survey waves were combined to establish a panel data set. Based on this unique data, insights were gained on changes in standardization activities and the application of formal and informal standards from 2013 to 2016. Due to a low number of observations, data from the pilot study in 2012 was excluded from the panel data set.

Already in 2015, the special section of the survey addressed the importance of standards in times of increasing digitalization. This year's survey explores this topic further by analyzing the significance of standards in the specific context of Industry 4.0. The standardization panel's 2016 results provide new insights into current challenges as well as future needs for introducing standards into different areas of Industry 4.0.

The here presented analyses validate last years' results and confirm initial trends. In addition, new insights into the trend towards standardization could be gained. The following core results were derived:

1 Formal standards, specifications and other technical rules developed by standardization organizations are by far the most important types of documents to the companies interviewed, as they promote legal certainty and facilitate market access for companies. The great significance of standardization work is reflected by a relatively large number of businesses that maintain specialized standardization departments, in particular among medium-sized and large companies. Investigations of changes over the years reveal that the importance of national formal standards is diminishing.

2 Internal company standards are the third most important type of document and considered more relevant than informal consortial or de-facto standards. Internal company standards are applied by the majority of businesses surveyed, but particularly by large and innovative companies. They serve primarily to promote quality and productivity improvements. Over the last few years, internal company standards have gained in importance, specifically among medium-sized companies and in the service industry. For smaller companies, company standards still play a minor role, while consortial standards are of increasing importance. The latter are primarily used to improve bargaining positions vis-à-vis suppliers and customers.

3 Informal consortial and de-facto standards are primarily relevant for smaller companies and at the national level. However, our data shows a general trend towards an increasing relevance of consortial standards and participation in informal standardization processes in addition to formal standardization. Consortial standards are most important for the realization of interoperability.

4 ISO 9001 (quality) and ISO 14001 (environmental) certifications are already widespread among survey participants and first certifications in this field are rare. In contrast, ISO 50001 (energy efficiency) and ISO/IEC 27001 (IT-security) certifications are on the rise.

5 This year's special section addresses the role of standards in the context of Industry 4.0. Only about a third of the respondents state that the topic is currently of great importance to their company or industry. The experts express a strong need for standardization in the areas "security and safety" and "interfaces and compatibility". Despite several initiatives such as "Plattform Industrie 4.0", a lack of information about and transparency of the involvement in standardization processes can be observed. Our results further indicate that standards in the context of Industry 4.0 have not yet fully diffused throughout companies.

CREATING AN EMPIRICAL BASIS FOR THE EXPLORATION OF THE GERMAN STANDARDIZATION LANDSCAPE

Introduction

Innovation is commonly regarded as a source of growth and prosperity. Many factors contribute to the transformation of ideas into successful market solutions. Standardization is considered one of these factors. Panel data, i.e. data that is gathered on a regular basis, facilitates causal inference and is therefore necessary for the scientific analysis of the effects of standards. For example, the 2012 survey revealed that companies active in standardization invest more in innovations and realize their innovations with higher success.[1] This correlation, however, does not necessarily imply that participation in standardization positively affects the innovativeness of companies. Rather, innovative companies could be more likely to become active in standardization. In order to define directions and sizes of effects, companies' activities have to be observed over a longer period of time.

Inspired by the innovation survey carried out among EU Members by the European Commission which started in the early 1990s, the DNP generates a comprehensive collection of empirical data containing a large amount of information on businesses, which can be used for the exploration of central issues in standardization research.[2]

Goals

The data generated by the DNP forms a basis for scientific research on the standardization activities of companies, the implementation of standards, and the effects of standards on entrepreneurial success. The survey results can also be used to develop strategies for the involvement in European and international standardization, as well as to articulate national business interests, among others, towards the European Commission.

An additional goal of the German Standardization Panel is to address current standardization policy issues and to evaluate measures taken. The last survey waves addressed the role that standards and standardization play in the trade with the United States and China, as well as the consequences of digitalization and digital networking on formal and informal standardization. In addition to that, the data allows for the identification of new trends.

Finally, the panel raises awareness of the importance of standardization for businesses which have not yet used formal standards or have not yet been active in standardization, thus motivating and encouraging increased participation. This requires a wide dissemination of the survey results via reports such as this one.
The DNP is designed to help achieve these goals of standardization research, policy, and promotion.

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[1] In Blind, K. and Rauber, J. (2013): Normung als attraktive Plattform für innovative Unternehmen. In: DIN-Mitteilungen December 2013, pages 26 – 29, a positive correlation between innovation and standardization is shown based on the German Community Innovation Survey.

[2] This is a reference to the panel based on the EU's Community Innovation Surveys (CIS), which repeatedly interviews the same companies about their innovation activities, successes and problems.

Heuristic model

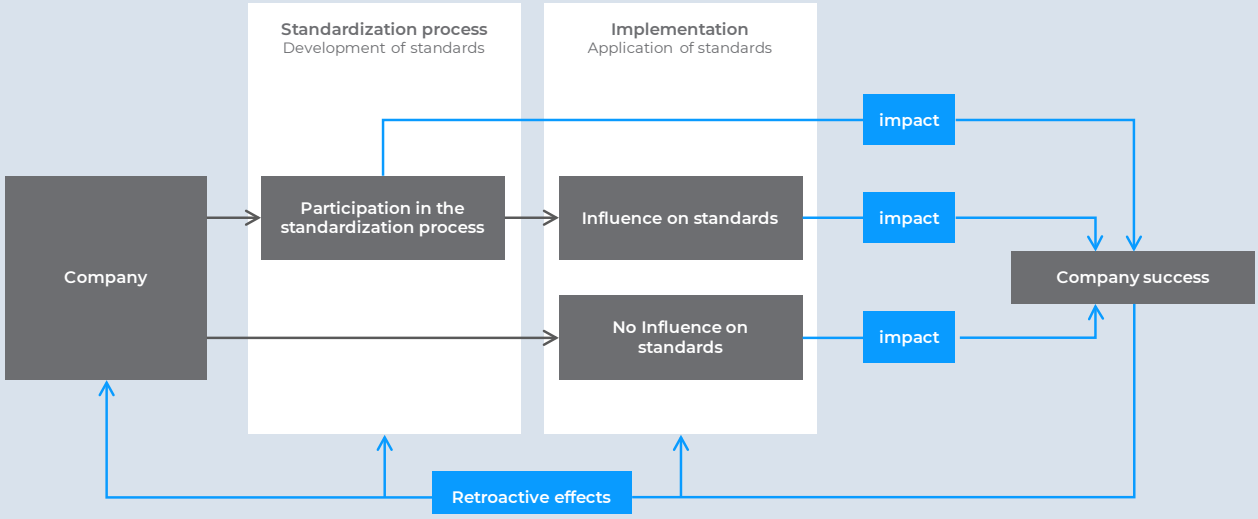
Questions asked in the annual survey fall into two categories: core questions and questions related to a specific subject. The core questions are conceptually based on a heuristic model (see figure 1). This model is comprehensive, allowing for the integration of a broad array of topics and questions. It illustrates the multidimensional links between participation in the standardization process, the implementation of formal standards and corporate success.

The survey measures standardization activities in dimensions that describe their nature and scope, e.g. time required, necessary human resources, participation in standards committees, etc. The implementation of standards is reflected in dimensions of cost and benefit. Apart from this, the DNP's long term goal is to assess the impact of standardization, as well as the application of standards on business success.

A number of questions can be asked in this context: Does participation in the standardization process increase the success that is achieved through the implementation of formal standards? Does standardization have a direct impact on corporate success or is the impact indirect, e.g. through networking opportunities? Which dimensions of success are influenced by standardization? Do insights gained by participating in standardization mainly apply to those self-developed standards, or is there a more general learning process? What does this learning process look like? How do company-specific characteristics influence company success through standardization work? Does the impact of standardization work vary depending on industry or company size?

