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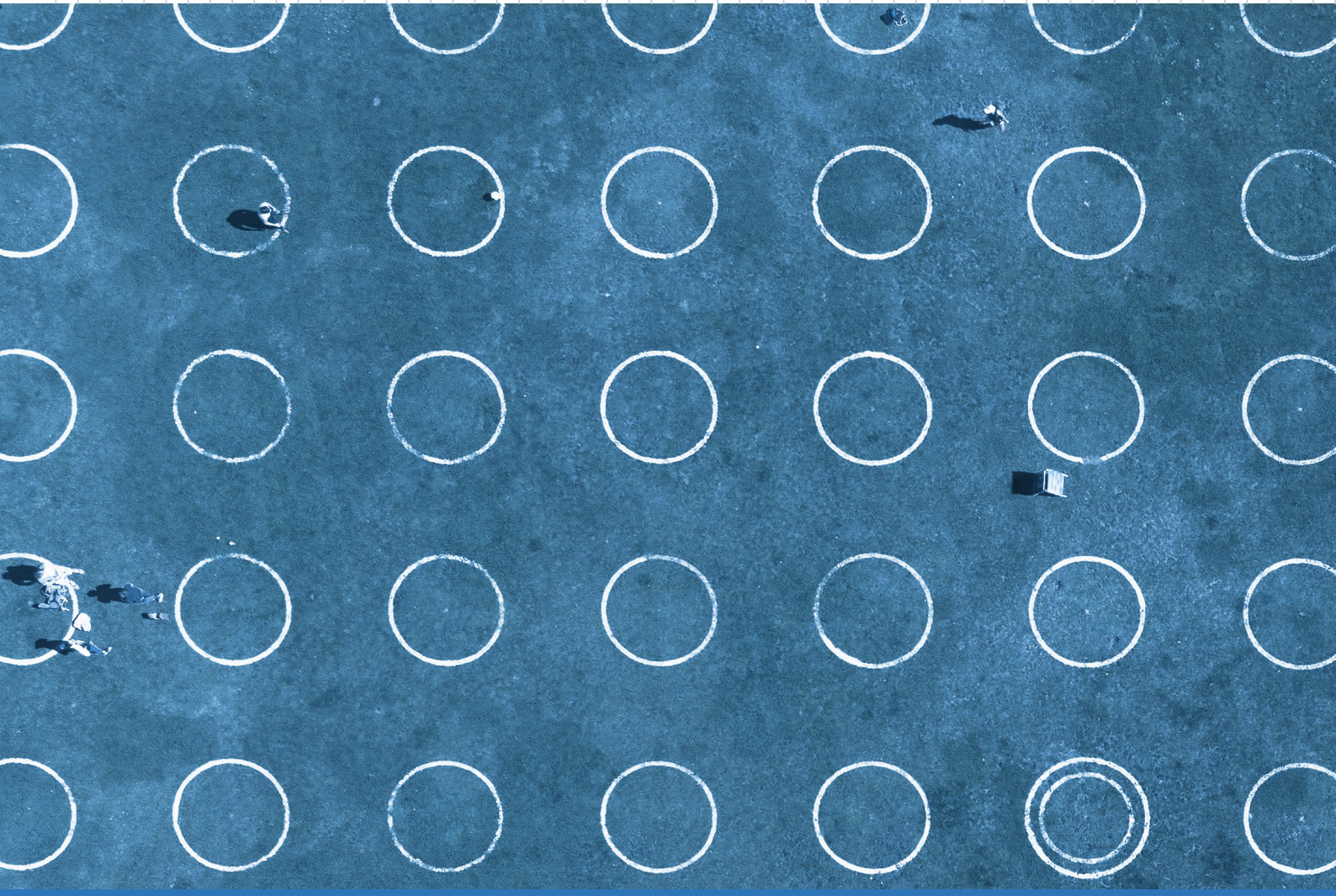

GERMAN STANDARDIZATION PANEL (DNP)

Standardization Research, Policy and Promotion

Indicator Report 2021

» **Effects of the coronavirus pandemic on standardization**

SUPPORTED BY DIN AND DKE

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GERMAN STANDARDIZATION PANEL 2021

YEARLY 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 2020 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 helped to promote research on topics and questions related to standardization in order to make qualitative assessments of aspects regarding standardization policy. Since 2019, the project is directly financed and supported by DIN and DKE. 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 eight 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 2020. The pilot study in 2012 was excluded from the panel data set due to a low number of observations.

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. Over time, a slight reduction of the importance of standards on national and EU-level can be noted, while consortium standards gain importance, especially on international, but also on EU-level.

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, 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. Smaller companies use these standards to improve bargaining positions vis-à-vis suppliers and customers.

3 Informal consortia and de-facto standards are primarily relevant for the realization of technical interoperability. Participation in consortia is mainly motivated by the high speed of processes, while the type and number of users, as well as the possible influence on government regulation is perceived as an advantage in formal standardization.

4 ISO 9001 (quality) and ISO 14001 (environmental) certifications are already widespread among survey participants, so that a decline in initial certifications is now apparent. The strongest growth in certifications in recent years has been in the DIN EN ISO 50001 standard (energy efficiency).

5 In the first year of the Corona pandemic, standardization activities remained constant. The majority of standardizing companies planned to maintain or even expand their participation. The importance of standards did not change significantly for the companies as a result of the crisis. The adaption of standardization processes was associated with a strong digitalization effect, which reduced costs, increased efficiency and enabled more (international) participation. However, many standardization experts commented on a lack of informal, personal exchange.

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, which is also underlined by the fact that in 2018 it was included as such in the OECD's Oslo Manual[1] for the first time. 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.[2] 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,[3] 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.

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 public sector, as well as the consequences of digitalization and digital networking also in the Industry 4.0 area for 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 busines-

[1] OECD and Statistical Office of the European Communities (2018): "Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data, 4th Edition", https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm

[2] Blind, K. and Rauber, J. (2013): „Normung als attraktive Plattform für innovative Unternehmen", DIN-Mitteilungen Dezember 2013, S. 26 – 29

[3] 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.

ses 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.

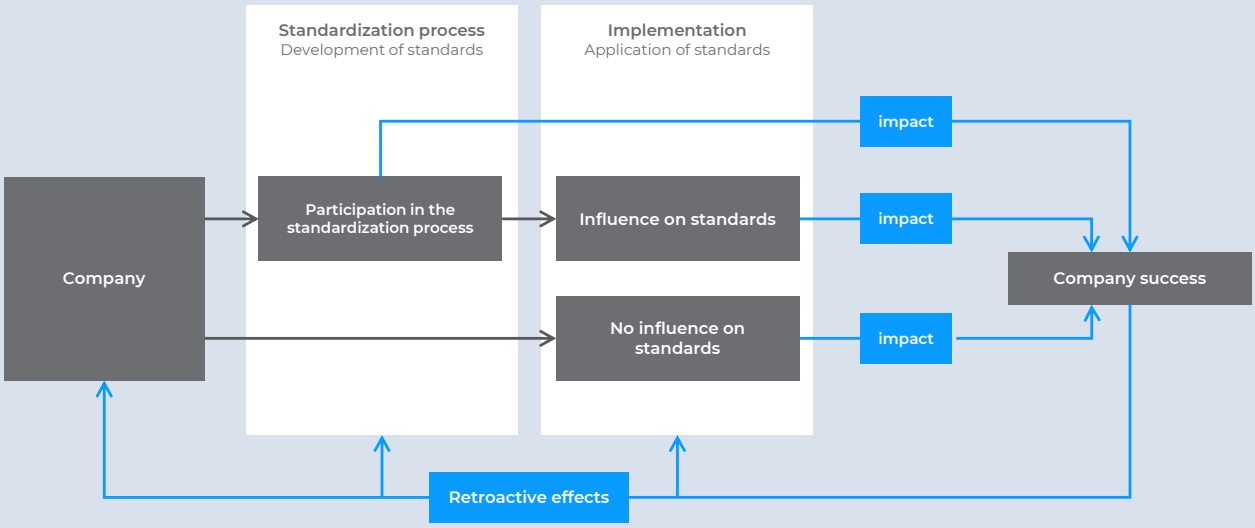
Heuristic model

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?

Figure 1 Heuristic model of the German Standardization Panel



The waves of the 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.

Realization

On October 14, 2020, World Standards Day, the ninth wave of the DNP company survey went into the field. The project is conducted by the Department of Innovation Economics at the Technical University of Berlin and is financed and advised on content by DIN and DKE. In 2020, the German Federal Ministry for Economic Affairs and Energy (BMWi) has again gratefully assumed patronage of the DNP.

A total of more than 30,000 experts were contacted. The number of usable questionnaires lay around 2,400, equal to a response rate of just under 10%, which is a significant increase compared to the level of previous years. A high response rate to the special section shows that the topic of the impact of the Corona pandemic on standardization has met great interest in the community.

In order to obtain a detailed overview of the development of various indicators over the entire survey period, results from the individual samples of the respective years were compared. With the aim of enabling more robust comparability and a sufficient degree of representativeness, the companies' responses were weighted on the basis of company size and assigned industry. The target distribution was an estimate of the distribution of company size and industry allocation of the companies active in standardization at DIN, which was created on the basis of a database of almost 10,000 companies. The 2020 survey took place in a highly dynamic context. While some companies responded before the 2nd lockdown, others responded after the pandemic peak at Christmas. Since it could not be ruled out that this influenced the responses, additional weighted individual samples were created based on the date of response (October, November, December 2020), or the date of response was included as a control variable in regression models.

On the basis of this unique data set, it is possible to gain insights on changes in standardization behavior and the application of standards by companies over time.

Composition of the sample in 2020

In this report, industry, company size as well as research and innovation activities are the main differentiation criteria used to structure the results and highlight individual characteristics. This year's sample composition is roughly the same as in previous years, confirming the panel's general sample structure of experts and companies.

