

THE INFLUENCE OF STANDARDS ON THE NORDIC ECONOMIES





Preface

This study is conducted by Menon Economics in cooperation with Oxford Research and the Social Science Research Institute of the University of Iceland. Together we represent a cross-Nordic project group cooperating on an analysis of how increased use of standards influences economic development in the Nordic countries.

The study was commissioned as a joint initiative by the Nordic standardization bodies: Standards Norway (SN), Danish Standards (DS), Swedish Standards Institute (SIS), Finnish Standards Association (SFS) and Icelandic Standards (IST). Nordic Innovation – an institution that works to promote cross-border trade and innovation between the Nordic countries – has contributed with financial support.

The project work started in May 2017 and was finalized in May 2018. The study has succeeded in giving a broad perspective on the impact of standardization in the Nordic economies, and what benefits it provides to Nordic companies. We believe that the report will provide valuable new insight to companies as well as decision-makers, politicians and authorities in the public sector focusing on efficient sustainable economic growth.

Apart from making a contribution to a better understanding of standardization in the Nordics, the study is in itself a good example of the value of cross-Nordic cooperation. In the course of the project, we have cooperated closely with the project reference group led by Erik Winther (SN) with participants from all the Nordic standardization bodies. Each of the participants has made a valuable contribution to the study, and I would like to take the opportunity to thank each and every one of you for your time, effort and patient cooperation. Without the data and skilful advice from the reference group, this project would certainly not have been possible. Moreover, the study has been supported by the steering group where the managers from each of the Nordic standardization bodies have contributed in the process.

Not least, I would like to thank my colleagues. The project team represents a diverse group of social scientists from different parts of the Nordic region: Eirik Dyrstad, Endre Kildal Iversen and Peter Aalen from Menon Economics, Elisabet Hauge, Roe Langaas, Jakob Falk, Jens Marl Christiansen, Arttu Vainio and Vesa Kokkonen from Oxford Research, and Guðbjörg Andrea Jónsdóttir and Guðný Gústafsdóttir from the Social Science Research Institute of the University of Iceland.

On behalf of the project team, I would also like to thank the respondents that used their time to answer the web survey and give interviews. All remaining errors are the authors'.

May 2018

Gjermeund Grimsby
Project leader
Menon Economics

Contents

EXECUTIVE SUMMARY	3
1. INTRODUCTION – THE IMPORTANCE OF STANDARDS IN THE NORDICS	7
2. STANDARDIZATION AND PRODUCTIVITY AT THE MACRO LEVEL	10
2.1. Measuring the development of standardization over time	10
2.2. Standards and productivity in the Nordic economies	11
2.2.1. Testing the relationship between standards and productivity	12
2.2.2. Standardization and growth in labour productivity and GDP	15
2.2.3. Comparison of results with other studies	17
3. INFLUENCE OF STANDARDS AT COMPANY LEVEL	19
3.1. The survey respondents	19
3.2. Cross-sector findings from the Nordic survey	22
4. BENEFITS OF STANDARDS AMONG THE SECTORS STUDIED	31
4.1. Construction products and services	31
4.2. Manufacturing industry	41
4.3. ICT	46
4.4. Healthcare	51
4.5. Petroleum production	58
4.6. Process industry and materials	64
4.7. Trade	71
4.8. Seafood and fisheries	75
5. PARTICIPATION IN STANDARDIZATION WORK	81
6. CONCLUDING REMARKS	84
REFERENCES	86
APPENDIX	87
A1. Explanation of technical terms	87
A2. Methodology and data for estimating the correlation between productivity and standardization	88
A3. Development of patents in the Nordic countries	89
A4. Regression results on the national level	90
A5. Robustness test: Regression results based on industry level data	91
A6. Regression results for selected industries	92
A7. Sector definitions	94
A8. Questionnaire – Web survey	96

Executive summary

The world is in need of further, sustainable growth. Ever since the Austrian economist Joseph Schumpeter's seminal work in the 1930s, it has been recognized that innovation in products and processes is a prerequisite for long term economic growth. To ensure persistent economic growth over time, it is however not sufficient to create new knowledge through research and development. The knowledge must also be spread and applied by a broad group of companies and institutions. Standards that are developed in consensus with the participation of companies are an effective means for spreading and applying knowledge, and in turn creating benefits for the wider economy.

In this report, we study the impact of voluntary consensus standards on economic growth in the five Nordic countries: Sweden, Finland, Norway, Denmark and Iceland. We address the topic using different complementary approaches:

- **Macroeconomic approach:** Econometric estimation of a productivity model including stock of standards as an explanatory variable covering all five Nordic countries over a time span of nearly 40 years.
- **Company level approach:** A comprehensive business survey on the benefits of standardization covering 1 179 Nordic companies with prior experience from the use of standards. Case studies based on in-depth interviews with companies in different industries and countries throughout the Nordic region.

The key findings from the study are:

Macroeconomic approach

We find that standardization has contributed to increased labour productivity in all of the Nordic countries. In particular, the econometric study shows that:

- Doubling the stock of standards is associated with an **increase of 10.5 percent in labour productivity** across the Nordic countries. This estimate is close to a consensus estimate from previous international studies applying similar methodologies. The positive association between stock of standards and increased productivity is **statistically significant**, both when we consider the Nordic region as a single entity, as well as when we estimate the relation for each country individually.
- Given the average growth in stock of standards in the Nordic countries of 6.8 percent during the period studied (1976-2014), standardization is associated with an **annual increase in labour productivity of 0.7 percent per year** of a total average growth of 1,8 percent. This result suggests that **standardization is associated with as much as 39 percent of the labour productivity growth and 28 percent of GDP growth** in the Nordic countries during the period.

We also perform separate estimations for selected industries across the Nordic countries. The most reliable results are found within the construction sector. We find that doubling the stock of standards available for the **construction sector is associated with an increase in labour productivity of 6.9 percent** within the sector. Given the annual growth rate in the stock of standards relevant for the sector during the estimation period 1976-2014, standardization is associated with an annual increase in labour productivity of 0.6 percent within the construction sector.

The above-mentioned findings should be interpreted with caution. Standards are used as a proxy for the dissemination of knowledge within the economy and should therefore be regarded as an important indicator of a broader infrastructure supporting that process. Standardization plays a symbiotic and complementary role with factors such as rules and regulations and technological development, only partly controlled for in the estimation model. While standards are central to this process, they form part of a broader architecture and it is therefore necessary to treat the findings as upper bound estimates.

Company level approach

The business survey covers companies from eight different sectors; five sectors in each country. Iceland is an exception here as it only has respondents from three sectors of the economy. The survey provides a detailed explanation of the high positive association between productivity and standardization observed at the macro level. Moreover, the survey reveals that following and applying standards is an important part of Nordic companies' business plans, which gives a strong indication that standards also will be important for future economic development. In particular, the business survey shows that:

- **The most important reason** for companies to use standards is to **improve market access** (34 percent of respondents), **improve product/service quality** (32 percent of respondents) as well as **reduce risk** (26 percent of respondents).
- Companies experience **similar benefits of standards independently of which country they operate from**. This result is consistent with the findings from the macroeconomic impact analysis.
- A large majority of the companies (87 percent) consider **standardization an important part of their future business plans**. This supports the hypothesis that standardization is an important business tool in the modern economy.
- **Three out of four firms (73 percent) consider benefits to exceed costs of standards**, while 18 percent say that benefits equal costs. In general, the larger the company, the more likely it is to experience that the benefits of using and implementing standards exceed costs.

Sales, marketing and market access. The respondents confirm that standards are an important means of improving sales and market access for Nordic companies. In particular:

- 85 percent of respondents agree with the statement that **standards create trust and confidence with customers**.
- Three out of four companies report that **standards improve the quality of their products and services** (74 percent) and that standards **simplify the communication between producer and customer** (72 percent).
- 69 percent of exporting companies find that standards **simplify their exporting of goods and services**. Standards appear just as important for facilitating exports for small exporting companies as for larger exporting companies.

Nearly half of the respondents report that standards have helped them to increase sales, either by gaining new customers or increasing sales to existing customers. As much as two out of five companies report that standards have helped them gain new customers, while one out of six companies reports that standards help them gain new customers both in the domestic market as well as in the international market. This result is supported by in-depth interviews where companies across sectors emphasize that following standards often is a requirement for gaining market access. Our findings show that standards are just as important for small as for large companies in gaining new customers.

Ability and willingness to develop innovative solutions. The survey reveals a clear rejection of the notion that standardization is an impediment to innovation. Moreover:

- When asked whether standards prevent their company from developing innovative technology, only 14 percent of the companies responded positively to this claim.
- In fact, six out of ten respondents **emphasize standards as a good means to follow technical developments**. The result is robust across sectors, although regarded as particularly important by companies operating within Seafood and fisheries (73 percent), ICT (67 percent) and Trade (65 percent).

Production and supply chain efficiency. Improvements in production efficiency can be achieved within the boundaries of the company, or it can be done in other parts of the value chain:

- 59 percent of respondents emphasize **that standards simplify purchasing and tendering processes, thus increasing efficiency and saving costs**. This gain from standards is also supported by the in-depth

interviews with companies. Standards contribute to reduced operating costs over time by building a floor for the minimum requirements on the tenderers.

- Consequently, **standards are particularly important in sectors with complex tendering processes** where the quality of the product or service is hard to assess in advance, such as the petroleum, healthcare and construction industries. In these sectors standards' positive effect on simplifying tendering processes is emphasized by about 70 percent of the respondents. In sectors with more transparent products, such as Trade, Seafood and fisheries and Manufacturing, only about 45 percent of respondents consider this benefit important.
- Production errors or receiving a poor-quality product from sub-contractors can be costly. 65 percent of the respondents point out that **standards reduce the risk of manufacturing errors within the company**. The same share of respondents also say that **standards raise the quality of subcontractors**. The result is robust across sectors.
- Half of the respondents, independently of sector affiliation, emphasize that by implementing and following standards they **reduce their company's negative environmental impact**.
- 84 percent of respondents report that **standards help them comply with regulations**. Simplifying procedures to achieve compliance saves the company administrative costs. In addition, following the standard helps the company signal compliance with regulations to the market. The more regulated the sector is, the larger the benefits of following standards that help the companies comply with these regulations. Thus, in the petroleum and the healthcare sectors a respective 94 and 89 percent of the respondents answer that standards help them comply with regulations.

Participation in standardization work. The work of developing new formal standards is organized in projects run by committees. The committee work is facilitated by national or international standardization organizations. The committees are composed of relevant stakeholders for the given topic, including companies within the industry, other experts and public authorities. Results from the survey show that:

- The three main benefits from participating in this work are: Possibility to **influence standards** at the sector level (82 percent), **networking with other experts** (75 percent), and **anticipating changes at an early stage** (73 percent). The result is robust across sectors.
- The survey sample shows that larger companies (250 employees or more) are twice as likely to participate in the work of developing new standards as smaller companies (less than 50 employees). Some smaller companies emphasize that the standardization work is dominated by the larger companies, and thus that the interests of the smaller companies are not sufficiently reflected in the standards. The contrary argument from some of the companies participating in the work is that there are too many companies free-riding on the efforts of others.
- There is a tendency that those who participate in standardization work have a more favourable view on standardization: 90 percent of companies participating in standardization work report that standards are an important part of their future plans, compared to 84 percent of the non-participating respondents. Moreover, 88 percent of participating companies report that standards create trust and confidence with customers, compared to 83 percent of the non-participating respondents.

Looking ahead. Overall, standardization has undoubtedly improved economic performance, facilitated improved user experiences, and contributed to safer and more environmentally friendly work environments. Since the beginning of the 2000s, the growth rate of the stock of standards managed by the Nordic standardization organizations has been steadily decreasing. In the period 2000 to 2009 the average growth rate in stock of standards was about 7 percent, while in the period 2010 to 2014 it has been 3 percent. Still, we do not expect a smaller impulse on productivity growth from standardization in the future. An important reason why the positive association between growth in standards and productivity is so robust across countries in the past is most likely that the use of standards addresses specific recurring problems in the market. As technological development continues, yielding new industries with innovative products and solutions, new recurring problems will arise. In fact, as markets and technological development continue to change more rapidly than ever before, there is reason to believe that the importance of standards and their coordinating role in the market is more likely to increase in the time to come.

Reader guide

The study aims at several audiences; companies and policy makers interested in learning more about the economic impact of standards, national as well as international standardization bodies, certifiers and academics. Covering several topics, including eight business sectors and five countries, the study is extensive. However, the report is constructed in chapters that can be read separately, depending on the reader's personal interest. Here is the guide on how you can read the report:

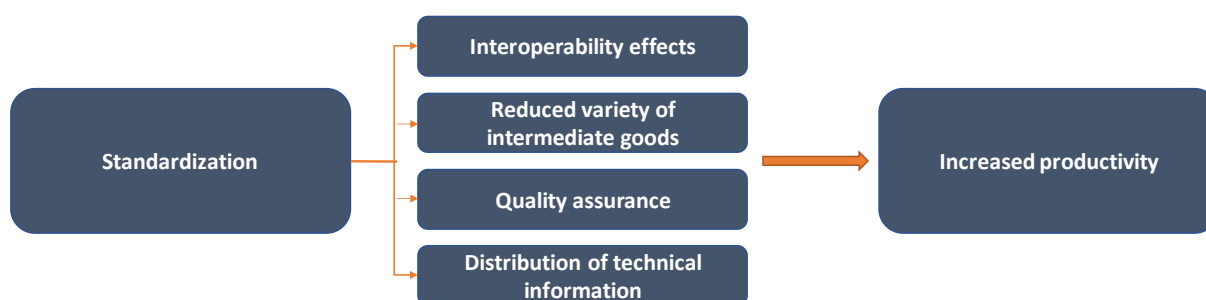
In the beginning of the report, we provide an **executive summary** of the study. **Chapter 1** briefly introduces what a standard is, as well as how, according to theory, one expects standards to affect the productivity in the economy. For readers that are familiar with standards and the economic rationale for applying them, this chapter can easily be skipped. In **Chapter 2** we present a study of the relation between the development of the stock of standards and productivity in the Nordic economies. This chapter should be particularly interesting for policy makers concerned about welfare at the society level, as well as academics studying standardization. **Chapter 3** presents the method and the overall results of the company level analysis on the benefits of standardization. A comprehensive business survey is conducted to gain a better understanding of how companies experience the benefits and costs from standards, and how this varies across industries as well as other company characteristics. This part of the study is particularly relevant to companies applying standards, and not least companies contemplating to apply them. **Chapter 4** cover each of the sectors handled in the business analysis individually. The chapter presents the views on standardization through the lens of the companies that apply them. The analysis has been supplemented by personal interviews and business cases on a selection of representative companies. **Chapter 5** presents the views of the companies on their role as participants in developing new standards. This chapter is particularly relevant for companies considering taking part in this process, as well as standardization bodies facilitating the process of developing new standards. **Chapter 6** provides concluding remarks on the study, as well as some thoughts on the role of standards in the economy looking ahead. For more details on technical terms commonly used in the report see section A1 in the appendix.

1. Introduction – the importance of standards in the Nordics

A standard is a common solution to a recurring problem or to reach a certain level of attainment. In modern economies, standards typically cover a vast range of activities. Standardization can entail, among other aspects, a specification of how a product should be made or how a certain process should be managed. There are standards specifying how credit cards should be manufactured, how companies can improve their environmental performance, what dimensions a door should have, how to implement systems that increase the probability of detecting corruption, and standards that aim to increase safety in the workplace, to mention just a few. In many ways, standards are quite similar to regulations, the main difference being that following a standard is voluntary. Standards are also closely related to certification, which is a third-party confirmation that certain criteria are met. Today, there is a large volume and variety of standards; some standards are e.g. European Standards (EN) developed by the European Standards Organizations (CEN, CENELEC and ETSI), which are implemented as national standards in Nordic countries, or International Standards, developed by the International Standards Organizations (ISO and IEC), which could be adopted as national standards in Nordic countries.¹

ISO's definition of a standard is a document, established by consensus and approved by a recognized body, that provides, 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. Thus, standardization helps companies coordinate and overcome multiple problems that would otherwise not yield optimal economic outcomes.

Figure 1-1: Standardization and productivity



The impact of standardization is likely to depend on the type of standard in question. Figure 1-1 above explains mechanisms in which standards influence productivity (Swann, 2000). Although standards may affect several relevant policy variables such as prices, market entry, competition, innovation, and trade, ultimately these variables are relevant because they are indicators of increased productivity. For example, increased interoperability in the supply chain reduces costs (which is the same as increased productivity), which leads to reduced prices or increased profits. Reduced prices or increased profits intensify competition between companies, which in turn has a positive effect on productivity. Thus, in the following we will focus on the positive productivity effects of standards since productivity is the widest and most relevant measure of economic development (for a more detailed description see Swann (2000, 2010)).

Improving interoperability. A common aim of standards is to improve compatibility and interoperability between systems and products. Improved interoperability can increase productivity through reducing transaction costs as well as spurring positive network effects. An example is the standardized cellular network GSM². The benefit of having a mobile phone increases with the number of users on the same network, thus the

¹ CEN = European Committee for Standardization, CENELEC = European Committee for Electrotechnical Standardization, ETSI = The European Telecommunications Standards Institute, ISO = International Organization for Standardization and IEC = International Electrotechnical Commission.

² Global System for Mobile Communications

market outcome is improved by having one standard for cellular networks where all phones can literally talk together. Moreover, a common standard also reduces switching costs, making it cheaper for customers to switch telephone operators without needing to change their phone. The latter factor provides incentives to increase productivity as the market price for communication services becomes the key factor in competing for customers. Notice that in this case it is less important what type of cellular network is the standard; what is important is that there is a standard.

Reducing the variety of intermediate goods and services. Diversity in consumer goods and services is undoubtedly beneficial from the perspective of the end consumer. Variety in intermediate goods³ and services, on the other hand, is typically associated with inefficiency. Reducing the variety of intermediate goods and improving interoperability between products and systems are very similar mechanisms. One distinct difference is that promoting interoperability is about reducing the number of competing systems while reducing the variety of goods and services is about deciding on dimensions of specific products or services, e.g. the metric for doors, or standards for connection electronic devices such as sockets, USB or Bluetooth. The perhaps most famous example of a standard reducing the variety of intermediate goods and services is the standardization on twenty-foot equivalent units (TEUs) for freight containers. Agreeing on the TEU standard has had huge positive effects on trade and productivity on a global scale. Without this standard, there would have been many parallel systems with substantially higher freight costs (see text box 1).

Textbox 1. The “square wheel”: Standardized metrics for freight containers

Within an industry supply-chain, standardization aligns the expectations of buyers and sellers, yielding more productive outcomes. Imagine that there was no standard way of producing freight containers. In such a case, there would likely be a vast amount of different types of containers within the freight market. The first standard relating to freight containers was published in 1961 by the International Organization for Standardization’s technical committee. ISO/TC 104, “Freight containers” has since standardized almost every aspect of freight containers. Containers would not only vary in size, but also in quality and the total weight they could carry. To minimize transportation costs, a car manufacturer who needs to ship cars overseas would have to use time and effort to get an overview over all the different container types available in the market, before estimating the transportation cost associated with each container type. Furthermore, the shipping company would probably end up transporting vast amounts of containers of different sizes, which in turn is likely to result in inefficient use of the ship’s cargo hold. Loading and unloading the ship would be demanding and time-consuming. If the containers were to be forwarded by train, the same issues would arise for the railway company. In the end, if containers were not standardized, one would have a more inefficient market with less competition, higher company costs and higher consumer prices. Hence, standardization of intermediate goods and services increases productivity, which under normal market circumstances benefits both producers and consumers.

³ An intermediate good is a product utilized to produce a final good or finished product. These goods are sold between industries for resale or to produce other goods.

Quality assurance. Standards can also be a means for verifying the quality of products and services. Most products and services compete on two central parameters: price and quality. While prices are easily observable, the quality of a product or service is often costly to verify. In fact, if it is very hard for consumers to separate high quality from low quality products and services, price competition will often undermine the market for high quality products or services. Standards that set requirements for the quality of a product or service can solve this problem by sending a credible signal to the market that the product or service meet the set requirements and can be trusted. Quality management standards are example of standards that promote the companies' work on continual improvement, and thus minimize production errors and defects. This reduces the information asymmetries between buyer and seller, which in turn creates a more efficient market.

Distribution of technical information. Unlike patents, standardization processes do not develop entirely new technological knowledge. However, technical standards make product information and descriptions accessible, in turn diffusing technological progress to a wider group of companies. Within an industry, efficient exchange of information implies a reduction of information asymmetries between competitors. Diffusion of technological information makes it easier for new companies to enter the market. Moreover, by spending less resources on gaining the basic industry knowledge, they can focus their resources on innovative activities. Lowering the cost associated with gathering information with respect to other companies' products can also increase productivity.

Adverse short run productivity effects of standardization. Although the overall effect of standardization is likely to be positive for productivity and thus economic development, it is possible to imagine instances where standardization adversely affects productivity growth. For instance, standardization could cause companies to choose well-established procedures and solutions, which would dampen innovation. In this case, solutions that could potentially facilitate productivity growth would neither be invented nor utilized, and de facto growth in productivity would be lower than what it could have been. Furthermore, it is not obvious that standards that promote, for instance, health and safety or environmentally sustainable corporate conduct are beneficial in terms of companies' productivity in the short run. Such standards could make production procedures more cumbersome, raising average labour costs, and thereby reducing average output value per employee. The extent of the existence of such adverse effects would in general depend upon the specific standard in question, in addition to the time scope considered. However, as standards are voluntary, one will expect that the net benefit for the companies implementing them is positive. A health and safety standard might cause a more cumbersome and costly production process, raising costs and decreasing productivity growth in the short run. In the long run, however, implementing the standard might affect workers' perceived health risk of being employed at the company or within the industry, causing them to demand less in risk compensation, manifested through wages, thereby reducing overall wage costs and hence increasing labour productivity.

Textbox 2. De jure vs de facto standards

De jure standards are formal standards – standards developed by official standardization organizations (Hesser et al., 2010). These organizations can be global (like ISO and IEC), regional (like the European CEN, CENELEC, ETSI) or national (like SFS, SIS, DS, SN, IST etc.) and have been given formal recognition to produce formal standards. Use of de jure standards is voluntary.

De facto standards are standards that are not developed by one of the above-mentioned recognized bodies, but gain prominence through widespread use rather than official endorsement. De facto standards can be developed by consortia or fora, where the development process is more or less similar to the formal standardization process by e.g. being consensus-based and including public consultations. These types of de facto standards are often developed by standards developing organizations (SDOs). In other cases, de facto standards are developed by one organization or a closed circle of organizations, or simply as a result of one or more companies' products being so influential that they become a 'standard' in themselves.

A unique feature of the European de jure standardization system, essential to the functioning of the European Single Market, is that every European Standard (EN) must be adopted as a national standard by all the national standard bodies, and any pre-existing conflicting national standards must be withdrawn. This ensures that the same set of requirements (the same standard) applies in all member states; a market of over 500 million consumers. De facto standards, however, are not part of this system and thus sometimes the result is different standards describing the functionality of the same type of product.

2. Standardization and productivity at the macro level

Standards help to solve fundamental processes, organizational and technical problems, which, if left unresolved, could result in inefficient market functioning and poor economic outcomes. Thus, the key question in this respect is not whether standardization improves overall macroeconomic performance, but the degree to which it does so. In broad terms: “What does the development of standards mean to all of us?”. To answer this question, we introduce and test a model for how standardization is associated with changes in productivity in the Nordic countries. The results show that there is a positive and statistically significant relation between standardization and productivity across all the Nordic countries. The average growth in the stock of standards has been close to 7 percent over the past four decades, which is associated with 39 percent of the labour productivity growth during the period. The findings should be interpreted with a certain degree of caution. Standards are used as a proxy for the dissemination of knowledge within the economy and should therefore be regarded as an important indicator of a broader infrastructure supporting that process. Standardization plays a symbiotic and complementary role with factors such as rules and regulations and technological development, only partly controlled for in the estimation model.

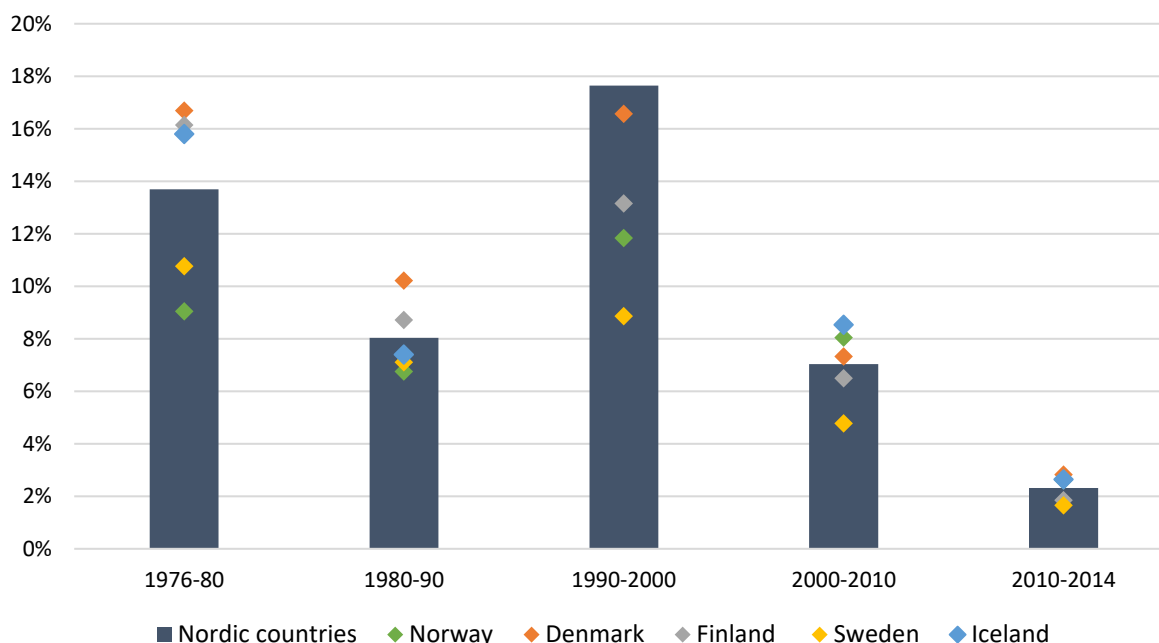
2.1. Measuring the development of standardization over time

To measure the effect of standardization in the Nordics, we use the *net stock of standards* as a proxy for the impact of standardization over time. Net stock of standards is the sum of all published standards up to the end of a specific year minus the sum of standards that has been withdrawn up to the end of that year. The definition is identical to the one applied by Hogan et al. (2015), which has been used in other studies on standardization and productivity growth.

Figure 2-1 below illustrates the yearly growth rates in the net stock of standards across the Nordic countries through the last five decades. In 1986, the European Standards Organizations CEN and CENELEC adopted new rules, with an obligation for the members to adopt all EN standards as national standards within six months’ time after their publication. This is the main reason the stock of standards in European countries started to grow. The other reason for the rapid growth in the stock of standards in the 1990s was the European Union’s implementation of the New Approach (1985), which preceded the New Legislative Framework (2008), for drawing up product-related directives and regulations. As a measure towards establishing a single market, which would enable free movement of goods and services by breaking down trade barriers, it was decided that only general and essential requirements were to be formulated in product-related EC (now EU) directives and regulations. European standards that are linked to the directives in accordance with the New Approach are called harmonized standards. In fact, according to CEN around 25 percent of European Standards published by CEN have been developed in response to standardization requests (Mandates) issued by the European Commission. These standards contain more specific requirements than the directives. Hence, a company that meets the requirements of the standards also complies with the requirements of the directives. Applying the harmonized standards is the easiest way of demonstrating compliance with the overall and essential requirements of the directives.⁴ As the harmonized standards were adopted at a national level the net stock of standards in the Nordic countries started to increase rapidly, which explains the fast growth starting at the beginning of the 1990s. By 2014, the Nordic national standardization bodies had collections of in total between 23 and 35 thousand standards, approximately six to seven times as many as in the mid-1970s.

⁴ It is compulsory to apply the harmonized standards within the area of CE marking of construction products.

Figure 2-1: Average yearly growth rates in net stock of standards over time.*⁵ Source: Menon Economics, Standards Norway, the Swedish Standards Institute, the Danish Standards Foundation, the Finnish Standards Association and Icelandic Standards



*The average yearly growth in the stock of Icelandic standards was 76 percent during the 1990s. Thus, for illustrative reasons the figure for Iceland in the period 1990-2000 is taken out of the graph.

The reduction in the growth rate of the stock of standards after the 1990s is natural, as the European stock of standards has grown to the amount that is needed, and only new areas of standardization increase the collection. Moreover, as the stock of standards becomes larger over time, keeping up the growth *rate* would require an increase in the number of standards produced. While, on the other hand, as the economy grows and becomes more international, the need for coordination and standardization also increases. The latter, combined with the *New Approach*, explains why the number of new standards per year is larger today than it was in the late 1970s and early 1980s.

The complete list of the number of standards over time has been provided to us by the five Nordic standardization bodies. The nation-specific data contains the implementation and withdrawal date of all published standards since the standardization bodies were founded. The data set is unique in the sense that this is the first time this has been analysed at the Nordic level.

2.2. Standards and productivity in the Nordic economies

Productivity is the best indicator for a given society's welfare potential. A higher level of productivity means that you can produce the same level output with less resources put into production. An increase in national productivity can raise living standards because more real income improves people's ability to purchase goods

⁵ The national standardization bodies offer more than 200 000 individual standards. In this study, however, we only count standards that are nationally adopted. This choice is based on two arguments. First, we find it likely that the difference between standards offered and the number of standards being utilized in practice on the national level is smaller for nationally adopted standards compared to the equivalent difference corresponding to all standards offered. Second, since some of the standardization bodies delivered datasets containing only nationally adopted standards, focusing on these standards ensures comparability between the countries.

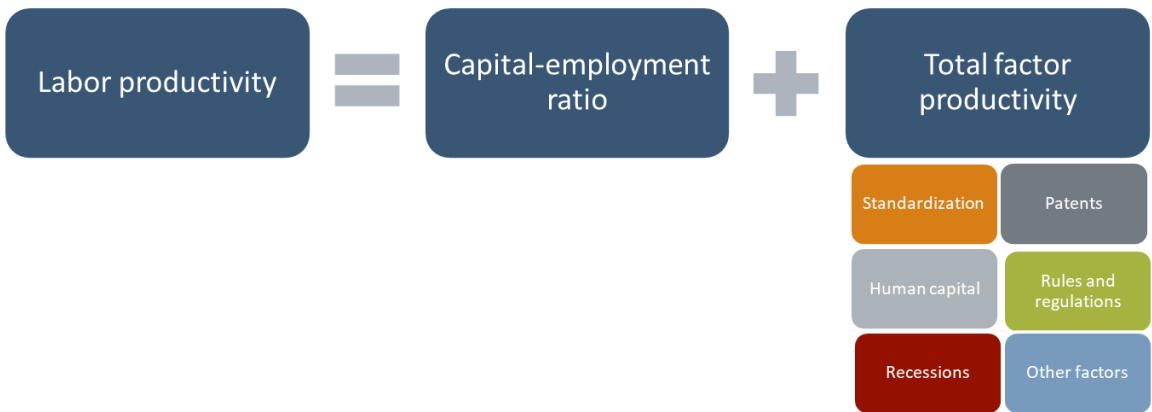
and services, enjoy leisure, improve housing and education and contribute to social and environmental programs.