The waves of surveys from 2013–2015 provided initial evidence to answer the last two questions, the more complex questions, e.g. regarding learning effects, however, can only be answered through an analysis over a period of time, which includes a measure for business development.

Figure 1 Heuristic model of the German Standardization Panel



Realization

The fifth survey wave of the Germany Standardization Panel was launched on October 14, 2016, World Standards Day. The DNP is a project of the German Society for the Promotion of Research on Standardization (FNS) and is conducted by the Chair of Innovation Economics at the Technische Universität Berlin. For the first time, the Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie, BMWi) has thankfully accepted the patronage for the DNP in 2016. By doing so, the BMWi is emphasizing the significance of standards not only for companies but for the economy as a whole.

1,076 of the 19,677 experts contacted participated in this year's survey, corresponding to a response rate of 5 %. The rate's decline has several possible reasons: First, the list of active experts provided by the DIN and DKE, which constitutes the core contacts for the DNP, has been strongly reduced. To make up for this fact, the list of contacted experts was expanded further by including contacts from other industries, as well as addresses obtained through official websites. These additional contacts from the public sector, unions, and associations as well as standardization and research institutes have a much lower response rate of about 3 %. The lower rate possibly reflects a lower significance of standardization in those industries or can be explained by the potentially arbitrary selection of contacts through websites. In contrast, those experts who responded to previous surveys had the highest observed response rate. We thus argue that the reduction is not likely to primarily arise from declining interest of long-term participants, but rather from the transition to a more extensive share of mandatory questions. This adjustment, however, generated an increase in the average rate of responses per question (856), almost reaching the level of the most responsive year. The comparability across participants is further enhanced, as information for all core questions was obtained for all participants. More robust statistical analyses can be conducted as a result. Future surveys will thus aim at a stable relationship between the number of participants and the quality of responses.

As in previous years, 58 additional responses to a brief version of the survey could be by addressing clients of Beuth Verlags GmbH. Combined with the responses of the DNP, the dataset for the year 2016 includes 1,089 experts and representatives of companies. About 65 % respondents answered from the perspective of a company or business group and about 35 % as experts of the particular industry. The majority of the participants works in the fields of research and development, quality management, standardization, or senior management.

This report also summarizes results from the panel dataset that combines data from the last four survey waves. In order to increase the consistency of response behavior, responses in multiple years by the same participants are desirable when constructing the panel dataset. The current panel data set includes 1,244 companies who participated at least in two of the last four years. The balanced sample contains 141 companies who responded in all four years. Based on these unique data, insights into the development of standardization behavior and the application of formal and informal standards over time can be gained.

Composition of the sample in 2016

In the following report, industry affiliation[3] and company size serve as criteria for structuring the results and identifying particularities. The distribution of company characteristics is similar to previous years, confirming the composition of the sample. The greatest share of participants is located in the service industry. Further, the electrical and the mechanical engineering industry as well as the automobile and the construction industry are most represented. Participants of the information and communication industry, as well as the agriculture and mining industry are least represented.

Of the 669 companies for which information on the numer of employees was collected, the majority falls into the range of 50 to 1,000 employees. About a third are large companies with more than 1,000 employees. 168 responses (25%) were obtained from companies with 50 or fewer employees. Information about companies conducting innovation and research were obtained from 924 experts. Half of the companies conducted process- as well as product innovations. The share of companies not innovating at all however rose to 20 % compared to previous years. Internal and external research is widespread among the participants. Only 27 % stated not having conducted any research in 2015. The majority of participants is furthermore exporting goods and services. In 2016, about 40 % stated that exports contribute to more than half of their revenue.

[3] Industries according to the classification by the Federal Statistical Office of Germany, 2008 edition. Klassifikation der Wirtschaftszweige, Ausgabe 2008 (WZ 2008), Statistisches Bundesamt.

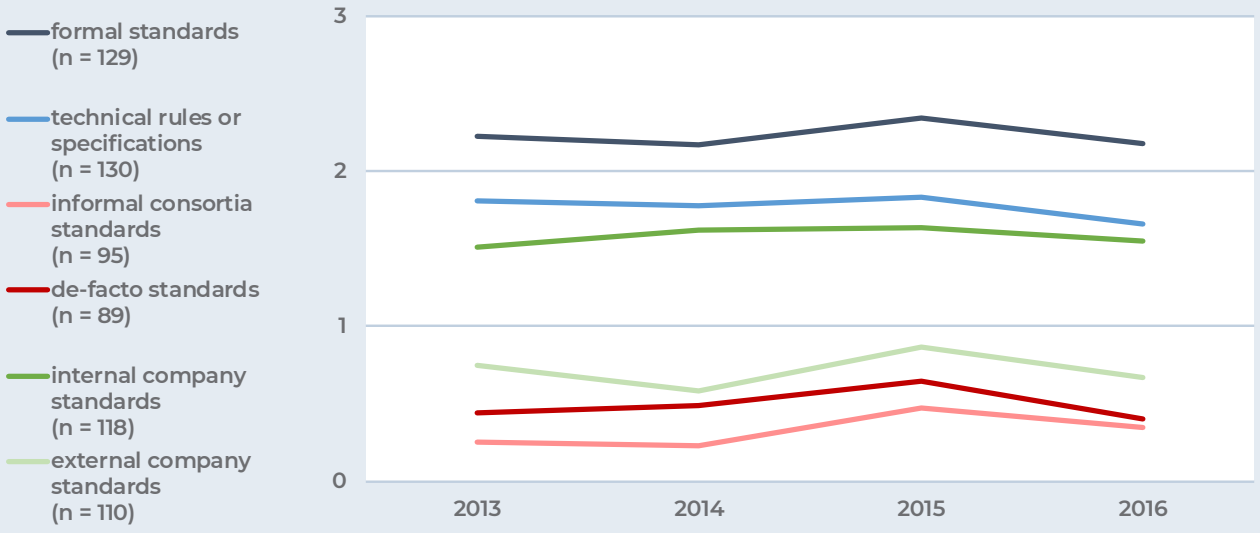
THE IMPORTANCE OF STANDARDS AND SPECIFICATIONS

Continuing trend towards higher significance of consortial standards

The first core section of this year's survey addresses the general relevance of standards for companies of different industries. The survey distinguishes between six types of standards on different regional levels, namely formal standards, technical rules or specifications, informal consortial standards, de-facto standards as well as internal and external company standards. In general, participants rate European standards as most significant. Figure 2 shows the average importance of the six types of standards for companies responding in all four years. Formal standards, followed by technical rules and specifications represent the most relevant standards as seen from the experts' perspective. These standards are also the most implemented. This observation holds along different industries and level of innovativeness. There however exists a slight correlation between a company's size and its stated relevance of formal standards.