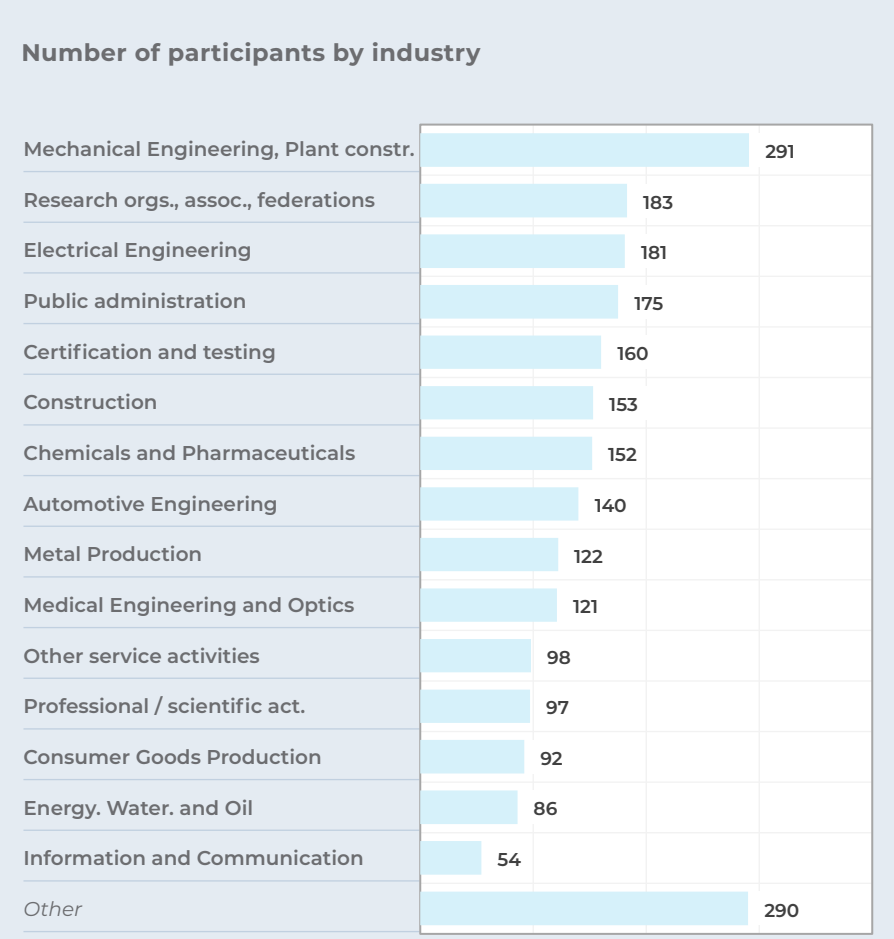
Of the nearly 2,400 responses used in the analysis, 59% represent companies or groups of companies. 41% of the responses are the views of experts who are answering on behalf of a representative company in their sector. Respondents from smaller companies (up to 50 employees), were mostly active in upper management positions. For large companies, the participants were mostly based in research and development departments. Participants most frequently stated that they had a specialized standardization background in companies with more than 1,000 employees. Overall, 22% of participants were from management or operations, 22% were from research and development departments, 9% were from dedicated standardization

departments, and 9% had a quality management background.

Location & size

As in previous years, the main group of companies responding to the survey were German companies. At just under 86%, these made up by far the largest group of participants. Most foreign participants came from Europe (8%), followed by the USA (3%) in third place. The size distribution of participating companies has remained relatively stable since 2013. Each group formed by company size (categorization: <250, 250+ employees) contains approximately half of the participants. It was thus also possible to represent the views of small and medium-sized enterprises (SMEs, <250 employees), which account for 52% of the sample. While the share of smaller companies was highest in the area of freelance and scientific services (>80%), responses from groups of companies with 1,000+ employees came mainly from mechanical engineering, electrical engineering and automotive engineering.

Figure 2
Number of participants per industry. N=2.395.



Industries

The composition by industry[4] has changed only slightly compared to previous years. At around 12%, most of the participating companies are active in mechanical engineering and plant construction, followed by 8% each from electrical engineering, universities, clubs and associations, and 7% each from certification and testing, public administration and automotive engineering. In contrast, only 2% of companies were active in the information and communications sector. Compared with the 2019 survey, the proportion of participants from the automotive engineering sector has

[4] *Industries according to the classification by the Federal Statistical Office of Germany, 2008 edition.*

fallen slightly. By contrast, significantly more companies from the education sector, clubs and associations, and public administration took part.

R&D

The innovation activities of this year's participating companies were very similar to those of the previous year's survey. 56% of participants reported having introduced process innovation and 61% product innovation in the previous year (2019), while these figures were 51% for process innovation and 65% for product innovation in the 2019 survey (for the previous year 2018). Research activities were carried out by a total of 56% of the companies, with 40% cooperating with external research institutions. Such activities were much more widespread among large companies than among smaller ones. The proportion of companies that carried out innovations, conducted research or entered into research and innovation cooperations was lower among SMEs (just under 50%) than among large companies (approx. 65%). Companies from the consumer goods manufacturing, chemical and pharmaceutical, and automotive engineering sectors most frequently indicated that they had introduced product innovations in 2019. Here, the proportion of innovative companies was over 80%. Process innovations were introduced somewhat less frequently, with the consumer goods, automotive, manufacturing and medical engineering sectors leading at just under 70%. A very similar picture emerged for internal research activities, which were carried out most frequently in automotive engineering (80%), followed by chemicals and pharmaceuticals (76%) and medical engineering (71%). Companies from these sectors also entered into research collaborations most frequently (about 50% to 60%).

Export

Of the more than 1,000 companies that provided information on their export activities, most exported within the EU, followed by exports to Asia. The average share of exports in the total sales of the responding companies was just under 31% in 2019. This figure was just under 9% for exports to Asia and 6% for exports to the US. Similar to previous years, the industries with the highest export shares were automotive engineering (52%), followed by mechanical engineering and plant construction (51%), metal production (45%), and the chemical and pharmaceutical industries (43%).

Level of digitalization

This year, we again asked for a self-assessment of organizations' digital maturity levels (based on a PwC study from 2014, see 2016 indicator report). Participants were asked to classify themselves into one of four levels: 1) “Digital Novices” (25%) or companies that successfully digitalized 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” (35%) 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” (29%) or companies that are vertically and horizontally digitally networked, and use standardized methods to manage risk and compliance; and 4) “Digital Champions” (11%) that show the highest degree of digitalization. Here, 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.

THE IMPORTANCE OF STANDARDS AND SPECIFICATIONS

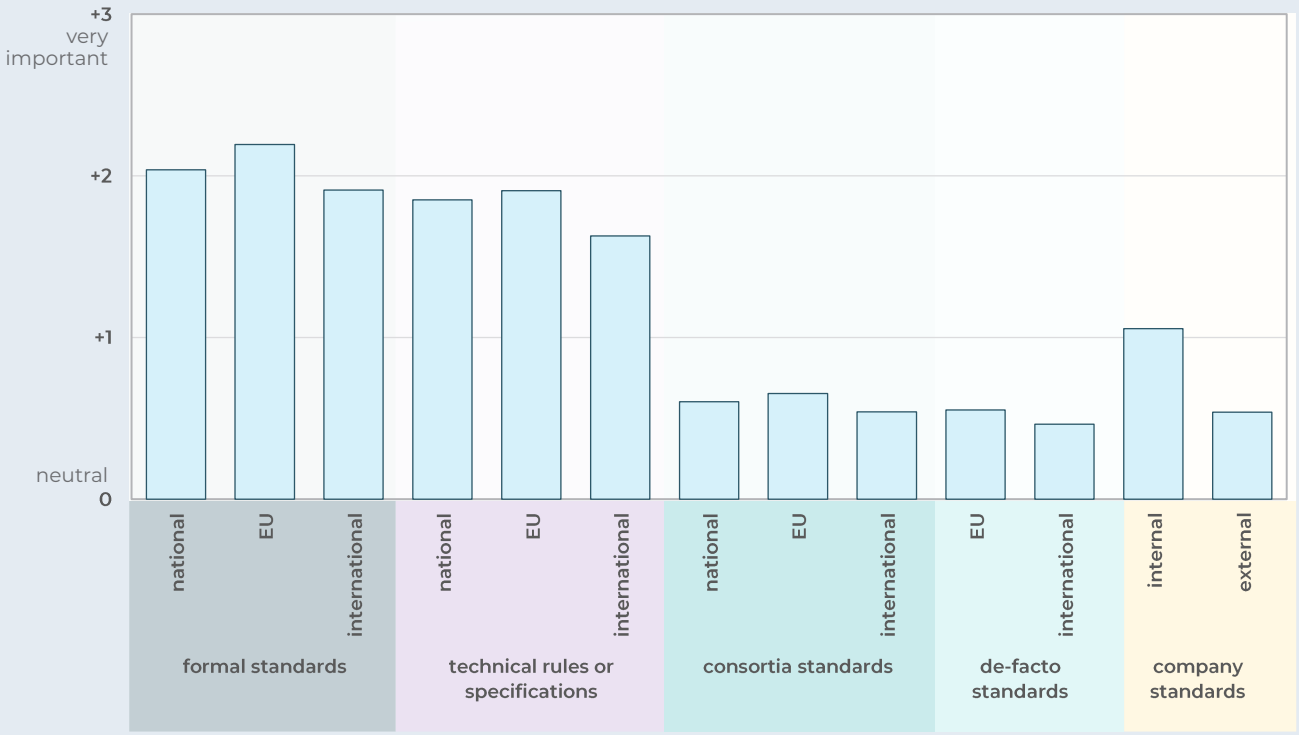
In its first core part, the annual survey of the German Standardization Panel collects the assessments of companies from different industries of the importance of standards. The survey distinguishes between five types of standards: Formal standards such as the DIN standards, technical rules or specifications (e.g. DIN SPEC), informal consortium standards, de-facto standards, and internal as well as external company standards. With the exception of the latter, their importance is measured for the national, European and international level. In the case of formal standards, for example, this referes to DIN standards (national), the European standards EN (CEN, CENELEC or ETSI), and ISO standards (international).

Formal standards remain most important type of standard, especially at European level

As in the surveys of previous years, formal standards and technical rules or specifications continue to be the two most important types of standards for experts active in standardization in 2020 (see Figure 3). While this applies irrespective of sector and innovation and research activities, the importance of formal standards

Figure 3

Importance of standards
Average rating of the importance of standards at various regional levels. Rating scale from -3 (very unimportant) to +3 (very important). N=2,390 to 2,394, 95% confidence intervals.



increases on average with the size of the companies, in line with previous years. The assessment by SMEs and large companies differs most clearly with regard to internal company standards and international standards. Obviously, the importance of formal standards stands out above all in the area of certification and testing, followed by medical engineering, mechanical engineering and plant construction, and the chemical and pharmaceutical industries. Internal company standards were rated most significant in the automotive, chemical and pharmaceutical, and consumer goods manufacturing sectors. External company standards, i.e. those standards that are often specified by companies downstream in the value chain, are particularly important in metal production, automotive engineering and the chemical and phar-

Figure 4

Importance of national and international formal standards and consortia standards, as well as internal and external company standards by industry.
-3 (very unimportant) to +3 (very important).
Total N=2,395, industries N = 2,369 to 2,372.