Economic theory predicts that real economic growth depends on the factors of production employed, among others physical capital and labour, and how efficiently these factors are utilized. Although growth can be sustained by increasing capital or labour, it is common to assume diminishing returns to scale, meaning that an additional unit of input generates less new output than what the previous additional unit of input generated. Thus, when levels of capital and labour employment become sufficiently high, an increase in productivity is necessary to create economic growth.

Technological progress, represented by for instance standards, patents or other technological developments, can facilitate improved productivity, thereby offsetting the decline in growth that would otherwise occur as economies mature. Hence, standardization is a potential source of and contributor to improved productivity, economic growth, and improved economic performance.

The methodological approach⁶ we employ in this report enables us to estimate labour productivity⁷ as a function of the capital-employment ratio and total factor productivity. As Figure 2-2 illustrates, several components affect total factor productivity, including standardization, patents, human capital, rules and regulations and economic recessions.

Figure 2-2: Factors that affect labour productivity



We use our data to control for patents and recessions, thereby achieving estimates of the correlation between standards, patents and recessions on labour productivity. We also want to control for levels of human capital, “learning-by-doing” through experience, rules and regulations and other possible influencing factors, but our dataset does not allow us to incorporate these factors as separate control variables. We therefore seek to control for them through a time trend in our model specification.

2.2.1. Testing the relationship between standards and productivity

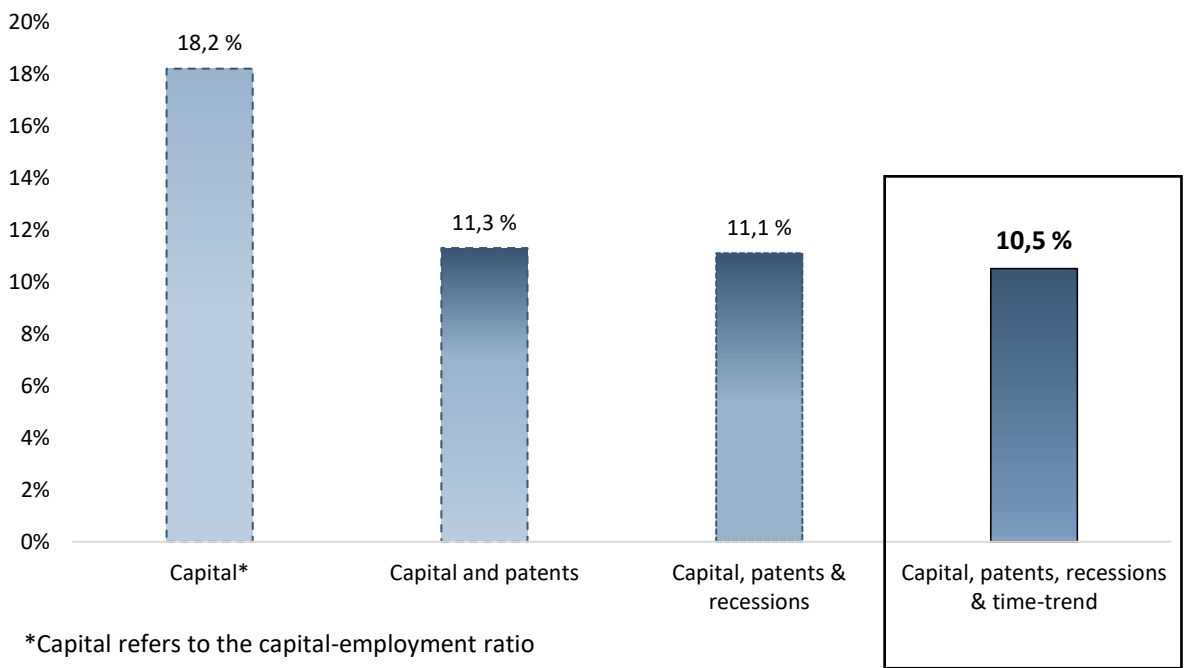
Our regression result for the Nordic region tells us that a one percent increase in the net stock of standards is associated with a 0.105 percent increase in labour productivity. Productivity is measured as gross domestic product in constant prices per worker. Another way of saying this is that if the stock of standards would be twice

⁶ A detailed specification of the econometric model is provided in the appendix.
⁷ Labour productivity is measured as output per worker.

the size of today, labour productivity, the amount of economic output per labour hour, would be 10.5 percent higher across the economy. Our estimates are statistically different from zero with 99 percent probability.

In Figure 2-3, we show how the estimated effect of standards on labour productivity changes as we gradually add relevant explanatory variables to the model specification. When we only control for the capital-employment ratio, the effect of standards is estimated to 18.2 percent (see column furthest to the left). The estimate drops by approximately seven percentage points when we add patents as an additional explanatory variable, implying that the correlation between standardization and productivity is 11.3 percent. Furthermore, adding year-specific dummies to control for economic recessions reduces the standard estimate to 11.1 percent, while including a linear time-trend variable in the model to control for education and human capital growth reduces the standard estimate to 10.5 percent. From the graph we see that controlling for the time trend has a moderate impact on the estimate. One reason for this is probably because much of the trend growth is already embedded in the growth rate of patents.

Figure 2-3: Our estimations of the association between one percentage point increase in the stock of standards and labour productivity when including additional controls



When we include patents in the regression, the estimated effect of the net stock of standards on labour productivity is reduced by 40 percent. This underpins the importance of controlling for patents. The estimated effect from patents is also positive and statistically significant. Although the development in the stock of standards and patents is similar (see description of patents in section A3 of the appendix) both estimators are statistically different from zero, which implies a sufficient degree of variation in the dataset. In comparison, it was not possible to separate the effect of these two variables in a similar study by the Centre for Economics and Business Research (CEBR) for the British Standards Institution (BSI) (Hogan et al. 2015).

Country-specific estimates of the associated effect of standardization on labour productivity vary between 5 and 15 percent, the estimates for Sweden and Norway being the highest followed by Finland and Denmark, and those for Iceland the lowest (see section A4 of the appendix for country-specific regression results). It is worth mentioning that the estimated effects of patents are not statistically different from zero for Sweden, Norway and Finland. As the effect of standardization on labour productivity is estimated to be highest in these three countries, this could imply that the estimated association between standards and productivity also includes the effect of technological progress itself. The country-specific regressions rely on less data than the pooled regression model where the Nordic region is treated as a single unit. While the results yielded by the pooled

model are based on 163 data observations per year, the Swedish regression results are only based on 23 yearly data observations.⁸ Thus, it is not surprising that there is not enough variation in the Swedish data to separate the effect of standards from that of patents.

Most of the country-specific estimates are in close proximity to each other. We have conducted tests to check if the country-specific estimates are significantly different from each other, and find that the estimates for Norway, Sweden, Denmark and Finland are not, while the Icelandic estimate is statistically significantly lower than the other countries' estimates (except for Finland). Since the country-specific regressions rely on less data we find the results from the pooled Nordic model most reliable. Thus, we focus on the Nordic estimate when we compare our findings with findings in other studies.

In addition to estimating the effect of standardization on the national level, we also perform separate estimations for selected industries across the Nordic countries (see table with regression results in section A6 of the appendix). In this analysis we use ICS-codes (International Classification for Standards) to allocate standards according to sectors.⁹ For the sectors where we run regression analyses the associated effect of standardization is positive and significantly different from zero across all industries. The most reliable results are found within the construction sector, as well as within transportation, where the data allows us to control for sector-specific patents. Based on a sample of all the Nordic countries we find that doubling the stock of standards available for the construction sector is associated with an increase in labour productivity of 6.9 percent within the sector. Similarly, we find that the same doubling is associated with an increase in labour productivity of 9.5 percent within the transportation sector. The average growth in the stock of standards during the estimation period 1976-2014 was 8.5 and 8.2 percent for the construction sector and transportation sector respectively. Given the estimated relationship between the growth in the stock of standards and productivity growth and the growth rate of the stock of standards, standardization is associated with an annual increase in labour productivity of 0.6 percent within the construction sector and 0.8 percent within the transportation sector during this period. Although it would be highly interesting to investigate specific sectors country by country, the number of observations is inadequate to get sufficiently precise sector estimates at the national level. In general, the sector specific data is of poorer quality due to lower data quality on capital as well as missing patent data.

Textbox 3. Sanity checks and finding the best proxy for standardization and technological progress

As a sanity test of the model estimates we estimate an alternative model for the Nordic region. Not dividing the variables in the main model by employment, we include the number of employed persons on the right-hand side of the regression equation. The estimated effect from growth in capital and employment in the Nordics is respectively 0.27 and 0.58. These estimates are very similar to the results of Blind and Jungmittag (2007) as well as other productivity studies on OECD countries where the effect of a one percent increase in the capital stock is one third, and two thirds for labour.

The number of published standards and granted patents provides no information about the extent to which companies utilize standards or patents. For instance, a company can buy a standard with the aim of increasing productivity, but deviate from the standard's guidelines or suggestions as time goes by. A similar argument can be made with respect to patents. A company can research and develop an innovative solution or product, patent the solution, but for some reason never actually utilize the solution in practice. The difference between the number of published active standards and patents and the degree to which these are being used is an important aspect that we are unable to control for.

⁸ Due to differences in the availability of data across countries, the historic time periods that form the basis for the national specific estimates are different. Thus, if the effect of standardization on productivity has changed over time, for example that standardization was more important in the 1970s than in the 1990s, then the results are not directly comparable. However, based on previous studies from other countries, we have no reason to believe that the effect of standardization has lessened over time.

⁹ As a given standard can be applied in several sectors, thus the sum of net stock of standards over industries exceeds the net stock of standards on the country level.

2.2.2. Standardization and growth in labour productivity and GDP

In the previous section we found that a growth in the stock of standards by 1 percent is associated with an increase in productivity of 0.105 percent at the Nordic level. In terms of economic growth, this implies that:

- During the period the regression results are based on, the net stock of standards in the Nordic countries grew by an annual rate of 6.8 percent.¹⁰ Multiplying the growth rate of standards with the regression estimate, we find that the development of standards in the Nordic region is associated with an annual increase of 0.71 percentage points of an average labour productivity growth of 1.81 percent.
- The result suggests that standardization is associated with 39 percent of the growth in labour productivity and 28 percent of GDP growth in the Nordic countries during the period 1976-2014.

The results give a very clear indication that standards have an important role to play in promoting productivity and economic growth. Considering the contrafactual situation – a world without standards – it is possible to argue that the estimates appear reasonable. Standards influence all types of business operations, facilitating an efficient interaction between subcontractors, producers and consumers of goods and services. Take for example standards for freight containers. Without a standard for handling transportation of goods we would still have parallel logistics systems with less competition, higher company costs and higher consumer prices. The same logic goes for telecom networks, construction products, any products that rely on electricity, and so on. Standards also enable global supply chains, making it possible to reap benefits of economies of specialization and comparative advantages from international trade. Hence, the contrafactual level of productivity in a world without standards would be much lower than the current level.

The findings must, however, be interpreted with caution. Although we try to control for other important explanatory factors such as improvements in technology and human capital by including stock of patents as well as a time trend in the economic model respectively, isolating the precise economic impact of standards is not possible. Standards play a symbiotic and complementary role with other factors like rules and regulations. There may also be an interplay between standards and technological developments not captured by the development in patents, such as the advances in Information and Communication Technology (ICT). Moreover, it is not clear whether productivity gains can be attributed to standardization in and by itself, or whether standardization is a more formal implementation of technological developments that have previously taken place and been adopted by economic agents in the past. In fact, in some cases patents are embedded in standards, making standards a channel for the diffusion of intellectual property rights (Blind, 2013). Thus, standards are used as a proxy for the dissemination of knowledge within the economy and should therefore be regarded as an important indicator of a broader infrastructure supporting that process. Although standards are central to this process, the estimated correlation between standardization and productivity should be treated as an upper bound estimate of the effect from standardization on productivity.

Technological development, ICT in particular, has typically been found to spark labour productivity growth during recent decades. For instance, Byrne, Oliner and Sichel (2013) have estimated that investments, production and use of ICT accounted for as much as 64 percent of total labour productivity growth in the United States between 1995 and 2007. Furthermore, OECD-data suggests that the share of average annual GDP growth that can be attributed to ICT between 1985-2010 is 22, 55 and 56 percent in Finland, Sweden and Denmark respectively. Much of the gains accounted for as ICT-related are most likely due to standardization. In fact, standardization is the very essence of the efficiency gains from ICT. ICT cannot work without standards, while at the same time some of the gains captured in our model as due to the development of standards might be due to improvements within ICT. In contrast to the study by Hogan et al. (2015), however, we try to control for technological development by including the stock of patents in the model estimation. Patents is a commonly used proxy in productivity studies for advances in technology and innovation. Thus, we have tried to separate the relation between standardization and productivity growth and the general effect of technological development on

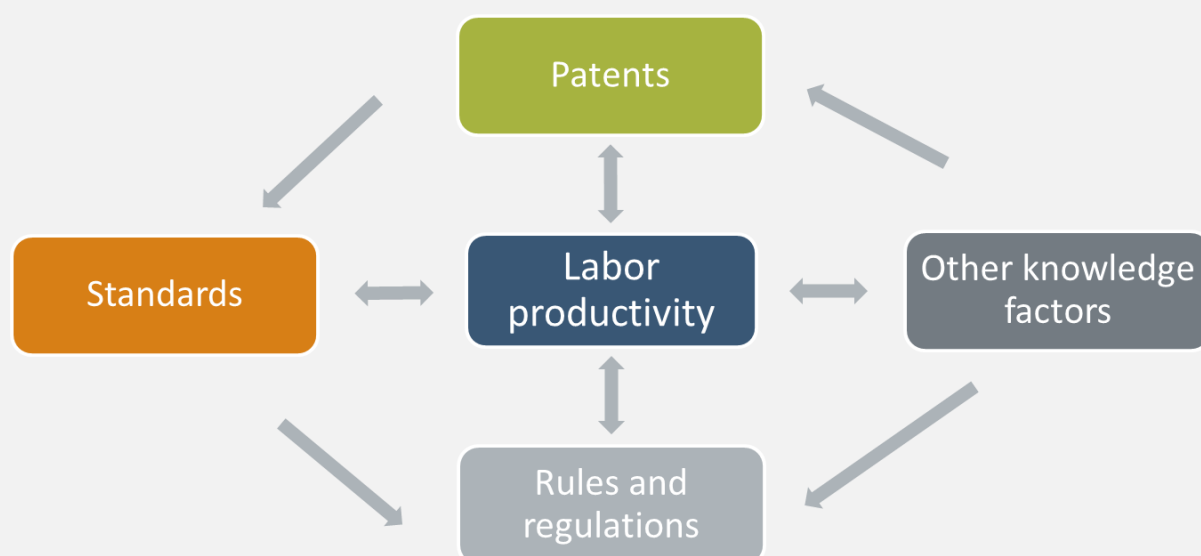
¹⁰ The annual increase is a population-weighted average of the national averages of trimmed yearly growth from 1976 to 2014. We have trimmed the dataset and omitted the years where national growth in standards exceeded 13 percent. The reason for excluding the most extreme growth figures in stock of standards is that we have seen that our model's ability to explain productivity is significantly weaker when yearly growth in standards is at its highest.

productivity growth. A more detailed explanation and discussion with respect to standardization and causality is provided in Textbox 4.

Textbox 4. Challenges with measuring the effect of standards on productivity

The figure below illustrates factors that are likely to affect labour productivity, and the many ways in which a productivity-enhancing process can take place. Some of the factors are likely interdependent. For example, the development of patents may over time affect the development of standards. In addition, causality between standardization and labour productivity might go in both directions: Formal standards are often written out and published after a production process has become quite common within an industry, which suggests that the behaviour of many companies may have changed before a standard was formulated.

Illustration of factors affecting labour productivity



Starting at the top, the main points of the figure can be summarized as follows:

A company might patent a productivity-enhancing solution. Utilizing the solution, patents would affect labour productivity directly, as illustrated in the figure. Indeed, if there is only one company with one patent, the macroeconomic effect on labour productivity would be negligible, but if there are many companies with different patents that all increase productivity, the overall impact of patents can be significant.

A solution that is patented, or once was patented, can be embedded in a standard. This is illustrated by the arrow from patents to standards in the figure.

As discussed in the previous section, standards can affect labour productivity directly, and in such a case, standards would have a causal effect on labour productivity. But it could also be that a productivity-enhancing technique or solution, widely adopted in the economy, becomes a standard. Hence, the two-headed arrow in the figure; causality might run in both directions, causing a re-enforcing cycle.

Standards might become de facto compulsory in an industry or in the economy in general. A standard can also aim to make it easier for companies to act in accordance with regulations, thus blurring the distinction between standards and regulations. Rules or regulations can have a causal effect on productivity, but causality might also run in the opposite direction. As is the case with standards, a technique or solution may become obligatory if for instance a governmental body perceives the macroeconomic advantage deriving from the solution as too great to be left to the choice of individual companies.

Finally, other knowledge factors, such as the general level of education, experience through “learning-by-doing”, or other technological developments might affect productivity. The latter factor might be the source of new patents, or cause a new rule or regulation to be implemented.

2.2.3. Comparison of results with other studies

The table below provides an overview of results from previous studies on productivity effects of standardization. To our knowledge, previous studies include France, Canada, Germany, Denmark, Australia and the UK. In addition, Blind and Jungmittag (2007) have conducted an analysis of Italy within the industry sector.

Table 2-1: Comparison of the Nordic study with other studies

	Nordic	UK	Australia	Germany	France	Canada
Organization	Menon	CEBR	Standards Australia	Blind et al.	AFNOR	CBoC
Publication year	2018	2015	2012	2011	2009	2007
Period of analysis	1976 - 2016	1921 - 2013	1982 - 2010	2002 – 2006	1950 - 2007	1981 - 2004
Estimated function	Labour productivity	Labour productivity	Labour productivity	GDP output	GDP output	Labour productivity
Stock of standards, elasticity	0.105	0.11	0.15	0.18	0.12	0.36
Share of labour productivity, %	39.5	37.4	-	-	27.1	17
Growth rate of GDP % p.a.	2.5	2.4	-	-	3.4	2.7
Controls for patents	Yes	No	Yes	Yes	Yes	No
Recessions	Yes	Yes	No	Yes	Yes	Yes
Other controls	Time trend	No	Time trend	Imported licenses	No	No

The table above shows that the estimated elasticity of stock of standards differs quite substantially across studies. For instance, while CEBR estimates the elasticity in the UK to be 11 percent between 1921 and 2013, the Conference Board of Canada (CBoC) estimates the elasticity to be 36 percent in Canada between 1981 and 2004. The latter study does not control for patents, which might explain why the estimated effect of standardization is much larger than in the other studies. AFNOR, CEBR and Standard Australia's estimates, for France, the UK and Australia respectively, are close to equal in magnitude to the estimates we find for the Nordic countries. However, in the study by CEBR on the UK, patents are not included as a control variable. Thus, the estimate for the UK is most likely lower than 11 percent. Blind et al. (2011) finds an elasticity of 18 percent for the German economy between 2002 and 2006.

Generally, it is difficult to pinpoint the exact reason for the differences in estimates found in the individual studies, although one would expect the effect of standardization to vary across countries and time periods. The general picture is that standardization has a positive impact on labour productivity and economic performance. Moreover, all studies also have in common that the estimated association between the development of standards and productivity should be treated as upper bound estimates on the effect of standardization on productivity.

With the Nordic study, there are now five more countries for which a study of standardization and productivity has been conducted. The estimated association between the net stock of standards and productivity ranges between 4 percent for Iceland and 15 percent for Sweden. Based on a pooled regression for all the Nordic countries, where the countries are weighted according to size, the estimate is 10.5 percent. The fact that the Nordic study is based on a sample of more countries enables more robust estimates than previous studies. In particular, the cross-country variation in the data enables statistically significant estimates of both stock of standards and stock of patents in the same model.

In the studies listed in the table above, standards are associated with between 5 to 35 percent of productivity growth in the respective countries. The Nordic estimate is at the top tail of this range with an estimate of 39 percent. This estimate depends on the relation between standardization and productivity, but also the growth rate of standards during the period examined. Not least does it depend on the size of the productivity growth during the period. In a recent meta study by Hogan et. al (2016), the share in Ireland is assessed at 14 percent. The share of labour productivity was low for two reasons: Although a relation between standardization and productivity of 11 percent was used, the growth rate of standards in Ireland was low during the period. Moreover, productivity growth was high as Ireland has experienced a catch-up effect. Thus, although standardization most likely had a rather large effect on productivity, other factors were probably more influential. Hence, one should be careful with just comparing the share of productivity growth associated with standards, because this does not necessarily say much about how important standards may be in the future.

3. Influence of standards at company level

The sector analysis aims to examine the question: “What benefits do standards generate for my business?”. The question of the use of standards and the influence of standards in business activities and strategies is important for companies considering whether to apply standards. The sector analysis' aim is to gain a better understanding of how companies experience the benefits and costs from standards, and how this varies across industries as well as other company characteristics such as size and whether the company exports or not. For this purpose, a comprehensive business survey has been conducted among users of standards. This analysis is presented here. Moreover, the analysis has been supplemented by personal interviews and business cases on a selection of representative companies. Together with the macro analysis, presented in the previous chapter, the sector analysis will provide a comprehensive examination of the economic effects of standards on the Nordic region. The main results from the sector analysis are listed in the following bullet points:

- Following and applying standards is important for Nordic companies' strategies
- Standards support the productivity of Nordic companies by enabling the optimization of business operations
- Market access, product/service quality and reduced risk are the most important reasons for Nordic companies to follow and apply standards
- Following and applying standards gives net economic benefits for companies
- Almost all companies applying standards agree that standards create trust and confidence among customers and help them comply with regulations
- Standards do not prevent companies from developing innovative solutions, rather following standards is a good means of following technical developments

3.1. The survey respondents

This section gives a brief description of the respondents and companies that participated in the web survey on standardization. The survey was directed towards companies and organizations with prior experience with applying standards in their business and/or participating in the process of making standards. In total, 1179 companies responded to the web survey.

The survey was conducted in the five Nordic countries, covering five different sectors in each country. Iceland is an exception here, as it only has respondents within three sectors of the economy. Which sectors are covered in each country varies depending on the structure of business and industry in the respective economies. For example, as an important sector in any economy, the construction products and services sector is covered in all countries, while the petroleum industry is only covered in Norway. Having collected data for nearly 1200 respondents, the sector analysis is based on what is, to our knowledge, the biggest international business research survey to examine standardization in Europe. With a high number of respondents, we consider the overall reliability and validity of the survey data to be satisfying. Iceland has the survey's best response rate with 23 percent, while the overall number of respondents from the country is only 28. Sweden has the lowest response rate at 9 percent, but with a high number of companies available, the country is represented in the survey with 300 respondents. The average response rate across countries is 17 percent, which we consider satisfactory for this type of business survey.

Table 3-1: Overview of web survey replies by country and sector (number of respondents)

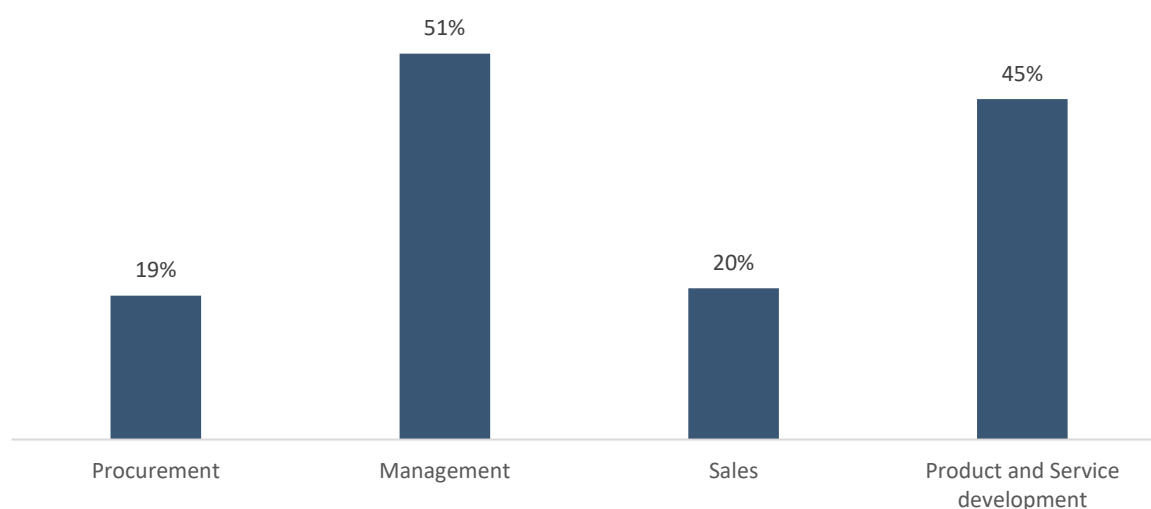
	Iceland	Sweden	Norway	Finland	Denmark	Total
Total all sectors	28	300	440	127	284	1179
Total all sectors, in percent	23%	9%	16%	20%	10%	17%
<i>Construction products and services</i>	12	56	152	34	69	323
<i>Manufacturing industry</i>	13	69	n/a	40	149	271
<i>ICT</i>	3	91	73	20		187
<i>Healthcare</i>	n/a	26	54	16	23	119
<i>Petroleum production</i>	n/a	n/a	141	n/a	n/a	141
<i>Process industry and materials</i>	n/a	58	n/a	17	17	92
<i>Seafood and fisheries</i>	n/a	n/a	20	n/a	n/a	20
<i>Trade</i>	n/a	n/a	n/a	n/a	26	26

Source: Web survey

The survey respondents represent companies within the eight sectors listed in the table above. There are large differences in the number of respondents across sectors. Partly, these differences are explained by the number of countries the sector is covered in as well as the number of companies in that sector, and partly they depend on how common it is to use standards in that sector. It is not possible to assess the representativeness of the respondents' experiences with standards in a sector by simply looking at the number of respondents. The reason for this is that unlike in political polls, where you have actual full population elections to control their representativeness, there is no full population survey on the experiences with standards among companies. Thus, we do not know the true variation of experiences in the population. However, we take the fact that the results seem stable across sectors as a sign that the samples are representative for that sector's view on standardization. Whenever we have concerns about the representativeness of the sample, we state that explicitly in the text.

The respondents have different roles within their companies, which may also include more than one area of responsibility. The question: "What is your role in the company?" allowed several answers. Figure 3-1 shows that most respondents have key positions within management and/or product and service development. In general, however, we do not find that the respondent's professional role in the company has a significant influence on the respondent's perception of standardization and its benefits.

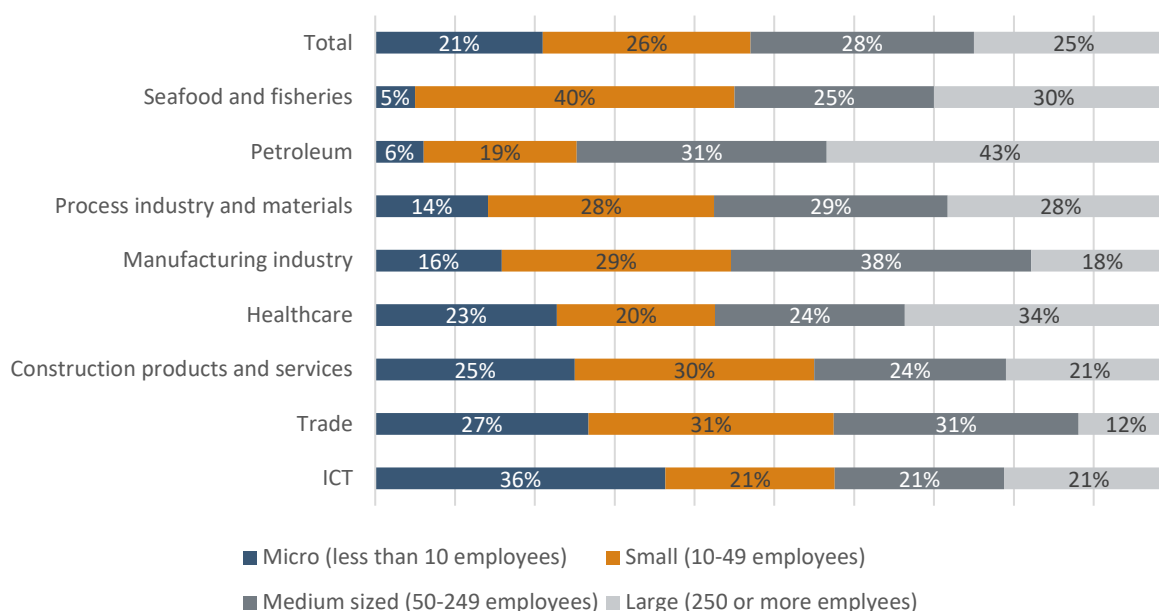
Figure 3-1: What is your role in the company? (in percent - several answers allowed). N=1179



The companies represented by the survey participants are relatively equally distributed between micro (less than 10 employees), small (10-49 employees), medium-sized (50-249 employees) and large (250 or more employees) companies, with approximately one quarter of the respondents in each group. 28 percent of the respondents

represent medium-sized companies, which is the largest group of respondents. The smallest group of respondents are from micro companies, amounting to 21 percent of the sample. The following illustration presents the distribution of the studied companies grouped by sector and size.

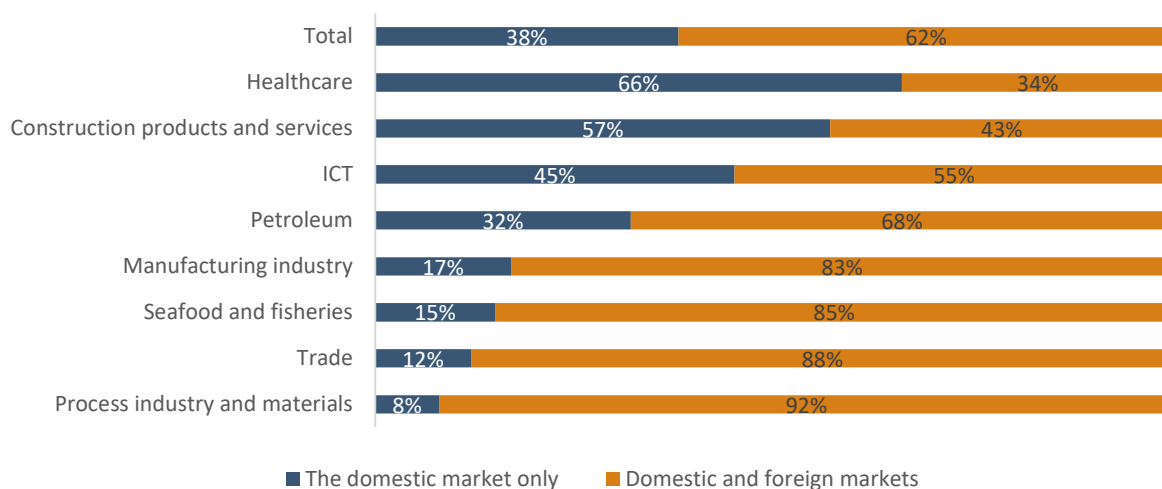
Figure 3-2: Business sector and company size (in percent), N=1179



The figure above shows that Petroleum and Healthcare have the largest share of large companies, while Trade, ICT and Construction products and services are the sectors with the highest share of micro companies. This finding implies that our sample is representative for the company demographics of the sector it represents. For example, while small start-up companies are overrepresented in the ICT sector, sectors such as petroleum and healthcare are dominated by large companies, for example state-owned companies.