Figure 2

Developments in the average score of relevance of different types of standards (balanced sample). On a scale from –3 (not important at all) to +3 (very important)

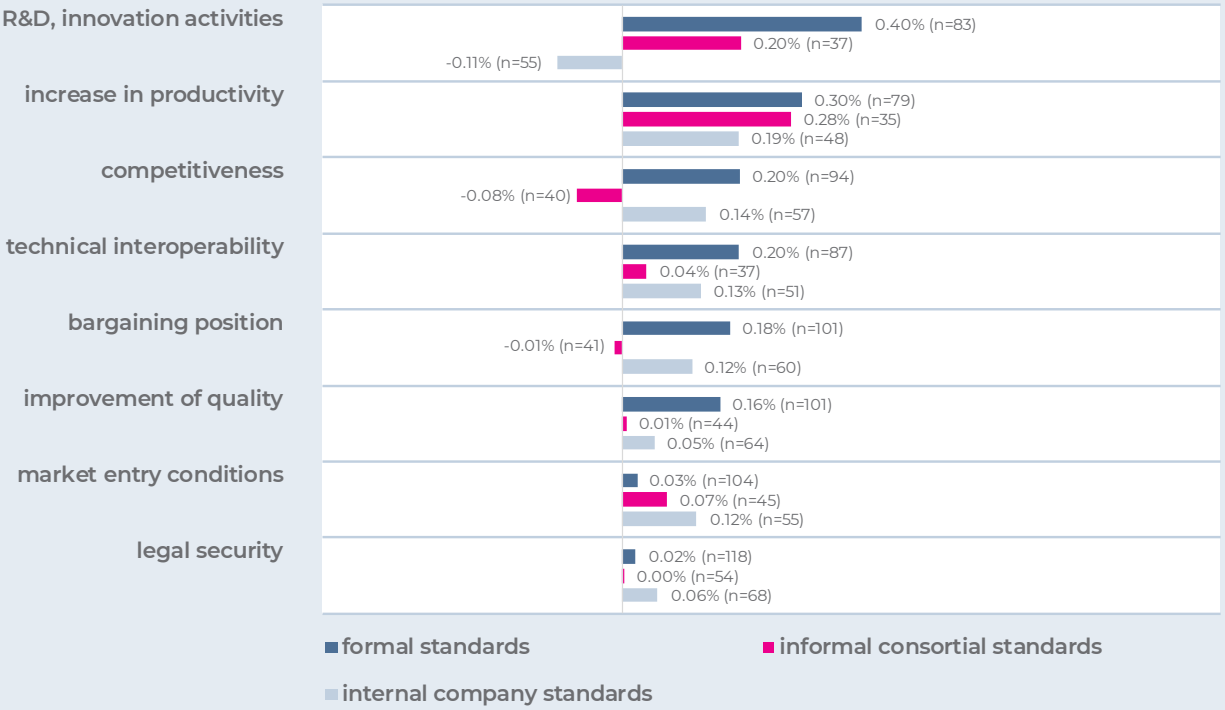


Formal standards and technical rules and specifications are closely followed by internal company standards. These are of particular importance for more innovative companies and for companies operating in the automobile and the metal industry as well as in the chemical and pharmaceutical industry. Internal company standards are most relevant in regard to quality improvements and bargaining position towards suppliers and customers.

External company standards, de-facto standards, and informal consortial standards are generally considered less important and are being implemented in lower numbers. These standards tend to be of higher significance for larger enterprises that are part of multinational business groups. Consortial standards are more relevant for companies engaged in research activities.

Figure 3

Relevance of standards for factors of company success (balanced sample). Average of all years .



The importance of standards does not experience great fluctuations over time. However, analyses show that participants overall responded more positively in 2015, leading to the impression of a general decline of the relevance of standards from 2015 to 2016. Considering the developments over all four years instead, a different picture emerges: National formal standards experienced a slight reduction of their significance, while international standards became more relevant. There was furthermore a marginal decline of the importance of formal standards and technical rules and specifications. The generally less important types of standards have gained significance over time. In particular, informal consortial standards became more relevant compared to 2013, mostly due to judgements by companies with up to 250 employees, operating in the electrical and the metal industry. Internal company standards are first and foremost considered more important for companies with 250 to 1,000 employees, slowly converging to the level of large companies. External company standards gained most importance in the medical technology and the optics industry. The overall greater relevance of de-facto standards is mostly generated by smaller companies.

Formal standards and consortial standards are considered more effective over time

In regard to the influence on the realization of company goals, formal standards and technical rules and specifications are considered most effective compared to consortial and de-facto standards, especially for the aspects *legal security* and the fulfillment of formal and informal *market entry conditions*. In contrast to that, *increases in productivity* are regarded to be most positively affected by internal company standards, which in addition contribute to *quality improvements* and *bargaining positions* towards suppliers and customers. Consortial and de-facto standards are of greatest relevance for the realization of *technical interoperability*. Standards are seen as measures to realize company goals mostly by innovative companies, i.e. companies that have implemented new processes as well as product innovations within the previous year.

These results confirm the relevance of internal company standards for successful company-internal processes, while formal standards are first and foremost important for a good performance on the markets. This is in line with previous research that addressed the macroeconomic utility of standardization and concluded that company standards are most relevant for optimizing company-internal processes while formal standards are used to reduce transaction costs. [4]

The panel data set allows for the analysis of changes over time of the assessment of the significance of standards for the realization of company goals. A summary is shown in figure 3. First and foremost, the perceived effectiveness of formal standards has increased, in particular regarding the optimization of research and innovation activities as well as the increase of productivity and competitiveness. The results reflect the rising relevance of consortial standards. Their perceived impact on competitiveness, however, is decreasing over time. The data furthermore indicates that internal company standards are perceived more effective for all factors, except for the optimization of R&D and innovation. In regard to legal security, the impact of standards has remained at the same level.

[4] *DIN Deutsches Institut für Normung e. V. (2000): „Gesamtwirtschaftlicher Nutzen der Normung: Zusammenfassung der Ergebnisse. Wissenschaftlicher Endbericht mit praktischen Beispielen", Berlin, Wien, Zürich: Beuth Verlag.*

CERTIFICATION OF MANAGEMENT SYSTEMS

Trend towards certification of energy management systems is confirmed

The certification of quality and environmental management systems is widely spread among the participants. Companies were asked if they were certified according to DIN EN ISO 9001 (quality management systems), DIN EN ISO 14001 (environmental management systems), DIN ISO/IEC 27001 (Information technology – Security techniques – Information security management systems) and DIN EN ISO 50001 (energy management systems) in 2016, and if yes, in which year the initial certification was acquired.

More than 80 % of experts stated that their company or a typical company of the particular industry was certified in accordance to ISO 9001. This appears to be particularly indispensable for companies in the electrical and mechanical engineering industry. About half of the companies further have a certified environmental management system according to ISO 140001, while few companies are certified in accordance to the ISO 27001 and ISO 50001 standards. Only about half of the participants gave an answer to questions regarding those certifications. While still about a third stated having a certified energy managements systems, certifications for information security management systems were acquired by only about 14 % of the companies. In the automobile, the chemical and pharmaceutical industry as well as in the industries of rubber and plastics production, certifications for ISO 14001 and ISO 50001 are more widely spread. Certifications of information security management systems are most often observed in the information and communication and the automobile industry. The data furthermore indicates that larger companies are more likely to be certified. The certification of management systems is in addition slightly correlated with the degree of innovativeness of companies.

Most companies received initial certifications for ISO 9001 before 2005. Since then, the number of such initial certifications decreased. Certifications for environmental management systems were offered starting 10 years after the introduction of ISO 9001. Most companies thus acquired initial certifications according to ISO 14001 starting in 2000. Certified energy and information security management systems are more novel. However, numbers of initial certifications in accordance to ISO 50001 have steadily increased over the last 10 years. Future surveys will shed light on further developments of this trend.

STANDARDIZATION ACTIVITIES

Participation in consortia complementing formal standardization is increasing

A further important aspect of the DNP survey is the investigation of company involvement in standardization activities. The extent of external standardization work is captured by the frequency of participation in formal standards bodies and informal consortia on different regional levels. 947 experts answered questions regarding their participation in standardization organizations on different regional levels (e.g. DIN and DKE on the national level, CEN and CENELEC on the European level as well as ISO and IEC on the international level). Only about 10 % state that their company or a typical company of the industry is not involved in any of the formal standardization institutes (Figure 2). The high participation rate in activities of national standards organizations is consistent with the survey's focus on companies that are engaged in standardization. Companies are first and foremost participating in standardization processes on the national level. Involvement in European and international standardization organizations is lower across all industries. This is most likely a result of the national delegation system where national committees send delegates to participate in European and international mirror committees. 40 % of experts are active in committees on all regional levels, those mostly employed in companies with less than 1,000 employees. 22 % of participants state only to be involved in national standardization activities. About 21 % are additionally participating in European and international committees. The data furthermore includes 110 responses of experts only active on a supranational level. Larger and more innovative companies tend to participate more often in standardization organizations on national and supranational committees than smaller and less innovative companies. No such differences can be observed across industries. In general, most of the participating companies still make use of the opportunity to influence and steer the standardization process through participation in the standards committees of official standards organizations.

