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GERMAN STANDARDIZATION PANEL (DNP)

Standardization Research,
Policy and Promotion

Indicator Report 2016

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GERMAN STANDARDIZATION PANEL 2016

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

SUMMARY

Based on representative data on German companies engaged in standardization and, increasingly, companies that only apply standards, this 2016 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 on aspects regarding standardization policy. In the scope of 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. 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 three survey waves were combined to establish a panel data set. Based on the unique data gathered, insights were gained on changes in standardization activities and the application of formal and informal standards from 2013 to 2015. Due to a low number of observations, data from the pilot study in 2012 was excluded from the panel data set.

The analyses at hand validate last years' results and confirm initial trends. 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 standards work, identified as the top priority for medium-sized and large companies, is reflected by the large number of businesses that maintain specialized standardization departments. Investigations of changes over the years reveal that external standardization activities are of increasing importance for smaller companies, while company standardization activities are of rising importance for medium-sized companies and service providers.

2 Internal company standards are the third most important type of document and considered more relevant than informal consortia or de-facto standards. Internal company standards are applied by the majority of businesses surveyed, especially large and innovative companies. They serve primarily to promote quality and productivity improvements. As compared to the preceding survey waves, internal company standards grew in importance, especially among medium-sized companies and in the service sector. For smaller companies, this type of document still plays a minor role. In contrast, external company standards are of increasing importance for them, in particular for the bargaining position vis-à-vis suppliers and customers.

3 Informal consortia and de-facto standards are mainly relevant for smaller companies at the national level in order to realize interoperability. There is, however, a general trend towards increased participation in consortia, foremost among companies active in formal standardization.

4 ISO 9001 (quality) and ISO 14001 (environmental) certifications are already widespread among survey participants and there is little interest in new certifications in this field. In contrast, ISO 50001 (energy efficiency) and ISO/IEC 27001 (IT-security) certifications are on the rise, particularly in energy and water supplies, as well as vehicle manufacturing.

5 The special section on the "consequences of a digitally networked economy on standardization" reveals that 90% of the respondent companies see positive effects of digitization and digital networking for their business. "Digital Labor" and "Smart Data" are considered the most important topics. "Smart energy" ranks at the very bottom. Companies see data protection, security, management and analysis as the biggest obstacles to a digitally networked economy. In regards to data protection and security, companies express a need for regulation. In contrast, standardization is considered a potential tool to address the need for research, development and innovation and to realize compatibility. The biggest obstacles to the development and implementation of the respective formal and informal standards are too high costs and problems with transnational harmonization.

CREATING AN EMPIRICAL BASIS FOR EXPLORING 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 firms. 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 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 the basis for scientific research on the standardization activities of companies, the implementation of standards, and the effects of standards on entrepreneurial success. The results of the survey 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, vis-à-vis the European Commission.

An additional goal of the German Standardization Panel is to address current standardization policy issues as a means to assess any initiatives taken. The last survey waves addressed the role that standards and standardization play in trade with the United States and China, as well as the consequences of digitization and digital networking on formal and informal standardization. The data thereby facilitates 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 been active in standards, thus motivating and encouraging increased participation. This requires a wide dissemination of the survey results via reports such as this one. The DNP thereby helps to achieve the objectives 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] Concerned here is the panel by Community Innovation Surveys (CIS), that repeatedly interviewed the same companies about their innovation activities, successes and problems.

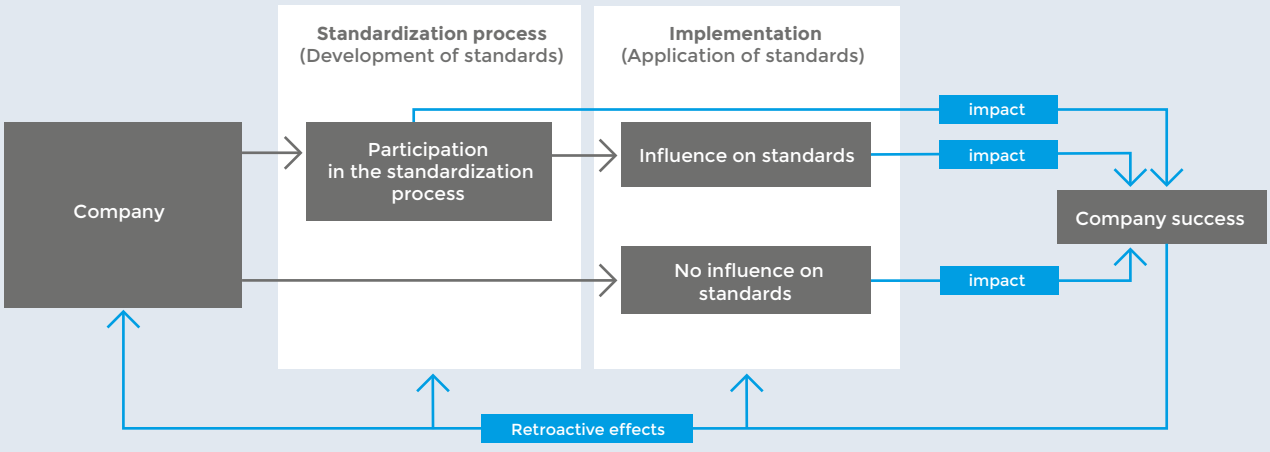
Heuristic model

The annual survey is divided into two sections: core questions and questions related to a specific subject. The core question section is 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. The model also illustrates the multidimensional links between participation in the standardization process, the implementation of formal standards and corporate success.

Standardization activities are characterized by the nature and scope of the work itself, e.g. time required, necessary human resources, participation in standards committees, etc. With regard to the implementation of standards, various dimensions of costs and benefits are determined. Apart from these aspects, which mainly concern the standardization process itself and the implementation of standards, 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 achieved through the implementation of formal standards? Does standardization have a direct impact on corporate success or is the impact indirect, e.g. observable via networking opportunities? Which dimensions of success are influenced by standardization? Do the insights gained apply mainly to those who actively participated in the development of given 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 standards work vary depending on sector 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 analysis of standardization activities, the implementation of formal standards, and business developments over a period of time.

Figure 1 Heuristic model of the Standardization Panel



Realization

The fourth survey wave of the Germany Standardization Panel was launched on October 14, 2015, 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.

Initial results from the panel dataset, constructed by merging data from the last three survey waves, are summarized in this report. Approximately 1,400 of the 10,800 experts contacted participated in this year's survey. This corresponds to a satisfactory response rate of 13%. To increase the consistency of response behavior, it is desirable to have the same person answering over time. Therefore, the 1,200 companies that replied to the surveys at least two times in three years were included in the panel. From the total pool of respondents, 337 companies responded all three 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.