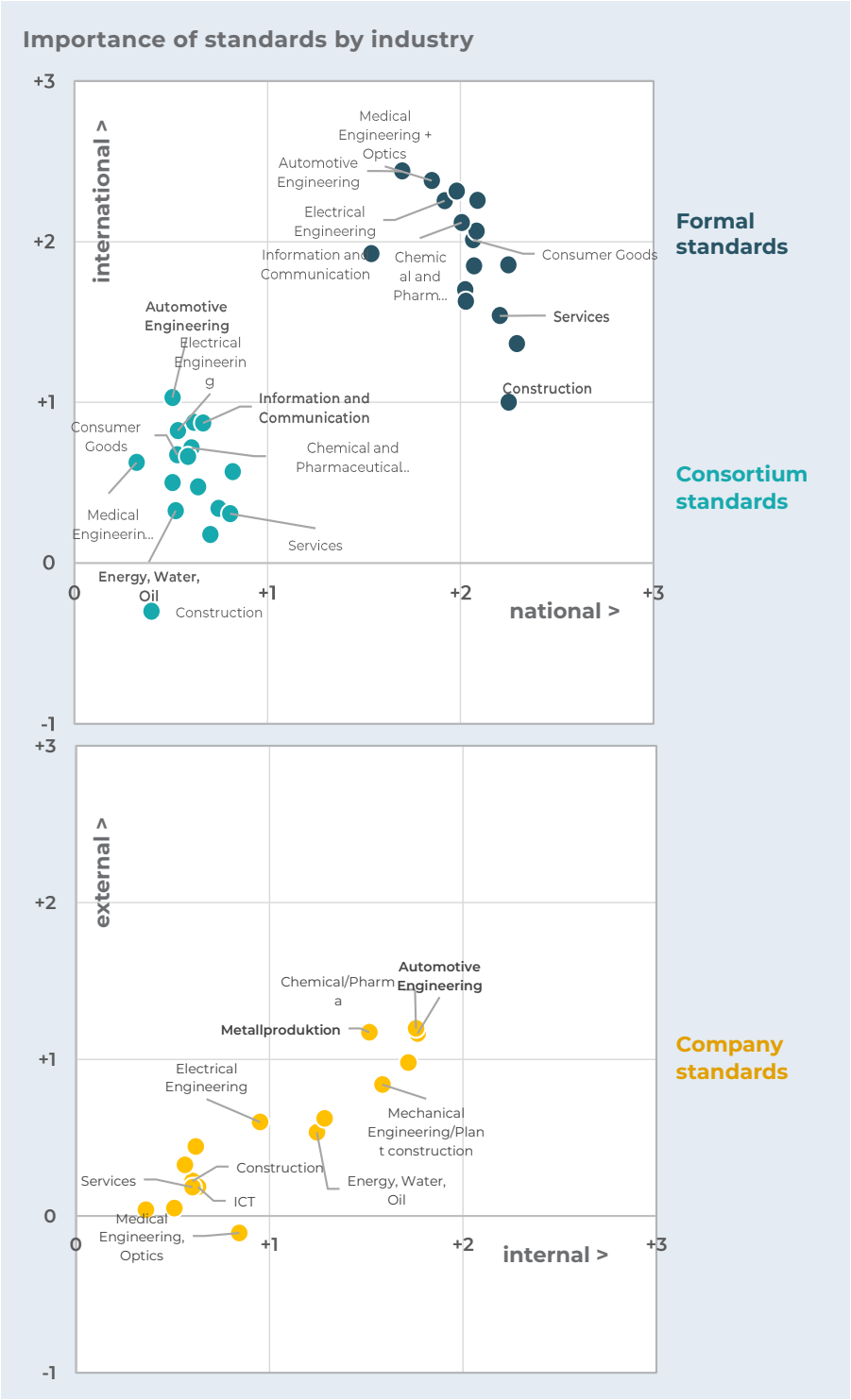
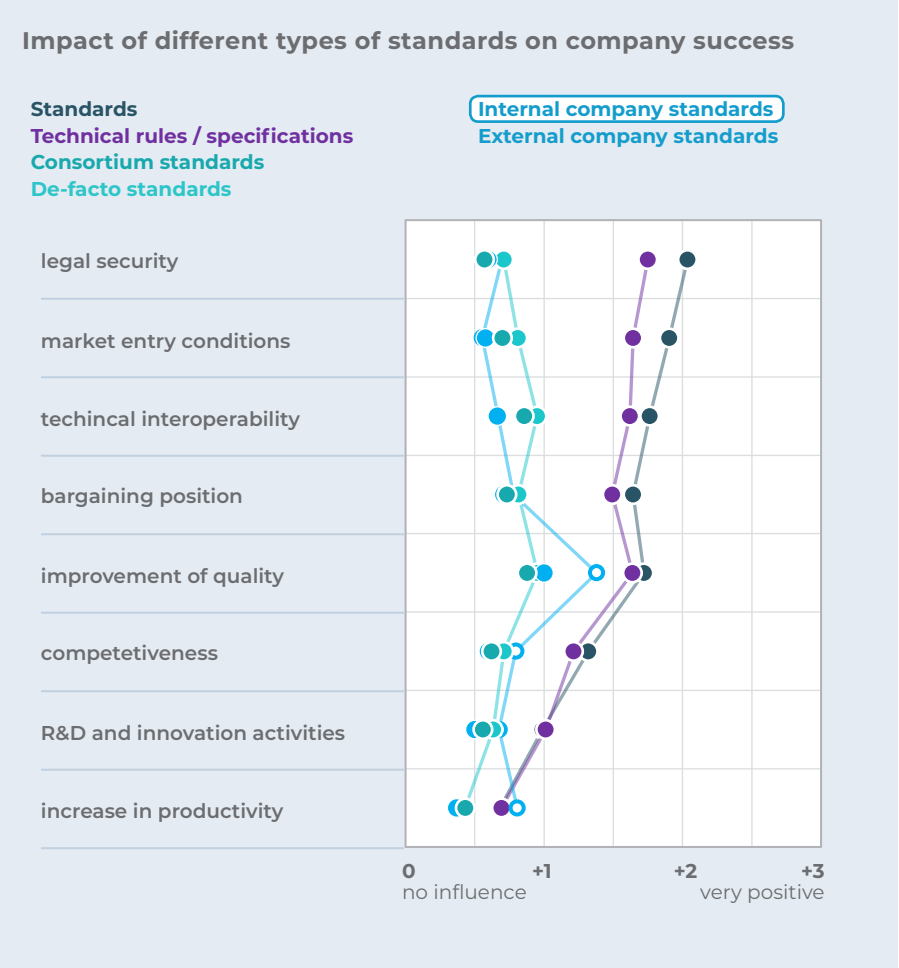


Figure 5

Average assessment of the impact of different types of standards on success factors. Basis N=1403 to 1743. -3 (very negative) to +3 (very positive).



maceutical industries. In these sectors, they are valued for quality and productivity improvements, as well as in bargaining positions with suppliers and customers. De-facto standards and consortium standards are rated as less important on average in comparison. They play a role in particular in the realization of technical interoperability for large, innovative companies which are part of a multinational group.

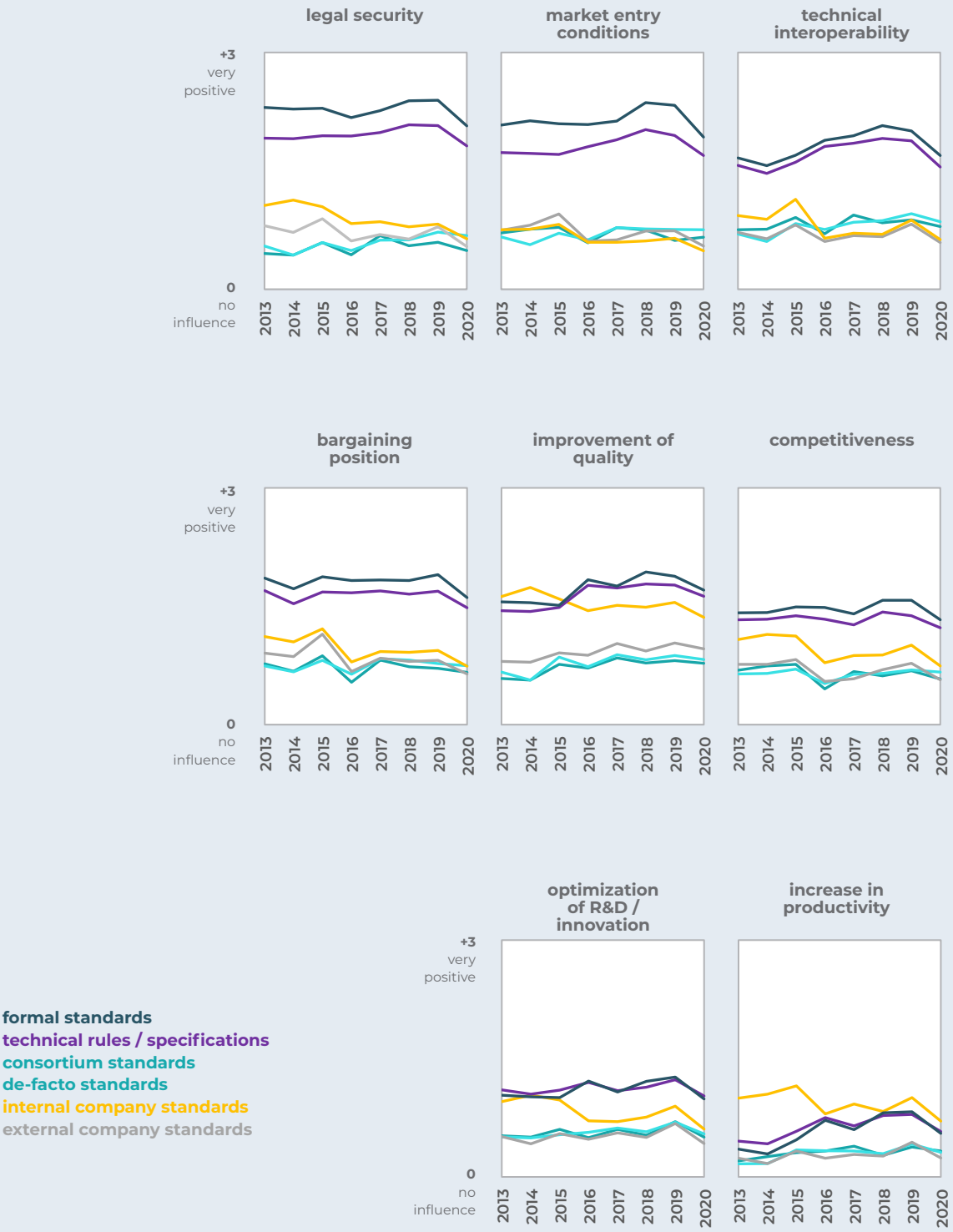
On average, participants attach the greatest importance to all types of European standards. In contrast to other sectors, international standards play a greater role for the construction, public administration and services sectors than international standards. The most clearly internationally oriented sectors are automotive engineering, medical engineering and information technology, which consider formal standards to be most important at this level. National technical rules or specifications were assigned a relatively high importance in this year's survey, while international de-facto standards were assigned the least importance on average.

Compared with the previous year, the average assessments based on the weighted samples and the balanced panel sample do not change significantly. Since the start of the surveys in 2013, international standards in particular have been gaining importance. In particular, European de-facto standards have been assessed as significantly more important since 2017 than in the three surveys from 2013 to 2016. At the national level, all types of standards lost some of their importance. Overall, a statistically significant decrease in the importance of company standards could be observed in 2020.