When additionally considering the participation in consortia, it becomes apparent that the majority of companies is involved in standardization committees as well as in consortia. About 20 % of the companies are only participating in formal standardization processes and only 1 % is only being active in consortia. These results reflect the fact that the information and communication industry, which is strongly engaged in consortia, is underrepresented.

Involvement in formal standardization has remained steady over time. In contrast, as can be seen in figure 4, companies are increasingly participating in consortia since 2015. This transition happened surprisingly sudden. As it is also observed for experts who responded in all years, this development cannot be attributed to the changing composition of the sample. Future surveys will show whether the tendency of formal and informal standardization as complements will last.

Benefits of standardization due to type and number of users and the influence on regulation

This year—for the first time—experts were asked to estimate how certain criteria influence the decision for participating in committees compared to consortia. Figure 5 depicts the most important criteria for involvement in committees and in consortia measured by the share of experts considering these beneficial. Participation in standardization committees is mainly motivated by types and a greater number of users as well as by the potential influence of formal standards on regulation. In contrast, the speed of processes, the decision-making process (majority vs. consensus) as well the capability to solve technical problems give main reasons for the decision to participate in consortia. The speed of processes, the use of open source mechanisms and the costs for documents are, however, the only criteria perceived to be more beneficial in consortia. Main reasons for being involved in committees also include positive experiences in the past and personal contacts.

Slight increase of companies with standardization departments

The high number (about one third) of participants stating that their company has an independent standardization department reflects the high significance of standardization activities. Responsibilities of such departments include internal and external standardization as well as technical regulation and quality managent. Such departments are most common in the automobile industry as well as in the electrical engineering and the mechanical engineering industry. Companies of the chemical and pharmaceutical as well as the information and communication industry have the lowest share. As expected, the share of companies with an independent standardization department is higher among larger companies than among smaller companies.

Figure 4

Development of the share of companies that are active in the national standardization process.

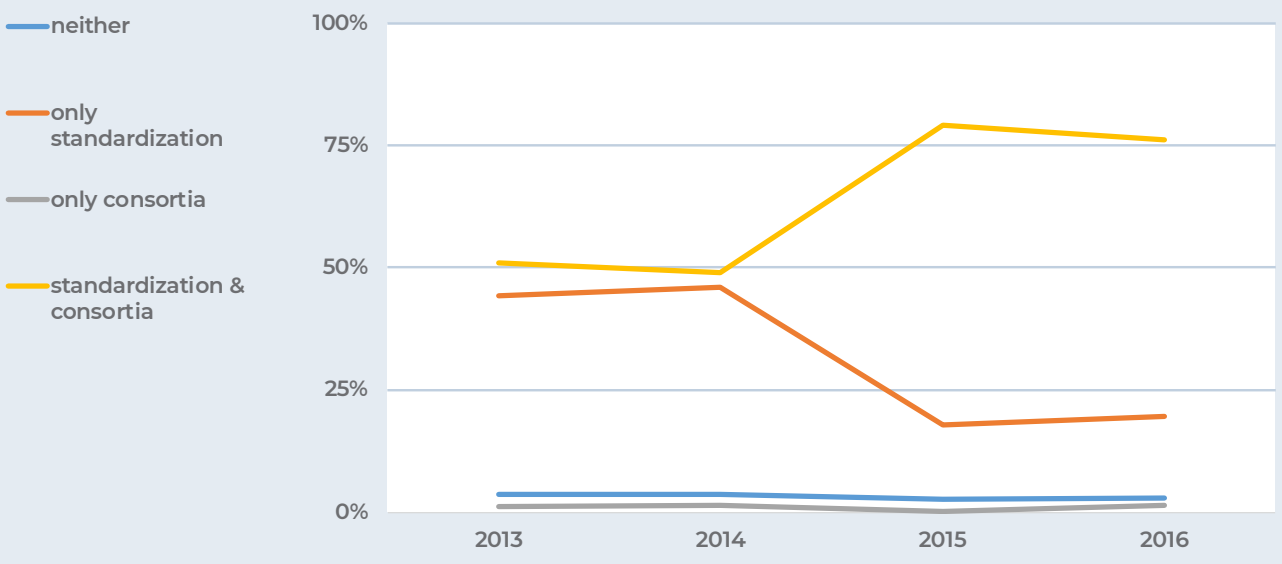
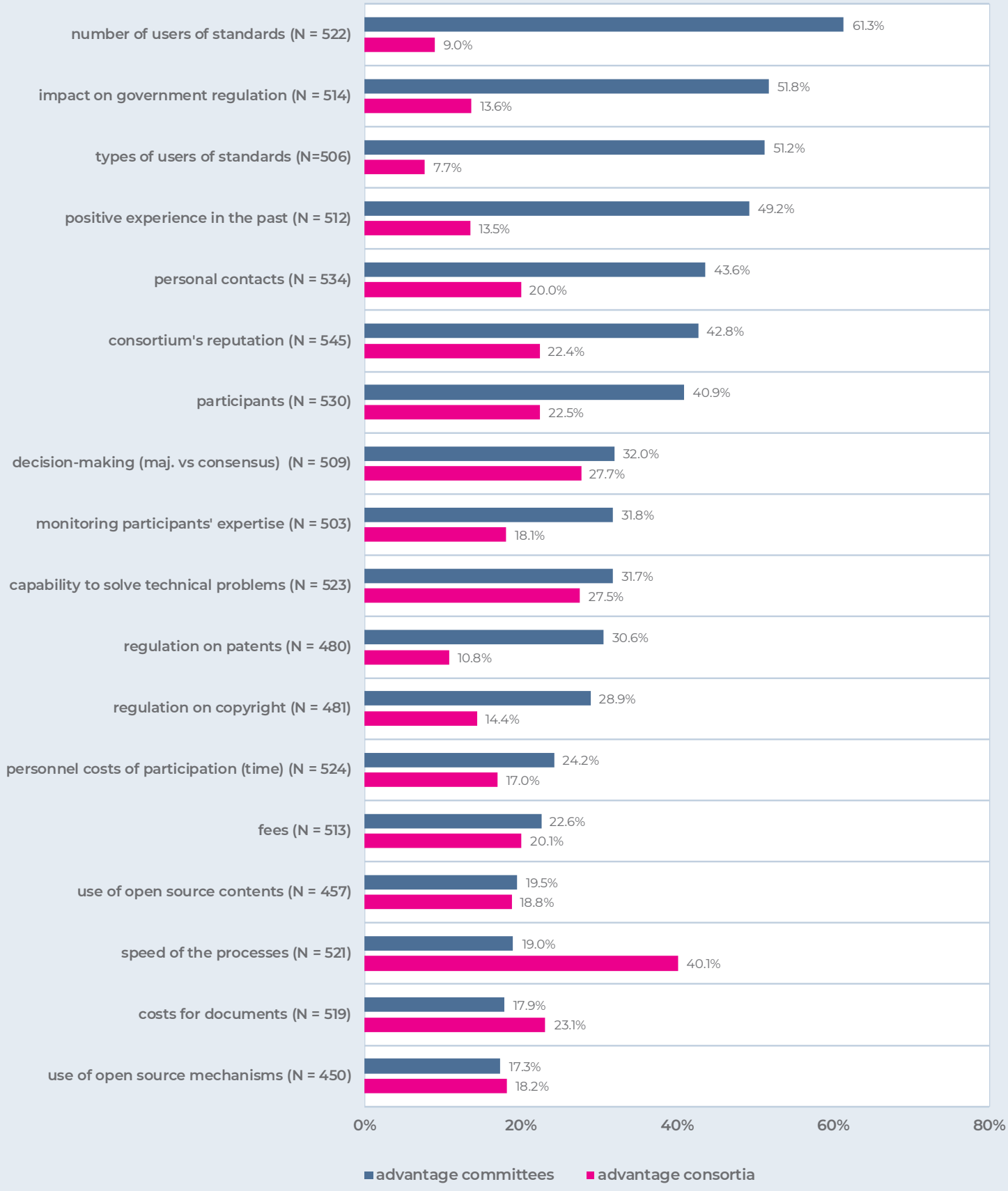


Figure 5

Share of participants that consider the respective criteria beneficial for an involvement in committees and consortia.