In the following, industry affiliation 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. Companies active in electrical engineering and service providers are still the majority. The latter are mostly active in freelance, scientific and technical service particularly "trade, maintenance and repair of vehicles". The distribution over size classes, operationalized as the number of employees, also remained stable. Approximately 50% of the participants represent companies with more than 250 employees, 25% represent medium-sized (50 to 249) and 25% represent small companies with less than 50 employees.

In an effort to collect another attribute for analyses, this year's survey asked companies to categorize themselves according to degree of digitization. Following the 2014 study by PricewaterhouseCoopers Aktiengesellschaft Wirtschaftsprüfungsgesellschaft on industry 4.0[3], we identified four types: 1) "Digital Novices" or companies that successfully digitized parts of the company, while coordination and strategic alignment of the activities can still be improved, risks are not recorded and compliance is not guaranteed.; 2) "Vertical Integrators" or those that have consistently assigned their product and service portfolios with digital functions along the vertical value chain, whereas horizontal networking is still expandable; 3) "Horizontal Collaborators" or companies that are vertically and horizontally digitally networked, and use standardized methods to manage risk and compliance; and 4) "Digital Champions" that show the highest degree of digitization. Operative and administrative processes are globally networked, virtualized, optimized, and increasingly automated, while operative business focuses on core segments and new, disruptive business models are realized. From these four options, 17% classified themselves as "Digital Novices", 34% as "Vertical Integrators", 34% as "Horizontal Collaborators, and 12% as "Digital Champions".

THE IMPORTANCE OF FORMAL STANDARDS, CONSORTIA STANDARDS AND INTERNAL COMPANY STANDARDS INCREASING IN FIRM SIZE

Relevance of formal standards, informal standards and specifications

The general significance of six different types of standards for businesses is examined. Figure 2 shows that formal standards and technical rules or specifications are the most important factors to participants, closely followed by internal company standards. For companies active in construction, vehicle manufacturing and mechanical engineering, internal company standards are the most important type of standard. Companies active in information and communication consider internal standards rather unimportant. Differentiating by company size (figure 3) illustrates further interesting results: while formal standards are considered very important by businesses of any size, the significance of internal company standards rises in a linear fashion with the number of employees. This is the only type of document whose importance is positively correlated with the degree of digitization. External company standards, as well as consortia and de-facto standards are, in general, considered less important. While there are only minor size-dependent differences regarding consortia and external company standards, de-facto standards are clearly more important for businesses with less than 50 employees. As it would be expected, companies in information and communication state that consortia standards are of high relevance. De-facto standards have the highest relevance for companies in vehicle manufacturing and metal production. External company standards are mostly relevant in construction and chemistry and pharmacy.

Differentiating between various regional levels, it becomes apparent that standards are particularly relevant on a national level, except for formal standards, which are more relevant on a European and international level.

INTERNAL COMPANY STANDARDS ARE GAINING IN IMPORTANCE, ESPECIALLY FOR SMALLER, LESS INNOVATIVE COMPANIES IN THE SERVICE SECTOR

Looking at the development of the average significance of the different kinds of standards over time, a general trend towards the growing relevance of standards becomes apparent. This is especially true for company standards. Still, there are some industry-specific differences. The importance of formal standards has only remained constant in the manufacturing industries. The participants from the service sector rate this type of standards higher than they did in 2013, thereby closing the gap between sectors in 2015. This kind of catching-up process is also observed regarding the importance of internal company standards. The latter became more important for small and medium-sized companies and for less innovative companies. There were indications last year already that technical rules and specifications are losing importance. This trend can now be confirmed.

While smaller companies consider de-facto standards more important and formal standards and consortia standards less important than two years ago, the opposite is observed for bigger companies. Only the relevance of internal standards increased irrespective of number of employees and industry, albeit slightly more for service companies and medium-sized companies.

Figure 2
Developments in the assessment of the general importance of different types of standards from 2013 to 2015.
On a scale from –3 (not important at all) to +3 (very important)