The majority of respondents are exporting companies (61 percent). The healthcare sector and the construction products and services sector deviate from this general pattern (see Figure 3-3 below). In these sectors, most respondents operate in the domestic market only. The lower share of exporting companies in these two sectors is not surprising, as many of them provide services that must be delivered locally. It should be noticed, however, that the healthcare sector is very fragmented, consisting of both high-tech exporting companies, as well as public sector organizations whose business is mostly local. With regard to Construction products and services, this is also a sector with many small companies that do not have the capacity to export their services. In comparison, we see that between 80-90 percent of the companies within Process and materials, Trade, Seafood and fisheries and Manufacturing are exporters.

Figure 3-3: Companies' markets by sector (in percent), N=1179



3.2. Cross-sector findings from the Nordic survey

In this subchapter, we present the key findings from the Nordic business survey. In particular, the chapter looks into questions regarding:

- The importance of standards in companies' planning for the future
- Companies' most important reasons for following and applying standards
- How companies perceive that standards affect their ability to develop innovative solutions
- Net benefits and costs of following and applying standards

The importance of standards in companies' planning for the future

The macroeconomic analysis confirms that standardization has been an important source for productivity growth in the Nordic economies. The response from the business survey provides a strong indication that this result will also be valid for future development. On the question "On a scale of 1 (not important) to 5 (very important), how important is following and applying standards to your company's plan for the future?", the large majority of companies (87 percent) confirmed that standardization is an important part of their future business plans (see Figure 3-4). Only four percent replied that following and applying standards is not important for their companies, while nine percent replied neutrally.

Figure 3-4: On a scale 1 to 5, how important is following and applying standards to your company's plan for the future? (in percent), N=1136

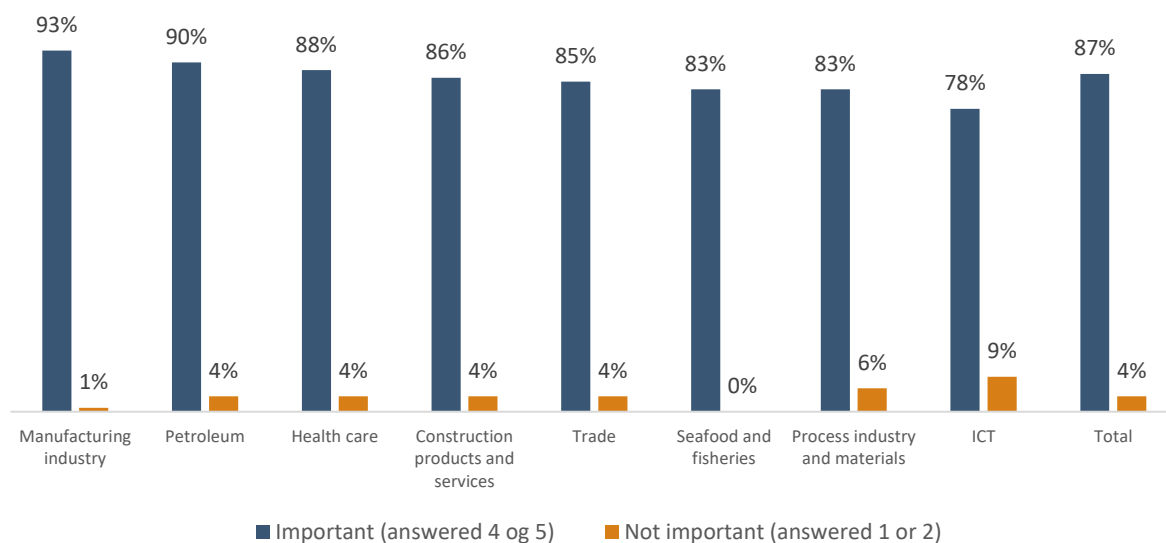


Figure 3-4 shows that the finding that standardization is an important part of the company's future plans is robust across the eight sectors represented in the survey. This finding lends support to the main conclusion from the macro analysis stating that standardization has a massive influence on economic growth on an aggregate level, as well as across sectors. A deeper dive into the survey data reveals that:

- The importance of standards for future business plans is a robust result across countries and sectors.
- Companies from Denmark and Iceland on average report a slightly higher score valuing the importance of standards for their future business plans.
- Following and applying standards seems to be most important for companies within the following three sectors: Manufacturing industry (93 percent), Petroleum (90 percent) and Healthcare (88 percent). ICT is the only sector where the reported importance is statistically significantly lower than the others; still, 78 percent of the companies in this sector report that standards are important for their future business plans.
- Following and applying standards is especially important for the business plans of exporting companies (90 percent consider standards important, and 65 percent very important).
- Following and applying standards seems to be a more important part of the business plans for big companies (94 percent) than for small and medium-sized companies (88 percent), and least important for micro companies (75 percent).
- 91 percent of respondents using management standards and 87 percent of those using technical standards claim that following and applying standards is important to their company's plan for the future.

Most important reasons to use standards: Market access, product/service quality and risk reduction

Even though the dominant tendency regarding the importance of standardization for the companies is clear, the motivation to use and perceive benefits from standards can be different for various archetypes of companies and business sectors. Figure 3-5 shows the companies' reported main motivation to use standards.

Figure 3-5: Overall, what would you say is the most important reason for your company to use standards? (Please rank the three most important effects from 1-3) (in percent). N=870

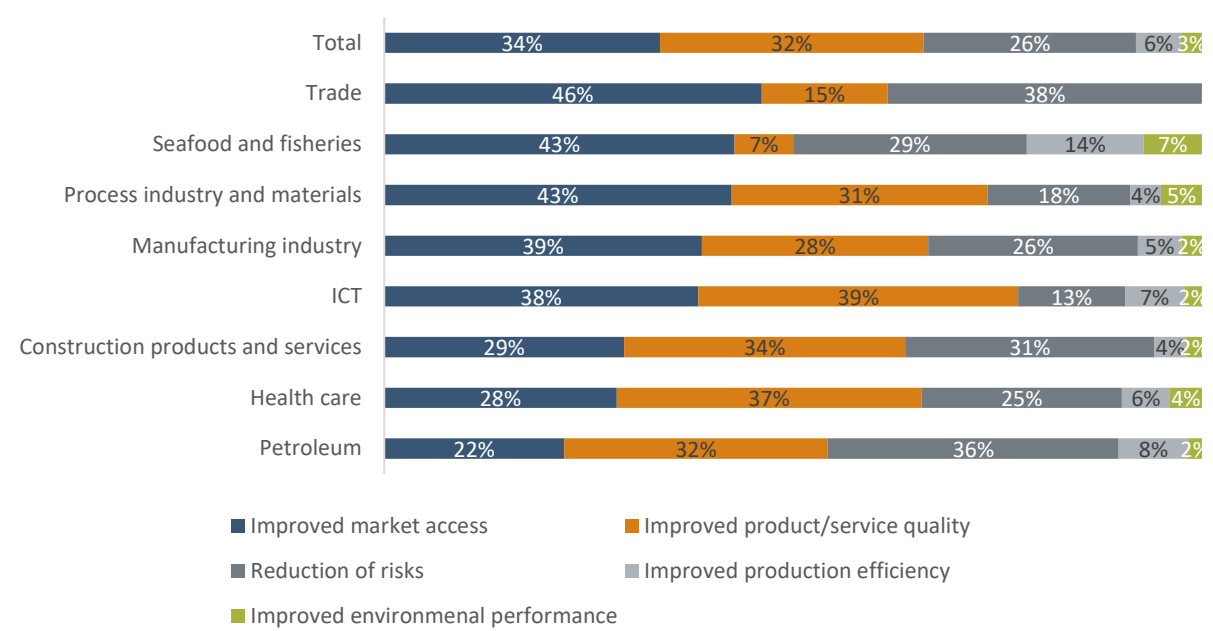


For 90 percent of the respondents, the most important reason for using standards is either “improved market access”, “improved product/service quality” or “reduction of risks”. This tendency is also evident in the respondents’ response on what is the second most important reason for using standards. As the second most important reason, the use of standards is also motivated by the reason “Improved production efficiency”. Production efficiency and increased environmental performance are considered the most important reasons to use standards by less than 10 percent of the sample. Further, we find that:

- Improved market performance through either improved market access or better products/services is the most important reason for using standards. Reduction of risks is also very important. Efficiency gains are considered the most important reason by surprisingly few respondents.
- Micro companies’ main motivation to use standards is to improve their market performance, while big companies use standards to reduce the risk of unwanted incidents. Improved product/service quality is very important for micro companies (38 percent), while big companies (38 percent) are significantly more motivated by risk reduction than others. Improved market access is most important among small (39 percent) and medium-sized companies (37 percent), but also important for micro companies (32 percent). Large companies (25 percent) put relatively less emphasis on improved market access.
- Motivations for using standards differ between companies solely operating in domestic markets and companies operating both domestically and abroad. 40 percent of the companies operating solely domestically state that their main motivation for using standards is to improve their products and services, significantly more than for companies that also operate abroad (28 percent). Companies that operate abroad are more motivated by improved market access (39 percent) compared to companies operating solely domestically (25 percent).
- Improved market access is most important for Danish companies (39 percent), while the Icelandic companies are first and foremost motivated by improved product/service quality (63 percent). Swedish (17 percent) and Icelandic (13 percent) companies are significantly less motivated by risk reduction than companies elsewhere.
- A very important aspect of standards is the strengthening of trust among companies and customers. According to 86 percent of the companies, standards increase sales because of increased trust from their customers. Better products and better communication could be two important factors explaining the increased trust. 75 percent of the companies agree that standards improve the quality of products and services, while 73 percent of respondents feel that standards simplify communication between producer and customer.

Figure 3-6 illustrates how companies’ motivation to use standards varies between different sectors.

Figure 3-6: Overall, what would you say is the most important reason for your company to use standards? (Please rank the three most important effects from 1-3. Rank 1 reported in graph) - in percent. N= 870



The trade sector states market access as the most important reason for using standards, while risk reduction also plays a major part. Since trade implies buying and selling other industries' products, it is only natural that improved products and services are a less important motivation for using standards. Seafood and fisheries also states improved market access as the most important reason for using standards. Most companies within Seafood and fisheries are exporters, and as we have mentioned above, exporters are in general more motivated by improving market access when applying standards than other companies.

The ICT industry and the healthcare industry state improved product and service quality as their most important motivation for using standards. These industries are characterized by rapid development and innovation, and product quality is the determining factor for competitiveness. The petroleum industry is characterised by global companies. Nearly 70 percent of the companies operate in both domestic and foreign markets. Nearly all the respondents confirmed that their companies use technical standards. The petroleum companies are interdependent with other companies in the value chain, and use standards to reduce both risks and costs through simplifying e.g. purchasing and tendering processes.

A wide range of benefits from standardization

Figure 3-7 below reports the companies' response to various statements regarding standardization. The respondents confirm that standards are an important means to improve sales and market access for Nordic companies. The benefits are grouped into three different categories: 1) Sales marketing and market access, 2) Production and supply chain efficiency and 3) Quality, risk and environment.

Figure 3-7: Please indicate whether you agree or disagree on a scale from 1-5 with the statement. Share of respondents agreeing with the statement (responding 4 or 5). N=1092



Sales marketing and market access:

- 85 percent of respondents agree with the statement that standards create trust and confidence with customers. Applying standards help companies secure and signal quality. In fact, three out of four companies report that standards improve the quality of their products and services and that they simplify the communication between producer and customer. This is slightly higher than the study by Hogan et al. (2015) among British companies where 70 percent of respondents stated that standards had contributed to improving the quality of supplier products and services.
- 69 percent of the respondents representing exporting companies agree with the statement that standards simplify their exporting of goods and services, while 20 percent are neutral. Closer analysis shows that standards appear just as important for facilitating exports for small exporting companies as for larger exporting companies. The result is robust across exporting companies in all sectors. Still, the manufacturing industry is the sector where the largest share of respondents considers standards important for simplifying exports of goods, with 73 percent of the exporting companies responding positively to this statement.
- Nearly half of the respondents report that standards have helped them increase sales, either by gaining new customers or increasing sales to existing customers. As much as two out of five companies report that standards have helped them gain new customers, while one out of six companies report that standards help them gain new customers both in the domestic market as well as in the international market. This result is supported by in-depth interviews where companies across sectors emphasize that following standards often is a requirement for gaining market access. Our findings show that standards are just as important for small as for large companies in gaining new customers. Comparing sectors, we find that standards are most important for gaining new customers within Trade (58 percent) and Manufacturing (48 percent), while standards as a tool for gaining new customers seem less important within Healthcare (31 percent) and Petroleum (34 percent).

Production and supply chain efficiency:

- Improvements in production efficiency can be achieved within the boundaries of the company, or it can be done in other parts of the value chain. 59 percent of respondents emphasize that standards simplify purchasing and tendering processes, thus increasing efficiency and saving costs. This gain from standards is also supported by the in-depth interviews with companies. A large Swedish publicly owned construction company stated that standards help it simplify external relations in its value chain. Standards contribute to reduced operating costs over time by building a floor for the minimum requirements on the tenderers. There are, however, quite large variations across sectors as to how important this benefit of standards is. In sectors with complex tendering processes where the quality of the product is hard to assess in advance, such as the petroleum, healthcare and construction industries, this benefit is emphasized by about 70 percent of the respondents. In sectors with more transparent products, such as Trade, Seafood and fisheries and Manufacturing, only about 45 percent of respondents consider this benefit important.
- As much as 84 percent of respondents report that standards help them comply with regulations. This is an important benefit of standards, as it saves the company administrative costs related to compliance. In addition, following the standard helps the company signal compliance with regulations to the market. The more regulated the sector is, the larger the benefits of following standards that help the companies comply with these regulations. Thus, in the petroleum and the healthcare sectors a respective 94 and 89 percent of the respondents answer that standards help them comply with regulations.

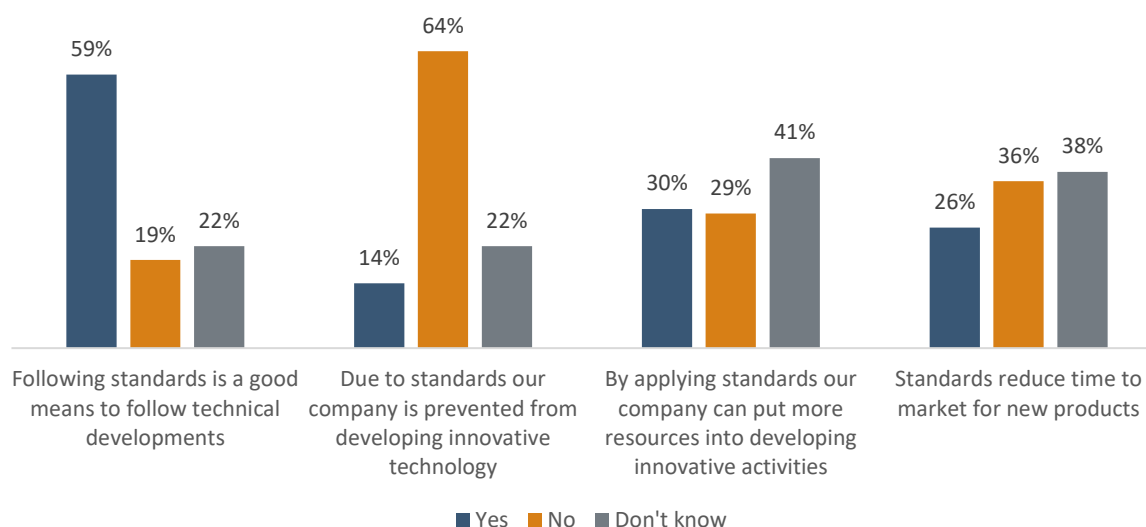
Quality, risk and environment:

- Production errors or receiving a poor-quality product from sub-contractors can be costly. 65 percent of the respondents point out that standards reduce the risk of manufacturing errors within the company. The same share of respondents also say that standards raise the quality of subcontractors. The result is robust across sectors, the main outliers being Seafood and fisheries, where as much as 80 percent of respondents emphasize standards as an important means for improving the quality of subcontractors, and Trade where only 46 percent respond that standards are important for the quality of their product.
- A separate aspect of efficiency is the company's impact on the environment. Half of the respondents, independent of sector affiliation, emphasize that by implementing and following standards they reduce their company's negative environmental impact.

Ability and willingness to develop innovative solutions

In the survey, the respondents were asked whether standards prevent their company from developing innovative technology; only 14 percent responded positively to this claim. We interpret the fact that very few answered positively on this statement as a clear rejection of the notion that standardization is an impediment to innovation. On the contrary, six out of ten respondents emphasize standards as a good means of following technical developments. This result is in line with Blind (2013) who emphasizes the role of standards in transferring technological knowledge, as well as Hogan et al.'s (2015) study among British companies for which 54 percent of respondents reported that information was made more accessible through the dissemination of technology. The result from the Nordic survey is robust across sectors, although this is regarded as particularly important by companies operating within Seafood and fisheries (73 percent), ICT (67 percent) and Trade (65 percent). ICT was also the sector with the highest share of companies answering positively on this claim in the British study (60 percent). Moreover, 30 percent of the respondents in our survey agreed with the claim that by applying standards their company can put more resources into developing innovative activities, while 40 percent said they are uncertain.

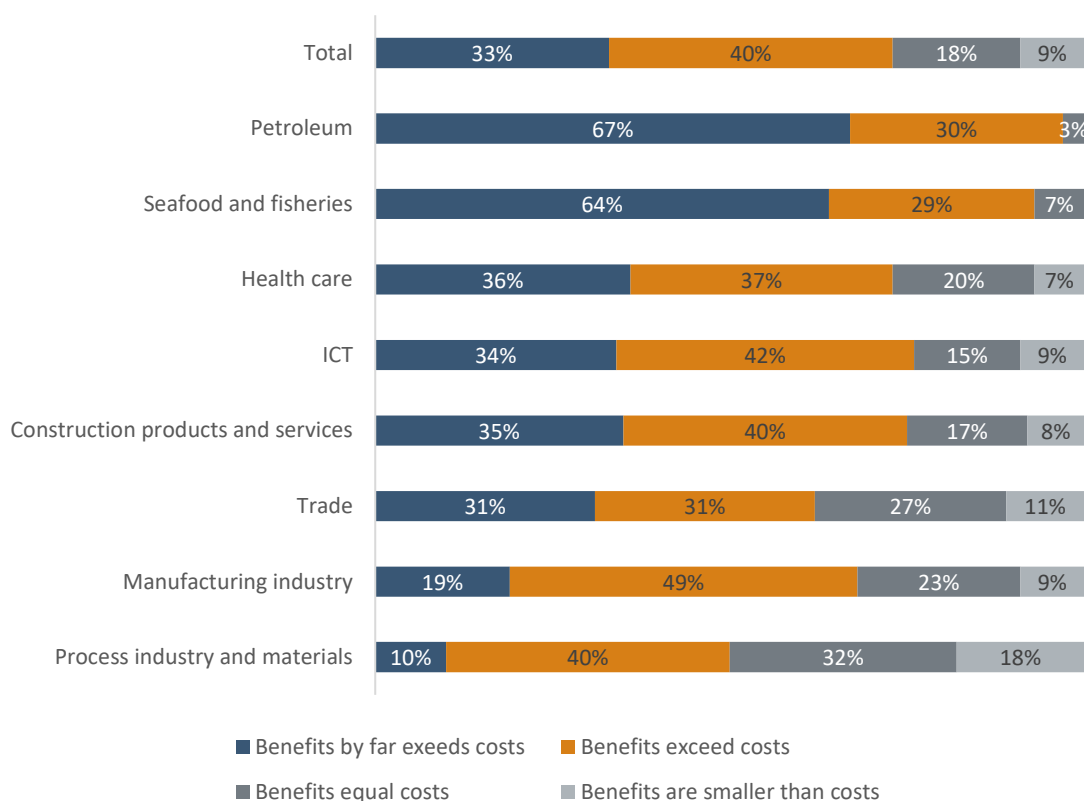
Figure 3-8: In what way do standards affect your company's ability or willingness to develop innovative solutions? Do you agree or disagree with the following statements? N=1043



Net benefits and costs of following and applying standards

The significance of standards becomes visible also in companies' experiences of the benefits and costs of standards, cf. Figure 3-9.

Figure 3-9: Respondents' view on how benefits of using standards compare to costs, by sector (in percent). N=1153



On the question of benefits related to costs, most respondents (73 percent) state that the benefits of applying standards exceed the costs. This is a high share, particularly considering that the benefits of applying standards are not necessarily observable for the company directly, but rather elsewhere in the value chain outside the boundaries of the company. At the same time, the majority of the respondents (87 percent) across sectors report that following and applying standards is important for their companies' future plans. This finding indicates that despite the costs caused by standardization, following standards is considered important to succeed in the markets.

The companies within Petroleum and Seafood and fisheries have the highest fraction of respondents reporting a net positive economic outcome of standards, while the process industry stands out with half of the responding companies reporting that benefits are equal to costs or smaller than costs. The differences across sectors are persistent when controlling for company size, whether the company is exporting its product and whether the company has had an active role in standardization development processes. Still, despite the relatively low level of respondents reporting that benefits of standards exceed costs, 83 percent of the process industry respondents find standardization is important for their company's future plans. This might be an indication that following and applying standards is necessary to be able to compete in international markets. Thus, costs of standards must be dealt with. The case study company representing the process industry and materials sector underlined the importance of standards by explaining that *"... Standards are an essential part of the supply chain as well as production processes in the steel industry. They are used in all production technologies, and all different steel categories have their own standards. The standards concerning production technologies are important for efficient investments in new technology and facilities. Standards ensure the safety of new machines and production processes. Without standards, everything would have to be tested separately. The standard proves that required tests have already been carried out, which saves both time and money. When all the suppliers work according to the standards, CE-certification is easier to obtain. In general, benefits exceed the costs of standardization"*. Figure 3-10 reports companies' experienced costs related to buying, implementing and acting in accordance with standards.

Figure 3-10: Costs related to buying, implementing and acting in accordance with standards (in percent). Share of respondents answering which of these costs related to standards is dominant in their company (multiple answers possible). N=1179

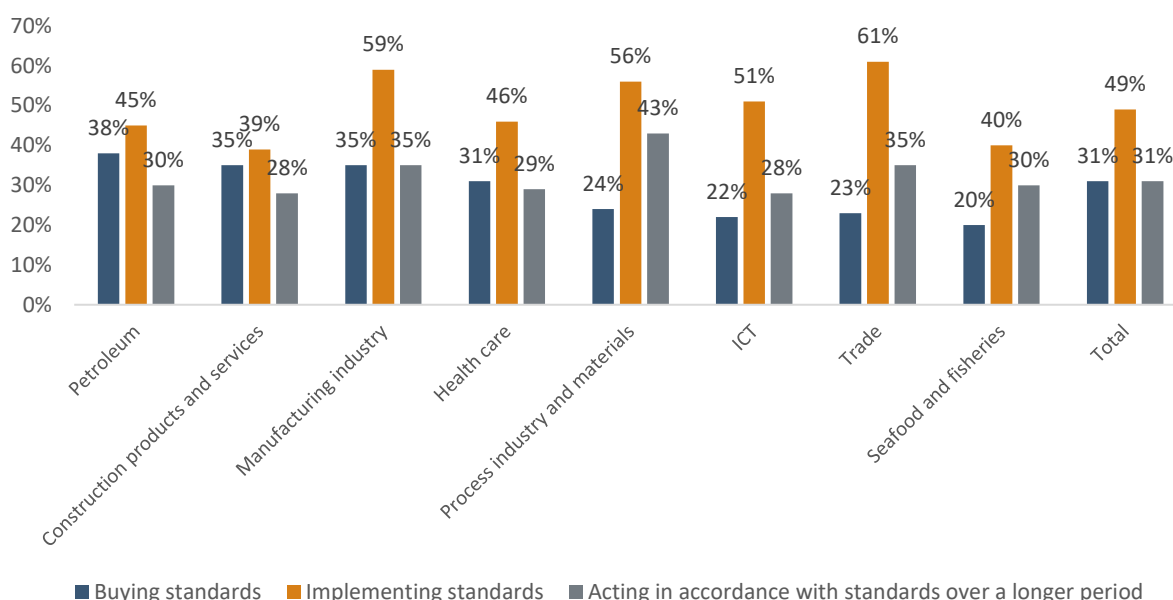


Figure 3-10 indicates that the majority of respondents, independently of sector, experience *implementing standards* as the most important cost related to the use of standards. Thereafter *acting in accordance with standards* and *buying standards* are regarded as the most dominant costs by an equal share of respondents. The share of respondents' experience of the two last types of expenses varies among the eight sectors. While a larger

share of respondents within Petroleum, Construction products and services and Healthcare experience buying standards as a more dominant cost, acting in accordance with standards over a longer period is regarded as the dominant cost among a larger share of companies within Process industry and materials, ICT, Trade and Seafood and fisheries. The finding that relatively few respondents report buying standards as a significant cost is not surprising as the standards offered by the national standardization bodies are usually made available to the public for a cost-covering fee. Only in some cases are standards subject to the payment of compensation to owners of related intellectual property rights, such as patents (Blind et al. 2011).

4. Benefits of standards among the sectors studied

In this chapter, we present a separate analysis for each sector, discussing how variation related to applying and implementing standards appears. Each sector is compared to the survey average. Data including all respondents in total are referred to as "all sectors" in the illustrations. As the countries are represented by five sectors each (with the exception of Iceland, where only three sectors have been analysed) in the survey, the category "all sectors" is composed individually for each of the sector presentations. Each chapter regarding the sector analysis therefore starts with a fact box explaining which countries and how many companies each sector analysis includes.

4.1. Construction products and services

Ever since the 2008-09 financial crisis, developed economies across the world have experienced weak productivity growth. One of many possible explanations for this relates to uncertainty. In uncertain times, companies are wary of investing in new equipment. The construction industry has been afflicted by problems of low productivity growth for a long period. Since 1995, the global average value-added per hour in the construction industry has grown at around a quarter of the rate in the manufacturing sector, and relative to other industries, the productivity increase in the construction industry has been close

to negligible for the last two decades. The situation is especially dismal in rich countries, the Nordics being no exception. In terms of value added, the construction industry stood for between three and five percent of total value added in 2014, while the output-share is within the five to seven percent range. These shares are somewhat low considering that the construction industry employed between seven and nine percent of all workers in the respective countries in 2014. As previously reported in this paper, the construction industry is among the industries with the highest number of individual standards. We find that a doubling in the stock of standards is associated with a 7 percent increase in labour productivity in construction. In light of having a positive statistically significant impact on productivity, standardization is likely to play an important role with respect to future productivity-enhancing measures.

Key information – data set: 323 companies from Norway, Sweden, Denmark, Finland and Iceland

Company size: Micro: 25% Small: 30% Medium: 24% Large: 21%	Exporting companies in sample: 43% Use of standards: <ul style="list-style-type: none">• Management standards: 34%• Technical standards: 95%
--	--

The use of standards

The Construction products and services sector covers all aspects of construction activities including architectural services and parts of the manufacturing industry producing construction products.¹¹ Construction products and services is a sector highly influenced by standards in all Nordic countries. The formal standardization work for this sector dates to before the 1920s (Sindeband, 1924). The importance of standardization in the construction industry is also reflected in the survey. The sector is the only industry represented in all countries in this study, and it is also the sector with the highest number of respondents. Due to its size, the analysis of all sectors in total is significantly influenced by this sector. This is also a part of the explanation why the construction products and services industry is representative for the average across sectors on almost every question raised in the survey. However, excluding construction companies from the category of all sectors, one can see that the sector is also close to average for all sectors overall.

The respondents' understanding of the importance of standards is clearly present in the construction products and services sector. A dominating group of respondents (86 percent) reported that standards are important or very important for their companies. A regression analysis shows that the bigger the companies the respondents represent, the more important standards are for them.

The use of standards in the construction industry reflects the sector's characteristics. However, when it comes to Construction Product Regulation, the European standards are mandatory. The construction industry is unique among the studied sectors, in the sense that it is the only sector where standards are mandatory on nearly all

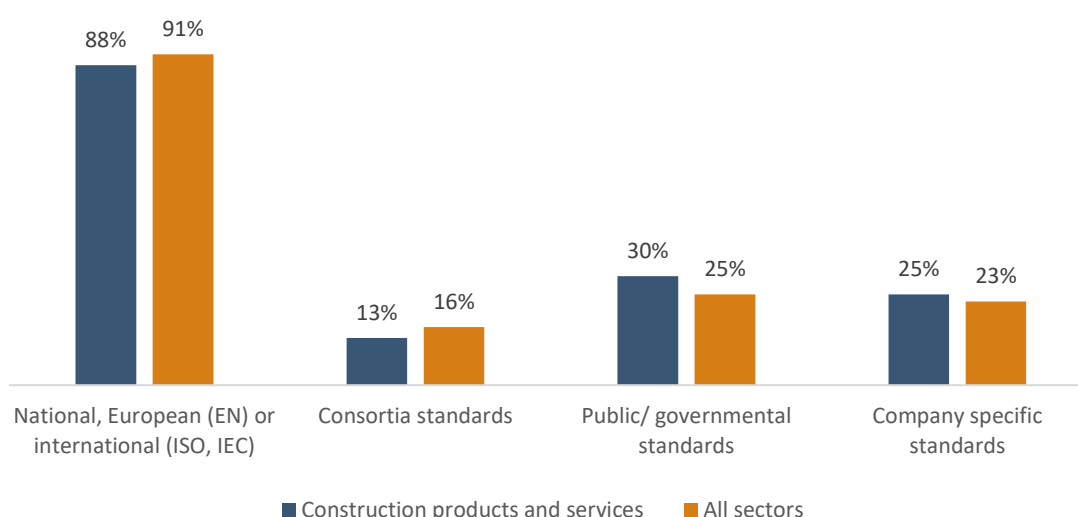
¹¹ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

products sold in the EU (Hogan et al. 2015). One of the case study companies elaborated: *"Standards make it possible for us to deal with customers and sub-suppliers, and help our employees to understand the job assignment; what to do and how to do it. The use of standards varies among different customer groups, who define quality by e.g. asking for standards. Standards are about following the common agreements in the industry."* Moreover, companies depend on quality and transparency in the entire value chain. The companies' demand for specific quality delivery levels are often linked to standards. At the same time, it helps to use subcontractors that follow certain standards to reduce different kind of risks in the industry.

Figure 4-1 illustrates how the use of standards among construction products and services companies relies on standards developed by independent, non-governmental organizations such as CEN, CENELEC, ISO and IEC, where the national standards bodies are members. 88 percent of the companies in the construction sector apply these types of standards. Their use gets more frequent with increased company size. The use of these standards is the same for big as well as for smaller companies. However, these standards are of importance for all sectors studied; the understanding of their importance is also high across countries. All the Construction products and services respondents in Finland confirmed that their company uses these standards. In addition, Denmark also had a rather large group of companies in this sector saying that these standards are more used in their company. In Sweden "only" four out of five respondents confirmed that their company makes use of these standards. This might be explained by Swedish companies' preferences for use of other standards such as consortia standards, which are used rather seldom by the rest of the sample. The use of consortia standards is more frequent among small and micro-sized companies. Two out of three companies that use consortia standards are micro or small companies.