Figure 6

Change in estimates of the impact of standards on success factors 2013 - 2020

Average assessment of the impact of different types of standards on success factors. -3 (very negative) to +3 (very positive).
Weighted samples 2013 - 2020. N=4429 to 6322.



Formal standards and technical rules, specifications have greatest positive effect on company success

Overall, the conclusions from previous surveys can be confirmed, stating that formal standards have a much stronger influence on (business) success factors than consortia or de-facto standards. Companies see such advantages especially for aspects that are related to transactions costs created by use and access to markets. For example, formal standards as well as technical rules and specifications are considered to have a significantly higher influence than other types of standards in terms of ensuring legal certainty, meeting formal and informal market access conditions, achieving technical interoperability and bargaining positions vis-à-vis suppliers and customers (see Figure 5).

Company standards play a more important role when considering factors that affect internal company processes, and are primarily related to increases in quality and productivity. Further aspects where company standards are relevant relate to the optimization of R&D, innovation activities and competitiveness. Such dichotomous assessments are in line with the results from a previous survey on the macroeconomic benefits of standardization[5], which also came to the conclusion that internal company standards are important for the success of internal company processes and that formal standards are particularly important for successful operation on the market. The latest surveys indicate that formal standards and technical rules or specifications are increasingly assuming both functions (Figure 6). Compared with the previous year, these assessments have decreased slightly in various areas. This will be discussed in more detail in the next section.

[5] *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.*

STANDARDIZATION ACTIVITIES

Participation increases

The second core part of the DNP survey addresses the external and internal standardization activities of companies. Over 1,000 company and industry representatives provided information regarding participation in standardization organizations at various regional levels (DIN and DKE at national level, CEN, CENELEC and ETSI at European level, and ISO, IEC and ITU at international level). The largest proportion of companies stated that they had been active in formal standardization at national level in the previous year of the survey (2019) (DIN 80%, DKE 28%). Data on participation at European (CEN 51%, CENELEC 23%, ETSI 11%) and international level (ISO 51%, IEC 22%, ITU 8%) are relatively similar. More than half of the companies (56%) were also represented in national consortia, 40% participated in consortia at EU level and 34% at international level. Compared to SMEs, large companies (250 + employees) were more strongly represented in at least one committee of a standardization institute at all levels.

While most of the surveyed companies participate in standardization at national (German) standard-setting organizations, the prevalence of participation at European and international level is lower. To a certain extent, this can be attributed to the system of representation of the interests of national bodies in European and international mirror bodies by individual delegates. In particular, large companies from the electrical engineering, mechanical engineering and plant construction and automotive engineering sectors are most active at all levels.

Diffusion of standards and influence on government regulation are main benefits of formal standardization

Comparing the criteria which speak in favour of participation in formal standardization versus consortia, this year's results largely confirm those of previous surveys. In line with the more pronounced participation in formal standardization in the sample, the positive assessments of participation in standardization predominate.

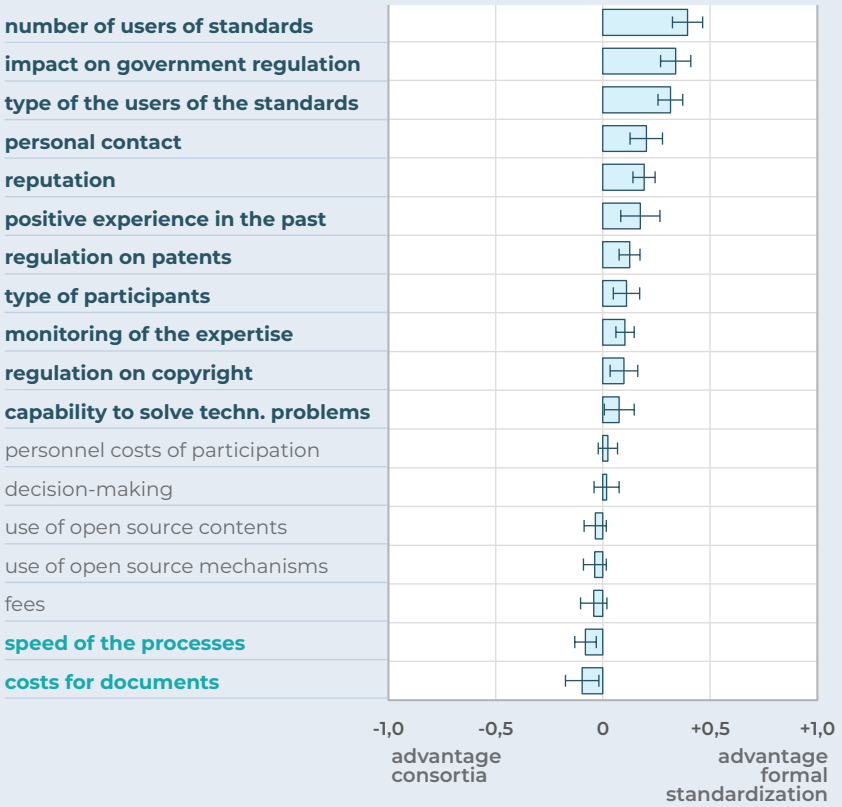
The strongest arguments in favour of standardization for the companies continue to be the high level of dissemination and the great influence of formal standards (Figure 7). The clearly highest rated criterion for participation in standardization is the high number of users of formal standards. This is followed in second and third place by the influence on government regulation made possible and the type of user of these standards. Also clearly in favour of activity in standards organizations were their high reputation, contact with other participants, and positive past experience. Regulations on patents (such as licensing terms for standard-essential patents) and on copyrights, as well as the ability to solve technical problems, also tended to speak in favour of standardization.

In all surveys, two criteria are seen as advantages for standardization in consortia: faster processes and lower costs for documents. Whereas companies are more inclined to participate in consortia because of lower fees, personnel costs associated with participation in standardization processes speak in favor of formal standardization.

Figure 7

Assessment of the extent to which different criteria influence participation in consortia and formal standardization. -3 (advantage consortia) to +3 (advantage formal standardization). N=1257 to 1313

Criteria for participation in consortia and standardization



Main criteria in favour of consortia, such as speed of processes, and those in favour of standardization, such as reputation and influence on government regulation, had become more and more aligned between 2016 and 2018. However, a further decline of the positive assessment of formal standardization and convergence towards an assessment equal to that of consortia could not be confirmed in the last two years. Rather, the distinguishing criteria are consolidating as shown in Figure 7; there were no significant changes here compared with 2019.

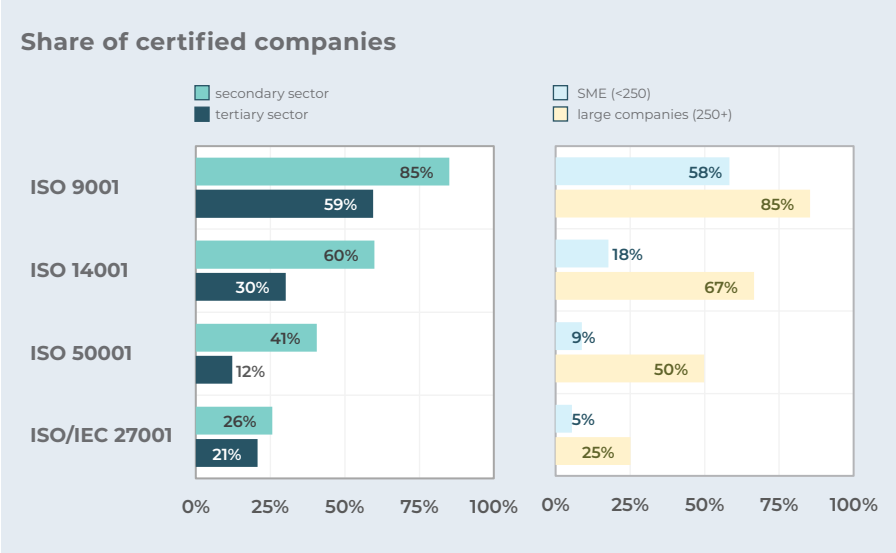
CERTIFICATION OF MANAGEMENT SYSTEMS

Trend towards certification of energy management systems continues

As in previous surveys, respondents provided information on whether they received certification to designated formal standards in the previous year of the survey (2019). If this was the case, they were further asked to indicate in which year the initial certification took place. A total of 1,733 companies provided information on these questions.

Figure 8

Share of companies certified according to major standards. (2019, yes/no)



As in previous surveys, a large proportion of companies reported to have been certified according to at least one of the significant quality, environmental, energy or IT security management system standards (see Figure 8). The ISO 9001 quality management system standard was the most prevalent, with 76% of companies certified overall, and as many as 85% of all companies in the secondary sector certified. Moreover, half (50%) of all companies stated to have implemented an environmental management system certified according to ISO 14001. The standard with the strongest growth in certifications in the last years, energy management systems standard ISO 50001, achieved a level of 31% certified companies in 2019. Overall, companies in the secondary sector were more likely to be certified. As expected, there was also a significantly higher proportion of certifications among large companies.

Certification according to ISO/IEC 27001 most relevant for ICT, energy and water supply and automotive engineering

The biggest differences between large and small companies and across industries could be observed for IT security management, where less than 5% of SMEs were certified according to ISO/IEC 27001. Certifications according to ISO 50001 and ISO

14001 were just as infrequent among small companies, while around half of large companies were certified according to these standards. Certification of quality management systems according ISO 9001 was more prevalent among small companies (58% certified), and among large companies (85%). Innovative companies were also more frequently certified - especially to ISO/IEC 27001.

In particular, companies from the energy and water supply sectors, the chemical and pharmaceutical industries, electrical engineering, mechanical engineering and plant construction, automotive engineering and the metal industry certified themselves, while this was significantly less the case for service companies. Certification of an information security management system was observed above all in the ICT sector, the energy and water supply industry and in automotive engineering. Here, the proportion of certified companies was 33% (ICT), 51% (energy, water) and 61% (automotive engineering).

Just under 604 companies provided information on certification in accordance with other types of management system standards. As in the previous year, the largest share was accounted for by testing and calibration laboratories and certification bodies certified to ISO/IEC 17025 (n=210), ISO/IEC 17065 (n=40) or ISO/IEC 17020 (n=16). On the other hand, industry-specific quality management systems, especially in the field of medical devices (ISO 13485, n=67) and in the automotive industry (ISO/TS 16949, n=38), as well as certifications of occupational health and safety management systems according to OHSAS 18001 (n=31) played an important role.

The trend toward certification of energy management systems diagnosed since the 2018 survey was also confirmed again in the course of the initial certifications surveyed this year. Initial certifications of ISO 50001 increased slightly more than those of ISO/IEC 27001 or ISO 14001. Compared to the previous year, a slightly smaller proportion of companies were certified. Since the survey period does not yet cover the beginning of the Corona pandemic, it can be assumed that this can be explained by fluctuating sample compositions. Next year's survey will show the extent to which the crisis has affected the number of initial certifications.