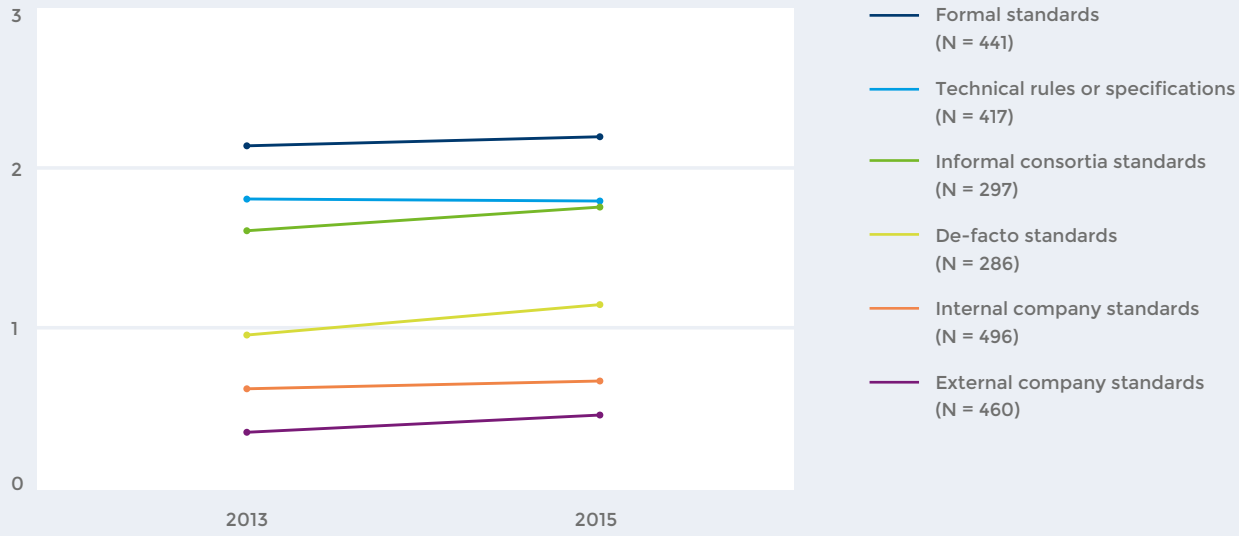
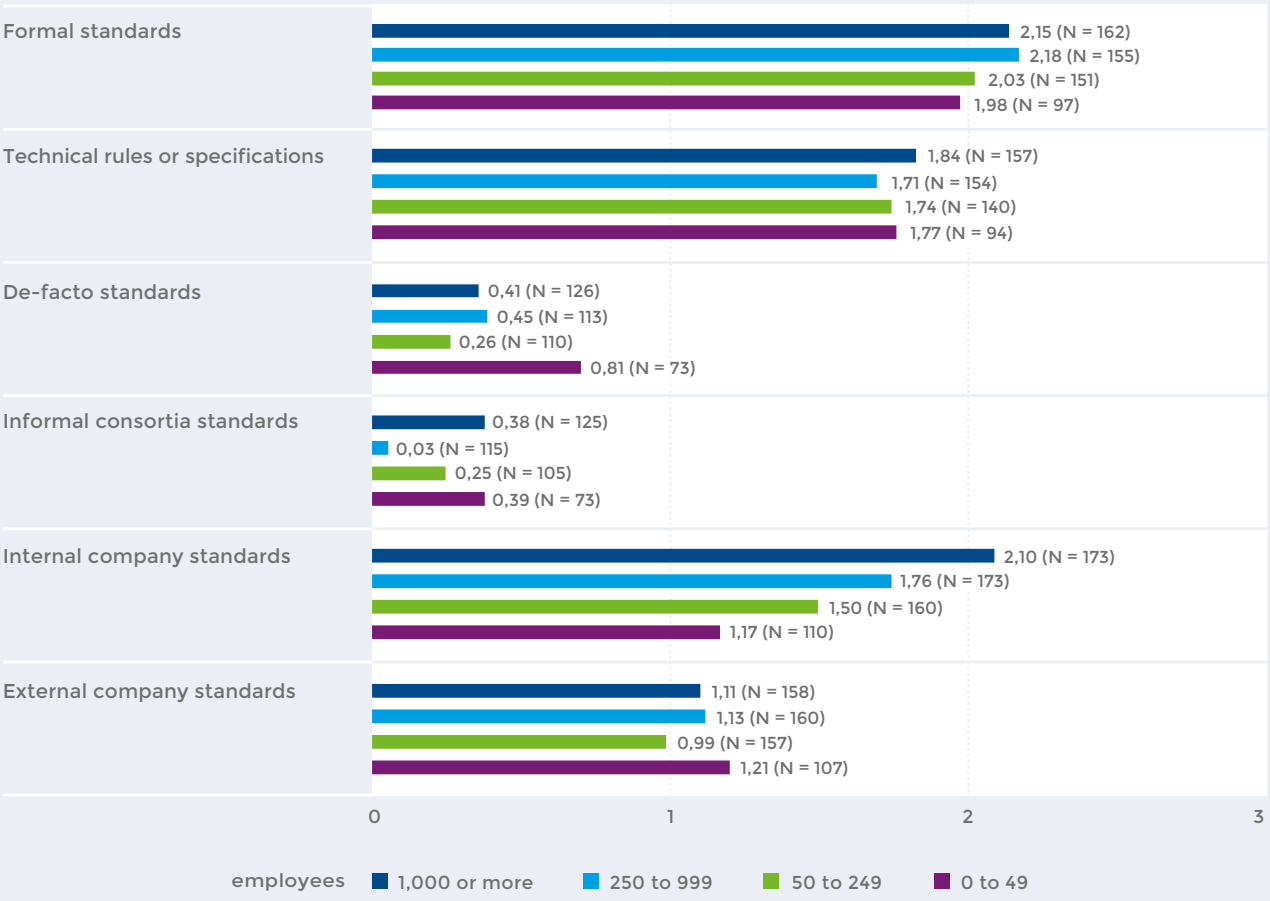


Figure 3

Assessment of the general importance of different types of standards differentiated by size.
On a scale from –3 (not important at all) to +3 (very important)



The results also provide important insights into the relationship between the different types of standards and innovation activities of companies, operationalized as the realization of product and process innovations in the previous financial year. In general, standards are more important for innovative companies. However, in regards to the significance of de-facto standards, no differences between companies that introduced a product- or process innovation and those that did not exist.

Furthermore, the importance of different types of standards is related to the extent of cooperation in research and innovation activities. For example, companies that consider internal company standards relevant maintain more co-operations with non-university research facilities. This is in accordance with the 2015 finding that innovative companies in particular consider this type of standard important. The significance of formal standards and informal consortia standards is, as expected, positively correlated with the amount of cooperation with national competitors. These companies also work more with external consulting firms.

ESPECIALLY LARGE COMPANIES USE STANDARDS TO ACHIEVE PRODUCTIVITY GAINS

In regard to the impact of different types of standards on the realization of various business objectives, the analysis again shows that the survey participants consider the impact of formal standards and technical rules or specifications on nearly all aspects of business success more significant than the impact of consortia and de-facto-standards. Here it is evident that the impact of formal standards is very strong, especially as regards "Legal security" and "Fulfillment of formal and informal market entry conditions". Improvements in quality and productivity and the optimization of research, development and innovation activities are, however, more strongly influenced by internal company standards. The results also underscore the outstanding role that internal company standards play for increases in productivity and it is big companies in particular that use standards for this purpose. Smaller companies increasingly apply external company standards to this end, but also in order to fulfill market entry requirements. Moreover, analyses reveal that standards have a significant impact on the optimization of research, development and innovation activities for companies that introduced both product and process innovations.

These results emphasize the importance of internal company standards for the logistical processes within companies and formal standards for decisive success on the market. Previous investigations concerning the macroeconomic benefits of standardization concluded that company standards improve internal business processes. Formal standards, on the other hand, are the dominant means of lowering transaction costs[4].

NUMBER OF APPLIED STANDARDS RISES WITH NUMBER OF EMPLOYEES AND DEGREE OF INNOVATIVENESS

Application of formal and informal standards and specifications

The great significance of formal standards and technical rules or specifications is also reflected in the number of formal standards applied within companies. Only 0.3% of the companies did not use any formal standards in the past financial year, whereas one third applied more than 100 formal standards. Also, the majority of businesses (approx. 97%) applied technical rules and specifications, with 17% of these companies applying more than 100 such documents. Likewise, almost 90%

[4] *Economic benefits of Standardization – Summary of results. Final report and practical examples. DIN German Institute for Standardization e. V. Berlin; Wien; Zürich: Beuth, 2000*

of the companies applied internal company standards and nearly 80% of all firms applied external company standards, demonstrating the great importance of company standards. The minor significance of de-facto and informal consortia standards is mirrored in the fact that the percentage of companies not using either type is the greatest (30%). Only 1 out of 25 companies implemented more than 100 documents, indicating that there are only few important informal standards.