Many companies, however, apply more than one type of standards. About 30 percent of companies in the construction sector report that they use public/governmental standards, independently of a companies' size. The Norwegian companies stand out as diligent users of public and governmental standards; nearly half of the Norwegian respondents confirm that they use such standards. More in-depth analyses show how the use of both technical and management standards becomes more frequent with increasing company size. The use of these standards is more frequent among the biggest sample companies. One out of four companies in the sample uses company-specific standards.

Figure 4-1: What standards are the most used in your company? (Multiple answers allowed – in percent). N=323

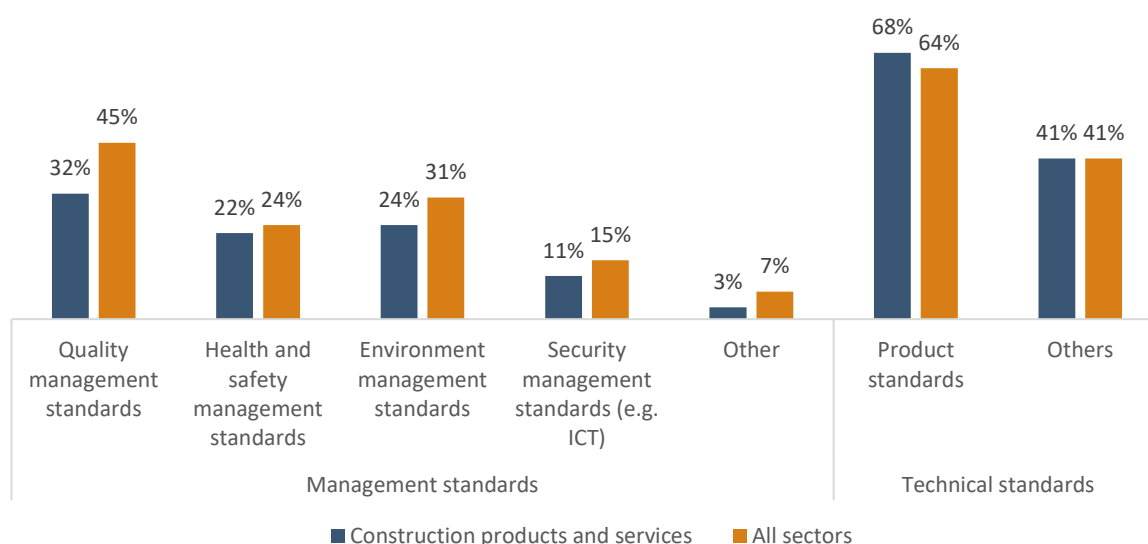


More detailed analyses of the companies' use of standards show the sector's specific nature, where satisfying customers' technical requirements plays a big role. Over 95 percent of the sector companies report that they use technical standards, even though it is not voluntary to use harmonised standards on construction products. The use of technical standards is closely related to the use of product standards. Therefore, the variable "use of technical standards" was operationalised into two sub-categories: product standards and other standards. In the

survey the respondents were asked to report which type of technical standards their companies use. Among the users of technical standards, a dominant group across countries and company sizes report that they use product standards (see Figure 4.2).

34 percent of respondents in the sector report that they use management standards. The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The respondents were asked to report which management standards their companies use. Several answers were allowed. Figure 4-2 shows that the use of management standards is relatively equally distributed among quality management standards, health and safety management standards and environmental management standards, while fewer use security management standards. Analyses of the use of various management standards indicate that the use of different management standards seems to be especially frequent among Finnish companies, where about 1/3 of the respondents' report that they are users. The Finnish companies stand out as diligent users of management standards such as quality management standards, health and safety management standards and environmental management standards compared to the rest of the sample.

Figure 4-2: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=323



Standardization within construction products and services is highly product-oriented and of great importance to entire value chains. Based on respondents' use of standards, the survey supports previous research stating standards are of crucial importance to the players' competitiveness and development. This notion was strengthened in several interviews which showed that using standards is entirely necessary to make sales in the business. One of the case study companies highlighted this by explaining that *"... the advantage for the customer is that they are assured that a minimum of interests is met. Builders are professional and follow standards, and they ensure that standards are kept through the whole value chain."* Other important factors were better safety of employees and customers as well as improved efficiency which follows both better safety and faster and more functional service procedures.

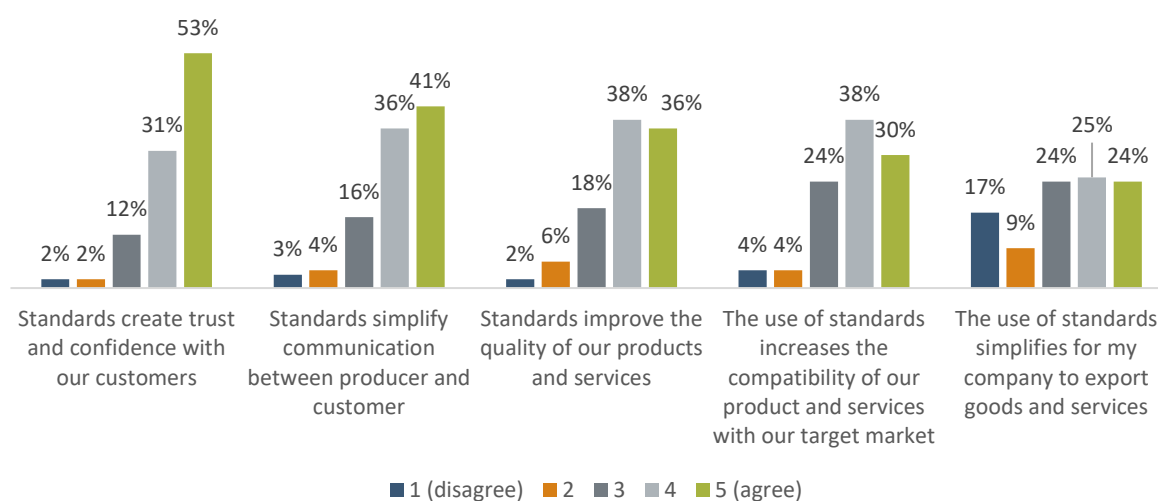
Sales, marketing and market access

How the use of standards affects economic development at the micro level is clarified when respondents answer questions about the relationship between standards and sales, marketing and market access. On various claims relating to benefits related to sales, marketing and market access, respondents were asked to rate these on a scale of 1 = disagree to 5 = agree. The vast majority of respondents, like the cross-sector average of the companies that participated in the survey, agreed (answered 4 or 5) that following standards has benefits for the company. Creating trust and confidence with customers is regarded as the commercially most important feature of

standards. In general, there are few discrepancies for companies in the sector as compared to the average. Following standards helps companies increase the compatibility of the companies' products and services with target markets, improves the quality of products and services, simplifies communication between producer and customer and creates trust and confidence in the companies' customers.

To the statement "The use of standards simplifies for my company to export goods and services", there were slightly fewer companies that agreed. Here, there was a somewhat lower average for companies within construction products and services. This is due to the fact that companies in this sector more often serve only national markets rather than foreign markets. This is for example the case with the company DK Beton, which produces ready-mixed cement that cannot be exported due to its physical properties (see case study DK Beton).

Figure 4-3: Sales, marketing and market access (in percent). N=323



One interesting finding regarding different variables describing different sides of the relationship between standards and sales, marketing and access, is linked to company size and the respondents' evaluation of how important following and applying standards is to their company's plan for the future. Regression analyses indicate that the bigger the companies are, the more the respondents agree with the statements listed in Figure 4-3. Regression analyses give support for that the more important respondents find following and applying standards to their companies, the more do respondents agree with the statements listed in Figure 4-3.

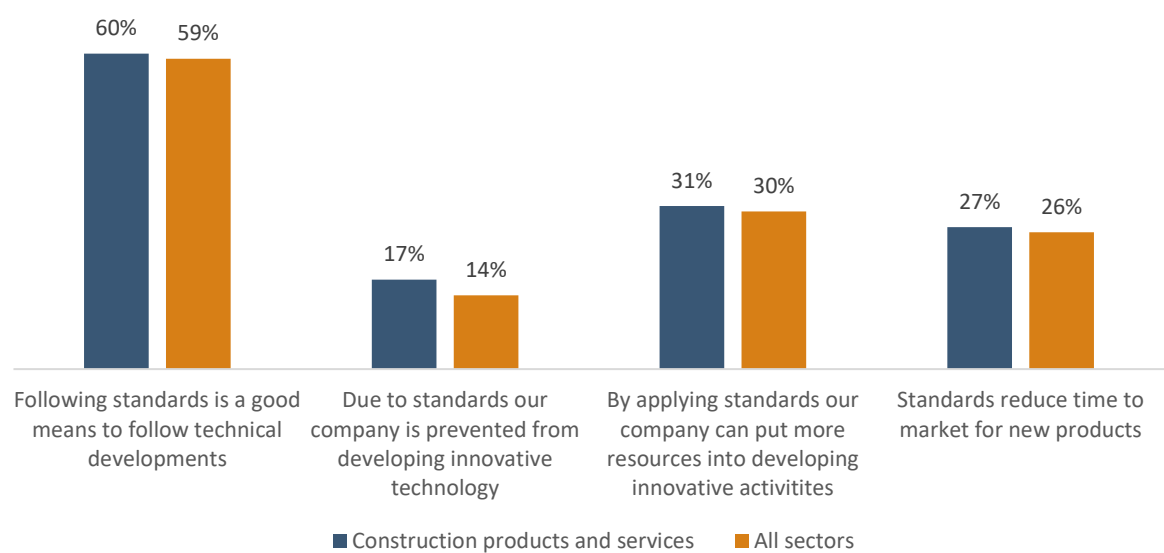
The respondents were given an opportunity to elaborate on their answers regarding their evaluations of the statements in Figure 4-3. Many respondents within Construction products and services used the opportunity to point out that at the same time as standards help to build mutual trust, strengthen communication, improve quality, product compatibility and simplify export, standards also increase both the customers' and the companies' costs. One of the respondents explains that *"most markets have their own versions or additional standards, which makes new market entry expensive"*. This respondent was supported by a colleague who claims that *"the only thing standards do is to make products more expensive for the customers"*. Even though there were a few critical voices, most respondents related standards to the ability to operate in both domestic and international markets. One of the Norwegian respondents summed up the respondents' apparent collective conviction of standards' usefulness related to sales by saying *"[standards] promote predictability and repeatability, traceability, etc. We do not need to think what or where, because it is determined by the standard. We know, and our customers and suppliers know."*

Production and supply chain efficiency

The UK standardization study concluded that one of the important areas where standards have benefited companies is in the relationship between companies in the supply chain (Hogan et al. 2015). Like the UK companies, also this survey sample finds proof that standardization affects companies' innovation efforts both internally and externally linked to the value chain. While standards contribute to increasing companies' focus on

quality in production, standards are also an element that can be perceived as an inhibitor for innovation. Figure 4-4 focuses on the relationship between standardization and innovation. This figure is based on yes-no questions related to different dimensions of how standardization affects companies' ability or willingness to develop innovative solutions. The figure shows that within the sector, following standards is considered as a good means of following technical development. 60 percent of respondents agree with this. Few of the respondents agree with the statement that “due to standards our company is prevented from developing innovative technology”. It may therefore appear that the respondents believe that their companies have found a good balance between standardization and innovation. At the same time, only 30 percent of the respondents agree that by applying standards their company can put more resources into developing innovative activities and that standards reduce time to market for new products. One possible explanation for these results is that the sector tends to be characterised by relatively little innovation and that the sector's products essentially need to comply with standardized demands.

Figure 4-4: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=323



That standardization simplifies cooperation across value chains becomes apparent in Figure 4-5. The figure shows the average, on a scale of 1 = disagree, to 5 = agree, on statements related to different elements of the company's value chain. On statements regarding production and supply chain efficiency, construction companies adhere to the average for all companies in the survey in total. Regression analysis shows that the degree of agreement on the different elements regarding production and supply chain efficiency rises with increased company size.

Figure 4-5: Production and supply chain efficiency (in percent). N=323

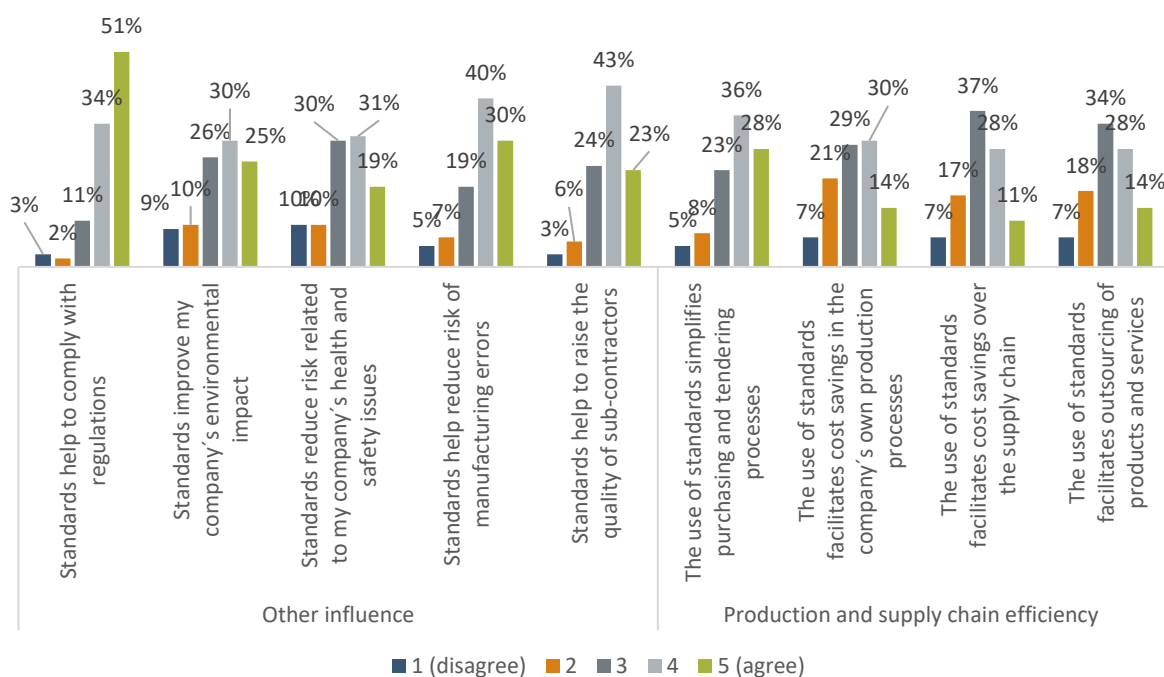


Figure 4-5 shows that the role of standards in simplifying companies' purchasing and tender processes is regarded as important in the value chain. Moreover, there is a consensus among a wide group of companies within the construction sector that standards help reduce the risk of manufacturing errors, including raising the quality of sub-contractors. Companies agree less on the importance of standards for facilitating cost savings in the company's own production process or across the supply chain. It is also interesting that companies within this sector are less agreed in that standardization facilitates outsourcing of products and services.

In line with the rest of the companies that participated in the survey, companies within the construction products and services sector agree that standards facilitate compliance with regulations. The use of standards simplifies the process of understanding how companies will respond to regulations. For example, a micro-sized Swedish architecture company states that standards help the company to deliver products in accordance with the rules and requirements of the industry, which is a tendency followed by other respondents who have elaborated their answers regarding the influence of standards. On the other hand, standards do not affect how the company itself is run. Standards also contribute to lowering risk internally and externally for the company in the total value chain. Standardization makes it easier to prevent risk to health, safety and manufacturing errors, raises subcontractors' quality and reduces environmental impact. The case study on DK Beton is an example of how standards are implemented in companies and how standards stimulate quality of production, purchasing, dealing with customers etc.

Case study: DK Beton

The Danish company DK Beton specializes in supplying ready-mixed concrete for various constructions. DK Beton covers all of Denmark and has a wide customer base, comprising the oil industry, builders and contractors, and farmers, among others. Although DK Beton only has Danish customers – since ready-mixed concrete cannot be transported too far if you want to maintain its ideal properties – DK Beton is also part of the multinational conglomerate HeidelbergCement Group, which was founded in 1874. With its presence in more than 60 countries and with more than 100 concrete plants, HeidelbergCement Group is one of the world's largest producers of cement.

DK Beton uses national, European and international standards. The company also has internal standards and has developed standardized procedures that allow it to document the properties of its products. Some of the essential standards for DK Beton are standards on working environment and environmental standards, as well as the EN 206 standard, a European standard mandatory for concrete in Denmark. These are the fundamental standards that enable the company to comply with national regulations.

DK Beton considers standards an efficient means to formalize quality criteria, to follow regulations and create materials with the right qualities in line with customers' demands. Standards are also important in DK Beton's procurement processes. When DK Beton buys supplies from subcontractors it has some clearly specified standards that the subcontractor needs to comply with. The standards help DK Beton to make sure that the subcontractor can deliver the right quality compatible with its own product. Therefore, if a subcontractor does not comply with, say, the EN12620, DK Beton will not do business with the subcontractor.

There is a clear difference in how management standards and product standards are being used at DK Beton. Whereas some management standards, such as the ISO 14001, have open and less stringent requirements, product standards define absolute thresholds and the composition of a material. For example, a management standard often includes a requirement that the company has a system for its working processes without necessarily defining what this system is or what the outcome of the implementation of the system needs to be. Management standards can therefore be used as pedagogical guidelines within the company. Internally, standards regarding working procedures are also used to motivate employees. Externally, environmental standards and management standards can be used to communicate the company's CSR policies.

However, there are times when standards can become a problem when DK Beton is getting its supplies. One component in cement is ashes, which are supplied by power plants. The problem is that European power plants have started to use wood chips and that, according to the existing standards regarding ash supplies for concrete, these ashes are not allowed to come from wood. Development and new technologies or practices can thus create a need to update standards. Standardization committees in Europe and Denmark are currently working on revising the standards to address this development. DK Beton is taking part in standardization work on a national level. By doing so, it can anticipate changes in national standards. This also allows the company to revise some standards and make sure that they are internally consistent. The manager of technology and quality has previously seen standards that were internally contradictory, and the company is interested in preventing such contradictory standards that are either impossible to comply with or where compliance relies heavily on the interpretation of the standard. By participating in standardization work, the industry can make sure that standards meet the needs of industry and are not too burdensome to comply with.

Case study: Swedavia AB

Swedavia AB is a big state-owned company with over 3000 employees. The company was founded in 2010, after taking over ownership and operations of airports from the Swedish Civil Aviation Administration (LFV). Swedavia owns, operates and develops Sweden's national basic infrastructure of airports – a network of ten airports from Malmö in the south to Kiruna in the north. Swedavia's vision – "Together we bring the world closer" – highlights the company's focus on making the transportation of both passengers and cargo (nationally and internationally) as accessible, efficient and attractive as possible.

The use of standards is essential to the construction products and services industry. Swedavia complies with a diverse range of technical industry-specific standards as well as general management standards. With vast-reaching operations in different areas of the industry, Swedavia complies with standards such as the ISO 9001, ISO 14001 and ISO 50001. Moreover, the company follows the SMS (Security Management System), SeMS (Security Management System) and ADQ (Aeronautical Data Quality), which are not outright standards but rather methods related to the EASA (European Aviation Safety Agency). ADQ was developed according to the ISO 9001 standard and is thus closely linked to the quality management standard. Furthermore, Swedavia has Airport Carbon Accreditation (ACA), a climate certification tool for airports based on ISO 14064 (Greenhouse Gas Accounting).

Implementing and complying to standards constitutes a central part of operations at Swedavia. Standards offer a structure for quality and environmental management that helps the company to improve its economic efficiency and efforts to lower the environmental impact. Moreover, standards provide a solid backbone for the management that reaches out to all parts of the organization, which is particularly important considering that the company's operations are scattered between ten different airports.

Swedavia's focus on environmental sustainability affects all aspects of its operations. In this context, environmental standards such as the ISO 14001 help the company by providing a structure for assessing environmental aspects in decision-making processes. Complying to – and actively implementing – the ISO 140001 standard in templates used for decision-making contributes to the long-term work towards the company's goal of zero fossil carbon emissions by the year 2020. Moreover, standards help simplify Swedavia's external relations down the value-chain, particularly with regards to tendering processes and outsourcing of construction products. In this respect, standards contribute to reduced operating costs over time by building a floor for the minimum requirements on the tenderers. Standards can, however, also act as a barrier to tendering processes. In situations where no potential subcontractor, for example in construction, meets the technical and environmental requirements of the standards, Swedavia must invest resources into researching the market of subcontractors before initiating the tender process.

Standards help simplify Swedavia's external relations down the value-chain, particularly with regards to tendering processes and outsourcing of construction products. In this respect, standards contribute to reduced operating costs over time by building a floor for the minimum requirements on the tenderers. Standards can, however, also act as a barrier to tendering processes. In situations where no potential subcontractor, for example in construction, meets the technical and environmental requirements of the standards, Swedavia must invest resources into researching the market of subcontractors before initiating the tender process.

Standards do not only shape the overarching strategic goals of Swedavia, but also affect the travellers using the company's services. This is especially relevant seeing that safety and security measures are vital within airports. Industry-specific security standards are used by Swedavia and other airport facilitators to streamline security routines on airports across countries within the EU – giving travellers a similar airport experience regardless of country. Furthermore, standards simplify and systematise the handling of customer complaints and feedback. At Swedavia, standards are not seen as interfering with innovative solutions and business development. On the contrary, the company has embraced the new ISO-standard's focus on the systematic use of standards to detect improvement in areas such as sales development at the airports.

The main cost of standards for Swedavia lies in the implementation phase. Seeing that implementation is a learning process for employees at all levels, implementation of standards is a time-consuming process in a big company like Swedavia. To ensure that standardized working methods permeate all levels of the organization, Swedavia offers in-company training to all employees, as well as separate training programmes for management and on environmental sustainability. On an overall level, the company believes that the benefits of using standards clearly exceed the costs.

Representatives from Swedavia actively participate in standardization work both nationally and internationally within different areas such as quality and environmental management and safety and security. The company sees this as a necessary effort in establishing standards that suit the national conditions of Sweden, to avoid having to use standards that are either too general or better adapted to other countries. Participating in standardization is also seen as an opportunity for employees to constantly improve their knowledge about standards and, accordingly, to gain advantage on how to adapt to relevant changes within the industry at an early stage.

Case study: Caverion

Caverion produces technical construction services, real estate services and industrial maintenance to customers in the public sector, industry, real estate companies and construction companies. Caverion has about 16 000 employees in 12 countries. Its revenue for 2017 was about EUR 2.3 billion. Caverion's head office is located in Helsinki. As one of Europe's leading providers of technical solutions for buildings and industries, the company designs, builds, operates and maintains intelligent and energy-efficient solutions for buildings, industries and infrastructures in Northern, Central and Eastern Europe. Caverion's strategy is to focus on service production, and it has sold all of its manufacturing units during recent years.

Caverion applies mainly ISO standards in its service production, procurement activities and quality management systems. Other product standards are applied when it comes to equipment and supplies. ISO standards are considered important as they create trust among customers and simplify sales to all types of markets. By committing to these standards, the customers gain a better understanding of the product they are buying and can rely on the product being compatible with any related systems (technical, electrical etc).

Among all the benefits from applying standards, Caverion considers health and safety issues as the most important. Moreover, Caverion states that standards improve its service quality and customer satisfaction, and therefore lead to new sales as well. Companies in this business are expected to follow basic standards, and all of Caverion's major competitors do so, at least in the Nordic markets. Hence, Caverion does not consider using standards as a competitive factor as such. Rather, applying standards is a prerequisite to be in the market. Caverion also considers standards very useful in outsourcing its services. Standards form a basic set of requirements and make outsourcing more simple and efficient. They ensure that all rules and regulations are followed and that all health and safety issues have been taken into consideration. They also prevent errors in service production.

In some cases, lack of standards (or their non-existence) has been an obstacle in presenting technological innovations. If the product is completely new, there are no standards for it, which makes it hard to sell the product in the market as several customers are only willing to buy standardized products. Caverion has also experienced that standards may slow down technological development. An example of this is a pre-assembled electronic control room which is designed to be installed on top of a building. In this case, it is not completely clear for Caverion whether it should follow standards for construction business or for electronic equipment. Thus, a lack of predefined order of priority among standards from different technological areas can create an uncertainty in the technical design of complex products.

According to Caverion, the most expensive phase of applying standards is implementation. It requires continuous learning from the whole organization. On the other hand, continuous learning is a competitive factor and can be seen as a necessity in the market.

Case study: Frøiland Bygg

Frøiland Bygg is a Norwegian construction company delivering solutions to households, private sector companies and state institutions. Frøiland Bygg AS was established in 2006 with its headquarters in Stavanger. The company currently has nearly 280 employees, with over 30 branches spread all over Norway. Insurance companies are a large customer group, for which Frøiland Bygg performs reparations and renovation related to claims and damages.

Frøiland Bygg reports that use several types of business standards, of which many are managed by Achilles StartBANK. The company is a user of NS 3511:2014 Measurement of the relative humidity (RH) in concrete, and NS 3512:2014 Measurement of moisture in timber structures. The two standards are important for Frøiland Bygg to establish a common understanding with customers regarding accepted humidity levels when repairing moisture damage in buildings. For Frøiland Bygg, product standards within chemistry and materials are important from an HES perspective. Without standards, the company and customers are prone to disregarding implications on health and safety. To safeguard the health and safety of workers, the company complies with the standards for e.g. working clothes. Similarly, noise reduction equipment and clothes suited to a hazardous work environment are important. To ensure this, the company's procurement department works on standardization of various categories. These standards also include choosing environmentally friendly products. Requiring that vendors' products comply with specific standards means that Frøiland Bygg ultimately can rely on fewer suppliers with lower prices for the products. In other words, the use of standards improves relations with suppliers, facilitates cooperation, minimizes the risk of accidents, and ultimately increases effectiveness in general.

Frøiland Bygg emphasizes that standards help it to fulfill its ambition to deliver products and services in accordance with the customer's expectations. In fact, not following standards would simply mean that customers would go elsewhere. Standards help the project managers to structure and be aware of prioritized and defined tasks. Applying standards benefits Frøiland Bygg especially by establishing efficient cooperation between customers and subcontractors, in addition to efficient routines for procurement. The company's experience is that without applying standards, the markets for their services are limited.

Frøiland Bygg also participates in the development of new standards owned and administered by Standards Norway. A promising new standard that is under development and expected to be introduced to the market focuses on moisture proof construction processes. According to Frøiland Bygg, the standard has a large impact on its market since the insurance companies, one of Frøiland's most important customer groups, take part in the group developing the standard. By involving the insurance companies in the consensus process of developing the standard it becomes more likely that the insurance companies will acknowledge the standard and use it in their business.

4.2. Manufacturing industry

As in most other developed economies, the Nordic manufacturing industry has undergone quite dramatic and substantial changes during the last two decades. As thousands of manufacturing jobs have been lost, terms like “de-industrialisation” are often used to describe the industry development. On average, the manufacturing share of employment has dropped by close to six percentage points over the last two decades in the Nordic countries. In absolute numbers, this equates the loss of nearly half a million jobs in the Nordic region between 1991 and 2013. Offshoring of production, loss of competitiveness vis-à-vis newly industrialized countries and increased use of automation are the main causes. This somewhat depressing picture is offset by the development in output, which has grown steadily during the period. The combination of increased output and reduction in employment suggests that in terms of labour productivity, the industry is thriving. The latter argument is underpinned by the fact that on average, the Nordic manufacturing industry experienced an annual productivity growth of more than three percent within the period.

Key information – data set: 271 companies from Sweden, Finland, Denmark and Iceland

Company size:	Share of exporting companies in sample:
Micro: 15%	83%
Small: 29%	
Medium: 38%	Use of standards:
Large: 18%	<ul style="list-style-type: none">• Management standards: 61%• Technical standards: 98%

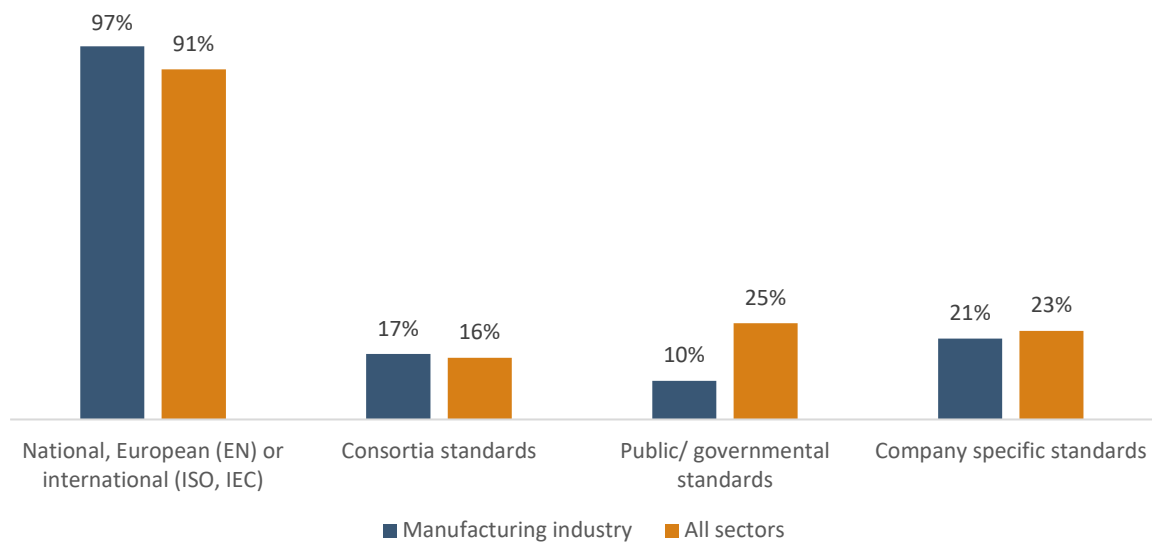
Automation of production processes requires systems that cooperate and communicate, suggesting a need for coordination. As previously discussed, standardization can reduce the variety in intermediate goods, thereby reducing switching costs, in addition to causing interoperability effects that enhance productivity. As future technologies and solutions arise, facilitating new production methods, standardization will likely be vital to maximise their potential.

The use of standards

Our definition of the manufacturing industry covers production of all types of products ranging from production and repair of machines and motor vehicles, electronic and electrical equipment as well as furniture.¹² The manufacturing industry dataset includes answers from 271 respondents and is thereby the second largest sector studied in the Nordic survey. Norway is the only country that is not included in this sector analysis. Use of standards among the companies reflects the manufacturing industry's close association with international markets. In this study, four out of five companies' respondents represent companies that export their products. This is related to the high number of companies reporting that standards used in their companies are national, European or international standards, at the same time as there are relatively fewer manufacturing industry companies reporting that they use public and/or governmental standards, compared to the average survey company (see Figure 4-6).