IMPACT OF THE CORONAVIRUS PANDAMIC ON STANDARDS AND STANDARDIZATION

Standards are the result of collaborative efforts among stakeholders from industry, science, government and society to create rules that ensure product interoperability and enhance quality, safety and environmental protection. As part of the global quality infrastructure, they have been essential to the resilience of global value and supply chains in the crisis triggered by the Corona pandemic. They have been a key support factor for health systems in responding to the spread of the virus.[6] Particularly the stable operation of laboratories, the application of testing procedures, and the production of medical devices such as masks and ventilators benefited greatly from existing quality infrastructure.

As the pandemic also potentially impacted the quality infrastructure itself, the focus of the survey was to examine how resilient standardization was in response to the crisis. The main assumption was that the consensus-building process in particular, which requires a large number of participants and a high level of coordination, was challenged by COVID-19. At this point, the standardization system was challenged by the need to quickly reorganize processes, and in particular to move to full digital operations. In addition, negative demand shocks in most markets suggested that the resources of standardizing companies were being reduced, calling into question the sustainability of their standardization activities. Central questions that were targeted by the 2020 special section were therefore: To what extent are standardizing companies affected by the crisis? What is the role of standardization in the crisis, and how are standardization activities and the perception of standards changing? How strong is the digitalization effect in standardization and how are changes perceived by those affect by them?

Standardizing organizations were affected by the pandemic

The business of participating companies was clearly affected by the pandemic.The most substantial negative effect was due to a decline in demand or the cancellation of existing orders, which applied to 72% of all organizations. Even more common was a negative effect of staff shortages due to illness, quarantine, or child care, etc. In total, 81% stated to have been affected by this factor; however, on average less strongly than by declines in demand. This was followed by effects that hindered production and sales, either by making access to raw material or intermediate products more difficult (71%), or by affecting logistics, e.g., in distributing products to customers (60%). Around half of the organizations were affected by (temporary) closures of subunits such as factories or stores (48%), or liquidity shortages (49%). Only a small fraction of respondents (13%) stated that their organization had shut down completely.

An industry-level comparison of average impact (Table 1) showed that automotive and mechanical engineering and plant construction were significantly stronger affected in most effect categories. In contrast, organizations in the service industry faced fewer problems with material flow and logistics, while the construction indus-

[6] *UNIDO (2020): „Quality & Standards and Their Role in Responding To Covid-19", United Nations Industrial Development Organization.*

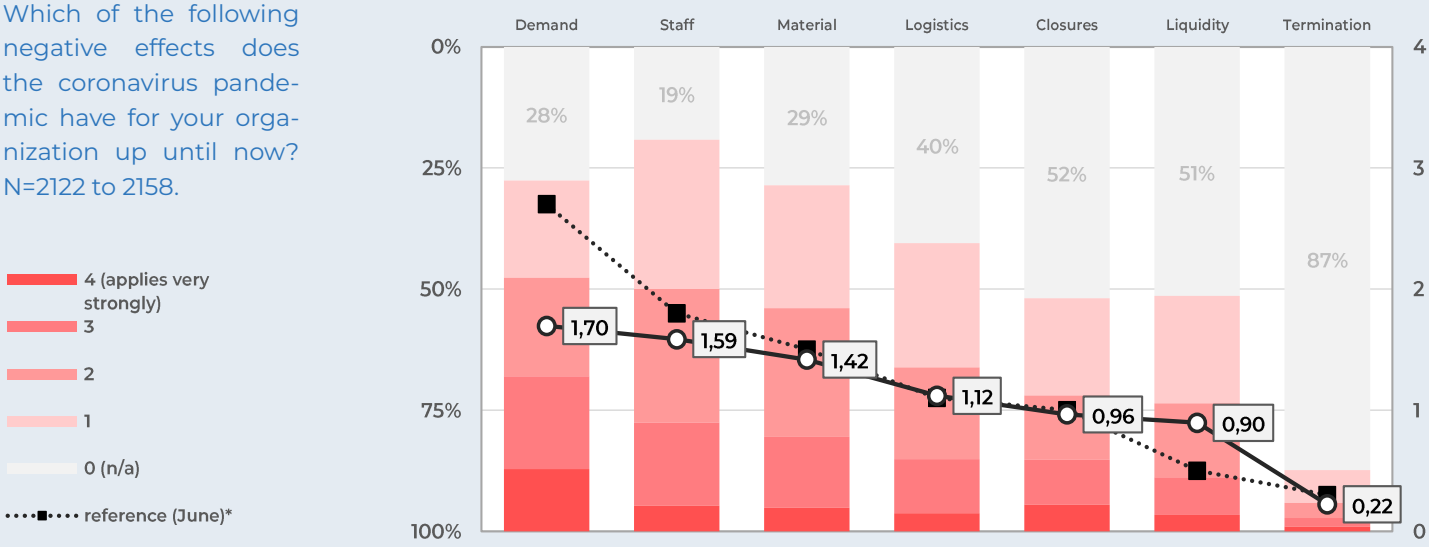
try suffered less from a drop in demand. Large companies (250+ employees) were more affected by staff and material shortages or logistical difficulties than smaller organizations. The crisis seemed to affect digital champions less. Horizontal collaborators and vertical integrators were more likely to report problems with staff availability, while digital novices were more likely to be affected by cash flow shortages. The proportion of companies constrained by partial or temporary closures increased slightly between the start of the survey in October and the later responses in November/ December.

Figure 9 shows the average impact rated on a 5-item scale alongside corresponding shares of companies affected by the factors. In addition, the equivalent average from a representative survey of German companies from June 2020 is included as a reference (dotted line). A comparison of both averages shows that the impact of the pandemic on standardizing companies is mostly in line with that on average German companies. Visible differences, particularly with regard to a drop in demand and liquidity bottlenecks, can possibly be explained by the dynamics of the crisis. While in June, companies were more affected by a drop in demand that was noticeable at the beginning of the crisis, the situation stabilized toward fall. At the same time, more companies used up their reserves in the course of the pandemic, resulting in increasing liquidity bottlenecks.

Figure 9

Which of the following negative effects does the coronavirus pandemic have for your organization up until now? N=2122 to 2158.

Negative impact of the pandemic on standard-setting companies



*Reference survey BMWi: https://www.bmwi.de/Redaktion/DE/Downloads/B/betroffenheit-deutscher-unternehmen-durch-die-corona-pandemie-zweite-erhebungswelle.pdf?__blob=publicationFile&v=10

Surveyed companies mostly did not perceive standards as instruments that helped them to mitigate the negative effects of the pandemic. In response to the corresponding question on a 5-point scale from 0 (not at all) to 4 (very much), 59% indicated that standards did not help "at all." Perceptions of support from company standards (65% "not at all"), technical rules or specifications (65%), de-facto standards (69%) and consortium standards (74%) were even lower. There were significant differences between the secondary and tertiary sectors in these assessments: on average, company standards were rated as significantly more helpful by secondary sector, while the opposite was true for formal standards, technical rules or specifications,

and consortia standards.

During the course of the pandemic, standard-setting organizations such as DIN or CEN had made relevant standards (e.g., for medical equipment) available for free. In total, 9% of all respondents stated to have downloaded or applied these standards in response to the crisis. This share was significantly higher among medical engineering firms and certification and testing organizations (13%). Two open-ended questions on the application (n=95 responses) and certification (n=53) of standards showed that standards for medical products such as masks, safety glasses, or gloves (EN 149, EN 14683, EN 13795, EN 455, etc.) were the most applied. Respondents also emphasized the relevance of company standards, risk/crisis management standards (ISO 31,000, ISO 22301), and IT standards (ISO/IEC 27001, etc.). Certifications in response to the pandemic were mostly carried out for health & safety standards like ISO 45001 / OHSAS 18001, general management standards (ISO 9001, ISO 14001), or specific standards for medical products (EN 14683, ISO 13485, EN 166).

Perception of standards stable

With the help of the data collected in the core section since 2013, possible changes with regard to the perceived importance of standards and the impact of various standards on the success factors of companies were examined. The companies' perceptions pointed in two directions. First, the importance of standards remained constant compared to previous survey waves. Figure 10 (left) shows the mean importance by year based on weighted samples. While the secondary sector puts more emphasis on formal standards on European level and (internal) company standards, the tertiary sector is more nationally oriented and perceives the importance of company standards on the same (low) level as consortia standards. This picture did not change in 2020: t-tests of the differences between means (2020 vs. 2019 / 2020 vs. rest) were not significant on a 95% confidence level.

On the other hand, the perceived influence of standards on success factors appears to have decreased since the pandemic. As Figure 10 (right) shows, assessments of the impact of various standards on success factors decreased on average. The only exception was the impact of de-facto standards on legal certainty, which was rated higher on average. The differences were particularly significant for the market-related functions of standards. In particular, the positive effects on ensuring legal certainty, facilitating market entry and improving bargaining positions vis-à-vis suppliers and customers decreased slightly (but statistically significantly). This pattern held true for standards, technical rules or specifications, and external company standards. One possible interpretation is that the impact of standards was perceived to be weaker due to the sharp change in challenges during the crisis. Faced with abrupt drops in demand and the short-term conversion of work and logistics processes, companies had to react dynamically. New regulations introduced at short notice may not have been able to build on standards. In addition, the assessment of the impact of standards on success factors must be seen relative to other success factors. As other factors gained in importance during the crisis (ability to reorganize, digitalization, diversification opportunities, etc.), the impact of standards may have paled somewhat in comparison.