Further differences in the application of different types of standards can be observed when comparing smaller and larger companies or innovative and less innovative companies. The number of applied standards rises significantly with the number of company employees. This effect is especially pronounced in the application of formal standards. Additionally, the degree of innovativeness is positively correlated with the application of standards, in particular internal company standards. For example, about one quarter of the interviewed companies which introduced neither product nor process innovations in the last year did not use any internal company standard, which is true only for 8% of the companies that introduced both.

STAGNATION OF INITIAL ISO 9001 AND ISO 14001 CERTIFICATIONS BUT TREND TOWARDS CERTIFICATION OF INFORMATION SECURITY AND ENERGY MANAGEMENT SYSTEMS

Certifications: ISO 9001, ISO 14001, ISO/IEC 27001 and ISO 50001

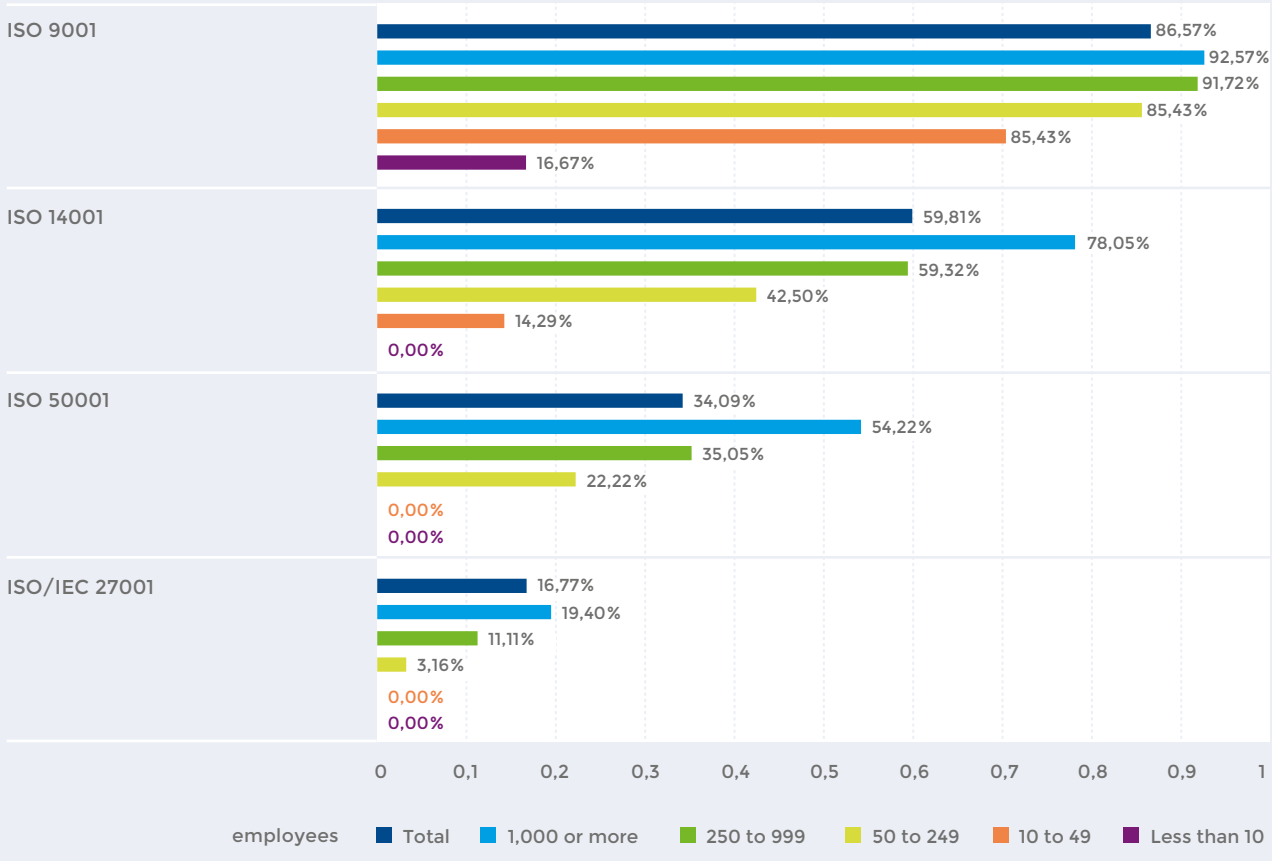
Companies were also asked if they were certified according to DIN EN ISO 9001 (quality management systems), DIN EN ISO 14001 (environmental management systems), DIN ISO/IEC 27001 (Information technology – Security techniques – Information security management systems) and DIN EN ISO 50001 (energy management systems) in 2014, and if yes, in which year the initial certification was acquired. Eighty seven percent of the participants hold ISO 9001 certifications. This appears to be particularly indispensable for companies in vehicle manufacturing (98%) and mechanical engineering (95%). Also, 17% of microenterprises, i.e. companies with less than 10 employees are certified according to ISO 9001 (figure 4). However, none of those companies stated to be certified according to the other standards. Sixty percent of all companies are certified in accordance to ISO 14001. It is again primarily large enterprises in automotive engineering (85%) and energy and water supplies (79%) which are certified. Fifteen percent of the companies with 10 to 15 employees have a certified environmental management system. One third of the companies acquired certification of their energy management system, mainly companies in water and energy supplies and chemistry and pharmacy. ISO/IEC 27001 certification is the least widespread. Only one out of six companies was certified according to this standard in 2014. ISO/IEC 27001 certification is most common among participants that classified themselves as digital champions. Here, one third of the companies is certified.

Furthermore, the survey reveals that most ISO 9001 certificates were first purchased before the turn of the millennium (figure 5). Since then, a decreasing trend can be observed. Certifying environmental management became possible only 10 years later and initial ISO 14001 certificates were mostly acquired after 2000. However, purchases stagnated over the past 15 years also. A more recent trend is the acquisition of initial certifications of energy and information security management systems Those have increasingly been acquired in the last 5 years. Future survey waves will show whether this is a lasting trend.

In comparison to data of the Mannheim Innovation Panel 2015[5], where only 20% of companies acquired certifications for their management systems, these numbers appear rather high. Given that most companies participating in DNP are active in standardization, it implies that those companies have a much higher tendency to be certified than the average German company.