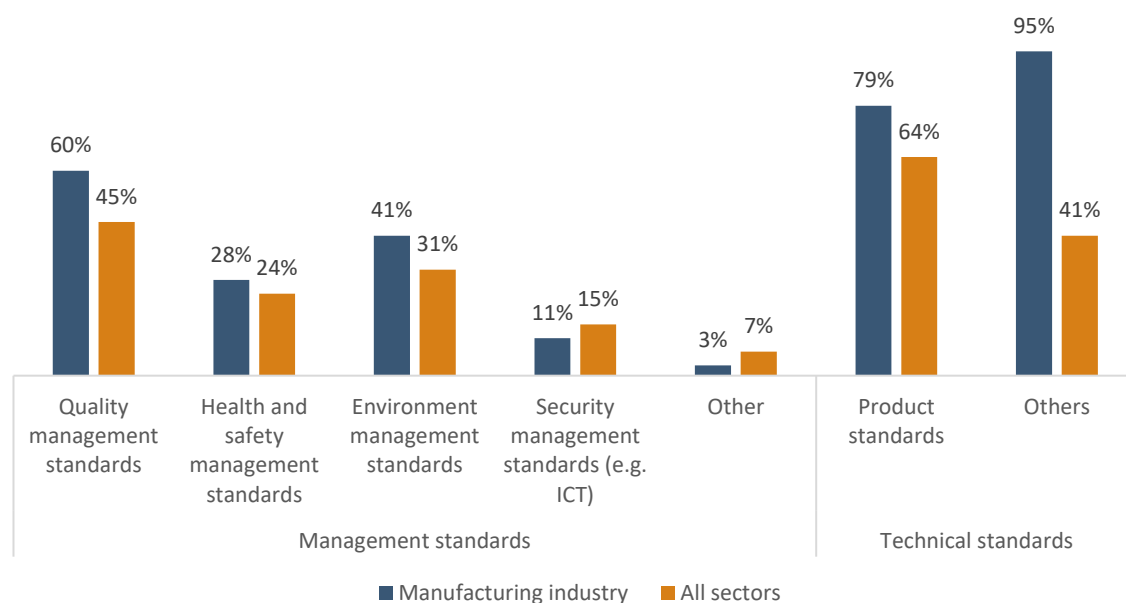
¹² See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

Figure 4-6: What standards are the most used in your company? (several answers allowed - in percent) N=271



The survey data indicates that the use of technical standards is of high importance for manufacturing industry companies (see Figure 4-7). Nearly all the companies in the sector (98 percent) report that they use technical standards. The use of technical standards is closely related to the use of product standards. In the survey the use of technical standards was operationalised into the two sub-categories product standards and other standards. The respondents were asked to report which type of technical standards their companies use. Several answers were allowed. In addition to a significantly higher percentage of companies saying that they use product standards compared to the rest of the companies, a high number of companies report that they use “other” technical standards. Examples of these kinds of standards are standards for machine safety, personal protective equipment (PPE), electrical installations, inter-process communication (IPC) or standards for testing.

Figure 4-7: Distribution of standards (Multiple answers allowed – in percent of total sample), N=271



61 percent of the companies within the manufacturing sector use management standards. The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety

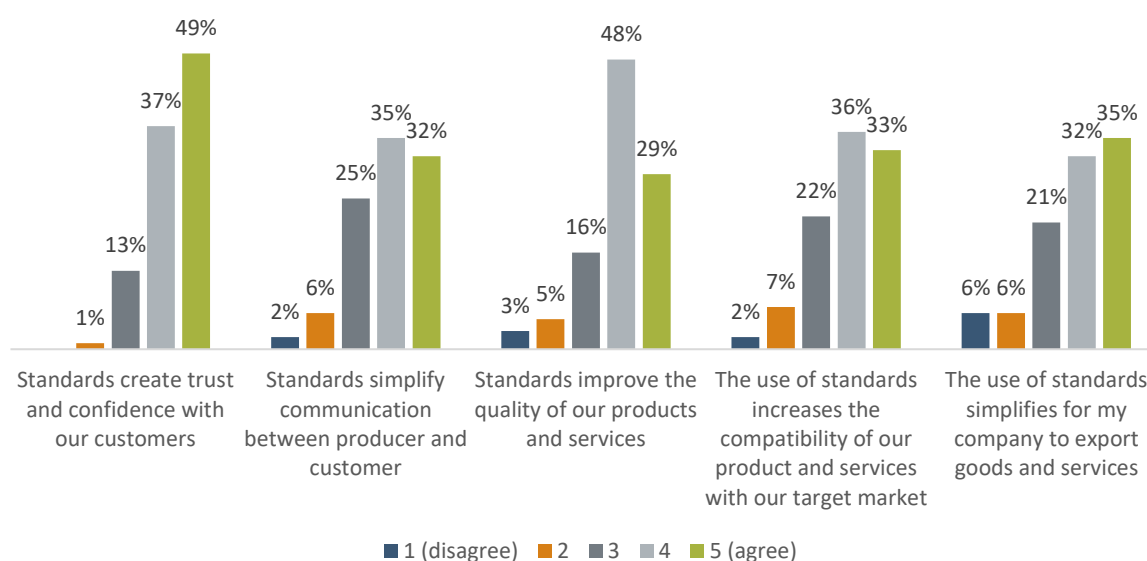
management standards, environment management standards, security management standards and other. The respondents were asked to report on which kind of management standards their companies use. Several answers were allowed. Among management standards used in the sector, quality management standards are used by 60 percent and environment management standards are used by 41 percent of the manufacturing industry companies. That is in fact more often than in the average survey company.

Sales, marketing and market access

When it comes to the benefits of standards, the manufacturing industry respondents report that standards have huge benefits for companies' entrance to and influence on markets. The results presented in Figure 4-8 reflect the manufacturing industry's focus on exporting its goods towards international markets, in that many respondents report that standardization simplifies their company's export of goods and services. One of the Danish respondents highlighted the importance of standards for export by claiming that *"... we export 99 percent of our products. Therefore, it is extremely important that the customers know that our products follow standards and regulations 100 percent."*

On various statements regarding benefits related to sales, marketing and market access, respondents were asked to rate these on a scale of 1 = disagree to 5 = agree. In general, creating trust and confidence with customers is regarded as the commercially most important feature of standards. This statement is followed by *standards improve the quality of our products and services*. In general, there are few discrepancies for companies in the sector as compared to the average related to country. To the different statements presented in the figure, the Swedish and Danish companies agree to a lower degree than the respondents from Iceland and Finland.

Figure 4-8: Sales, marketing and market access (in percent), N=271



In the free comment section of the survey, manufacturing industry respondents were asked to elaborate on their views and experiences regarding sales, marketing and market access. The respondents' main feedback is that following and applying standards is an absolute requirement to be able to compete on both domestic and international markets. One of the respondents highlights the importance of this by stating that *"... standards constitute a platform for technical communication"*. This respondent is supported by colleagues saying that *"Standards are a basic knowledge because it is the regulatory framework that we must adhere to in the industry"*, *"We regard standards as a common language that makes it easier and easier to make good agreements with our customers"* and *"Standards ensure that the product meets the customer's expectations"*. These findings are also supported by the UK standardization study. One of the findings from the automotive sector, which is one of the UK's most important manufacturing industries, was that a key benefit of standards is their contribution to improving the relationship between suppliers and Original Equipment Manufacturers (Hogan et al. 2015). The

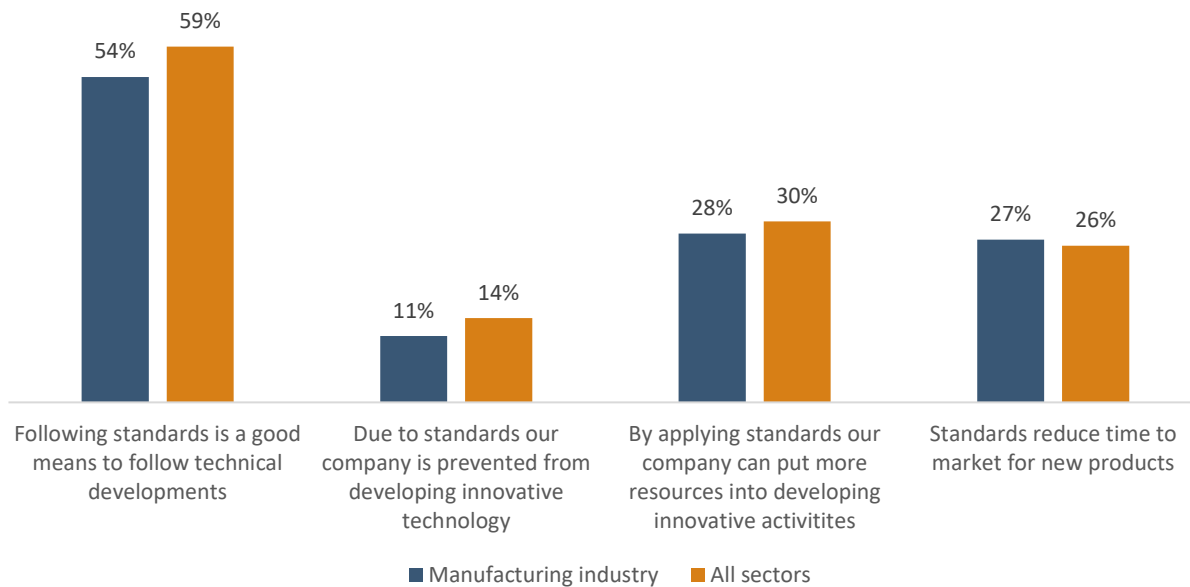
study further concludes that the relationship is improved through communication on product specification, improved quality outcomes and better regulation and allocation of individual and mutual responsibilities (Ibid).

Regression analyses indicate that the bigger the companies are, the more the respondents agree with the statements listed in Figure 4-8. Regression analyses provide support for the hypothesis that the more important respondents find following and applying standards to their companies, the more the respondents agree with the statements listed in Figure 4-8.

Production and supply chain efficiency

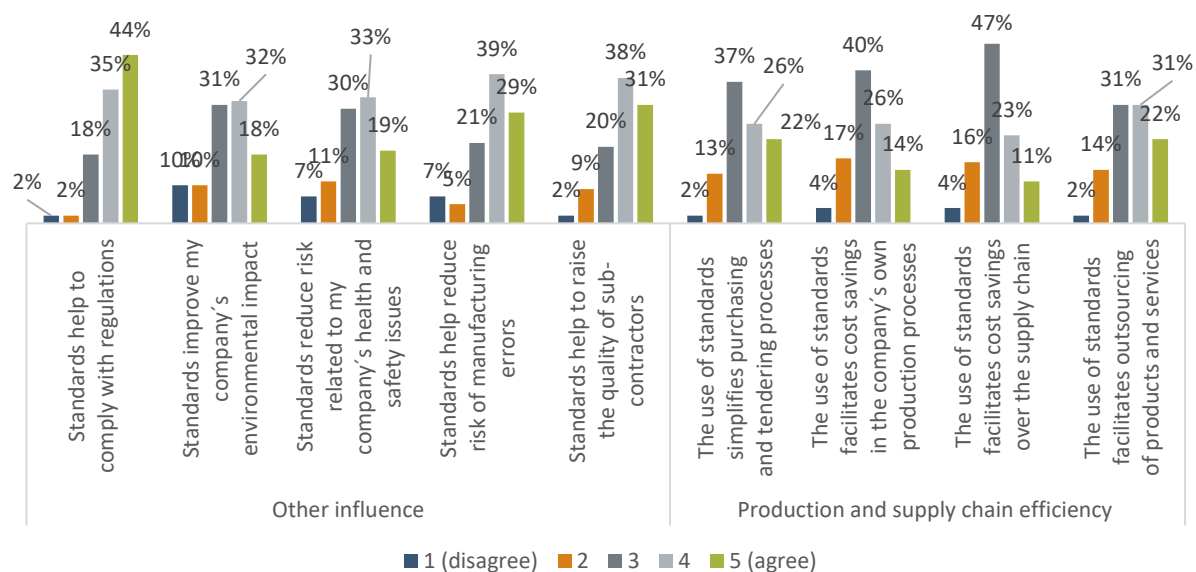
The manufacturing sector in the Nordic countries has been heavily influenced by fierce international competition and rapid technological changes. Renewal in terms of production process streamlining is one important driving force to acquire increased competitive advantages for companies. Figure 4-9 focuses on the relationship between standardization and innovation and reveals that the manufacturing industry companies consider following standards a good means to follow technical developments. The results displayed are based on yes-no questions related to different dimensions of how standardization affects companies' ability or willingness to develop innovative solutions. The responses of companies in the manufacturing industry are very similar to the survey average. Very few manufacturing companies regard standards as an impediment to innovation (11 percent); in fact, as much as 28 percent of respondents find that standards help the company put more resources into innovative activity.

Figure 4-9: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=271



The results presented in Figure 4-10 indicate that except with regards to the statement “Standards facilitate outsourcing of products and services”, the companies within the manufacturing industry sector do not deviate from the rest of the sectors studied with regards to production and supply chain efficiency. The figure shows the average on a scale 1 = disagree, to 5 = agree, on statements related to different elements of the companies’ value chain. Again, the manufacturing companies follow the same tendencies as the average survey company. Standardization facilitates many ways of simplifying actions and operations in the value chain, at the same time as it contributes to raising quality in internal and external work tasks and operations conducted across different actors in the value chain.

Figure 4-10: Production and supply chain efficiency (in percent), N=271



Case study: Kvisgaard

Kvisgaard is a Danish, family-owned engineering workshop that produces spare parts for the food industry, the oil industry, space and aerospace as well as the defence industry. With regards to the defence industry, Kvisgaard recently supplied spare parts for the new F-22 airplanes. The company was founded in 1971, and it currently has around 55 employees. The company used to have a branch in Sweden, but this branch has now been moved to the Danish city Brøndby. At present, Kvisgaard is only producing in Denmark. About half of its revenue comes from exports. Some of the company's major clients are based in Italy and India, but it also exports to China, Brazil and England, among others.

Kvisgaard today uses more than 150 different standards, comprising both national, European and international standards. More specifically, these standards include standards from formal national and international standardization organizations such as EN, ISO, DIN, ASME as well as industrial standards such as MIL, FED, NORSOK and SECNAV. Some of the company's essential standards are the widely used ISO 9001 and ISO 14001. When these standards were institutionalized in the 1990s, they were a sign of quality and became a competitive advantage for those that applied them. However, since most clients demand these standards now, they are becoming almost mandatory for manufacturing companies that want to do business in the B2B market where Kvisgaard is operating.

Kvisgaard emphasizes that standards are built on know-how and a long tradition of continuous testing. Therefore, standards induce trust. This is important for Kvisgaard when it uses subcontractors. If it is buying spare parts from a subcontractor in India, it might take six months before the parts arrive. Knowing that its Indian subcontractor is producing in accordance with pre-specified standards, Kvisgaard can limit its own supply risks and therefore it knows that its own production processes will not be unnecessarily prolonged. Likewise, when Kvisgaard is using the standards that its clients demand, standards can also function as a form of insurance for both parties since the delivery can be specified in great detail.

Kvisgaard's standards are also used to specify both what should be produced and how it should be produced. One example is technical drawings that the company receives from clients. These drawings do not only contain references to the standards used by Kvisgaard, but standards for the digital format of the technical drawings as well as various European standards are a necessary condition if Kvisgaard wants to read and understand the

technical drawings. Kvisgaard has previously received drawings of products that it was basically unable to use because the drawings were not supplied in the right format.

Since Kvisgaard delivers relatively standardized products, the standards that it is using are necessary for selling its products in the market. Furthermore, because its products are so standardized, the standards it applies do not in general hinder product innovation. Still, the company has previously tried to make minor modifications of its products – such as making their metal components slightly more tolerant – but the result has been that some of these items did not comply with the formal standards that its customers demanded. This is not a major issue for Kvisgaard since such modified products would only be a fraction of its total sales. However, if the company did create a completely innovative product for a market with high standardization demands, it is likely that it would face challenges in selling this product due to deviations from the requirements in the standard.

The head of quality at Kvisgaard makes sure that the company complies with the documentation, tolerance of products and the standards that new clients demand. This means that Kvisgaard sometimes also needs to acquire new standards. The market for standards, however, is far from transparent as the documentation of a standard can easily be around 100 pages and refer to many other standards. Furthermore, you need to buy a standard to fully know its specifications, but once you have bought an industry standard from a standardization organization, you might realize that it is almost identical to a standard you already have. Acquiring standards can thus easily become expensive and bureaucratic, especially for smaller companies. This is one of the problems with the standards that Kvisgaard buys: A foreign client might demand the use of a specific industry standard for planes, but the company might already have another standard from another standardization institute that is identical with the industry standard. Kvisgaard will nonetheless have to buy the industry standard. It is important to notice that within the “de jure” standardization regime mechanisms are in place to avoid conflicting standards. Thus, the problem with overlapping standards is not due to overlaps within the standardization regime managed by the official standardization organizations such as ISO, IEC, CEN, CENELEC or ETSI. However, as the industry standards are managed by other standardization organizations outside the official de jure standardization regime there is no formal system in place for avoiding overlapping or conflicting standards.

Finally, Kvisgaard has the standards that are required for producing for aerospace and space technologies. These are very demanding and highly technical. Having these standards and being able to supply space technologies with spare parts implies a lot of marketing value for Kvisgaard, because it demonstrates that the company is able to deliver high quality. Although space and aerospace is not a large part of the company’s turnover, it can use these to showcase its technical abilities to clients in other markets.

4.3. ICT

Although it is a relatively young industry, ICT has become a major contributor to economic growth and increased productivity in almost all developed countries in the world. ICT is a general purpose technology (GPT) that has wide-ranging effects throughout the entire economy, reshaping systems of production and distribution. The industry employed between four and five percent of the work force across the Nordic countries in 2014. The share of total value added that can be attributed to the industry in the same year is almost equal to that of employment, except for Finland and Sweden where the share is between one and two percentage points higher compared to the other Nordic countries. Within the period covered by this analysis, the Nordic ICT industry contains global tech-giants such as Finnish Nokia and Swedish Ericsson, as well as newcomers such as Spotify, Skype and Mojang, which by themselves have been and still are major economic productivity-enhancing agents in their respective countries.

Key information – data set: 187 companies from Iceland, Sweden, Norway and Finland	
Company size:	Exporting companies in sample: 55%
Micro: 36%	Use of standards:
Small: 21%	
Medium: 21%	
Large: 21%	
	• Management standards: 51%
	• Technical standards: 84%

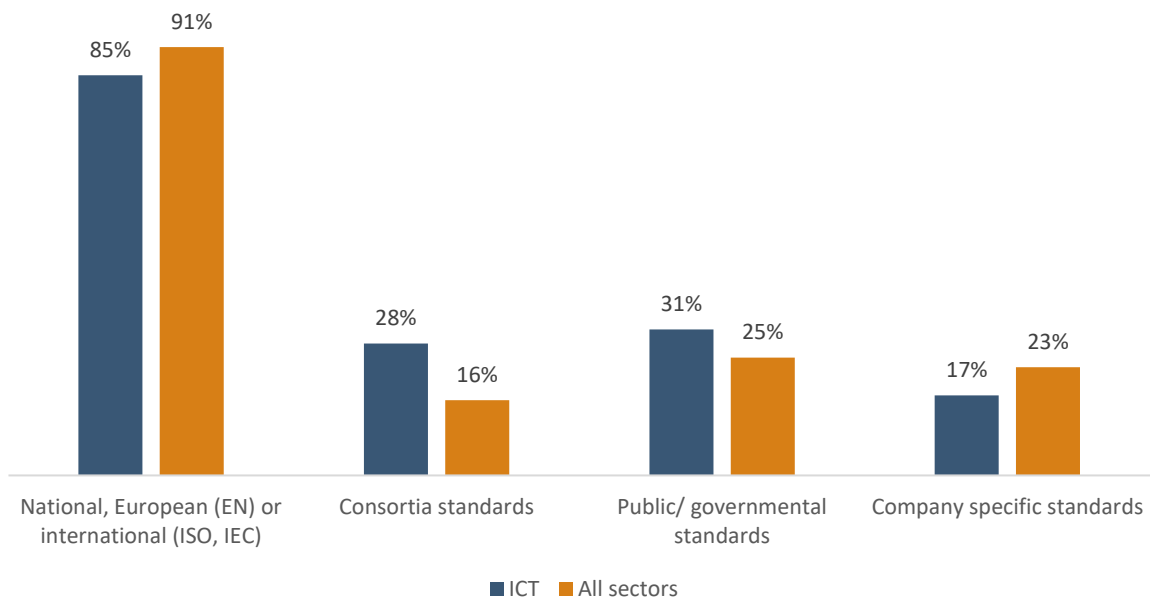
The Information Technology & Innovation Foundation (van Welsum, Vermeer and van Ark, 2012) estimates that the ICT industry contributed to a substantial share of GDP growth in the past 20 years. Standards are vital to coordinate and enable digital systems and solutions to communicate and work as efficiently as possible. As

innovative ICT-technologies continue to develop at a rapid pace, thereby increasing the industry’s relative importance for the economy in general and increased productivity specifically, the benefits of standardization are likely to become ever more present within the industry. The estimates in our industry-specific regression analysis indicate a strong correlation between appliance of new standards and labour productivity within the ICT industry.

The use of standards

The ICT sector covers telecom and broadcasting services as well as computer programming and other related services and products.¹³ To the question “What types of standards are most used in your company?”, most of the ICT respondents answered national, European or international standards, which is the dominant tendency for all sectors included in the survey (see Figure 4-11). On the question of the most used standards, ICT companies deviate in one category; there are more ICT companies saying that they use consortia standards than the dataset average. This was also found in the UK standardization study (Hogan et al. 2015), where companies reported that interoperability standards that form the fundamental architecture of the ICT industry are central for companies. This indicates that production and service development processes more often happen in consortia consisting of several actors. To effectively share data, each device must be able to send and receive information using a standardized format or software language.

Figure 4-11: What standards are most used in your company? (Several answers allowed - in percent), N=187



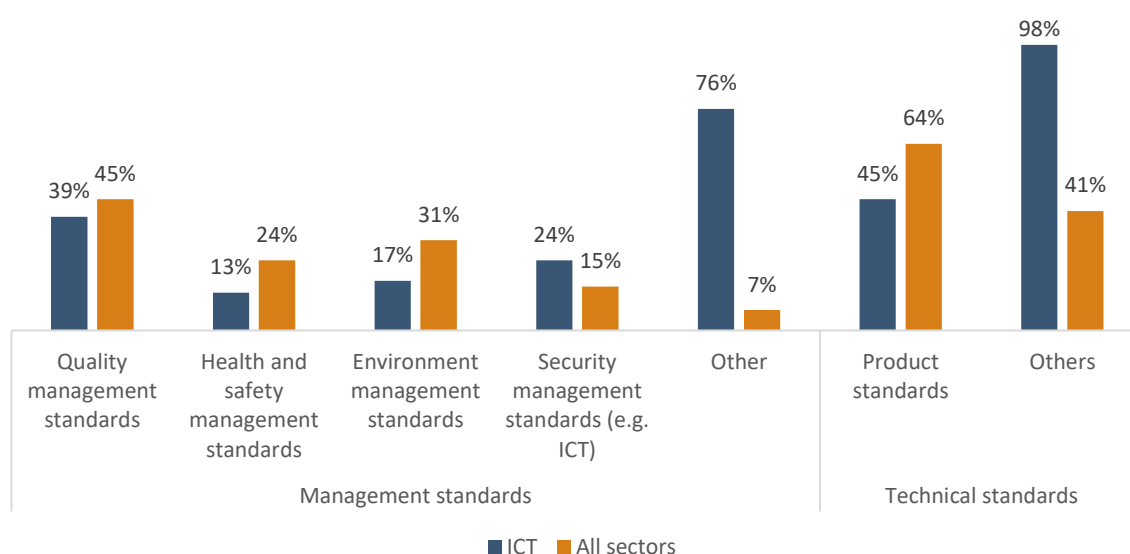
A further breakdown of standards used in the sector indicates that ICT companies have a higher focus on management standards than the rest of the survey respondents. While the average use of management standards is 30 percent, half of the ICT companies report that they use management standards. The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The respondents were asked to report on which kind of management standards their companies use. Several answers were allowed. Among those using management standards, the category “security management standards” is important. The largest category of management standards used, however, is “other”. This category is

¹³ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

exceptionally large. An example of a standard mentioned in this group are management standards for societal security and business continuity (ISO 22301).

The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories, product standards and other standards. The respondents were asked to report which type of technical standards their companies use. Percentagewise, there is a smaller group of ICT respondents saying that they use product standards (see Figure 4-12), while a higher percentage of respondents says that they use other technical standards. Examples of “other” types of technical standards used within ICT are electrotechnical standards, standards for data and telecommunication, standards for formatting data, as well as standards on geographical information. Multiple Swedish companies in the ICT sector highlight technical standards as an absolute prerequisite to achieving a well-functioning market. Technical standards permeate all levels of business – from marketing and communications to sales, implementation, quality assurance and follow up processes.

Figure 4-12: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=187

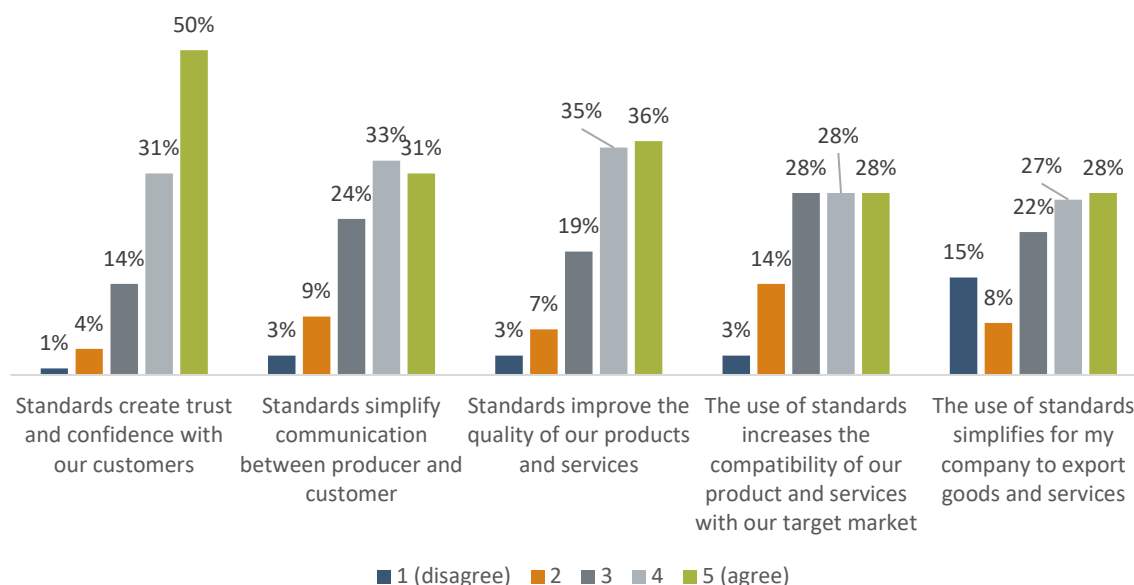


The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The analysis of standards used indicates that companies within the ICT sector use other management standards than companies within the other sectors studied. This might be partly due to the fact that ICT companies in general are small businesses operating on international markets. As explained in the sector introduction, the ICT sector is a relatively young sector where the use of standardization is in a maturation phase, and where many companies still are in a process of adopting and implementing standards.

Sales, Marketing and Market Access

Figure 4-13 displays how companies within the ICT sector follow the same tendencies as the survey dataset average. On different statements regarding sales, marketing and market access, the ICT companies are remarkably similar to the average survey company. The respondents were asked how they consider benefits of standards on a scale from 1 = not important, to 5 = important, in different statements. The results displayed in the figure demonstrate that the ICT respondents agree that standards to a high degree create trust and confidence with companies' customers, simplify communications between producer and customer, improve companies' products and services, increase the compatibility of products and services with their target markets and simplify export. ICT companies generally affirm the considerable benefits of standards. Figure 4-13 also shows that the result is robust across the Nordic countries.

Figure 4-13: Sales, marketing and market access, N=187



Regression analyses support that the more important respondents find following and applying standards to their companies, the more the respondents agree with the statements listed in Figure 4-13. In the free comment section of the survey, some of the respondents used the opportunity to elaborate on their understanding regarding standards' importance for sale, marketing and market access with expectations among customers in the markets. One of the respondents did e.g. report that *"... we use standards to enable our systems to interact with the outside world"*. This respondent got support from other colleagues. A typical response was for example *"Standards make it easier to access global markets"*, and *"Without standards, you cannot have an efficient and well-functioning market"*.

In the free comment section of the survey, some of the ICT respondents used the opportunity to explain why following standards is convenient. Typical responses from these respondents consisted of statements such as *"customers and partners become safer with standard usage, even if they get more expensive and inferior products than they could have obtained with higher ordering skills"*, and *"We work in the electronic commerce segment. It is undeniably important to have established standards for electronic communication of standardized commercial documents"*.

The ICT respondents deviate from the rest of the survey when it comes to company size. The respondents' answers as illustrated in Figure 4-13 did not seem to be correlated with company size. The ICT respondents evaluated the statements found in Figure 4-13 independently of the size of their companies. This might be due to the fact that the survey's ICT category consists of many micro and small companies compared to the rest of the survey.

Production and supply chain efficiency

To the general question *"In what way do standards affect your company's ability or willingness to develop innovative solutions?"*, the respondents were asked to answer *"yes"*, *"no"* or *"don't know"* to different assertions. Figure 4-14 presents results on the relationship between standardization and innovation. This figure is based on yes and no questions related to different dimensions of how standardization affects companies' ability or willingness to develop innovative solutions. Some Swedish companies in the ICT sector convey that standards can sometimes act as a brake on product development, especially in industries that progress rapidly. On the other hand, some companies see technical standards as a good base structure for value-adding innovations. Here too, companies in the ICT industry are approximating the survey average. The ICT respondents follow the same tendency as the rest of the respondents' answers.