STANDARDIZATION IN THE CONTEXT OF INDUSTRY 4.0

"Industry 4.0" is seen as one of the most relevant aspects of digitalization. The German survey "Innovationserhebung 2016" [5] revealed that most companies already use or plan to implement digitally connected production, logistics or service facilities, as well as networks involving customers and suppliers. Moreover, the study finds evidence that mainly legal and IT aspects but also uncertainty regarding future technical standards are considered as the main barriers to enhanced digitalization.

In order to provide more detailed insights into the relevance of standards in times of digitalization, the subject was already addressed by the DNP survey in 2015. This year's survey continues to investigate the importance of standards and focusses particularly on their relevance in the context of Industry 4.0.

The results of the DNP survey in 2016 include novel findings regarding the current situation and future needs concerning the development and the establishment of standards in all areas of Industry 4.0.

The relevance of Industry 4.0

Only about a third of the experts state that Industry 4.0 is already of importance to the company or the industry in general. The information and communication industry, the mechanical engineering and the automobile industry consider Industry 4.0 as highly relevant. Overall, about 43 % claim that Industry 4.0 will be of importance in the future mostly by companies operating in the metal industry and in the agriculture, the mining, and the construction industries. The remaining fourth of experts do not regard this subject to be of any relevance for their industry. Particularly the consumer goods and the construction industry as well as the chemical, the pharmaceutical, the rubber, and the plastic industry are represented in this fourth.

There furthermore seems to be a tendency of Industry 4.0 of being more important to larger and more innovative companies. The results indicate that the subject becomes important earlier on for those companies participating in the standardization process.

The 329 experts who consider Industry 4.0 as relevant for the company and the industry were asked subsequent questions of the special section which address the need for standardization, the participation in consortia, and the implementation of consortial standards in areas of Industry 4.0.

The following fields of Industry 4.0 were differentiated which were adapted from the "Roadmap of Industry 4.0" [6] published by DIN and DKE: "foundations (semantics, processes, models)", "inspection, measurement, and diagnostics", "interfaces and compatibility", "security and safety", and "quality".

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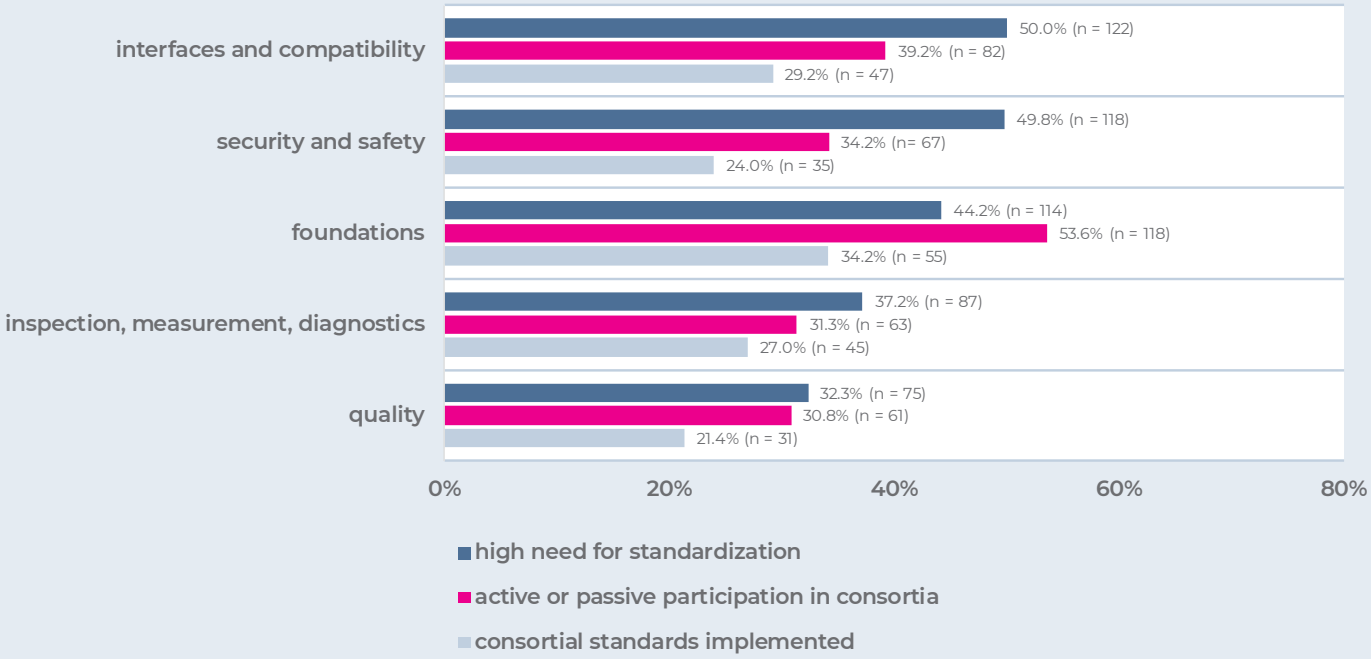
[5] Zentrum für Europäische Wirtschaftsforschung GmbH (ZEW) (2017): „Indikatorenbericht zur Innovationserhebung 2016", Mannheim.

[6] DIN/DKE (2015): „Deutsche Normungsroadmap Industrie 4.0", Berlin, Frankfurt.

Figure 6

Share of participants who state a high need for standardization in the respective fields and who participate in consortia and implemented consortial standards. Category "don't know" was excluded.



Participants gauge high need for standardization in fields "Interfaces and compatibility" and "Security and safety"

The participants were able to estimate the magnitude of the need for standardization in the fields of Industry 4.0 on a scale from 1 (no need) to 4 (high need). As can be seen in figure 6, the participants' need for standardization is greatest in the areas of *interfaces and compatibility* as well as *security and safety*. About 40 % of the experts state that there is a high need for standardization in these areas. *Interfaces and compatibility* seem to be of importance particularly for companies operating in the service industry, mechanical engineering, and the information and communication industry. The issue *security and safety* is most relevant for companies in electrical engineering and the construction industry. Still, 37 % of the participants state a high need for standardization in the field of *foundations*—mostly for companies in the consumer goods, the chemical, and the pharmaceutical industry. In the area of *inspection, measurement, and diagnostics* as well as *quality*, the need for standardization is lowest. The latter is regarded most relevant for participants employed in the medical technology, the optics, and the automobile industry as well as in the power and water supply industry.

A comparison with regard to company size shows that the need for standardization is generally greater for larger companies. Only in the field of *interfaces and compatibility*, the greatest need for standardization is stated by medium size companies, that is companies with 50 to 250 employees.

Participation most common for basics standardization

The special section furthermore capture the extent to which companies participate in consortia and to which they implement consortial standards in the respective fields of Industry 4.0. The participation in consortia with the aim of addressing *foundations* (semantics, processes, models) is most common, stated by about 38 % of the companies—most of the implemented standards also fall into this category. The results indicate that *basic* standards have already been established, and the focus now shifts towards *interfaces and compatibility* and *security and safety*. The shift towards these fields is not only reflected in a stated high need, it also shows in an increasing level of corresponding participation in consortia. Participants in contrast most rarely participate in the field of *quality*. Consortial standards concerning *inspection, measurement, and diagnostics* are implemented by relatively high share of experts.