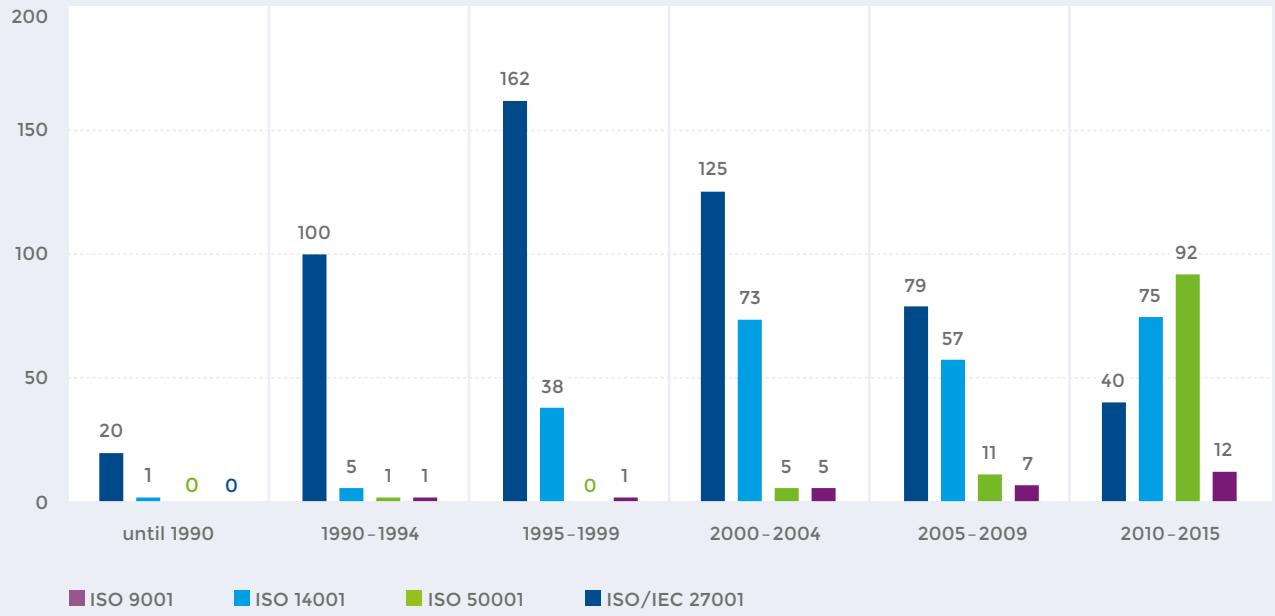
Figure 4

Percentage of companies with certification according to different standards in 2014 differentiated by size



[5] *Rammer, Christian; Schubert, Torben; Hünermund, Paul; Köhler, Mila; Iferd Younes; Peters, Bettina (2016): Dokumentation zur Innovationserhebung 2015, ZEW-Dokumentation Nr. 16-01, S. 104.*

Figure 5 Frequency of initial certifications according to different standards over time



PARTICIPATION IN CONSORTIA ON THE RISE

Standardization activities

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. The high participation rate (98%) in activities of national standards organizations is consistent with the survey's focus on companies that are engaged in standardization. In 2015, nearly 93% of responding businesses were active in the committees of DIN German Institute for Standardization, on average in three. Still, 61% of the responding companies participate in, on average, three committee meetings of DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE. At the European and international level, the rate of participation diminishes across all industries. This most likely is a result of the national delegation system where national committees send delegates to participate in European and international mirror committees. About 40% of the interviewed companies are active in electrotechnical standardization at European and international level (CENELEC and IEC). One in six companies is active in standardization regarding telecommunication on a European level (ETSI) and one in ten on an international level (ITU). Looking at participation in standards organizations at all three regional levels differentiated by company size, it becomes apparent that participation in national standards committees does not depend

on company size. Participation on international and European levels, in contrast, increases with the number of employees. In addition, the involvement in international standardization is positively correlated with the degree of digitization.

The panel further allows for the assessment of the development of the involvement of DNP-participants in formal standardization and consortia at different regional levels over time. Compared to the previous year, the share of companies in standards organizations at all regional levels remained more or less constant. A slight increase in international standardization work can be observed among companies with less than 50 employees. In general, it can be said that companies have recognized the opportunity to influence and steer the standardization process through participation in the standards committees of official standards organizations and consequently make good use of this opportunity.

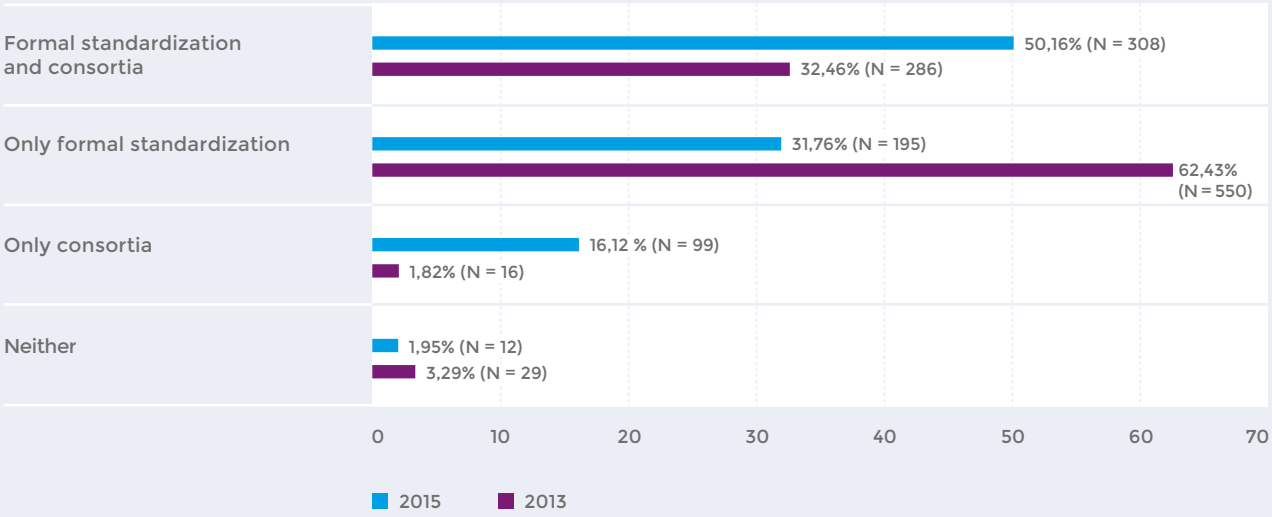
In contrast to the participation in formal standardization processes, the involvement in informal consortia has, starting from a low participation rate in 2013, significantly increased over time. In particular at the national level, the share of active participants rose significantly, irrespective of size or industry affiliation. This development is reflected in figure 6, which distinguishes the participants according to their participation in formal and informal standardization processes on the national level. In 2013, the majority of the participants was active only in formal standardization, one third in both formal and informal standardization, and 2% exclusively in consortia. Two years later, half of the companies state to be active in both, while only one third is active exclusively in formal standardization. However, 16% of the respondents now work in consortia only, 90% of which were active in formal standardization two years ago. The results of the Mannheim Innovation Panel 2015[6] show that 7% of the German companies are active in formal standardization and 1.4% in consortia. The DNP participants, as expected, are more often involved in standardization than the average German company. Further analysis of the Mannheim Innovation Panel show that participants of consortia are also typically active in formal standardization. From this it can be concluded that the decision to participate in consortia is complementary to the engagement in formal standardization. Based on DNP data, this is confirmed by the fact that the majority of the companies active in formal standardization in 2014 is active in consortia as well. Moreover, it is interesting that companies with a high digitization level tend to be involved in formal and informal standardization activities to a greater extent than digital novices.