The assessments of internal company standards consistently fell in all categories. However, this trend is not necessarily driven by the Corona pandemic, but may be part of a general trend. Ratings for internal company standards had already trended

Figure 10

Importance of standards

Average importance 2013 to 2020

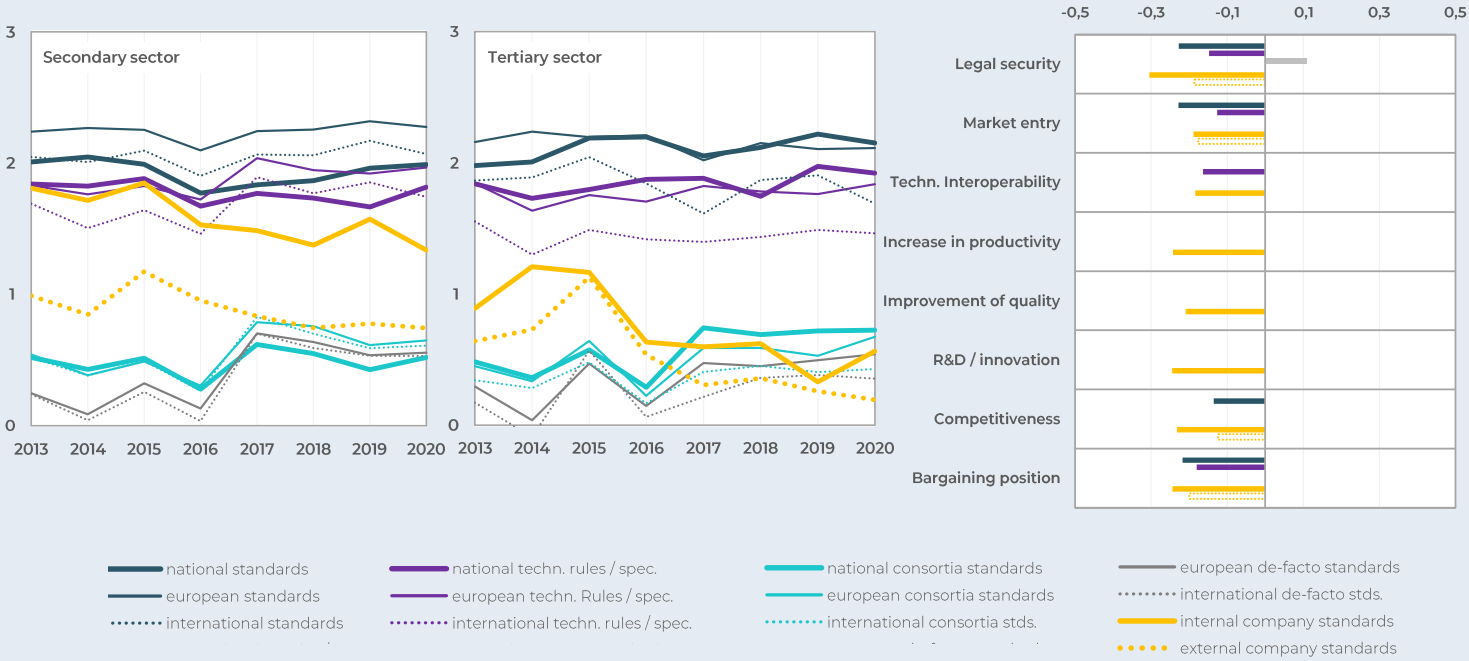
Scale: Very unimportant (-3) to very important (+3). Weighted samples.

Secondary sector: n=7,869 ratings, tertiary sector: n=2,808 ratings..

Effect on success factors

Change in average impacts 2020 compared to overall average 2013 to 2019.

Scale: Very negative (-3) to very positive (+3). Weighted samples. Only statistically significant. Without differentiation acc. to regional levels.



negatively over the previous eight years. Similarly, their average importance for the secondary sector had declined almost continuously since 2013 (see Figure 10, left).

Standardization activities continue

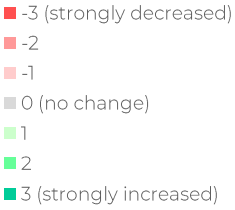
In the course of the restrictions introduced in 2020 to contain the pandemic, standardization also switched to remote operation. At DIN and DKE, for example, all committee meetings were held digitally from spring onwards. The assessments of the survey participants show that standardization activities were only slightly affected by this. The majority of organizations (55%) stated that their corresponding workload did not change in formal standardization (Figure 5). The rest was almost equally split between de- (23%) and increase (22%). An even higher share of participants noticed no changes in consortia (67%), while the rest was also equally split. Going into more detail, we asked about the development of the level of participation, the change in output of new standards, and the change in the emergence of new standard-setting topics. Each of these aspects revealed results similar to the overall workload. No change was perceived for the level of participation in formal standardization by 61% of organizations (73% for consortia). Equivalent values lay at 71% (formal standardization) and 81% (consortia) for the development of new stan-

dards, and at 70% (formal standardization) and 79% (consortia) for the emergence of new topics. Again, the remaining responses were very evenly distributed between increases and decreases, so that the average absolute change for each question was close to zero for both standardization and standardization activities in consortia.

We examined the assessments for differences in the characteristics of the responding companies and the timing of the response. We found that companies were more likely to report an increased workload for standardization and in consortia in December than in October or November. This perception deviated downward only for Vertical Integrators on average. Overall, standardization activities in formal standard-setting organizations and in consortia appeared to have increased over the course of the survey.

Figure 11

N = 1940 to 2007



Has the overall workload in standardization committees changed?

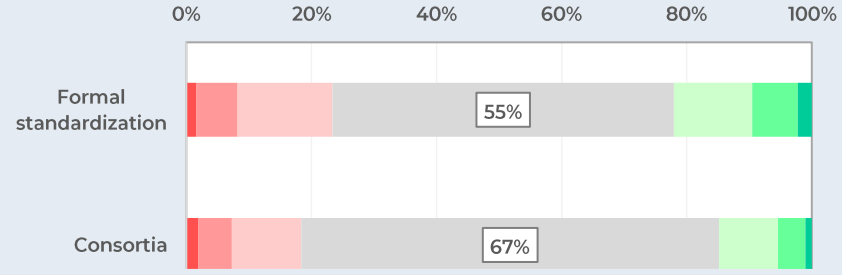
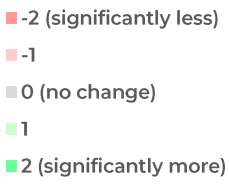
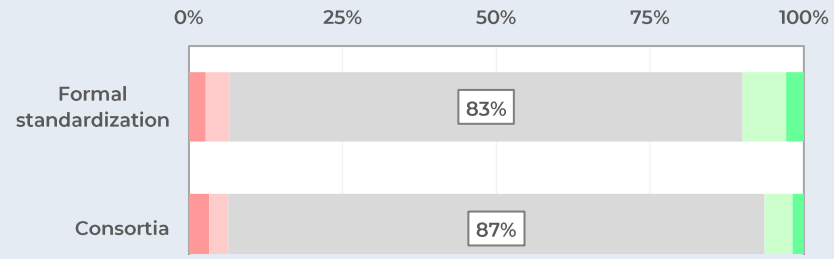


Figure 12

N = 2136 to 2151

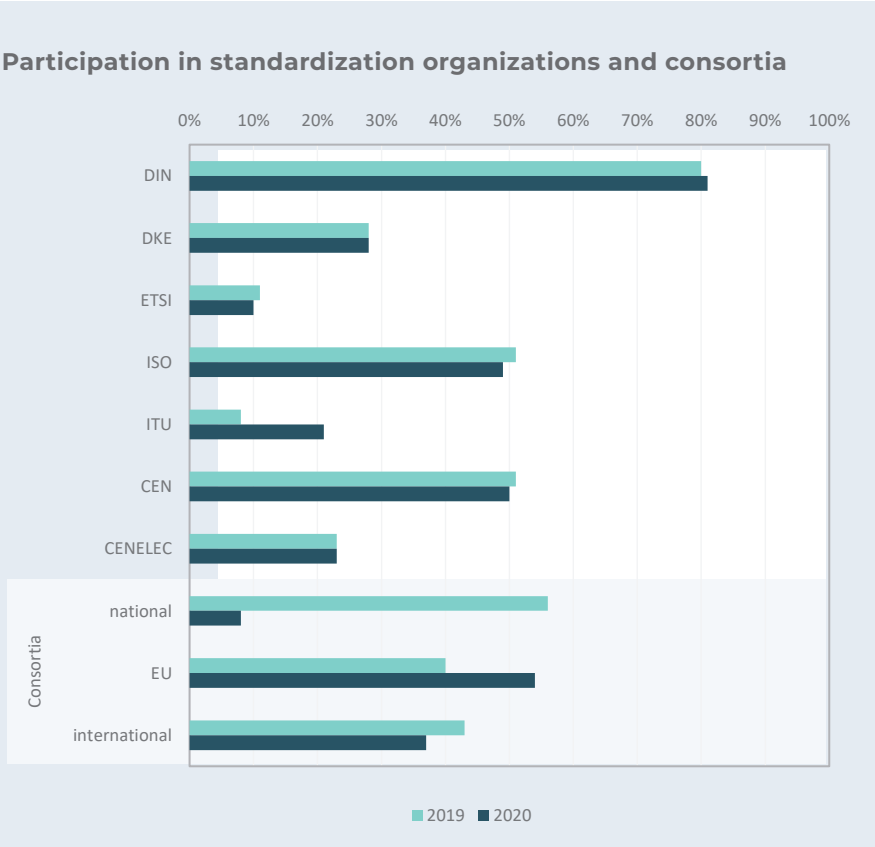


Have you changed or are you planning to change your participation in standardization due to the coronavirus pandemic?



The questions described above were mostly aimed at investigating changes that were caused by external restrictions of standardization activities. In an additional question we therefore addressed participants' standardization intentions that were potentially shaped by internal company decisions (e.g., changed standardization budgets). Here, a large proportion of companies stated that they had not changed their participation in standardization due to the pandemic, and were not planning to do so (Figure 12). This proportion lay at 83% (standardization) and 87% (consortia). 10% stated that they had actually increased their participation in standardization or were planning to do so (equivalent 6% for consortia). Multivariate analyses revealed no significant differences when accounting for company characteristics.
The overall stability of participation was reflected in activity in various standards-setting organizations and consortia (Figure 13). Participation values from

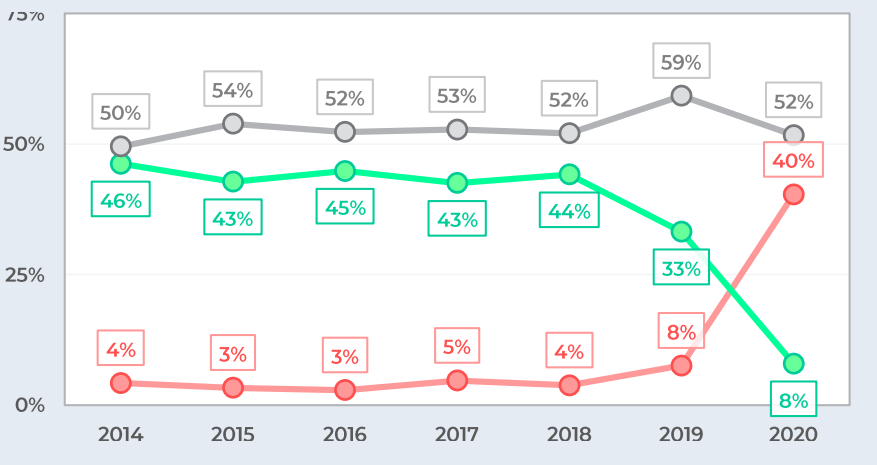
Figure 13
Participants who were active in at least one respective committee or consortium. N>1600



2019 remained nearly constant, with most participants at DIN (81%) and about half at CEN (50%) and ISO (49%). Participation at ITU was even more pronounced in 2020 than in 2019, where the proportion of active companies increased from 8% to 21%.[7] A stronger change was observed with regard to standardization activities in consortia. Participation in national consortia fell from more than half of the sample in 2019 (56%) to 8% in 2020. In contrast, the proportion of companies active in international consortia increased. This was most evident at the EU level, where 54% of companies reported participating in at least one consortium, in contrast to 40% in 2019. While activity in consortia also remained relatively stable, companies here seemed to substitute participation at the national level with participation at the international level. This was possibly attributable to easier (or cheaper) access

Figure 14

Weighted samples, eff. sample size N=2,128.