Figure 4-14: In what way do standards affect your company's ability or willingness to develop innovative solutions? (In percent), N=187

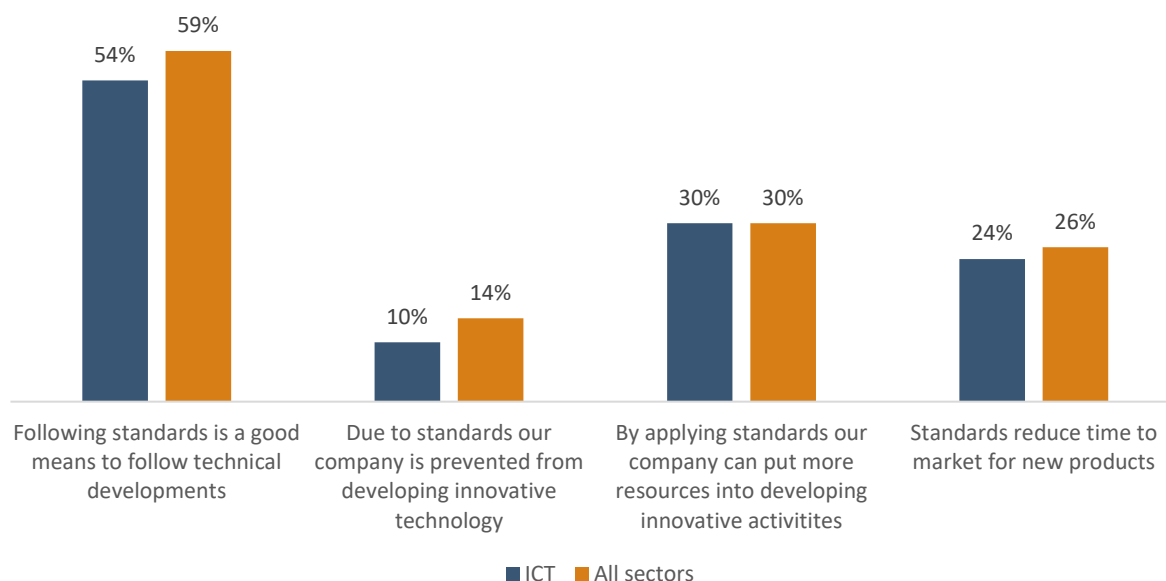
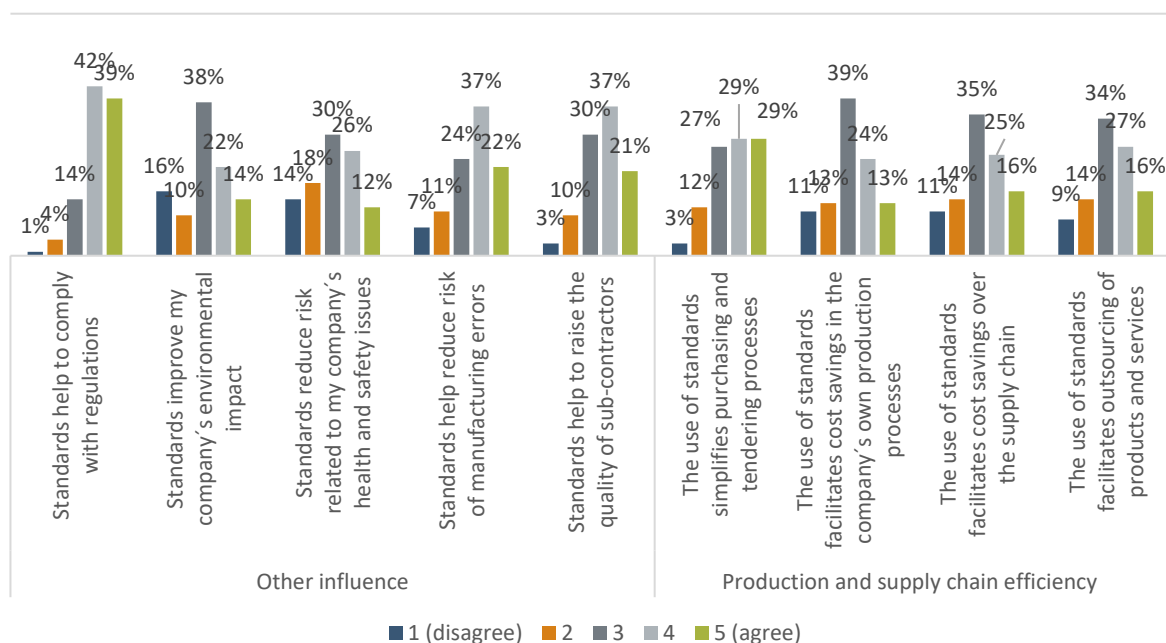


Figure 4-15 presents an overview of ICT companies' experiences of standardization's influence on the production and value chain efficiency compared to the average of all sectors. The figure displays that companies within the ICT sector regard standards as particularly important with respect to helping them to comply with regulations and reducing risk of manufacturing errors.

Figure 4-15: Production and supply chain efficiency (In percent), N=187



Case study: Stiki

Stiki - Information Security is a small Icelandic company specialized in software development, data hosting and consultancy, primarily operating on a global level. *Stiki* was the second company in Iceland to receive information security certification in 2002 (BS 7799, prior to ISO/IEC 27001). Standards include international comparison and certification of quality and thus using standards lies at the heart of the company's operation. *Stiki* develops two kinds of software, one for risk management and a health-evaluation software.

Until the turn of the millennium, information on people's health was hosted by the local health institutions in Iceland. Hosting sensitive information within a private company was highly controversial at the time. In order to meet the problem, applying standards was essential to *Stiki*'s ability to gain trust so that it could enter the market. In this context, implementing ISO/IEC 27001 on information security management system has proven to be of vital importance.

The fast-developing information technology has led to increased call for security resulting in the need of high quality risk-management. Risk analysis has become an inherent part of decision-making processes for all companies and the development of security standards is thus a key for further technological development. *Stiki* has identified security and quality policies to be the key to professionalism and success. Thus, *Stiki* builds its operation, for staff and clients, on ISO/EIC 27001 and ISO 9001 standards. *Stiki* assists companies and institutions worldwide in implementing information security and quality management systems based on ISO/IEC 27001:2013 and ISO 9001:2015. In connection with the company's operation *Stiki* possesses a large database of standards. The database includes knowledge of the historical development behind every standard and helps *Stiki* to predict trends and help companies take informed, cautious steps into the future.

In the aftermath of the financial crash in Iceland in 2008, many local companies lost trust on the international market, especially in the Netherlands and the UK. In the midst of the crash, *Stiki* made a deal with a large British contractor, proving that standards validate the professional practices of a company amidst external difficulties.

In a world of fast-developing technology and globalization, *Stiki* emphasizes that the implementation of standards has become gradually more important. In the modern sense, as recognized by *Stiki*, Iceland is not an isolated island. The international comparison built into the standards makes it possible for a small company like *Stiki* to place itself among the best on the international market.

4.4. Healthcare

The Nordic healthcare systems are taxation-based and locally administered with equal access to services for all citizens. The Healthcare sector is very heterogeneous, ranging from locally provided and publicly financed nursing services at the one end of the scale to exporters of high-tech medical technology and pharmaceutical products on the other. In general, markets have a low level of influence on the functioning of the healthcare systems in the Nordic countries, at least in part because equity and equality are important priorities at the political level. Nevertheless, productivity and efficiency are aspects that continually appear on the political agenda, both in general budget discussions and in more specific discussions such as the economic issues relating to the demographic changes resulting in a larger share of elderly people in the Nordic populations. As public healthcare expenditure constituted between 12 and 19 percent of total public expenditure in all the Nordic countries in 2014, measures that facilitate increased productivity could potentially cut public healthcare expenditure drastically without deteriorating either the quality or quantity of healthcare services. In this respect, standardization could play a significant role, whether in facilitating efficiency at healthcare institutions through for instance organizational management standards, or enabling the elderly to live longer in their own homes by ensuring that digital self-help solutions can communicate with each other and be operated in a user-friendly way.

Key information – data set: 119 companies from Sweden, Norway, Finland, Denmark

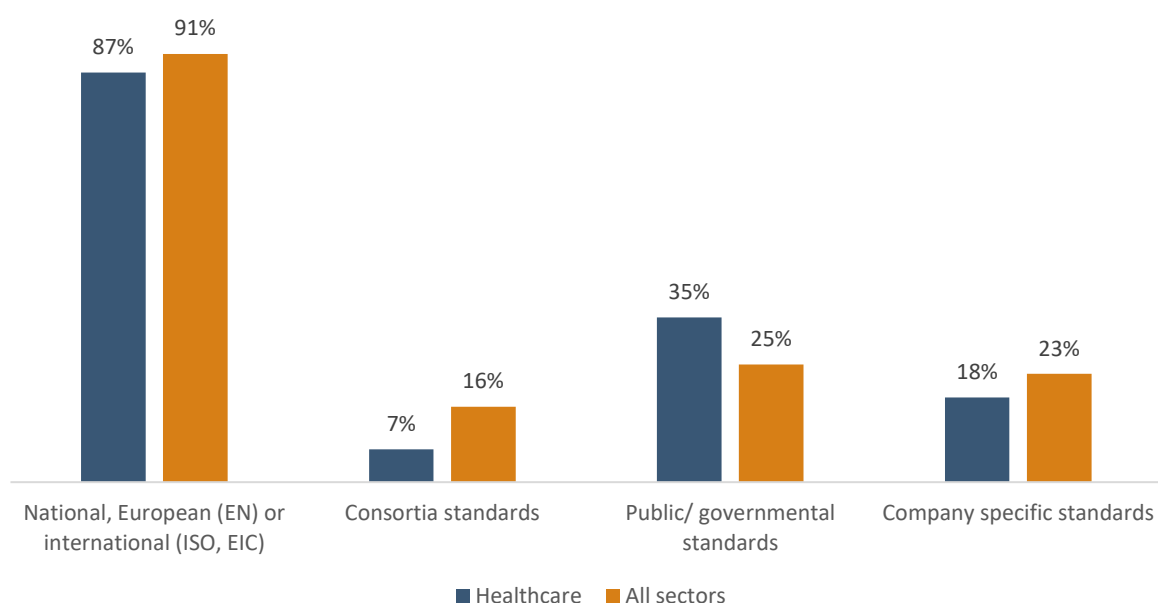
Company size:	Exporting companies in sample: 35%
Micro: 23%	Use of standards:
Small: 20%	
Medium: 24%	
Large: 34%	• Management standards: 57%
	• Technical standards: 73%

The use of standards

The healthcare sector covers a broad group of services and products including hospitals and different medical practices, residential and nursing care as well as manufacturing of pharmaceutical products and medical devices.¹⁴ Figure 4-16 below presents an overview of the standards used in the healthcare sector. In the same way as for the rest of the companies that participated in the survey, almost nine out of ten respondents say that their companies use national, European or international standards. In other words, standardization is also very important for healthcare development, which corresponds to the situation in other business sectors in the Nordic countries.

Healthcare is a heterogeneous sector including companies that serve only national markets as well as companies focusing purely on exports. In the survey sample, two out of three companies operate only in the domestic market. Among users of healthcare standards, there is a somewhat larger group that says they use public/governmental standards than the average. This may be due to the industry's close association with the public sector. Some of the respondents make a note in the comment section of the survey by clarifying that “... we call them [the users/customers] citizens, not customers”, “... we are a hospital”, “we do not sell anything” and “we are not a company that sells products or services, but we do purchase from other actors”. A large Swedish company for example carries out many different operations (healthcare, elderly care and rehabilitation to mention a few) and hence falls under different regulations depending on the type of the operation. The quality manager at the company emphasizes the importance of quality management standards (ISO 9001:2015) and environmental management (ISO 14001:2015) at all levels of the organization, and a shared responsibility between the different levels of management in the implementation of the standards.

Figure 4-16: What standards are the most used in your company? (several answers allowed) - in percent, N=119

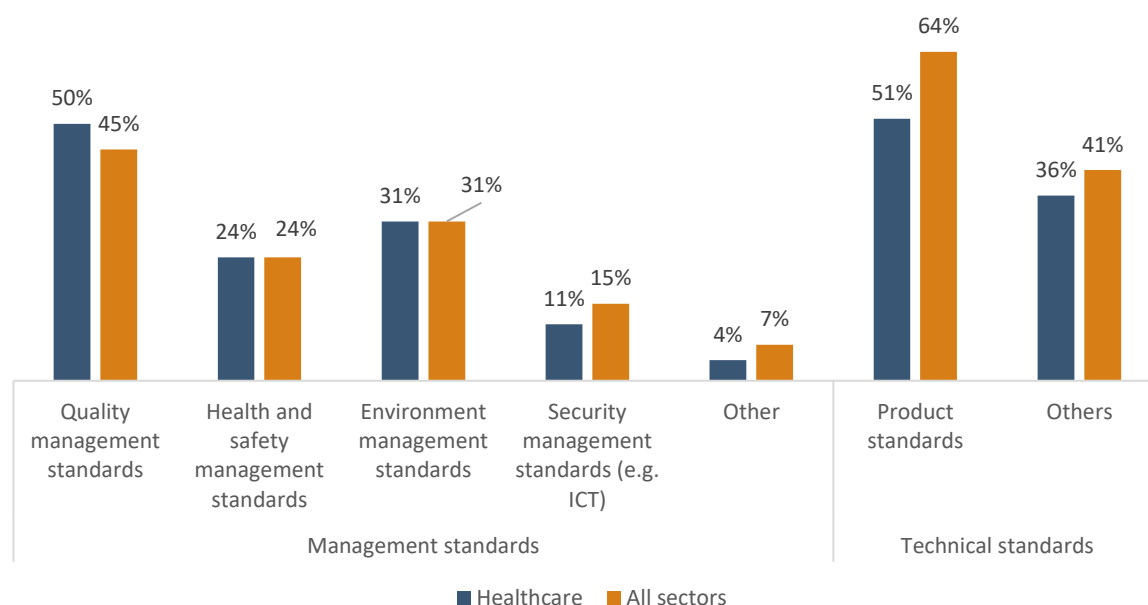


The survey showed that three out of four healthcare providers use technical standards, and 57 percent use management standards. Here the industry differs from the average sample. There are fewer companies that make use of technical standards, while there are more healthcare providers that use management standards. The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety

¹⁴ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

management standards, environment management standards, security management standards and other (see Figure 4-17).

Figure 4-17: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=119



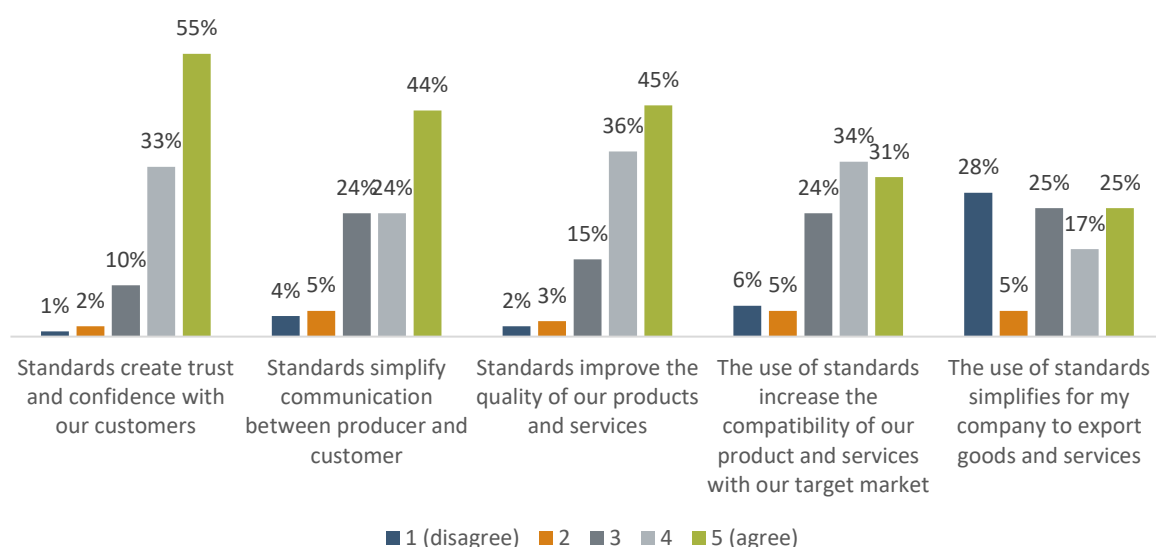
The companies have a distribution between the different management standard categories that is comparable to the rest of the data set, although there is a slightly larger group reporting that they use quality management standards. One Swedish company experienced a significant shift when it started to implement quality management standards – from a focus on economy to a primary focus on quality. According to the quality manager at the company, using quality management standards provides a structure to the organization, as well as facilitating different follow-up processes. The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories product standards and other standards. The respondents were asked to report which type of technical standards their companies use. As for the use of technical standards, there is also a smaller group that uses product standards than in the dataset overall.

Sales, Marketing and Market Access

A larger group of respondents replies that standards help their companies to acquire new international customers as well as to increase sales to existing international customers, even though the sector respondents in general seem less oriented towards sales and export. Many of the respondents elaborate on this in the free comment section of the survey by stating that *“questions regarding sale and export are not relevant for us”* and *“we do not export”*. At the same time, a large group of healthcare companies agree that standardization simplifies their company's exports of products and services. At the same time, many of the respondents repeat in the survey that their companies do not export, and that it is likely that they never will become exporters.

Figure 4-18 shows how companies within the healthcare sector follow the same tendencies as the survey dataset average. On different statements regarding sales, marketing and market access, the healthcare providers are remarkably similar to the average survey company. The respondents were asked to consider how they rate benefits of standards on a scale from 1 = not important, to 5 = important, in different statements. The experience of importance of the different items describing sales, marketing and market access increases with the size of the company.

Figure 4-18: Sales, marketing and market access, N=119



As for the rest of the survey's respondents, for respondents within the Healthcare sector, company size and their evaluation of how important following and applying standards is to their company's plan for the future seem to influence the respondents' tendencies to agree with the statements in Figure 4-18. Regression analyses indicate that the bigger the companies are, the more the respondents agree with the statements listed in Figure 4-18, and the more important respondents find following and applying standards to their companies, the more they agree with the statements listed in the figure.

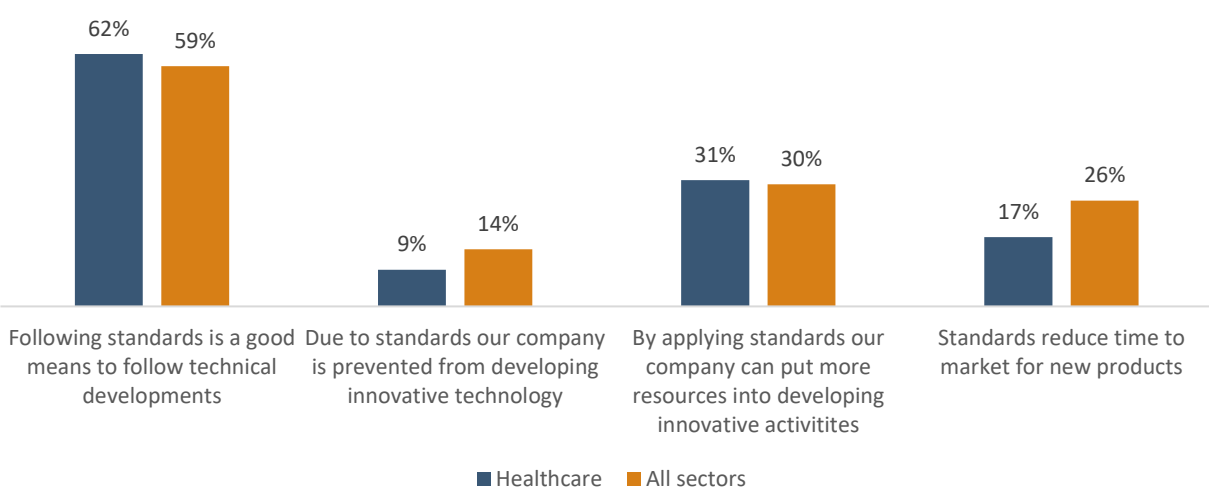
In the free comments section of the survey, Healthcare respondents were asked to elaborate on their views and experiences regarding sale, marketing and market access. Respondents' main feedback is that following and applying standards is not that relevant to compete in both domestic and international markets in normal commercial conditions. This also applies to the UK standardization study of life sciences (Hogan et al. 2015)¹⁵. The sector is a highly regulated industry; thus, most products cannot be sold without some kind of regulatory approval. As underlined previously, most healthcare actors are oriented towards or related to the public sector. Still, standards are important for end users regardless of whether the end user is in the public sector or in the private consumer market. For some of the respondents, standards contribute to increasing the costs for the development of products and services. A big share of the costs is related to purchasing processes.

Production and Supply Chain Efficiency

Figure 4-19 shows how companies in the healthcare sector differ from the average company in the survey with regards to innovation. The figure focuses on the relationship between standardization and innovation. This figure is based on yes-no questions related to different dimensions of how standardization affects companies' ability or willingness to develop innovative solutions. Here too, companies in the healthcare sector are approximating the average. Healthcare companies that have participated in the survey report standardization as a barrier to developing innovative technology much less than the average. Through standardization, more resources in the companies are released than in the other sectors to invest in innovation activities. This also reflects the sector's work and mission. Much of the sector development processes and challenges are about meeting the forthcoming challenges in the healthcare sector that are related to major societal challenges such as the aging population, services for relatives, e-care and so on.

¹⁵ The life sciences sector is comprised of three sub-sectors: pharmaceuticals, medical technologies (med-tech) and biotechnology.

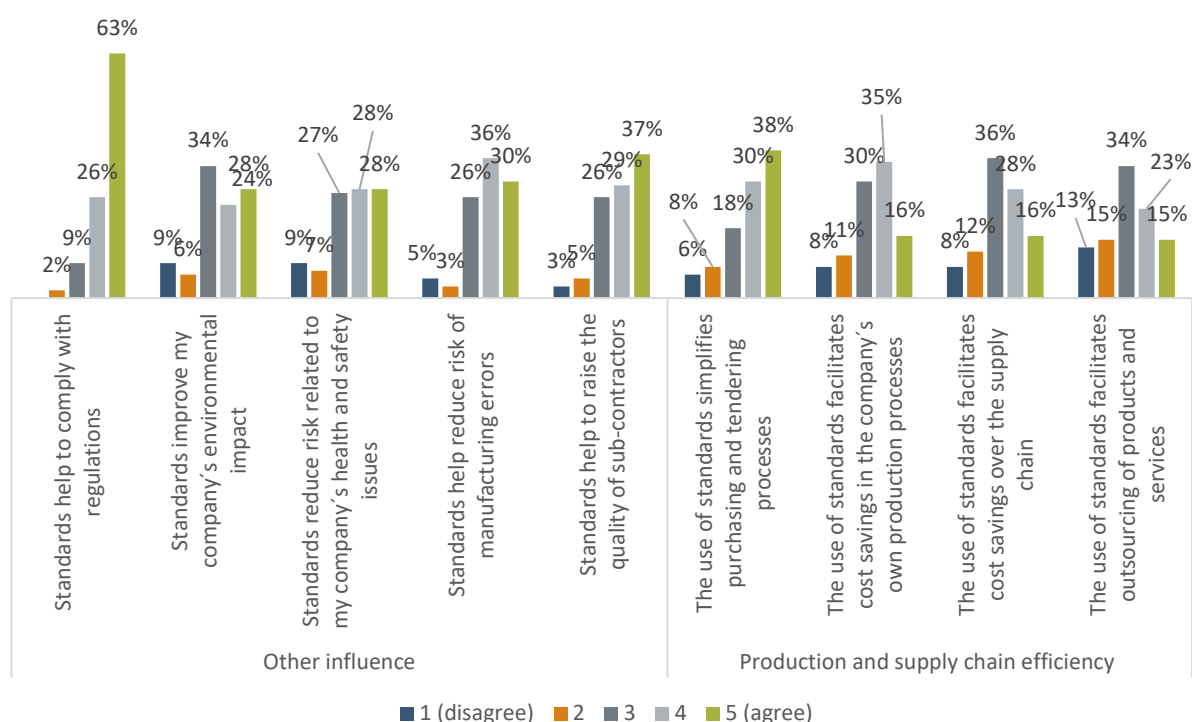
Figure 4-19: In what way do standards affect your company’s ability or willingness to develop innovative solutions? (in percent), N=119



With regard to statements related to how standardization contributes in the companies’ production and value chain, the respondents’ replies are close to the average. In a production and value chain perspective, the most important contribution of standardization seems to be that it simplifies companies’ purchasing and tendering processes. Like the rest of the survey respondents, the respondents within the healthcare sector agree that standardization helps their companies comply with regulations. Concerning this last statement, the respondents within the healthcare sector do in fact agree more that standards help them follow regulations than the average of all the respondents included in the data set, e.g. because healthcare providers are contracted by the public sector to provide healthcare services. For healthcare providers in general, applying and following standards is necessary to get new contracts with customers. One of the survey respondents highlighted that “... we are certified, but do not take part in standardization work. We seek new knowledge by participating in courses and seminars. The new knowledge is important to meet changes in the standards we are approved for or consider to be approved for”. The findings regarding benefits of standards are similar to the benefits discussed in the UK standardization analyses of life sciences (Hogan et al. 2015). The report concludes that standards simplify the process for regulators to ensure products are compliant. It would be costlier for companies to try to demonstrate compliance with regulations using their own procedures.

Figure 4-20 shows the average on a scale of 1 = disagree, to 5 = agree, on statements related to different elements of the company's value chain. On statements regarding production and supply chain efficiency, healthcare providers adhere to the average for all companies in the survey in total. Regression analysis shows that the degree of agreement on the different elements regarding production and supply chain efficiency rises with increased company size.

Figure 4-20: Production and supply chain efficiency (in percent), N=119



Case study: Stiftelsen Stora Sköndal

Stiftelsen Stora Sköndal is a big Swedish private foundation with around 600 employees. The foundation has operations in a diverse range of areas within the healthcare sector such as neurological rehabilitation, health and elderly care, psychological treatment and services for people with disabilities. In addition to healthcare services, Stiftelsen Stora Sköndal also maintains operations in areas such as childcare, education and property management.

Stiftelsen Stora Sköndal primarily operates on a national level. Its primary clients are public sector actors such as municipalities and country councils that procure healthcare or other services from the foundation. Its secondary clients are individuals that utilise the services.

As the sector analysis shows, the use of management standards is essential to the healthcare sector, with Stiftelsen Stora Sköndal being no exception. The foundation complies to a wide range of standards - ranging from general management standards such as the ISO 9001 and ISO 14001 affecting the core of its operations to industry-specific standards and technical standards for procurement of products and services.

Complying to standards is vital for Stiftelsen Stora Sköndal in maintaining high quality operations, which is essential in the competitive healthcare industry that the foundation operates in. In addition to contributing to good operational quality, complying to standards helps Stiftelsen Stora Sköndal in meeting the minimum requirements stipulated by public sector procurers in tendering processes.

The strategic decision to start implementing standards was taken a few years back, and has since had a significant impact on the foundation's operations. After the foundation started to implement standards, it has progressed from times of economic hardship, along the way experiencing a shift in focus from economic efficiency to a primary focus on quality development. Indirectly, this shift has benefitted the overall economic efficiency of the foundation.

One way in which standards have helped Stiftelsen Stora Sköndal improve the quality of its operations is by systematising different follow-up procedures and the regular work on quality assurance – both with regards to economic and environmental efficiency. For example, the use of standards has changed the way in which Stiftelsen Stora Sköndal follow-up on operational results that deviate from standard routines. Whereas before, the follow-up process was based on more or less arbitrary criteria, the criteria are now based on the quality management standard which has led to a perceived overall improvement in operational quality.

One concrete example is when Stiftelsen Stora Sköndal decided to replace its food supplier, as it did not live up to the minimum requirements stipulated by the standard. Another concrete example of how standards have been implemented in the foundation's work on quality assurance is in the streamlining and benchmarking of different parts of operations by using the same follow-up parameters everywhere, which is important for a big organisation such as Stiftelsen Stora Sköndal. Lastly, with regards to environmental aspects, environmental standards such as the ISO 14001 have helped Stiftelsen Stora Sköndal in reducing the use of chemicals in different products, as well as reviewing the energy consumption from heating, water and electricity.

The responsibility for the implementation of standards at Stiftelsen Stora Sköndal starts in the quality department and is then shared by the entire organization. The shared responsibility is aided by the fact that most of the foundation's operations are strategically bound to follow management standards. In addition, public sector procurers require healthcare providers such as Stiftelsen Stora Sköndal to adhere to environmental standards. Following standards also helps Stiftelsen Stora Sköndal comply with laws and regulations in the healthcare sector such as the Social Services Act (*Socialtjänstlagen*) and the Health and Medical Service Act (*Sjukvårdslagen*).

The main cost of standards at Stiftelsen Stora Sköndal lies in the implementation phase. Seeing that implementation is a learning process for management at all levels, implementation of standards is a time-consuming process in a big organization like Stiftelsen Stora Sköndal. At the same time, the use of standards has generated an overall willingness among employees to further develop the quality of the foundation's operations.

On an overall level, there is a belief among the management of Stiftelsen Stora Sköndal that the benefits of using standards clearly exceed the costs. The benefits are mainly related to improving the overall structure and quality of operations. The foundation believes that the use of standards will become increasingly important in future because of the growing competition among healthcare providers. Nonetheless, the management at Stiftelsen Stora Sköndal sees this as a good opportunity to further improve its operations by the help of standards, as well as a reason to start marketing the use of standards as a symbol for quality towards end users.

Case study: Sensio

Sensio is a Norwegian entrepreneurial company in the Home automation and welfare technology sector. Welfare technology is a collective term for technical solutions developed to make everyday life easier. Within the welfare market, Sensio provides a platform for welfare technology that provides comprehensive solutions across different services and systems. Sensio handles several products: Patient alert with mobile alarm central, social care alarm, environmental control, extended safety and housing planning, digital surveillance, video surveillance 24/7, violence alarms and indoor positioning. The platform is a form of flexible infrastructure making sure that new solutions can be applied as welfare technology matures. Welfare technology implies greater freedom, security and proximity for both patients, employees and next of kin. Through simple use of custom solutions, contact with family, friends and support can be maintained from the sofa as a supplement to the regular visits. The systems can be used both at institutions as well as in private housing and housing care. Sensio's solutions are purchased and used by many Norwegian municipalities and their inhabitants.

Sensio's welfare technology solutions are based on standard off-the-shelf products in combination with a constant innovation of new solutions. By using recognized standards for the integration of different solutions such as social care alarms and surveillance and digital surveillance, products from different suppliers are available. Standards help Sensio to communicate with customers and become supplier-specific. Standardization also makes it easier to work out tenders. One example is the development of Social Care Alarm Internet Protocol (SCAIP) as a standard that is implemented in e.g. social care alarm solutions. SCAIP is a Swedish national standard SS 91100:2014. Having defined SCAIP as a standard means that SCAIP is easy to include in tenders. After the

Norwegian Directorate of Health adopted SCAIP as a recommended standard, Sensio could become more specific in tendering processes. Standards allow information exchange. When systems talk together, the municipalities can go for safer procurement.

Welfare technology is a new industry. One of Sensio's biggest challenges is that standards are less developed and not applied in the welfare sector. National guides for welfare technology standards are missing. "As a supplier we do not have any standardization body or agency we can go to", says the company's CTO. Norway has many municipalities using different solutions and demanding different products implemented in different ways. This is also a challenge for municipalities that want patient control. There are no standards defining electronic medical records, response centres, or for receiving obligations from healthcare professionals. One example for this is the area of electronic medical records, where there are three vendors and all of them are defined differently. Sensio must therefore apply and handle three different standards in tendering processes. The lack of standards prevents innovation. If the municipality asks for two suppliers to collaborate, Sensio may experience that potential partners do not want cooperation because of the use of different standards. Strøm-Gundersen says that "to establish and reduce risk in innovation processes, more standards should be developed and applied to the sector both among producers and users". According to the CTO, "... the time waiting for standards to be developed and activated puts innovation processes on hold".

Sensio sees new challenges related to the lack of standards within upcoming business opportunities and innovation projects such as the use of protocols for administration and patient care and medical treatment. Lack of standards causes uncertainty among suppliers and customers. With the lack of standards, the consumer gets poorer solutions. The CTO states further that "I think that for both the society and us as a supplier of solutions, we will clearly be able to deliver better products if the standardization process was accelerating and more standards were available to apply."

4.5. Petroleum production

Ever since oil was discovered in Norway in 1969, the petroleum industry has gained increased importance for the Norwegian economy. For instance, although only 3.5 percent of all employed Norwegians worked within the industry in 2014, the sector's share of total value added to the economy was approximately 22 percent the same year. Industry-specific standards have been developed in tandem with the industry's growth in economic importance, ensuring efficient production procedures as well as safe and healthy work environments. Today, there is a vast range of standards targeting the industry, ranging from health and safety standards to technical production standards. Drilling standards, for instance, specify principles and requirements for fixed and floating platforms, including well maintenance, well control systems, in addition to specifications relating to well pipes, riser systems, well cementation and pressure testing. Although somewhat indirectly, one could argue that standards used in the industry have contributed to and enabled economic growth and financing of the Norwegian welfare system, the latter depending heavily on public tax revenues from the industry. Although the future price of oil is expected to remain somewhat lower than its record high average price in 2014, the industry will play a dominant role in the Norwegian economy also in the years to come. The petroleum estimate in our industry-specific regression analysis indicates a strong correlation between the application of new standards and labour productivity.