With the exception of "foundations", there is a positive correlation between the need for standardization and the level of participation in consortia. In particular smaller companies are less active in consortia than larger companies. The data furthermore reveals that a large share of experts chose the category "don't know". Most participants answered the question about the need for standardization. However, about a third of the experts does not give an answer to questions about participation in consortia in the five fields and almost half indicate a lack of knowledge with respect to the implementation of consortial standards. In general, the share of experts which are not capable to answer these questions tends to be greater for larger companies.

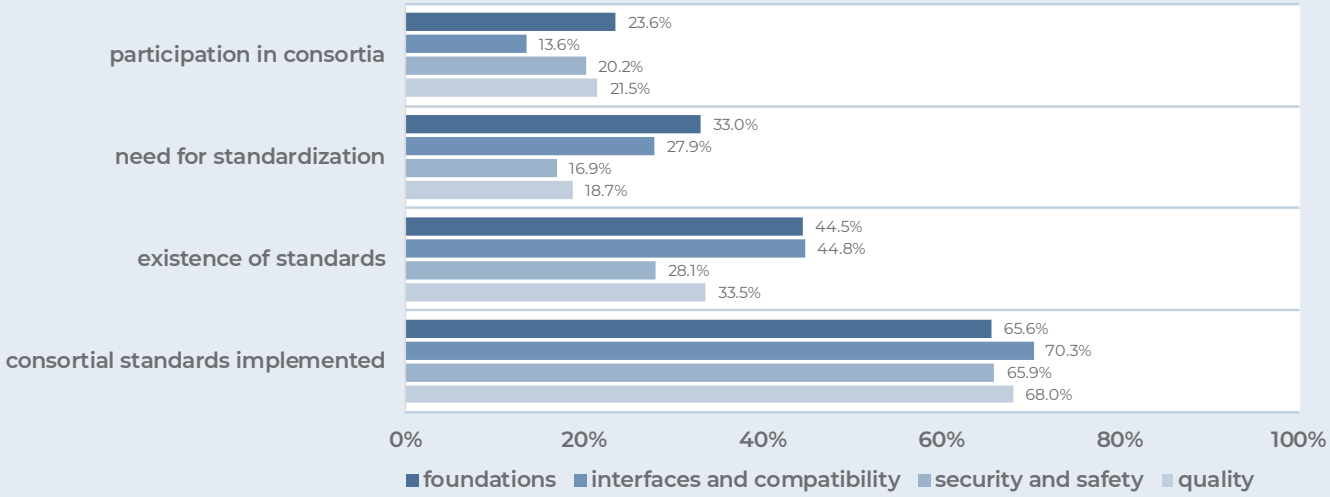
In-depth questions indicate a lack of knowledge

All fields were split in four sub-fields, namely the *existence of standards*, the *need for standardization*, the *participation in consortia*, and the *implementation of consortial standards*. A large share of the participants chose the category "don't know" in particular for the question of the implementation of consortial standards (figure 7). Most of these responses reflect a general lack of knowledge regarding the subject. As a result and combined with the overall low response rate for this question, the number of observations available is reduced to 25. For this reason, the findings for the implementation of consortial standards may not be conclusive. For all other questions between 76 and 140 observations were available, yielding more substantial conclusions.

The field "foundations" was split into eight sub-fields—the results are depicted in figure 8. About half of the experts agree on the existence of standards for *technical-organizational processes* and *industrial automation and information-oriented control technology*. Most participants estimate the need for standardization in these fields to be greatest and have further implemented most consortial standards. The level of participation is highest for consortia working on *reference models*. Only about 25 %, the lowest number of participants, states that there are standards dealing with *characteristics, semantics and ontologies*. At the same time, a similar number (about 25%) estimate the need for standardization in this sub-field to be high which is also reflected by the relatively a high level of participation in respective consortia. The fewest experts have participated in consortia addressing the subfield "*terminology of non-functional characteristics*".

The field "*interfaces and compatibility*", for which most participants expect to have the highest need for standardization, consists of nine sub-fields. As can be seen in figure 9, about 75 % state the existence of standards in the sub-fields "*system(-standards)"* and "*network management"*. Most participants state a high need for standardization in the field of *interoperability between systems*. In this sub-field the level of participation is highest. The areas "*infrastructure management*" and "*location management*" are estimated to be least relevant.

Figure 7 **Average number of participants not responding to the questions.**



Knowledge about the existence of product and process security standards most widespread

The in-depth questions about *security and safety* indicate that participants have the greatest knowledge of existing standards in this field. Only 14 % state the opposite and the share of the category "don't know" is lower than in all other fields. Mainly standards for *product and process security* and *electromagnetic compatibility* were established. The latter were implemented according to 88 % of the participants for which responses were obtained. Most experts further estimate the need for standardization to be high in the field "*information security*", for which the average participation rate of 15 % is comparable to the field "*foundations*". Participants are most commonly active in consortia in the area of *product and process security*. "*Reliability and robustness*" is in the last place for all questions.

Finally, the aspect of quality in Industry 4.0 was examined. Most participants state that standards for *verification and quality management of developed components* (72%) and *quality management of software for production facilities* (71%) exist. A high need for standardization, participation in consortia, and the implementation of consortial standards are indicated in the sub-field "*quality of data and data processing*". Least emphasis was put on *maintainability and maintenance*.

Share of participants responding “yes” to the existence of standards, a high need for standardization, the participation in consortia, and the implementation of consortial standards in sub-fields of…
Category “don’t know” was excluded.