[7] *A potential reason for this could have been the ITU's World Telecommunication Standardization Assembly (WTSA) planned for November 2020, which might have raised additional interest by participants.*

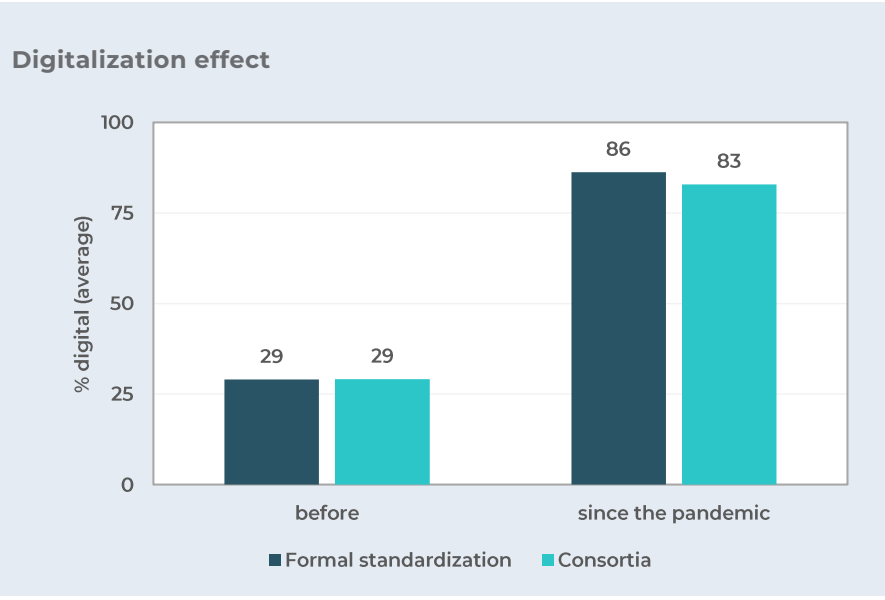
to international standardization.

The stability of standardization activities was contrasted by negative changes in related expenditures. Questions that targeted the exact (numerical) expenditures yielded few and unreliable responses. We therefore instead refer to categorical responses from companies with standardization departments (which also arguably have a better overview of this type of spending). As Figure 14 shows, about 92% to 97% of all companies with standardization department had increased or held constant their standardization-related spending from 2014 to 2019. In 2020, this share dropped to 60%, while the proportion of organizations that reduced their spending increased to 40%. The decreased spending combined with unchanged standardization activities indicates efficiency gains associated with increased digitalization levels and reduced travel.

Strong digitalization effect also in standardization

During the pandemic, physical meetings were replaced by digital remote meetings. The fraction of digital work increased from an average of 29% (mode=10%) to 86% (mode=100%) in formal standardization and 83% (mode=100%) in consortia (numerical entry in 5% steps, Figure 15). This digitalization effect was roughly the same across all industries. It affected all companies regardless of size or digital maturity level. Participants indicated that the pandemic had somewhat advanced the digitalization of work, both in their core business and in standardization. However, on the scale of -3 "strongly inhibited" to +3 "strongly promoted," the effect was significantly more pronounced for core business, averaging +1.5, than for standardization and standardization, at +0.8. The effect on core business was significantly higher on average for universities, associations and societies than for other industries. The smallest difference between digitalization in core business and standardization, and an overall significantly higher digitalization effect on standardization activities, was recorded by certification and testing organizations, possibly because here participation in standardization is often counted as part of the core business. A comparison of weighted samples also showed that the digitalization effect of those responding in December was slightly stronger than in the previous two months.

Figure 15
To what extent was the work done digitally / remotely?
N = 2007 to 2021

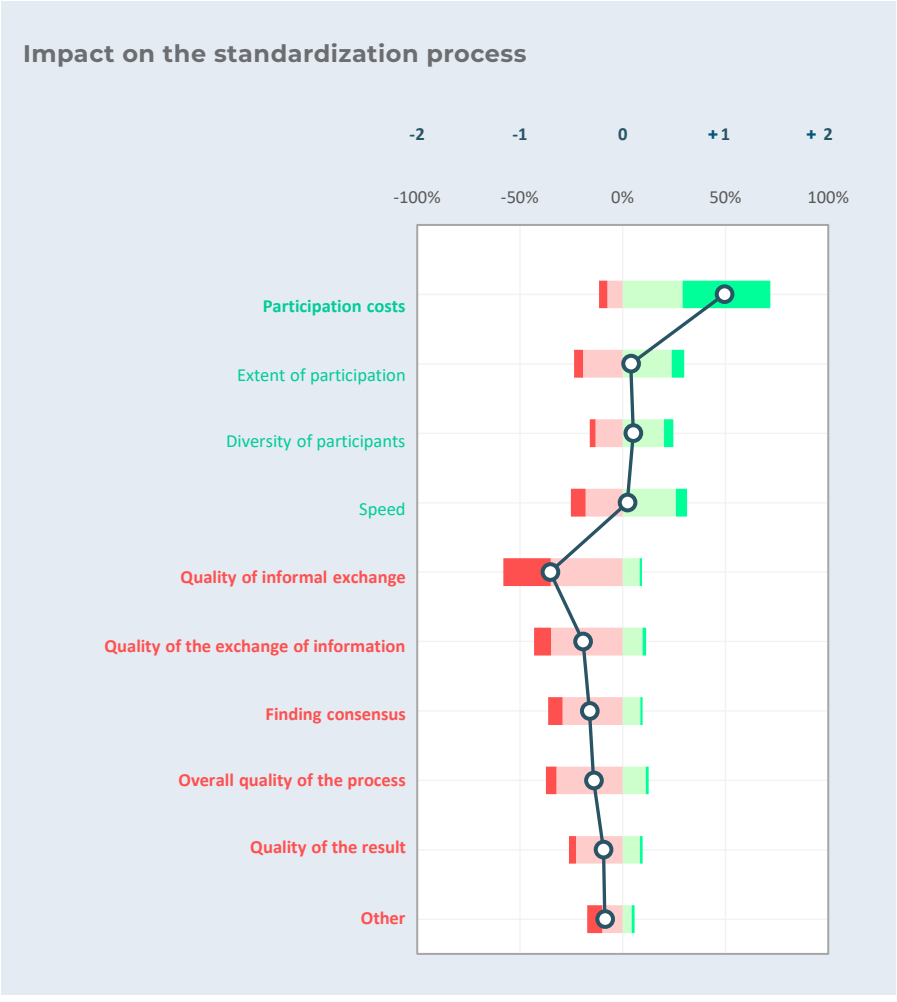


We investigated the effect of the digitalization of processes on different aspects related to participation costs, the extent of participation, quality, and speed (Figure 10). On a 5-item scale, respondents could state whether the aspects had strongly deteriorated (-2) to strongly improved (+2) during the pandemic. The question was asked for formal standardization and standardization in consortia, but responses did not show considerable differences. For both contexts, two aspects could be clearly assigned to either side of the scale. On the positive side, a majority of 72% stated that participation costs had improved in formal standardization. This included travel costs, which were the most important cost factor judging from the responses to open follow-up questions (see below). On the negative side, the largest effect of digitalized formal standardization processes was the deterioration of the quality of informal exchange, which was reported by 58% of respondents, in particular by very large organizations (1,000+). Opinions were almost equally split between positive and negative effects on the extent of participation, the diversity of participants, and the speed of processes. Aspects that were more often seen as having worsened were related to process and output quality: 37% of respondents perceived lower overall quality of the standardization process, 43% lower quality of information exchange, 36% reported worse consensus-finding, and 26% lower quality of results.

A large number of respondents (n=397) used the text field of the additional item "other" to give more detailed accounts of the effect of the digitalization of standar-

Figure 16

Do corona-related changes have a positive or negative impact on the standardization process?
N = 1187 to 1947

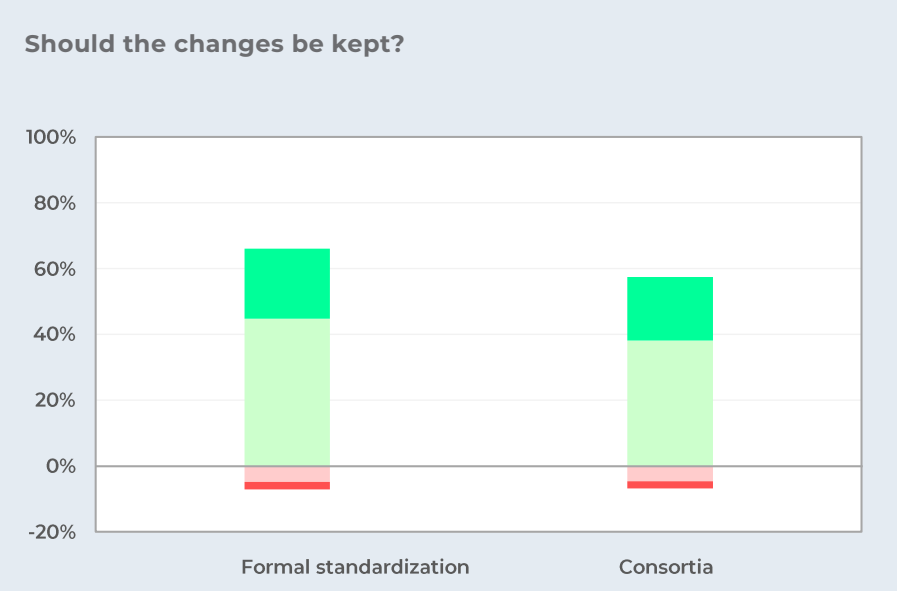


dization processes. The most discussed topic was the negative impact on the quality or extent of informal exchange (stated by 51%) or the exchange in general (11%). Some complained about a total absence of informal exchange, while others described a lack of depth, clarity, or understandability in digital exchange. Many stated that the lack of informal exchange made communication more difficult, especially by reducing the social aspects of collaboration. The most positive effects were the suspension of travel (5%) (not only in regard to saved costs, but also as a reduction of effort on a personal level), shorter and more frequent meetings (17%), and more participation (4%), especially internationally. In addition to re-stating and giving their opinion on some of the aspects already available as items in the original question, some respondents raised new aspects. These were often related to personal and social effects, such as decreasing motivation or commitment to contribute in meetings ("zoom fatigue"), loss of "team spirit," or concentration difficulties (7%). Another stated negative effect was the more complicated integration of new participants due to lower acceptance without personal contact and more challenging onboarding processes (3%). Further remarks that were collected in an additional open-ended question painted a similar picture (n=278). Here, 19% stated that digital meetings made coordination easier, while 14% stressed that more informal exchange was needed, 12% commented that in-person meetings were irreplaceable and that the current form of exchange was cumbersome (10%). Some participants (8%) requested more modern communication tools, while others (7%) proposed hybrid meetings (some participants meet in person, others join digitally) as a better solution for the future.

Figure 17

Should changes in the standardization process be kept in the long term?