Key information – data set: 141 Norwegian companies

Company size:	Share of exporting companies in sample: 68%
Micro: 6%	
Small: 19%	
Medium: 31%	Use of standards:
Large: 43%	<ul style="list-style-type: none"> • Management standards: 34% • Technical standards: 98%

The use of standards

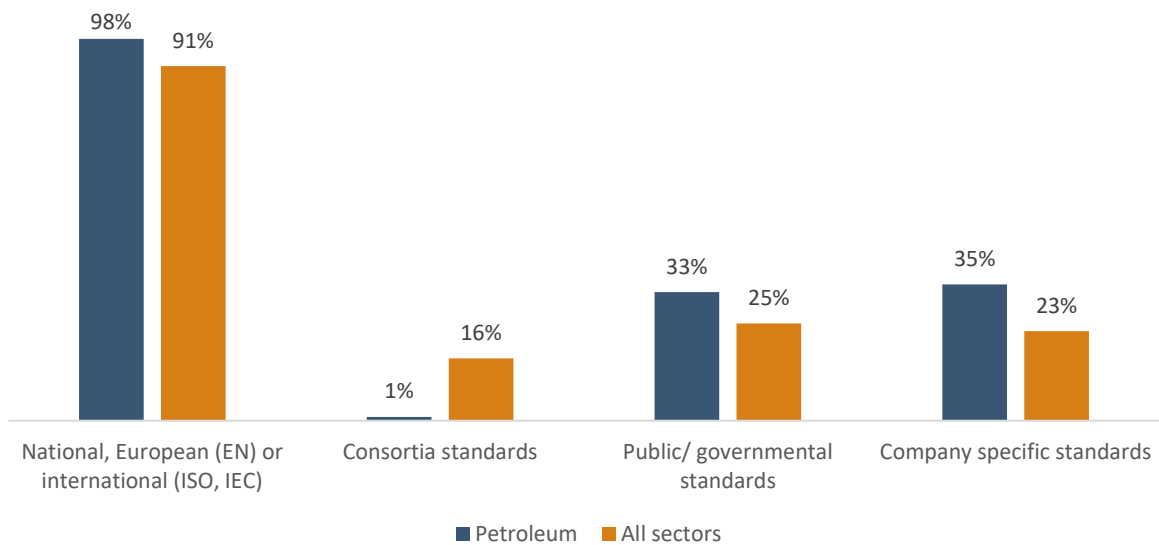
The petroleum production sector includes both extraction and refinement of petroleum resources, as well as the petroleum supply industry providing various support activities and manufactured goods.¹⁶ In the dataset, petroleum production mainly represents larger companies compared to the remaining sectors studied. Three out of four companies are medium-sized or big companies. The sector is further characterised by global companies. Nearly 70 percent of the companies operate in both domestic and foreign markets. The following

¹⁶ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

description of respondents’ experiences of standardization reflects the characteristics of the companies in the sector.

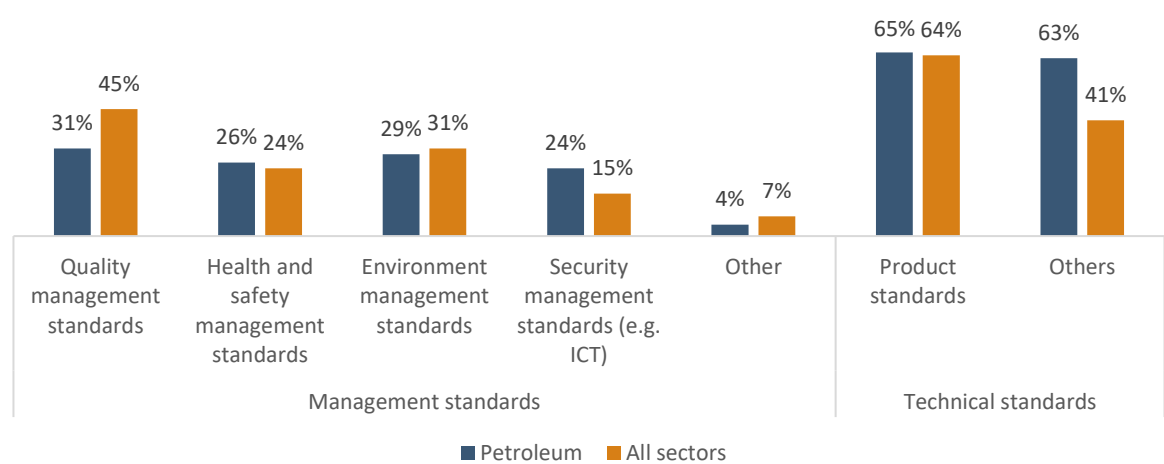
Regarding the question “What standards are most used in your company?”, multiple answers were allowed. Nearly all respondents replied that they use national, European or international standards, which is the same tendency as that of companies within the manufacturing industry. With regards to standards used, the petroleum companies stand out in one area: one out of three respondents within this sector reported that company-specific standards are among the most used standards in their company.

Figure 4-21: What standards are the most used in your company? (Multiple answers allowed - in percent), N=141



A deeper dive into the survey data reveals that nearly all petroleum companies use technical standards, which also makes companies in this sector stand out as super-users of technical standards among the industry sectors studied. The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories product standards and other standards. The respondents were asked to report which type of technical standards their companies use. In line with the situation in the average survey company, the most used technical standard type is product standards. In addition, nearly 2/3 of petroleum companies also use other technical standards. That is 20 percent more than the use of other technical standards across all sectors studied. Examples of “other” technical standards used in the petroleum industry are standards on how to perform certain tasks such as welding, inspections or general maintenance work, standards on how to use a certain type of equipment or standards for making contracts.

Figure 4-22: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=141

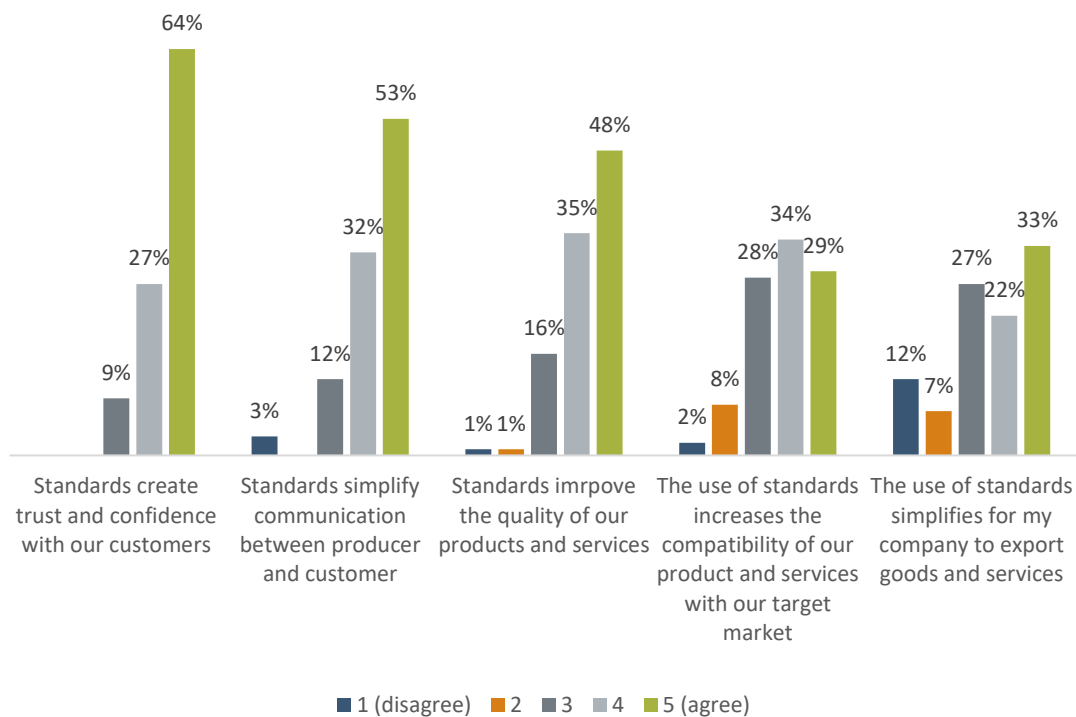


Compared to the survey average, the petroleum companies are limited users of quality management standards (see Figure 4-22). The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The respondents were asked to report on which of these standards their companies use. Multiple answers were allowed. While nearly half the total companies studied use management standards, only about one third of the petroleum companies are users of management standards. The limited use is especially related to qualitative management standards. The UK standardization study (Hogan et al. 2015) also demonstrates the importance of the use of management standards in the energy sector where oil and gas is an important industry. Respondents within the UK energy sector underline that health and safety standards, in addition to environmental standards and quality management standards, are widely used. The nature of activities in the energy sector, which involves dealing with hazardous materials and working in dangerous environments means that the health and safety of employees is a top priority together with reducing the risk of harm to the environment. The use of quality management standards demonstrates that compliance is commonly a pre-qualification requirement to tender for manufacturing or service contracts.

Sales, marketing and market access

The results presented in Figure 4-23 indicate that standards benefit the petroleum companies studied. In the survey, the respondents were asked to evaluate a set of potential benefits of standards on a scale from 1 = disagree to 5 = agree. The respondents strongly agreed with the statements expressing that standards benefit their company. The respondents agreed to a very high degree with the statements “standards improve the quality of our products and services”, “standards simplify communication between producer and customer” and “standards create trust and confidence with our customers”, compared to the average surveyed company.

Figure 4-23: Sales, marketing and market access, N=141



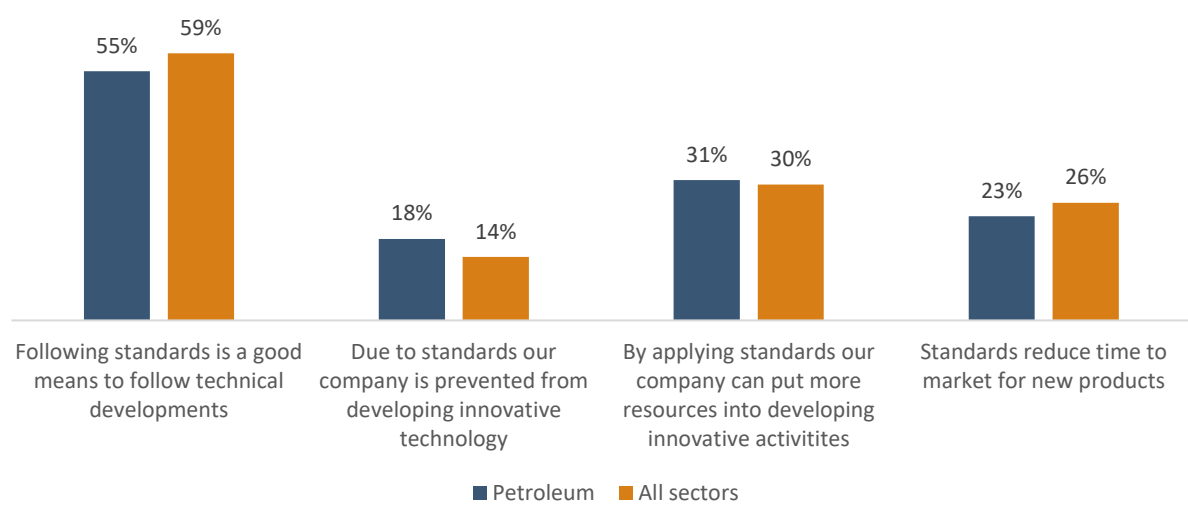
One interesting finding regarding different variables describing different sides of the relationship between standards and sales, marketing and access is linked to company size and the respondents’ evaluation of how important following and applying standards is to their company’s plan for the future. Regression analyses indicate that the bigger the companies, the more the respondents agree with the statements listed in Figure 4-24. Regression analyses support that the more important respondents find following and applying standards to their companies, the more the respondents agree with the statements listed in Figure 4-23. One of the respondents explained the relationship between sales, marketing and access by elaborating that “Standards are used for tendering and are often the basis for delivery”. Other respondents supported this statement.

The respondents were given the opportunity to elaborate on their answers regarding their evaluations of the statements in Figure 4-23. Many respondents within the Petroleum sector used the opportunity to point out that standards help building mutual trust and strengthen communication especially with regards to safety and product quality demands. “Priorities and safety requirements in different countries are covered by the set of standards, and a global engineering company like ours will be able to efficiently provide services globally due to access to the standards”, one of the respondents elaborated.

Production and supply chain efficiency

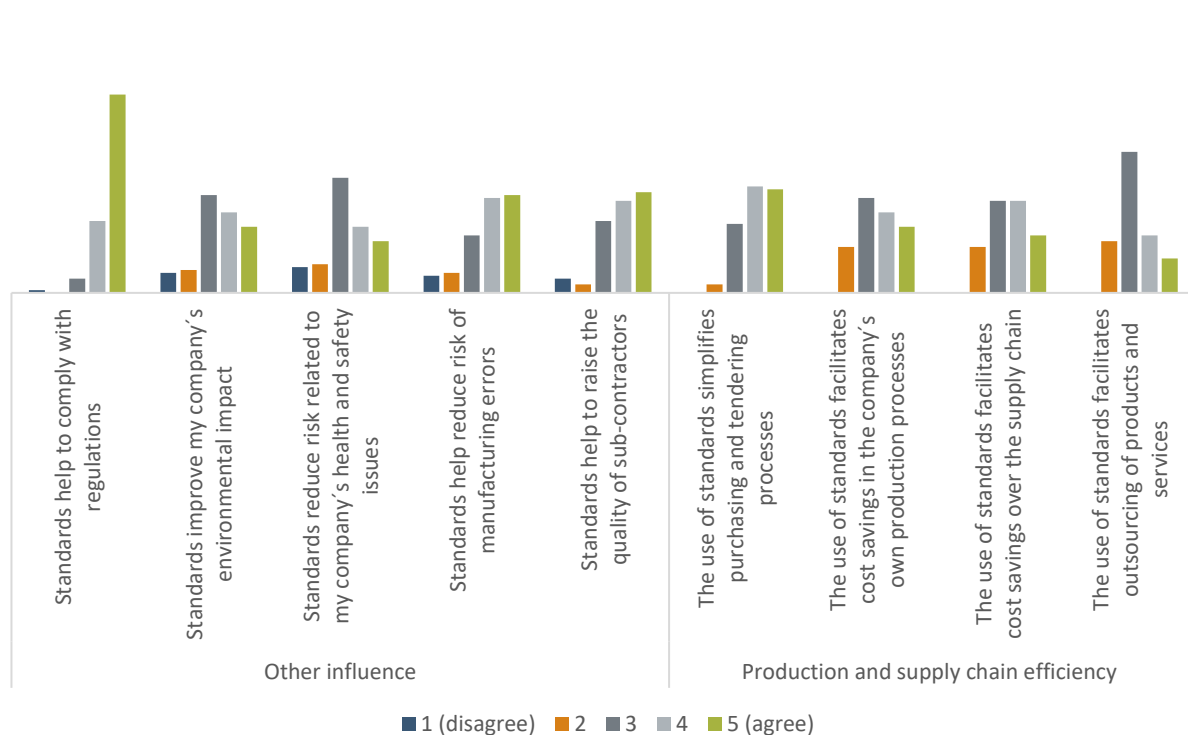
Figure 4-24 displays the respondents’ view on the relationship between standardization and innovation. This figure is based on yes-no questions related to different dimensions of how standardization affects companies’ ability or willingness to develop innovative solutions. To the question “In what way do standards affect your company’s ability or willingness to develop innovative solutions?”, the petroleum companies responded the same way as the survey average. Most petroleum companies agree that following standards is a good means for following technical developments. At the same time, standardization does not seem to prevent petroleum companies from developing innovative technology. For 30 percent of the petroleum companies, applying standards enables them to put more resources into developing innovative activities.

Figure 4-24: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=141



Further analysis of the survey data confirms that standardization contributes to strengthening work tasks and communication across the companies’ value chains (see Figure 4-24). One a scale from 1 = disagree, to 5 = agree, most respondents representing the petroleum sector agreed that standards affect the production and supply chain efficiency in a positive direction. Among the petroleum companies, standards are an especially important means to simplify purchase and tendering processes. The sector is characterised and influenced by governmental regulations. This may be the reason why petroleum respondents agree to a larger extent than the other sectors to the statement “standards help to comply with regulations”.

Figure 4-25: Production and supply chain efficiency (In percent), N=141



Case study: Statoil ASA¹⁷

Statoil was founded as The Norwegian State Oil company (Statoil) in 1972. Currently Statoil is by far the largest company in Norway and the Nordic region measured by sales income. Statoil is an international energy company with operations in over 30 countries and employs about 21 000 employees and consultants worldwide. The company is headquartered in Stavanger Norway and about 18 000 their employees work in Norway.

Partly due to the dramatic drop in oil prices from 2014, Statoil, like the rest of the oil and gas industry, needed to pursue cost cutting measures throughout their operations. Statoil is currently implementing a cost efficiency program called SSI – Simplification, Standardization and Industrialization. Through the implementation of SSI, Statoil reduces cost by removing customized solutions and implementing standards to induce industrialization. Thus, simplification and standardization is at the core of Statoil's cost saving strategy. In the 1990s the Norwegian oil and gas industry pursued the use of standards to reduce costs, with great success. Back then the Norwegian oil and gas industry including Statoil experienced a similar situation as it is now. In the mid-1990s, the industry cost level combined with low oil prices made development of new projects in the North Sea oil unprofitable. At that time the Ministry of Industry and Energy took the initiative to form a Development and Operations Forum for the Norwegian petroleum sector. This forum developed an industry initiative called NORSOK-(Norsk sokkels konkurransefortrinn) for which harmonizing the specifications of the Norwegian oil companies Hydro, Saga and Statoil into NORSOK standards was a significant part of this initiative. The NORSOK standards, managed by Standards Norway, did to a large degree refer to international standards and provided additions to them.

It is documented that Statoil and the Norwegian Oil and Gas Industry were at their most cost effective in project development around the year 2000. When the oil price rose during the 2000s, the oil and gas industry's focus shifted towards expanding production, rather than concentrating on the use of common industry and international standards in procurement processes. Expensive customized orders to suppliers, packed with extensive company-specific requirements, again became the norm again. Through the SSI program Statoil now go through all their topside equipment, reducing the complexity one by one, seeking to link their procurement to established standards. By removing simple and unnecessary features, Statoil has managed to bring down costs of some equipment by up to 90 percent in equipment packages the past five years. The company's ambition is to reduce the cost of equipment and equipment packages with more than 50 percent compared to the 2013-level, according to Statoil the results of its standardization work have been very positive so far.

Statoil is also an active participant in international standardization and is encouraging for implementation of industry standards globally. They emphasize that company-based requirements are a general problem and industrialization of the value chain demands compliance with standards across operators. Thus, recently, the largest oil producing companies of the world have initiated a new cooperation making more harmonized and common purchase specifications based on industry and international reference standards that will benefit the whole industry. The initiative is run through International Association of Oil and Gas Producers (IOGP) Joint Industry Project 33. The harmonized additions will be offered to the respective Standardization Development Bodies for inclusion in the relevant standards. Moreover, a recent extensive revision of the Norwegian NORSOK standards concluded that nearly 20 percent of the 79 NORSOK-standards should be withdrawn, and that the Norwegian oil and gas industry should take an active part in making the remaining standards become international ISO and IEC standards.

¹⁷ There is currently a proposal from the the board of directors of Statoil to change the name of the company to Equinor. The new name will be proposed to shareholders in a resolution to the Annual General Meeting on 15th of May 2018.

4.6. Process industry and materials

The process industry has been characterized by global consolidation in recent decades. The markets have become more integrated globally, and the industry is marked by a demanding mix of three competition factors: large irreversible capital investments, high fixed costs relative to variable costs and homogeneous products. Industries with these competitive conditions are highly sensitive to overcapacity. The Nordic countries have experienced a downturn in production after the financial crisis. For instance, the steel production in Sweden went down 20 percent from 2007 to 2016, while the Norwegian

production declined by 12 percent and Finnish production 7 percent. This follows the global pattern where production shifts from the western to eastern economies. Steel production in the EU went down 23 percent from 2007 to 2016, while steel production in Asia increased by 50 percent during the same period.¹⁸

Key information – data set: 92 companies from Finland, Sweden and Denmark	
Company size	Share of exporting companies in sample: 92%
Micro: 14%	Use of standards: <ul style="list-style-type: none">• Management standards: 79%• Technical standards: 76%
Small: 28%	
Medium: 29%	
Large: 28%	

Nordic companies try to compensate for high labor costs through product quality and thus higher prices, especially in consumer goods and technology markets. Access to competent labor is important, but processes are often automated, so the ability to further develop and improve production processes is even more critical. In the development of new processes and cleaner products, researchers work systematically in the industrial halls, together with the operators and engineers in the company. The same applies to the workshop expertise in industrial research and development units.

The use of standards

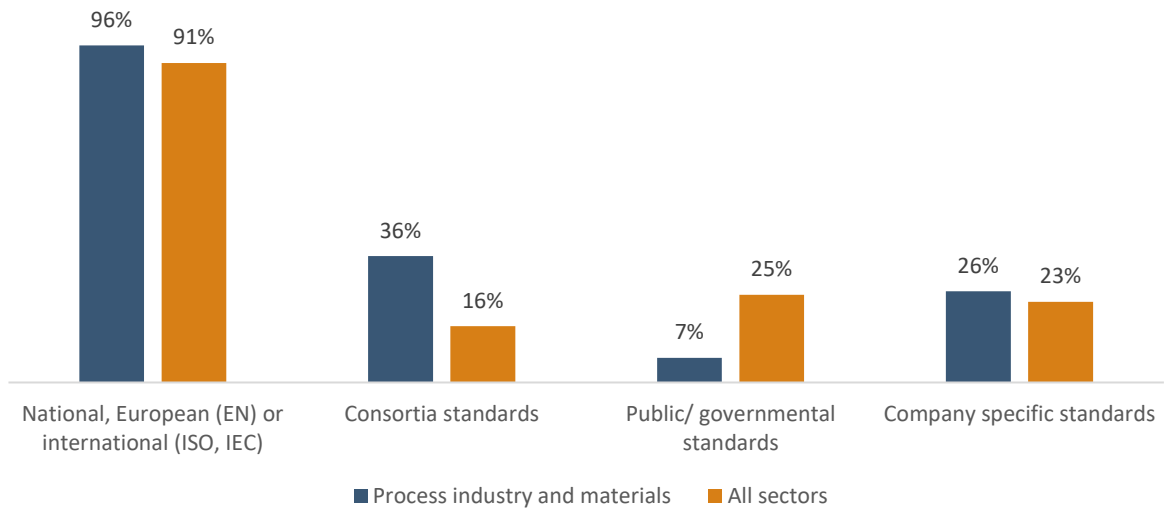
The process industry and materials sector includes production of a wide range of products including chemicals, wood based products and basic metal.¹⁹ Figure 4-26 presents an overview of the standards used in the process industry sector. As for the rest of the companies that participated in the survey, almost nine out of ten respondents state that their companies use national, European or international standards. In other words, standardization is also very important for process industry sector development, which corresponds to the situation in other business sectors in the Nordic countries. Process industry and materials is a highly international sector, with 92 percent of companies operating both in domestic and foreign markets. The high number of companies operating in international markets may explain the high number of companies using national, European and international standards. One of the respondents supports even more cooperation among standardization bodies across countries to comply with standards by elaborating that *“Standards should be even more harmonised at a global level to avoid that each country develops unique legislation and standards”*. Another respondent highlighted the importance of the use of standards by explaining that; *“... standards make it easier to describe production and products, and define what is good quality and what is not. Standards promote a structured way to work”*. A third respondent claimed that *“... applying standards does not promote cheaper products, but products that are more trustworthy”*. As with the rest of the Nordic sample, the understanding of the importance of standards increases with larger company size.

Compared to the total number of companies that participated in the survey, there is a higher number of process and materials companies that use consortia standards than among the remaining sectors.

¹⁸ <https://www.worldsteel.org/en/dam/jcr:3e275c73-6f11-4e7f-a5d8-23d9bc5c508f/Steel+Statistical+Yearbook+2017.pdf>

¹⁹ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

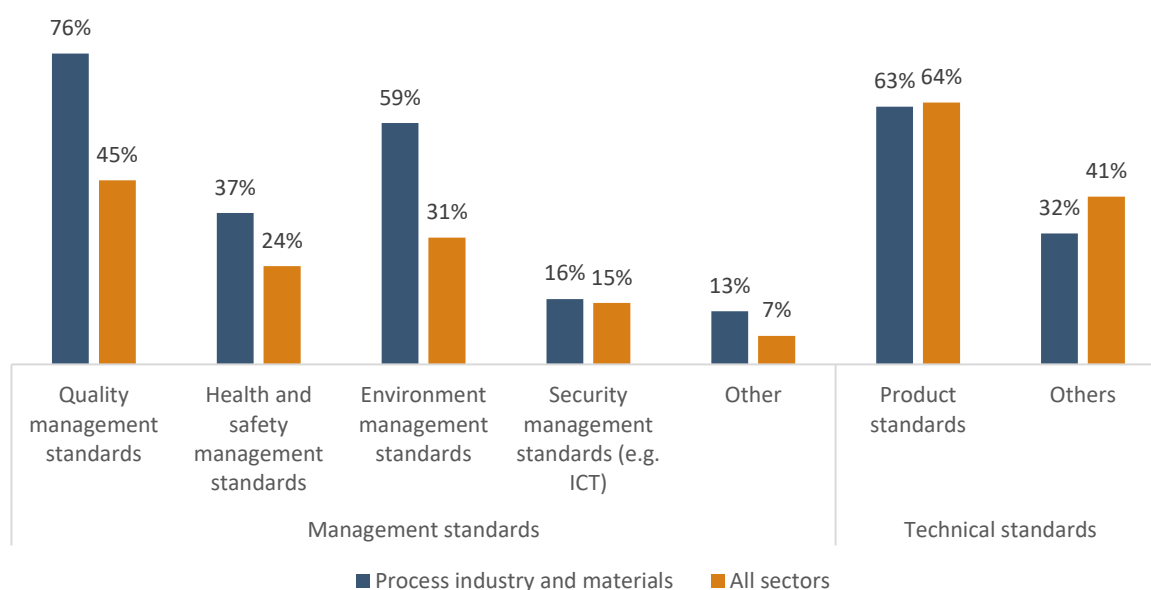
Figure 4-26: What standards are the most used in your company? (Multiple answers allowed - in percent), N=92



The process and materials sector stands out in the Nordic survey due to the high number of companies using management standards (79 percent), which is the same across all countries. Small and medium-sized companies contribute to raising the high share of companies using management standards. The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The respondents were asked to report on which management standards their companies use. Multiple answers were allowed. The process industry companies are particularly active users of quality management standards, environment management standards and health and safety management standards (Figure 4-26).

In addition to being a diligent user of management standards, the process industry is an active user of technical standards. Three out of four companies report that they use technical standards. The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories product standards and other standards. The respondents were asked to report which type of technical standards their companies use. Multiple answers were allowed. Similar to the rest of the Nordic standard sample, the process industry companies are frequent users of product standards (Figure 4-27).

Figure 4-27: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=92



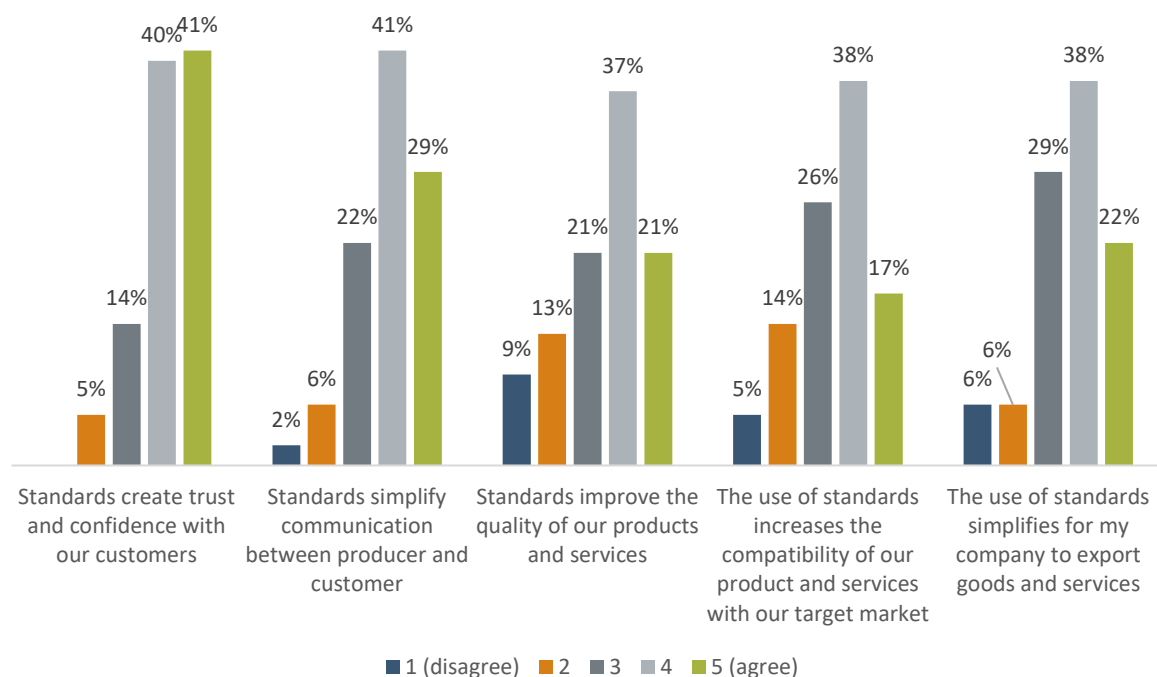
Sales, marketing and market access

How the use of standards affects economic development at the micro level becomes clear when the process industry respondents answer questions about the relationship between standards and sales, marketing and market access. On various statements regarding benefits related to sales, marketing and market access, respondents were asked to rate these on a scale of 1 = disagree to 5 = agree. Creating trust and confidence with customers is regarded as the commercially most important feature of standards. In general, there are few discrepancies for companies in the sector as compared to the average. The vast majority of respondents, like the cross-sector average of the companies that participated in the survey, agreed that following standards has benefits for the company. Following standards makes companies increase the compatibility of the companies' products and services with target markets, improves the quality of products and services, simplifies communication between producer and customer and creates trust and confidence among the companies' customers. To the statement "the use of standards simplifies for my company to export goods and services", there were slightly fewer companies that agreed. This finding might be caused by the sector's long tradition for export and that e.g. many of the companies are born global or influenced by global ownership. When the share of export is high, the experience of the relationship between export and standards becomes a routine or a normal sales and marketing practice.

One of the Swedish respondents elaborated on perspectives on benefits and sales by explaining that when his company's subcontractors refuse to use and apply product standards, the company is forced to find new business partners that share its aim of delivering products and services that correspond with the customers' expectations regarding price, functions, flexibility, etc.