Differentiating by national standardization activities reveals differences in the relevance of formal and consortia standards. While the importance of formal standards increased for companies not active in formal standardization in 2013, there were no observable changes among the companies active in formal standardization. Likewise, the importance of consortia standards rose only for companies that were not part of the development process. For companies that participate in consortia the trend is declining. Due to the fact that industries, for which consortia play an important role, such as information and communication, are still underrepresented in the DNP, the results concerning this aspect might have limited generalizability. Not least, in order to confirm the observed trends, it remains a target to extend the contact base of DNP to include consortia and to motivate their active members to participate.

[6] *Rammer, Christian; Schubert, Torben; Hünermund, Paul; Köhler, Mila; Iferd Younes; Peters, Bettina (2016): Dokumentation zur Innovationserhebung 2015, ZEW-Dokumentation Nr. 16-01, S. 104.*

Figure 6

Percentage of companies which conducted different types of national standardization activities in 2013 and 2015



The high significance of standards work is supported by the large percentage of companies with specialized standards departments. 37% of the respondents state to have such a department. Standards departments are common, particularly among companies in the automotive industry and mechanical engineering. In contrast, they are least common in companies active in information and communication and chemistry and pharmacy. Distinguishing between different levels of company size, a clear picture emerges: the larger the company, the greater is the likelihood that the company has a separate standardization department.

The share of companies with specialized standards departments slightly increased from 2013 to 2015. There is a slight negative correlation between the share of companies in an industry that maintained a specialized standards department in 2013 and the development over time. More precisely, the share increased most in industries that had particularly low shares in 2013. This kind of catching-up process is also observable between size classes. The share of companies with a specialized standards department decreased among companies with 1,000 or more employees and increased among companies with 250 to 999 employees, closing the gap between the two categories. The share also increased among small companies with less than 50 employees from 13% to 17%.

This year for the first time, participants were asked about the area of responsibility of these departments. Internal and external standards work (73% and 62%, respectively) are the core tasks, but also technical regulation (57%) falls within the scope of work. Especially for smaller and construction companies, as well as consumer goods producer, quality management, as well as research and development also belong to the responsibilities of the standardization department. In energy and water supplies, one in three companies states that standardization departments are also responsible for patenting.

STANDARDIZATION IN A DIGITALLY NETWORKED ECONOMY

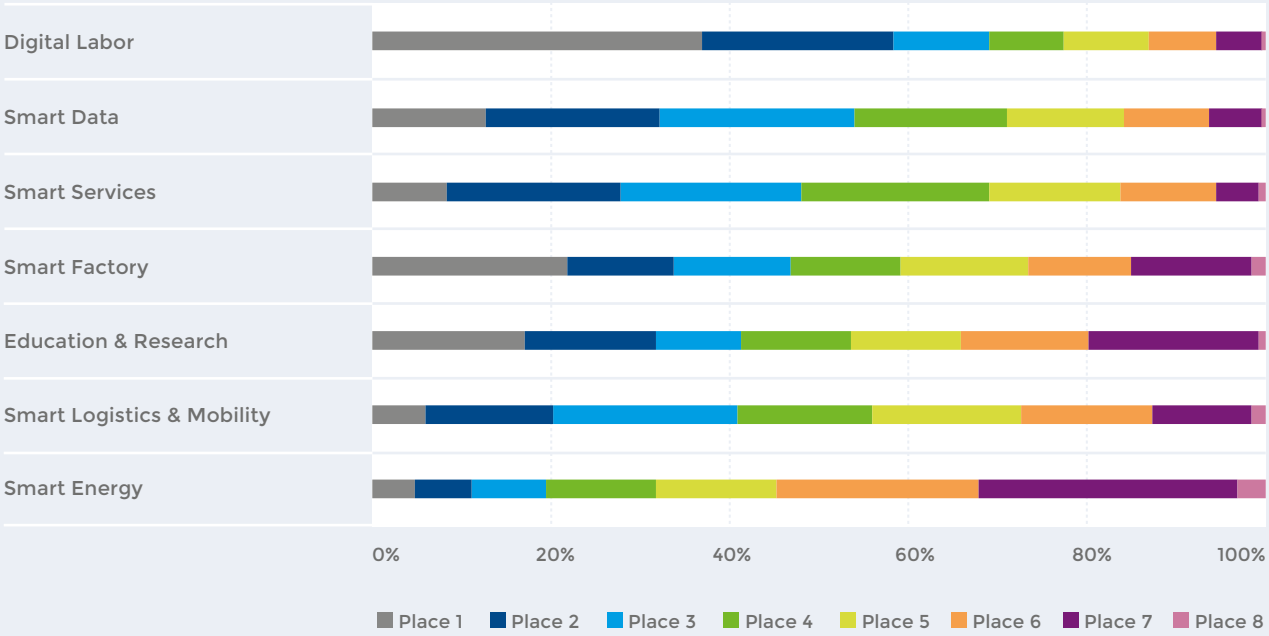
The ongoing digitization poses challenges, not only for companies that are active in standardization but also for standardization itself. In order to gain a better understanding of the topic, this year´s special section addresses "the consequences of a digitally networked economy on standardization"

"DIGITAL LABOR" AND "SMART DATA" ARE THE MOST IMPORTANT TOPICS CONCERNING DIGITIZATION AND NETWORKING

Participants were asked to rate several topics from the digital agenda of the German federal government[7] by importance. The topic "Digital Labor", which covers, for example, new forms and models of work and the lack of specialists and education, is seen as most or second most important by 60% of the participants and thus clearly takes first rank (see figure 7). The topic is of special importance for companies that are smaller, less innovative and not active in formal standardization. "Smart Data" has taken the second position and is relevant above all for companies active in information and communication and energy and water supplies, irrespective of company size. The topic is rated as more important by "digital novices", hinting at a catching-up process of less digitalized companies. "Smart Services" ranks third and is mostly relevant for smaller companies in the service industry. Although 20% of the companies rank "Smart Factory" first, for many others it is not important at all. It matters in particular for large, innovative companies in medical technology and optics and manufacturing of consumer goods. The topics "Education and Research" and "Smart Logistics and Mobility" are considered less relevant. "Smart Energy" takes the last place. As was to be expected, it is primarily companies in energy and water supplies that consider this topic important.