Figure 8 Foundations

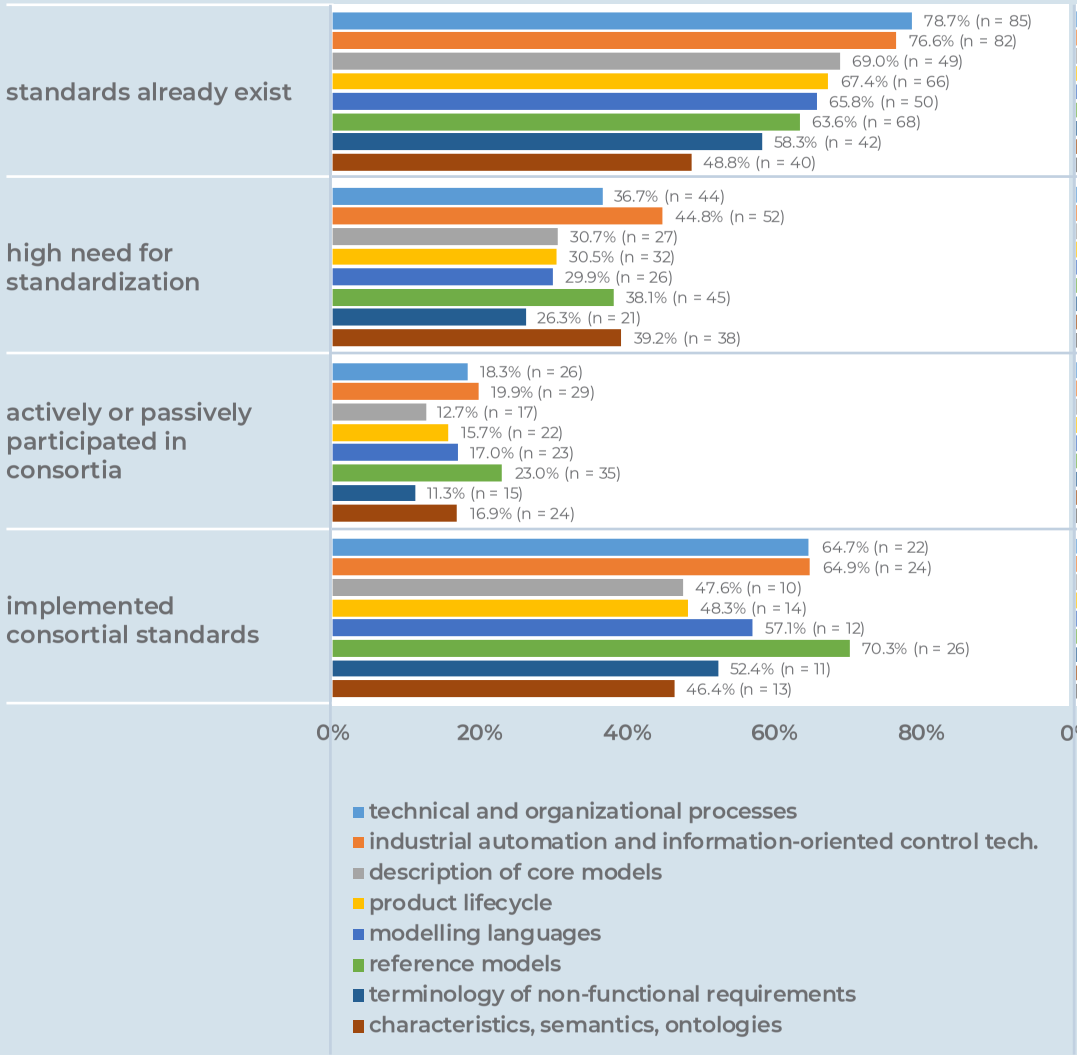
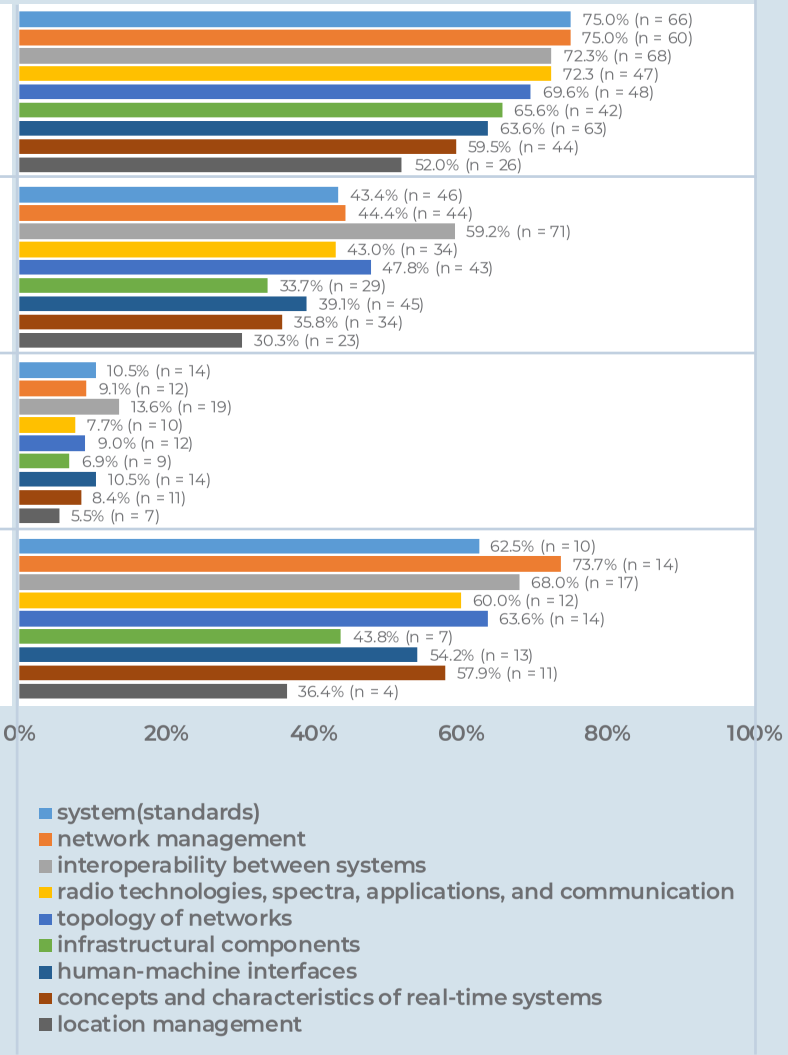


Figure 9 Interfaces and Compatibility



CONCLUSION

Central findings of the fifth round of the German Standardization Panel

The results of the 2016 survey of the German Standardization Panel and its connection with preceding waves of the survey validate the last years' findings. They also confirm initial trends and yield new insights into the development of standardization activities over time.

Formal standards, technical rules, and specifications developed by formal standardization institutes are by far the most important types of standards for the responding companies. These standards mostly serve to ensure *legal security* and to fulfill formal and informal *market entry conditions*. The third spot is taken by internal company standards which are of particular importance for larger companies, in order to achieve *increased productivity*. External company standards, de-facto standards, and informal consortial standards are generally considered less relevant. These types are especially essential for larger and more innovative companies that are part of multinational business groups. Consortial standards are further more important for companies strongly involved in research activities.

The significance of national formal standards as well as technical rules and specifications has slightly decreased from 2013 to 2016. In contrast, the importance of all other types of standards has increased.

DIN EN ISO 9001 certifications are widely spread among survey participants. However, the number of initial certifications has fallen since 2013. This tendency shows also for according numbers of *environmental* management systems. Conversely, initial certifications of *energy* management systems have become more widespread.

While the number of participants in formal standardization committees has remained steady, companies are increasingly participating in consortia since 2015. For the first time, experts were asked how certain criteria influence their decision to participate in committees compared to consortia. All in all, participants are considering formal committees more beneficial than consortia in regard to most criteria. Advantages of consortia merely include the *speed of processes*, the use of *open source mechanisms* and the *costs of documents*.

The high relevance of standardization work is further reflected by the increasing share of companies that have established independent *standardization departments*. Responsibilities of those departments are first and foremost internal and external standardization activities, but also technical regulation.

This year's special section addresses the role of standards in the context of Industry 4.0. Only a third of the participating experts state that Industry 4.0 is relevant to the company or the industry.
The general need for catching up in digitalization and Industry 4.0 that has been identified by other studies also applies to standardization. While the existence of standards in relevant fields could be confirmed, there is still a high need for fur-

ther standardization, especially for assuring an adequate level of interoperability. This need is reflected in an increasing level of participation in relevant consortia—a trend that has been visible in DNP data for the last two years.

The results however also underline that information on standardization in the area of Industry 4.0 should be further promoted by the relevant institutions. A lack of information is displayed even by experts, who show a high degree of uncertainty about the existing supply of standards and the need for further standardization. The observed uncertainty about the actual state of implementation of consortial standards indicates a growing fragmentation of the standardization landscape which might confront companies as well as standards setting organizations with great challenges.

SURVEY DETAILS

The fifth wave of the German Standardization Panel took the form of an online survey carried out in autumn 2016 with the support of DIN and several industrial associations. The survey itself and the data analysis and preparation were conducted by the Chair of Innovation Economics at the Technical University Berlin.

To present representative results for the companies involved in standardization, the results of the survey are being compared to DIN's data on companies active in standardization. In the medium term, data from the innovation surveys commissioned by the German Federal Ministry of Education and Research since the 1990's, and from the survey on the research and development of economic statistics by the Stifterverband für die Deutsche Wirtschaft are being used to complete the picture. The project was initiated in the context of the foundation of the German Society for the Promotion of Research on Standardization (FNS) and will be funded and guided by the FNS.

For the next surveys, it will be important to motivate previous participants to take part in subsequent survey waves in order to establish a useful panel structure. Finally, other businesses will need to be encouraged to participate in further surveys, in order to gain a wider, more representative data base.