+2 (keep all changes)
+1
0
-1
-2 (take back all changes)



Answers to the question "how will these aspects change in the future?" (n=860) matched the same pattern. Most respondents envisioned future standardization processes to be more often based on digital or hybrid meetings (51%). Many commented on the generally positive effects of the pandemic on the digitalization of standardization processes (30%), sometimes referring to higher speed and productivity (5%). The share of comments stating negative effects was lower (15%) and most often related to a deterioration of output quality (5%). Accordingly, the majority of respondents wanted to keep all or some changes to the processes in standardization (66% formal standardization, 57% consortia, Figure 11), only 7% wanted to revert the processes to the format from before the pandemic.

Summary

The results show that standardizing firms were affected by the pandemic, mainly by a decline in demand, staff shortages, and logistical difficulties. However, the system showed growth in participation and workload during the weeks of the survey (Oct-Dec). This likely followed an initial shock at the beginning of the pandemic, which resulted in the re-organization of structures and processes. Participation in formal standardization had not changed significantly compared to 2019, except for more participants at ITU and a shift from national to international consortia. The latter could be related to reduced differences in participation costs between national and international consortia, e.g., due to inability to travel.

Standards were perceived as a mitigation tool by only a few. Accordingly, the proportion of companies that introduced new standards, or recertified, in response was small. The offer of free access to relevant standards (especially for medical devices) was also used by only a few companies, mostly those from the testing and certification sector and medical engineering companies. While the overall perception of the importance of standards remained largely unchanged, the (perceived) influence on success factors decreased slightly. This can possibly be interpreted as a change in relative influence, as other factors for corporate success, such as reduced demand and personnel availability, dominated over standards-related factors during the crisis.

The workload created by developing standards remained constant or even increased for most firms. A very high share of organizations (93%) reported not having lowered or planned to lower their standard-setting activity due to the pandemic. These numbers were a bit lower when asked explicitly about perceived changes in the level of participation, the output of new/adapted standards, and approached new topics. Apparently, there was a difference in organizations' intentions to be active in standard-setting and to which extent they were able to realize their activities. An interpretation of this difference could be that limitations to standard-setting activities were rather evoked by restrictions and new rules raised by the system than being rooted in the reduction of efforts by the participating organizations due to new financial constraints. This suggests that it is likely that after restrictions imposed due to the crisis, the extent of standard-setting activities will return to old levels.

In contrast to relatively stable levels of activity, there cappeared to be a significant drop in expenditure for standardization activities. In 2020, 40% of organizations had reduced their budgets for dedicated standardization departments. It might appear that lower expenditures are inconsistent with stable levels of activity and the expressed intentions to keep up standard-setting efforts. A simple explanation, however, is the drastically increased level of digitalization which led to reduced costs (e.g., travel costs). From this perspective, lowered expenditures can be understood as a sign of increased efficiency.

The average fraction of digital/remote work rose from 29% before the pandemic to 86% since. It is not entirely clear how the remaining fractions of non-digital/non-remote work were performed, but it could be a reference to activities within organizations, such as internal in-person meetings in preparation for digital exchanges in technical committees. The increases were consistent among all surveyed industries and all digital maturity levels, indicating that the switch to digital processes had happened in all areas of standardization and had included the whole spectrum of participants.

While digitalized processes had a cost-cutting effect and facilitated the participation of new players, there was also criticism of them. In some cases, the quality of the standardization process and the resulting standards was perceived to be lower. The lack of informal exchange was usually cited as a central reason for this. Judging by the focus of the participants in the open questions, this aspect also seems to have suffered most from the "digitalization shock". This is a perfectly understandable point. For example, discussion and consensus-building processes are often based on informal, face-to-face interaction, which simplifies the exchange of complex knowledge. From this perspective, digital channels can reduce the capacity for information transfer, making consensus building more difficult. On the other hand, digital meetings also help reduce information asymmetries within committees, and between committees and external stakeholders. Easier access to standardization, especially through reduced travel and thus time and cost, can increase the number of participants and diversity, and thus further enhance the quality and legitimacy of standards.

Overall, standard-setting companies are very positive about the changes introduced in the Corona pandemic and, for the most part, intend to maintain them. As in other areas of society, changed forms of work in standardization must be further optimized. A key aspect here is to strike a balance between the efficiency gains from digitaliaztion and the benefits of personal, informal exchange.

CONCLUSION

Key findings after the ninth survey of the German Standardization Panel

Standardizing companies are mainly affected by a decrease in demand, staff shortages and worsened logistics. However, the standardization system showed stable levels of participation and workload that increased during the weeks of the survey (October to December 2020). This likely followed an initial shock at the beginning of the pandemic that led to a reorganization of structures and processes. Participation in formal standardization had not changed significantly compared to 2019, with the exception of more participants at the ITU and a shift from national to international consortia. The latter could be related to smaller differences in participation costs between national and international consortia, e.g., due to travel costs.

Only few companies perceived standards as a specific tool for handling the crisis. The proportion of companies that introduced new standards, or introduced new certification as a response to the crisis was accordingly small. The offer of free access to relevant standards (especially for medical devices) was also only used by few companies, mostly those active in testing, certification, and medical engineering. While the overall perception of the importance of standards remained largely unchanged, the (perceived) influence on success factors decreased slightly. This can possibly be interpreted as a change in relative influence, as other factors for corporate success, such as reduced demand and staff availability, dominated over standards-related factors during the crisis.

The workload associated with standardization remained constant or even increased for most companies. A very high proportion of companies (93%) reported that they had neither reduced nor planned to reduce their standardization activities as a result of the pandemic. These numbers were somewhat lower when explicitly asked about perceived changes in the level of participation, the output of new/adapted standards, and the amount of new topics. Apparently, there was a difference between the motivation of companies to be active in standardization and the extent to which they were able to realize their intentions. Lower levels of standardization activity may have been rather caused by restrictions and new rules in the standardization system than by constraints originating from companies themselves.

In contrast to the relatively stable levels of activity, there appears to be a significant decrease in spending on standardization activities. In 2020, 40% of responding companies had reduced their budgets for dedicated standardization departments. Lower spending seems inconsistent with stable activity levels and expressed intentions to maintain standardization efforts. A simple explanation is the strong digitalization effect, which led to reduced costs (e.g., travel expenses). From this perspective, the decreased spending can be understood as a sign of increased efficiency.

The average share of digital standardization activities increased from 29% to 86% during the pandemic. The remaining shares of non-digital work could be internal company standardization activities, such as face-to-face meetings to prepare (digital) committee meetings. The increased digital activity was consistent across all

surveyed industries and different levels of digital maturity levels, indicating that the shift to digital processes has taken place in all areas of standardization and spanned the entire spectrum of standardizing companies.

While digitalized processes had a cost-reducing effect and encouraged participation of new actors, there was also criticism of them. In some cases, the quality of the standardization process and the resulting standards was perceived to be lower. The lack of informal exchange was usually cited as a central reason for this. Also judging from most participants' responses to open questions, this aspect seems to have suffered most from remote work and digitalization. This is plausible: Discussion and consensus-building processes are often based on informal, interpersonal interaction, which simplifies the exchange of complex knowledge. Digital channels can reduce the capacity for information exchange, making consensus building more difficult. On the other hand, digital meetings also help reduce information asymmetries within and between committees and external stakeholders. Easier access to standardization, especially through reduced travel and thus time and cost, can increase the number of participants and diversity, thereby further enhancing the quality and legitimacy of standards.

Overall, standard-setting companies assessed changes that were introduced in the Corona pandemic positively, and, for the most part, would prefer to keep them in the future. As in other areas of society, changed forms of work in standardization must be further optimized. A key aspect here is to strike a balance between the efficiency gains from digitalization and the benefits of personal, informal exchange.

SURVEY DETAILS

The German Standardization Panel is conducted by the Department of Innovation Economics at the Technical University of Berlin (TU Berlin) and is financed and supported by DIN and DKE.

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.

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 effect of the coronavirus pandemic on standardization
3. Formal and informal standardization activities
4. General information

The complete questionnaires of all surveys since 2012 can be downloaded from the DNP website: normungspanel.de

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 andEuropean 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 consortium 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 whichensures 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 Germannational organization responsible for developing standards and safety specifications in electrical engineering, electronics and information technology. Its workresults 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).

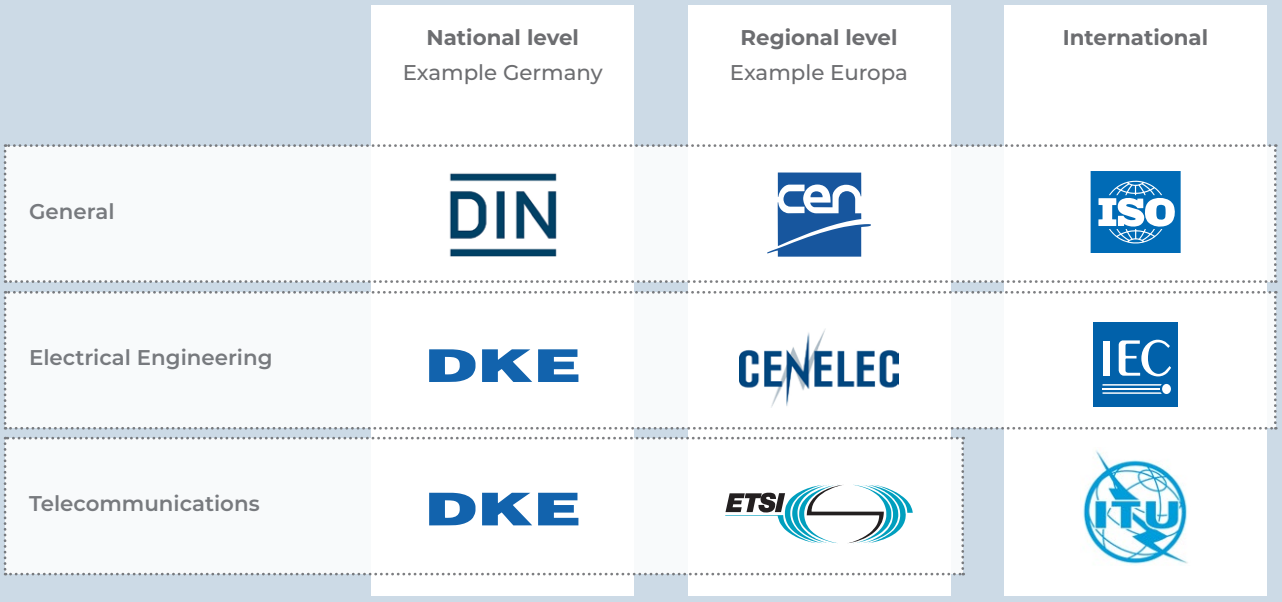
European standards organizations

IIn Europe, standards are drawn up by the three officially acknowledged Europeanstandards 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. Germaninterests 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 **Structure of international standardization** (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 com-

mittees 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.

Consortium standards Like specifications, consortium 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.

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.

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