[7] *Die Bundesregierung (2014): „Digitale Agenda 2014 – 2017".*

Figure 7 Ranking of various topics in the field of digitization and networking in % of companies



DNP PARTICIPANTS EXPECT POSITIVE EFFECTS OF DIGITIZATION FOR THEIR COMPANIES

The participants were further asked to assess the consequences of ongoing digitization and networking for their companies. In general, 90% of the companies associate digitization with positive or very positive effects. The majority expects increases in efficiency and productivity, and 20% expect increases in turnover and cost savings, respectively. Furthermore, transfer and exchange of knowledge, competitive advantages, compliance, transparency, improvements in quality, global networking and increased flexibility are named as positive consequences. Negative impacts, such as high investment needs, are less frequently mentioned. They further include complexity, differing international education levels, different tools, extremely uneven levels of digitization, transfer of information and inequality due to age.

DATA PROTECTION AND DATA SECURITY ARE CONSIDERED MAJOR CHALLENGES IN THE COURSE OF DIGITIZATION AND NETWORKING

Figure 8 lists the challenges companies face in the course of digitization and networking. Irrespective of size and for nearly all industries, data protection and data security are considered the greatest challenges. It follows the need for research and development and innovation, and compatibility of technology with external interfaces. In addition, digitization generates large amounts of data that, independent of company size, stresses in-house data management and analysis, as well as the often fragmented internal IT-infrastructure. Restructuring of tariffs and work-time models, as well as lack of regulation, are of minor relevance.

Survey participants were also asked to assess the potential of formal and informal standards to help overcome the obstacles. Companies active in standardization see the highest potential of standards regarding research, development and innovation. Compatibility of technologies with external interfaces, the central function of standardization, only ranks second place. The role of standards for data management and analysis takes third place. Data protection and security, which is considered the greatest challenge, only takes fifth place and should obviously be addressed by regulatory initiatives. It is also worth mentioning that standardization is considered to have some potential to replace lacking regulation.

The analyses also reveal interesting group differences in the assessment of the challenges and the potential of standardization. In general, companies in vehicle manufacturing and in information and communication see the greatest challenges in digitization, but also the highest potential of standardization to overcome them. Big companies name a need for research, development and innovations, strict routines and a lack of flexibility in operative processes and unclear responsibilities more frequently than smaller companies. They also see a higher potential for standardization to help meet the challenges than smaller companies. For “Digital Champions”, the need for research and innovation poses the greatest challenge, for digital novices it is the development of new business models. Participants of consortia consider the management of a fragmented IT-infrastructure the most relevant issue. For the latter, it is most important to address data protection concerns and to realize compatibility of technologies. It is also interesting that the assessment of the potential of standards to help overcome challenges does not differ between the companies that are active in formal or informal standardization and those that are not.

Figure 8

Challenges of digitization and networking and potential of standards to help overcome the challenges. On a scale from 1 (no challenge) to 3 (big challenge) and 1 (no potential) to 3 (big potential)

In the context of this question companies were asked to specify the potential of standardization to help overcome the various challenges posed by digitization in greater detail. Looking at the catchwords that were mentioned most frequently, two major topics stand out: “uniform interfaces” and “rules and security”. In relation to the first topic words like “specifications”, “implementation”, “global”, “industry 4.0”, “data interfaces and formats”, “data processing” and “company standards” were named. The second key area includes the buzzwords “framework”, “data protection”, “clarity”, “minimum standards” and “orientation”.

EXCESSIVE COSTS AND PROBLEMS WITH TRANSNATIONAL HARMONIZATION ARE THE MAJOR CHALLENGES WHEN DEVELOPING AND IMPLEMENTING RESPECTIVE STANDARDS

The main challenges the participants of the DNP face when developing respective standards are transnational harmonization and slowness and rigidity of development processes, along with complexity and lack of transparency of existing standards. Regarding the implementation of standards, too high costs are considered more of a hinderance than problems of harmonization. Insufficient protection of intellectual property and resulting dependencies are of lower importance for the companies.

In general, mainly large companies in vehicle manufacturing and medical technology see problems in association with the development of respective formal and informal standards. For companies in information and communication, legal requirements represent an even higher hurdle than complexity and costs. This is also the only industry where the slowness of development processes ranks last. Smaller companies see themselves confronted with excessive costs, too large risks due to dependencies and problems in identifying relevant standards. Large companies, in contrast, name slowness of processes, legal requirements and an insufficient consideration of their own needs more frequently. Lack of expertise is an obstacle mostly for companies with a low degree of digitization. Interestingly, companies which are not active in standardization see greater challenges in the development of standards but minor obstacles regarding the implementation. Companies that are exclusively active in consortia tend to consider the challenges to be smaller.

PILOT SURVEY AMONG BEUTH CLIENTS FACILITATES FIRST COMPARISON BETWEEN COMPANIES THAT ARE ACTIVE IN STANDARDIZATION AND COMPANIES THAT ARE NOT

Thanks to a new cooperation with Beuth, the core questions of DNP could, for the first time, be directed to companies that purchase formal standards, but are not involved in development processes. Approximately 3,700 Beuth clients were contacted and 70 exploitable questionnaires were returned, resulting in a weak response rate of 2%. This might be due to the fact that the majority of the target group had a low proximity to the topic and thus found it difficult to answer the specific questions.

In order to allow for a comparison of the answers of companies that are active in standardization and companies that are not, the data from the Beuth survey was merged with the data from DNP. The data are weighted in a way that the samples from both survey are identical concerning the structure of size-distribution and industry affiliation. This assures that differences can be attributed to activity in formal standardization only. The data set consists of 529 companies, 58 of which are not active in formal standardization.