Catalogue of questions

The goal of the German Standardization Panel is to measure not only the expenses and effort of companies invest in standardization, i.e. the activities in standards organizations, but also their utilization of the results of this work, that is, the application and implementation of standards and specifications. The questionnaire was divided into four sections:

1. Importance of formal and informal standards and specifications
2. The role of standardization in the context of Industry 4.0
3. Formal and informal standardization activities
4. General information on participating businesses

GLOSSARY

Formal standardization

In Germany, "formal" national standardization (also called "full consensus standardization") is defined as the "systematic unification of material and immaterial subjects carried out by all stakeholders working in consensus for the benefit of society as a whole" *(see DIN 820-1:2014-06 Standardization – Part 1: Principles, definition from DIN 820-3:2014-06).* Provisions are laid down with full consensus and are adopted by recognized formal standards institutes (such as DIN German Institute for Standardization and DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE). Formal standardization has a high level of legitimation due to its well-established processes.

In addition, the international and European standards organizations form a network of national standards institutes. DIN's staff administer international and European standardization activities carried out in Germany, ensuring that all rules of procedures and guidelines are complied with. They prepare, carry out and follow up meetings of international and European bodies and of the corresponding German "mirror" committees *(see www.din.de).*

Informal standardization

In Germany, a differentiation is made between "Normung" ("formal", full consensus standardization) and "Standardisierung" ("informal" standardization that is not based on full consensus). The latter process results in specifications, such as the "DIN SPEC", or consortial standards, for example. Usually these are developed by a temporary body or standardization consortium. Full consensus and the involvement of all stakeholders are not required.

National standards organizations

DIN, the German Institute for Standardization, is a privately organized provider of services related to standardization and the development of specifications. By agreement with the German Federal Government, DIN is the acknowledged national standards body representing German interests at all levels, including the European and international standards organizations. DIN's purpose is to encourage, organize, steer and moderate standardization and specification activities in systematic and transparent procedures for the benefit of society as a whole and while safeguarding the public interest. DIN publishes its work results and encourages their implementation. Some 30,000 experts contribute their skills and experience to the standardization process, which is coordinated by 400 DIN employees *(for further information see www.din.de).*

The **DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE** is a modern, non-profit service organization which ensures that electricity is generated, distributed and used in a safe and rational manner, thereby serving the good of the community at large. DKE is the German national organization responsible for developing standards and safety specifications in electrical engineering, electronics and information technology. Its work results form an integral part of the collection of German standards. VDE specifications also form the VDE Specifications Code of safety standards *(see www.dke.de).*

European standards organizations

In Europe, standards are drawn up by the three officially acknowledged European standards organizations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). The national standards bodies of CEN and CENELEC's 33 members work together to draw up European standards, which are adopted by the members at the national level *(see http://www.cencenelec.eu/aboutus/Pages/default.aspx).*

Each country is represented within Cen and CENELEC by one member body. German interests are represented by DIN within CEN and by the DKE at CENELEC. Each DIN standards committee decides on active participation at the European level. This work is supported by a working committee designated as the "mirror committee" to the relevant European body. This committee determines the German position on a particular subject and sends delegates to the European committees to represent this position and participate in the consensus-building process.

ETSI is responsible for drawing up globally applied standards for the information and communications technology (ICT) industry. This includes television and radio technologies as well as the internet and telecommunications. The European Union has officially recognized ETSI as a European standards organization *(see www.etsi.org/about).*

Figure A.1 **Formal standardization at three levels** (Source: www.din.de)

International standards organizations

ISO International Organization for Standardization and IEC International Electrotechnical Commission are private organizations whose members are the national standards organizations. The secretariats of ISO and IEC technical committees are held by these member organizations, who come from all over the world. DIN's standards committees decide on active participation at the international level and on the adoption of an international standard as a national standard. The main bodies of ISO and IEC are the respective general assemblies; other bodies include

policy-making bodies such as the council and technical executive committees, such as the Technical Management Board. Standards work is carried out by national delegations and their experts acting in technical committees, sub-committees and working groups.

Another international body that sets rules is the **ITU International Telecommunication Union**. The ITU is a subsidiary organization of the United Nations, and is based in Geneva, Switzerland. Recommendations of the ITU are developed by government representatives of the 191 member countries and representatives of companies and regional and national organizations. They serve as guideline for legislators and companies in the member countries.

Formal standards

In Germany, formal standards are developed by the standards committees in DIN and DKE with the full consensus of all stakeholders, and are largely recommendatory in nature. However, if they are cited in a law or contract, their use may become mandatory. They "provide, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at achieving the optimum degree of order in a given context" *(definition as in DIN EN 45020:2006 Standardization and related activities – General vocabulary (ISO/IEC Guide 2:2004)).* Standards define the state of the art at the time of their publication, and contain recommended properties, test methods, safety requirements or dimensions, for example *(see www.din.de).*

The most important designations for standards:

– **DIN** – National German Standard

– **DIN VDE** – National electrotechnical German Standards containing safety-relevant or EMV-specific provisions

– **DIN ISO, DIN IEC, DIN ISO/IEC** – German translation of an International Standard published by ISO and/or IEC and adopted, unchanged (but sometimes with national elements such as National foreword or National footnote), as a German standard

– **DIN EN** – Official German version of a European standard. All Europeans standards are to be adopted, unchanged, by the members of the European standards organizations CEN/CENELEC/ETSI

– **DIN EN ISO** – Official German version of a European standard which is the unchanged adoption of an International Standard

Specification (e.g. DIN SPEC)

In Germany, a "specification" such as the "DIN SPEC" is the result of an "informal" standardization process, and describes products, systems or services by defining characteristics and laying down requirements. Like standards, such specifications are developed by experts in formal standards organizations such as DIN. However, they differ from formal standards in that full consensus and the involvement of all stakeholders are not required.

Consortial standards

Like specifications, consortial standards are drawn up in an "informal" standardization process. They are developed on the basis of majority decision by a selected group of companies and organizations taking the form of a "consortium".

De-facto standards

De-facto standards are not developed by specific consortium, but are a consequence of market demand. De-facto standards are also known as "industry standards" and are developed in what is called an "informal" standardization process. All standards drawn up by industrial interest groups are de-facto standards.

Technical rules

Technical associations actively participate in DIN's standards committees in order to represent the interests of their members at the national, European and international level. Some of these associations also draw up their own technical rules *(see www.din.de)*, which contain recommendations on how to comply with legislation, a regulation or an established technical procedure. Although they are not legal documents in themselves, they can become legally binding where cited in a law or regulation, for example in building regulations. Technical rules published by organizations such as VDI, VDMA, VDE are not drawn up with full consensus.

Company standards

Company standards are developed and adopted by companies themselves and or by cooperating businesses (e.g. suppliers). For example, their use can be mandatory for a company's suppliers.

Transatlantic Trade and Investment Partnership (TTIP)

The "Transatlantic Trade and Investment Partnership (TTIP)" is a free trade agreement currently under negotiation that, if agreed upon, will take the form of an international treaty between the USA and the EU.
For further information see http://ec.europa.eu/trade/policy/in-focus/ttip/

Panel survey

A panel survey is a survey carried out among the same economic players (persons or companies) on the same topic and over time.

DEUTSCHER FÖRDERVEREIN ZUR STÄRKUNG DER FORSCHUNG ZUR NORMUNG UND STANDARDISIERUNG E. V.

The German Society for the Promotion of Research on Standardization (FNS) aims at enhancing the significance of standardization by promoting strategic research. Presenting this research in an open German platform helps effectively disseminate results not only at national level, but within Europe and internationally as well. Standardization can thus become established as a strategic instrument that can be used together with research findings, academics and practical application by actors in science, industry, politics and society as a whole.

The Society's activities include identifying trends in research and technology that are relevant for future standards work and monitoring any policy-making that relates to standardization. This ensures that new areas for standardization are identified early on and allows the Society to help further develop the standardization system.

Contact

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