The analyses revealed that companies that are not active in standardization consider formal standards mostly relevant on a national level. For companies involved in the development of formal standards, in contrast, they are most important on an international level. On a European level, there are no observable differences between the two groups. There are also hardly any differences concerning the impact of formal standards. For both purchasers and developers, formal standards exert the highest influence on most of the examined factors of business success. Only increases in productivity rank lower among companies active in standardization. In order to attain this objective, the respondents primarily apply internal company standards. It becomes apparent that companies which are involved in formal standardization are more successful in applying formal, as well as internal company standards, especially to improve competitiveness and the bargaining position towards suppliers and clients. In contrast, companies that are not active in standardization consider the implementation of external company standards for means of legal security and the fulfillment of market entry conditions more important. In order to fulfill these goals, purchasers also apply informal consortia standards more intensively than companies active in formal standardization. However, the latter are more involved in the development of informal consortia standards. The results again emphasize a complementary relationship between the involvement in consortia and the participation in formal standardization.

DNP REVEALS INITIAL TRENDS

Conclusion

The results of the 2015 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. For more innovative companies, they also contribute to the optimization of research, development and innovation activities.

A significant increase in the importance of formal standards can be observed for companies in the service sector only. As a result, no differences between the sectors exist in 2015. Internal company standards, in contrast, gained in importance. This trend can be observed irrespective of the number of employees and industry affiliation, though catching-up processes of smaller and less innovative firms begin to emerge. Internal company standards are mainly applied to achieve increases in quality and productivity, especially in innovative companies active in standardization. Regarding the importance of external company standards, there are no differences between innovative and less innovative companies. Still, they are most commonly applied by smaller companies in order to increase productivity and to fulfill requirements of market entry.

DIN EN ISO 9001 certifications are widely spread among the survey participants. 17% of the micro-enterprises, i.e. companies with less than 10 employees, have a certified quality management system. In contrast, none of the small firms is certified according to other standards, such as DIN EN ISO 14001 or DIN EN ISO 50001. Up to now, certification of the information security system is the least common among the respondents of the DNP. In the past financial year, only one out of six surveyed companies was certified according to DIN ISO/IEC 27001, including especially "Digital Champions". However, a rising number of energy and information security management systems and a stagnation of quality and environmental management systems certifications over the years can be observed.

Concerning standardization activities of companies, it becomes apparent that participation in national standardization is independent of company size. Participation on an international level, in contrast, increases with the number of employees and the degree of digitization. In comparison with 2013, the share of companies active in standardization at different regional levels remained constant. A slight increase of participation in international standardization bodies can be observed among companies with less than 50 employees. Unlike formal standardization, participation in consortia experienced, based on a low participation ratio in 2013, a massive increase. The results also imply that a company's decision to participate in consortia is complementary to its involvement in formal standardization processes. Companies that are active in both international formal standards bodies and international consortia are frequently involved in research and innovation activities with different international players.

The importance of standardization activities is also reflected by the large number of companies that maintain specialized standardization departments. The share of companies with specialized standardization departments increased over time, especially for companies in industries in which these departments were least widespread in 2013. The major tasks are internal and external standardization activities, as well as technical regulation.

The respondent companies are, in general, very optimistic when it comes to the effects of digitization. They face challenges with data protection, data security, data management and data analysis, research, development and innovation and the compatibility of the company's technologies with external interfaces. Standardization offers potential to help meet the challenges of digitization. Regarding the development and implementation of the respective standards, excessive costs and problems with international harmonization are considered the greatest challenges. The standardization bodies, however, have already responded to the time problem by accelerating development processes and the companies themselves are getting more active in international standardization.

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 several sections:

– Importance of formal and informal standards and specifications
– Consequences of a digitally networked economy for standardization
– Formal and informal standardization activities
– General information on participating businesses

SURVEY DETAILS

The fourth wave of the survey

The fourth wave of the German Standardization Panel took the form of an online survey carried out in autumn 2015 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).

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.

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 consortia 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).*

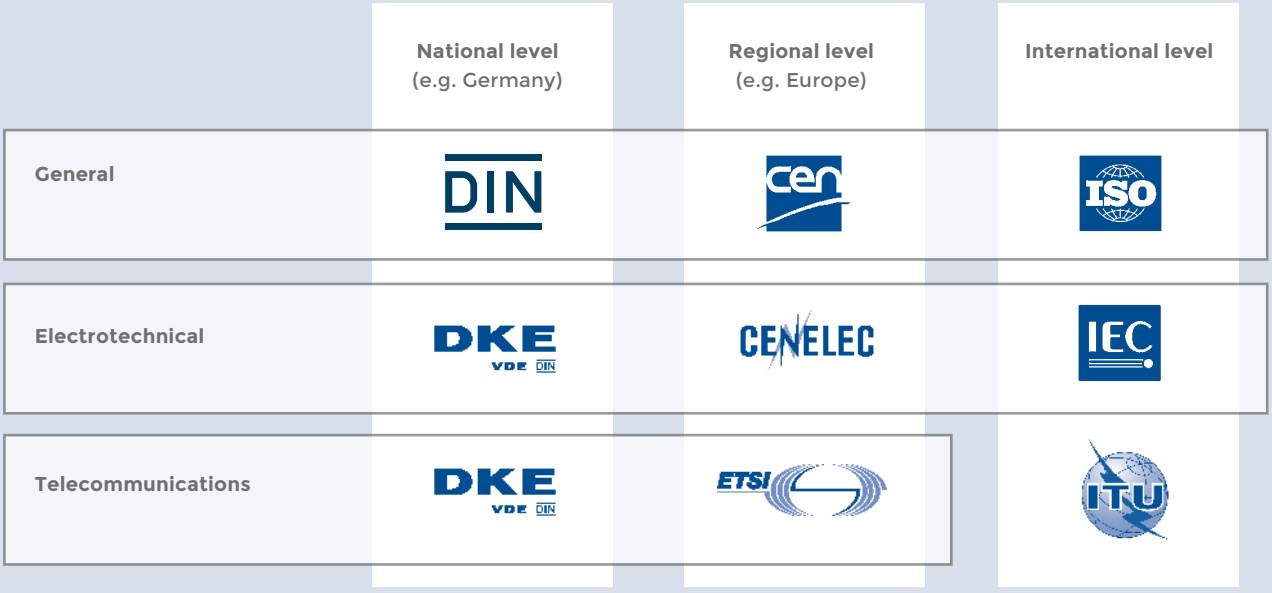
European standards organizations

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.[8]

ETSI is responsible for drawing up globally applied standards for the information and communications technology (ICT) sector. 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)



[8] *DIN: Das kleine 1x1 der Normung – Ein praxisorientierter Leitfaden für KMU (goo.gl/jt3eWX)*

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.

Consortia standards

Like specifications, consortia 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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