The survey results indicate that the companies within the process and materials sector experience benefits of standards to a lower degree than the total sample average. This is exemplified by the replies to the Swedish survey, which convey that the use of standards risks affecting production efficiency in a negative way, making production more expensive. One of the Swedish respondents elaborated this finding by claiming that "*sometimes standards lead to more expensive solutions and constructions. Standards do often limit alternatives and might also become a barrier for development*". Many Swedish companies use standards because their customers require it.

Figure 4-28: Sales, marketing and market access, N=92

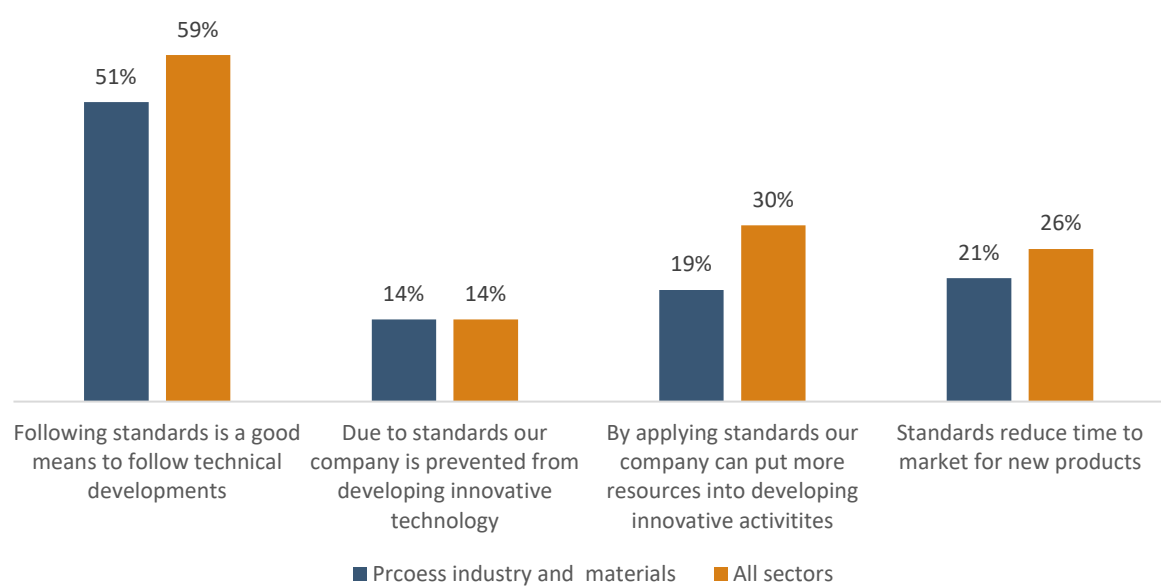


Regression analyses indicate that the bigger the companies, the more the respondents agree with the statements listed in Figure 4-28. Regression analyses support that the more important respondents find following and applying standards to their companies, the more the respondents agree with the statements listed in Figure 4-28. For the highly global market-oriented process industry and materials sectors, international standards are important to be able to compete on target markets. That might be the reason why one of the respondents elaborates that *“Standards should be harmonised more at a global level to avoid that countries develop their own national legislation and regulations”*.

Production and supply chain efficiency

Figure 4-29 presents the survey response on issues regarding the relationship between the use of standards and innovation. The figure presents different statements with the aim of illuminating different insights on the question “In what way do standards affect your company’s ability or willingness to develop innovative solutions?”. The figure is based on data from the companies that confirmed “yes” on different dimensions of how standardization affects companies’ ability or willingness to develop innovative solutions. The companies in the process and materials industry are approximating the average, and no single country deviates in a significant way. However, a tendency is that the responses become more positive the bigger the company is.

Figure 4-29: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=92



Some of the respondents further specified their answers regarding production and supply chain efficiency. One respondent claimed that “... we use standards to develop our production”. The respondent’s experience is that as long as end users of his company’s products demand specific standards, the company is forced to strategically focus on standards throughout the whole value chain. Unless it uses standards, the company quickly loses customers. At the same time, a group of respondents also elaborated their concern regarding the balance between use of standards and the companies’ innovation strategies. One of the respondents explained that “Sometimes standards get too much influence, which results in more expensive solutions. Standards might limit alternative solutions and sometimes be a barrier to innovation”.

Figure 4-30: Production and supply chain efficiency (in percent), N=92

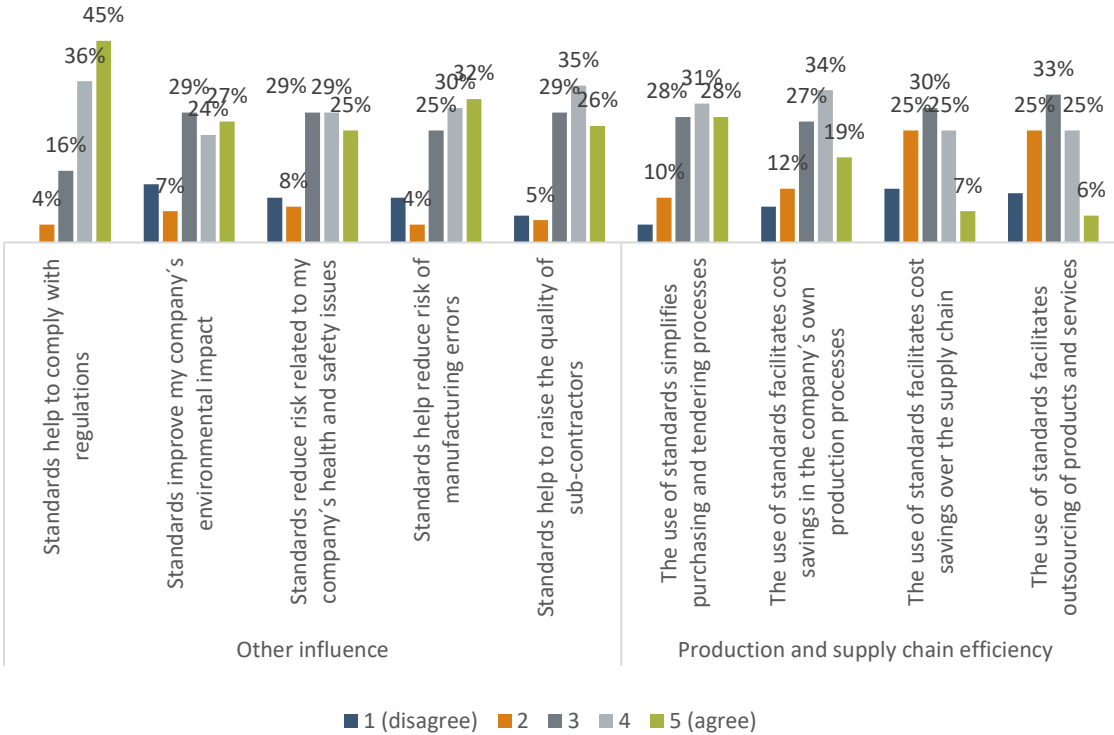


Figure 4-30 presents an overview of the process industry respondents' experiences on the question of how standards contribute to and influence the value chain in different ways. The respondents were asked to evaluate their degree of agreement on a scale from 1 = disagree, to 5 = agree. Also on these statements, the respondents within the process industry sector did not statistically deviate from the other sectors studied in this survey. None of the three countries deviated significantly from the major tendencies regarding the companies' experiences of the relationship between production and supply chain efficiency. Here, the same tendency as for other sectors can be found: the larger the company, the more the respondents agree with the suggested statements.

Case study: SSAB

SSAB (Svenskt Stål AB) is a Nordic steel manufacturer. It has a long history dating back to the 19th century in Sweden. It has its roots in many smaller local companies in the iron industry and metallurgy. Present-day SSAB has four production sites in Sweden, two in Finland, one in Russia and two in the USA. It has around 16 000 employees globally, and its turnover is 55 billion Swedish kronor. The company operates globally and its products are sold all over the world to various industries and construction companies using steel in their production. The most important markets are the Nordics and North America. In AHSS (advanced high-strength steels), SSAB is a global leader.

The company expanded to Finland in 2014 when it acquired Rautaruukki, originally a government-owned company founded in 1960. The company's main target was to secure a raw material supply for the Finnish marine industry. In its early years, Rautaruukki utilized Finnish ore resources, but later started importing iron ore. The company also owned mines of which the most notable was Otanmäki, located in Kainuu in the northern part of Finland. Over the decades, Rautaruukki diversified its production to new products like more processed steel products for different industry sectors.

SSAB uses many kinds of standards, mainly ISO standards for management systems and different technical standards. ISO standards like ISO EN 15804 and EN ISO 14025 are used in life-cycle management to prove that SSAB's production meets the needs of sustainable business. Those standards point out that a third party has

certificated SSAB's processes. In technical standards, EN 1090 is one of the most important standards for the steel industry and SSAB. SSAB has certified factory production control for manufacturers of hot-rolled steel products according to EN 1090, which guarantees that steel is functional for intended use, and gives right to use CE marking. That is a safety question for instance in construction where steel is used for bearing structures.

The fact that SSAB has its background in many independent companies, production sites and countries is also reflected in the company's current use of the standards. There are both companywide ways of using standards and more site-specific use of them. This case is based on the perspective seen from the Raahe production site in Finland. Raahe was the first production site founded by Rautaruukki, and nowadays it is SSAB's biggest production unit measured by number of employees.

In the steel industry, more or less all products are produced according to specific standards. For that reason, standards are a prerequisite for market access, especially in the petroleum and offshore industries. It is practically impossible to sell anything that has not been standardized to these industries. Moreover, the standards concerning production technologies are important for efficient investments in new technology and facilities. Another very important reason for using standards is the safety of SSAB's own employees and customers. Following standards supports process planning and production safety. Without standards, everything would have to be tested separately by SSAB. The standard proves that required tests have already been carried out, which saves both time and money. When all the suppliers work according to the standards, CE-certification is easier to obtain.

Recently, SSAB has invested in a new liquefied natural gas (LNG) terminal in Raahe to improve environmental friendliness. LNG technologies are rather new, at least in Finland, and for that reason some of them are not standardized. Due to this, the investment required extra work and collaboration between the company and the officials. The project was successfully completed, but it revealed in a concrete way why it is important to have standardized technologies.

In opening new markets, SSAB sells steel also for safety purposes - like structures that are used in war zones. They need to be bullet-proof, and there are standards that also cover these requirements. In this case standardization is used to guarantee that the steel can be used in solutions that protect human life in hostile environments. Use of standards, combined with certification, is important for showing that the production processes are in accordance with sustainable development. The certifications guarantee the customers that environmental issues are taken into account in SSAB's processes.

According to SSAB, standardization may be a barrier to innovation. Introducing new products is sometimes challenging since innovations may require the customer to change their way of doing things. In those cases, the customers' product standards may limit introduction of new products. However, in the long run the standards make marketing of the products more efficient. Even if standardization takes time, it is very useful to the markets as a whole.

In general, benefits exceed the costs of standardization in SSAB. The benefits of standards are typically related to health and safety. SSAB can develop its process when it can trust that suppliers' equipment works in its processes. SSAB's customers can also trust that steel is valid for the purposes it is used for. That is a critical safety issue for all SSAB's customers.

4.7. Trade

The Nordic countries are small, open, export-driven, and mixed economies. Still, the penetration of foreign international retailers in the Nordic countries is relatively low compared to other European countries. Denmark is the only country represented in this sector analysis.

The development in total turnover within the wholesale and trade sectors between 2010 and 2014 differed somewhat between the countries. In Denmark, aggregated turnover within the sector fell by almost five percentage points within the period. As with the manufacturing sector, the retail industry has undergone quite substantial changes due to automation and digitalisation. The increase in labour productivity, facilitated by factors such as automation of customer services and online shopping, depends on standards within logistics, efficient management, efficient freight, as well as quality assurance standards. Arguably, standards are vital for the recently experienced development in turnover, labour and consumer shopping trends to continue. The estimate in our industry-specific regression analysis indicates a strong correlation between appliance of new standards and labour productivity within the trade industry.

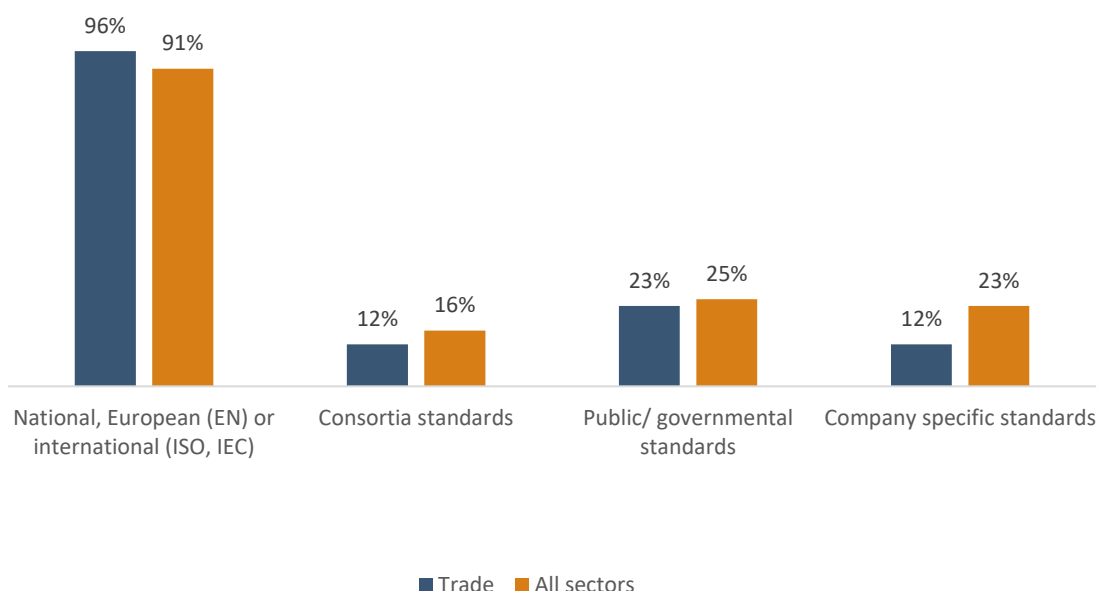
Key information – data set: 26 Danish companies

Company size:	Share of exporting companies in sample: 89%
Micro: 27%	
Small: 31%	Use of standards:
Medium: 31%	• Management standards: 50%
Large: 11%	• Technical standards: 96%

The use of standards

The trade sector covers both wholesale and retail trade services.²⁰ Most of the survey companies are small companies with less than 50 employees. Nearly 90 percent of the companies operate on both domestic and international markets. Figure 4-31 provides an overview of the kind of standards the companies use. The figure illustrates how trade companies follow the major tendency in the use of standards. Most trade companies make use of national, European and international standards, which is the same for the survey sample overall.

Figure 4-31: What standards are the most used in your company? (Multiple answers allowed - in percent), N=26

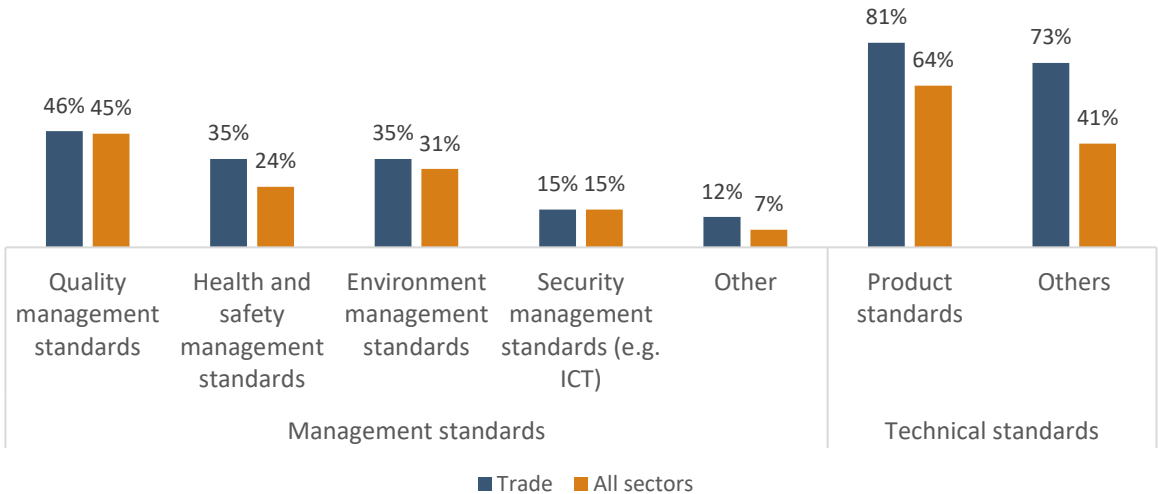


Similar to the rest of the sectors studied, a dominating group of respondents (92 percent) in the trade sector report that their companies use technical standards. The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories; product

²⁰ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

standards and other standards. The respondents were asked to report which type of technical standards their companies use. Four out of five companies reported that they use product standards, in addition to a large group reporting that they make use of other technical standards (see Figure 4-32). The studied companies follow the average tendency of using management standards (50 percent). The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was broken down into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The trade companies deviate in one category of management standards and percentagewise, more trade companies use health and safety management standards than the survey average.

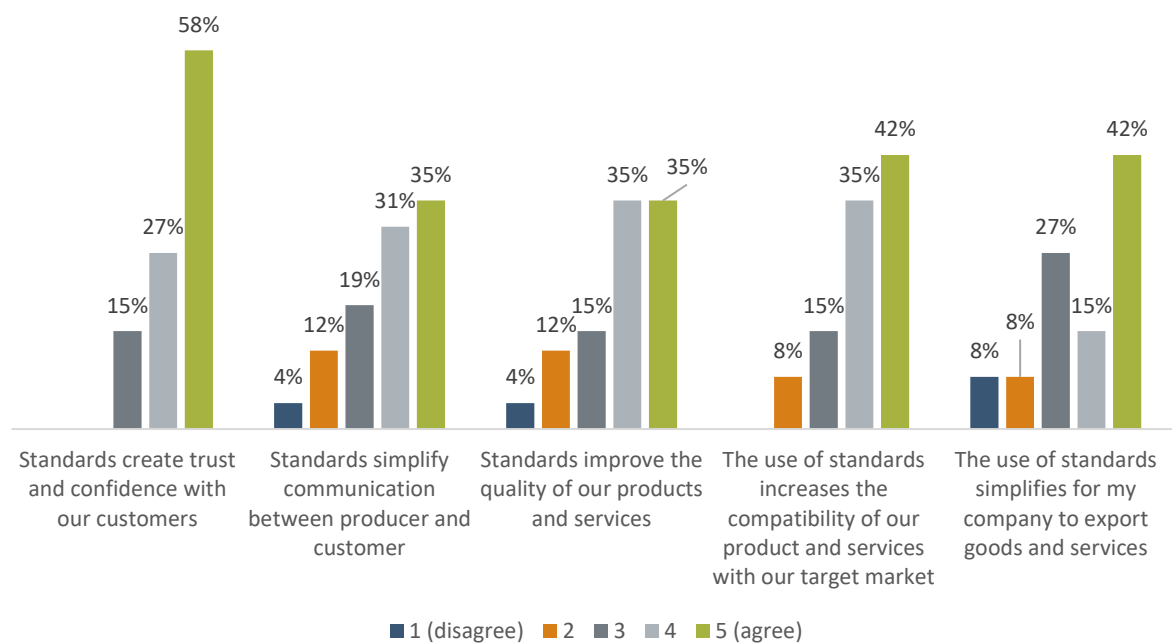
Figure 4-32: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=26



Sales, marketing and market access

The responses displayed in Figure 4-33 are a strong indication that standards benefit the trade companies studied; a result in line with the dominating tendency across the eight sectors studied. The respondents tend to agree with the statements expressing that standards benefit their company. In the survey, the respondents were asked to evaluate a set of potential benefits of standards on a scale from 1 = disagree to 5 = agree. Figure 4-33 describes how the trade companies follow the Nordic standardization sample average regarding benefits of standards. The respondents agreed to a very high level with the statements “standards increase the compatibility of our products and services with our target market”, “standards simplify communication between producer and customer” and “standards create trust and confidence with our customers”.

Figure 4-33: Sales, marketing and market access – in percent, N=26



The survey’s trade category included only 26 respondents. Regarding the questions on sales, marketing and market access, the free comments section of the survey includes statements from a limited number of respondents. The seven respondents who further elaborated on their answers brought up issues related to internationalization of standardization work; how to compromise with customers by using standards. The answers show an interest among the respondents to increase the focus on the importance of standards. Since there were only 26 respondents for the trade sector, no regression analyses have been conducted regarding the relationship between the respondents’ tendencies to evaluate their agreement with the statements in Figure 4-33 and company size, and the question on how important following and applying standards is to their company’s plan for the future.

Production and supply chain efficiency

Figure 4-34 describes different ways in which standards affect a company's ability to develop innovative solutions. In general, the trade companies follow the same major tendency as the other surveyed companies related to how standards affect their companies’ ability or willingness to develop innovative solutions. Figure 4-34 highlights that only a limited number of trade respondents claim that standards prevent their companies from developing innovative technology, which is notably different from the total survey sample. This may be due to a weakness of the data set caused by few respondents within the sector. The trade respondents' answers may also be due to low R&D investments related to developing innovative activities.

Figure 4-34: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=26

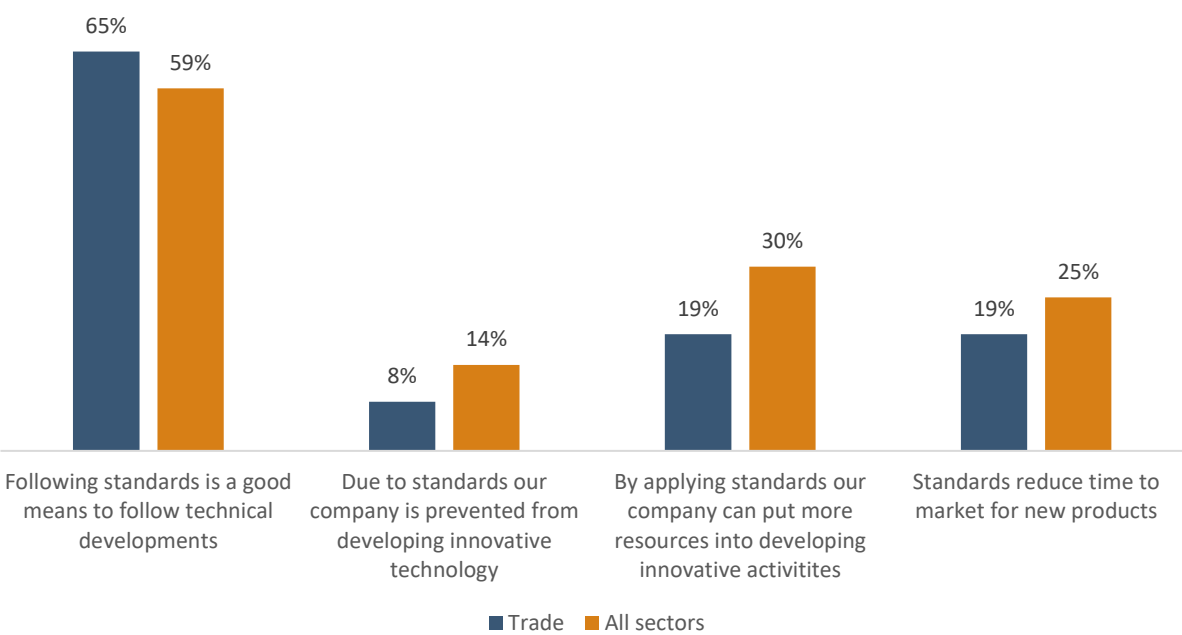
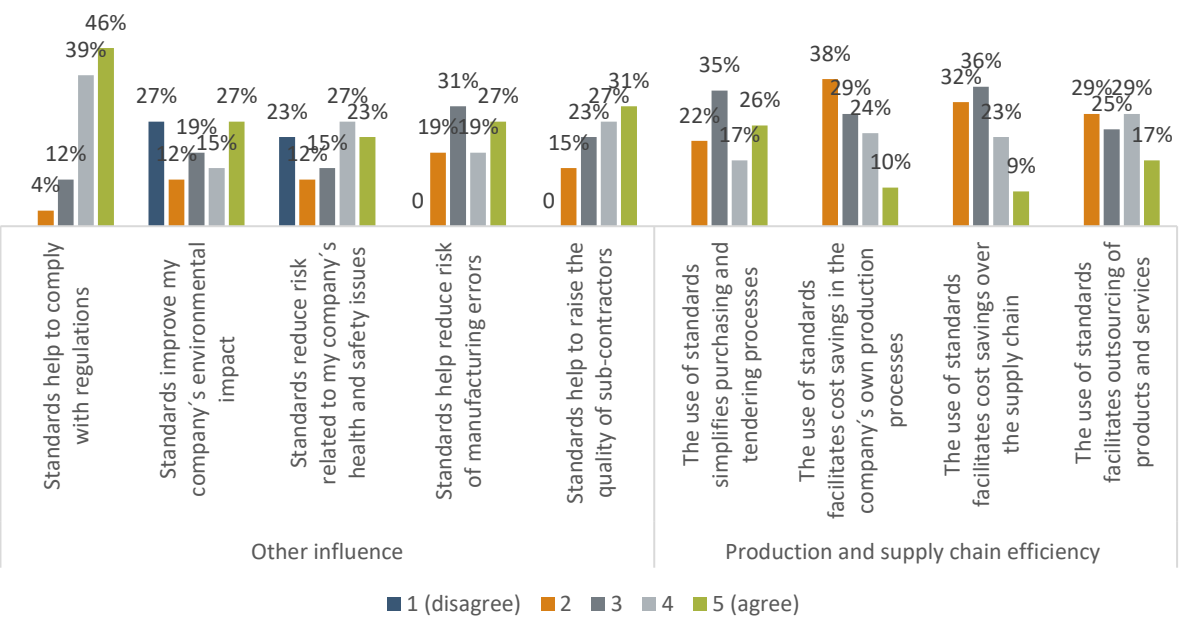


Figure 4-35 presents an overview of standards’ influence in trade companies’ production and supply chain efficiency. Standardization affects companies' innovation efforts linked to the value chain, both internally and externally. One of the trade respondents elaborated on the importance of using standards to agree on a specific quality between actors in the value chain: *“It is to our advantage that we are able to demand a specific standard when doing business with sub-suppliers. When using standards, we have a common language and understanding”*.

Figure 4-35: Production and supply chain efficiency (in percent), N=26



4.8. Seafood and fisheries

With long historic traditions within shipping and seafaring, seafood and fish are among the most important export articles for the Norwegian, Swedish, Icelandic and Danish economies. Salmon is the main export article, and the vast majority of importers of Nordic seafood are other European countries. In 2014, Norway exported seafood and fish for almost eight billion Euros in total, more than 2.5 times as much as Sweden, and close to three times as much as Denmark. Iceland exported seafood and fish for about 1.5 billion dollars, and is the biggest per capita exporter. In addition, Norway and Iceland differ from the two other Nordic countries in that a significant share of Norwegian and Icelandic exports reach countries outside Europe, Asian countries being the main importers.

Key information – data set:

20 Norwegian companies

Company size	Share of exporting companies in sample: 85%
Micro: 5%	Use of standards: <ul style="list-style-type: none">• Management standards: 25%• Technical standards: 100%
Small: 40%	
Medium: 25%	
Large: 30%	

Fisheries and aquaculture is a relatively new field of study with respect to standardization. Increasingly stricter requirements from consumers, in addition to environmental organizations, are a driving force for the development of standards within the field. Ensuring quality, efficient and sustainable production techniques, traceability and transparency, standards have become an important part of the industry, both at the national and international level. As the industry is highly international, standardization is an important contributor and premise for global trade of seafood and fish.

The use of standards

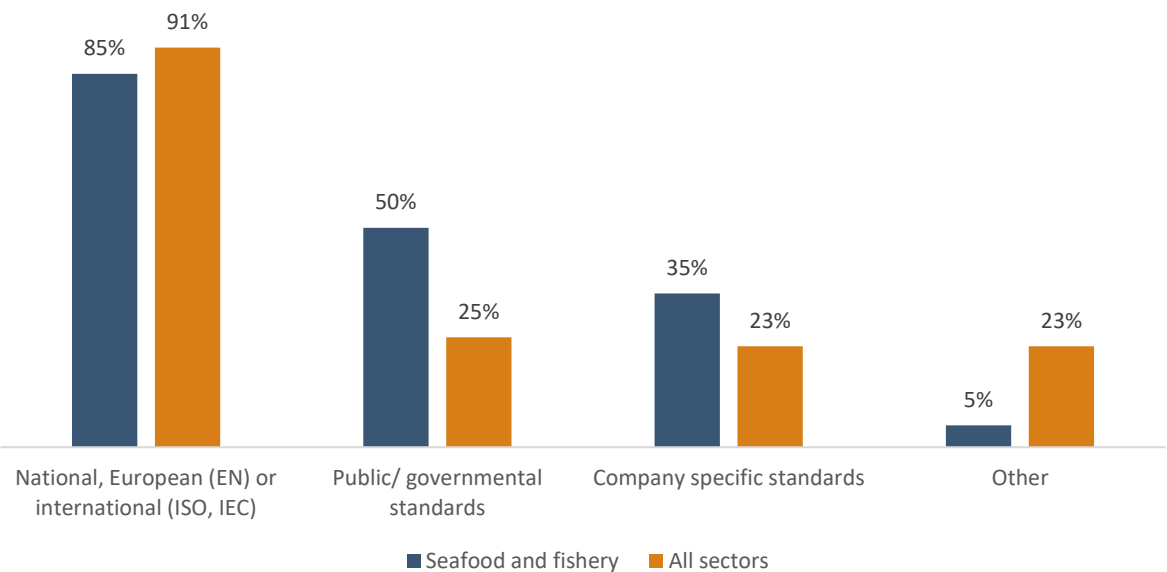
The seafood and fisheries sector includes fishing as well as breeding and processing of fish, crustaceans and molluscs.²¹ The seafood and fisheries sector sample includes 20 Norwegian companies. Although the sample size is small compared to the other industries, we expect the respondents' answers to be representative for Norwegian companies within the Norwegian seafood and fisheries sector that follow and apply standards. The main reason for this is that standardization is relatively new in the Norwegian seafood and fisheries sector and the total population of companies using standards in this sector is also relatively small compared to other sectors. Thus, a smaller sample of respondents can still be representative. Still, one should be aware that small samples are more exposed to outliers, which can affect representativeness. This concern is particularly relevant for detailed questions that only address a sub-sample of the population of companies within the sector.

The seafood and fisheries sector mainly consists of actors that operate in both domestic and foreign markets. All the companies use technical standards, and one out of four seafood and fisheries companies uses management standards.

Central to Seafood and fisheries is the necessity to demonstrate that the products are safe, traceable and of good quality. With regards to the question which standards are used the most, most of the companies report that they use national, European and international standards (see Figure 4-36). Seafood and fisheries companies stand out in the survey as experienced users of public and governmental standards, which 50 percent of them use. This may be explained by the companies' use of public food safety standards controlled and organized by the Food Safety Authority. If companies are not able to comply with these standards, the company risks being closed down by the public authorities.

²¹ See appendix section A7 for a detailed definition of the sector according to NACE industrial classification codes.

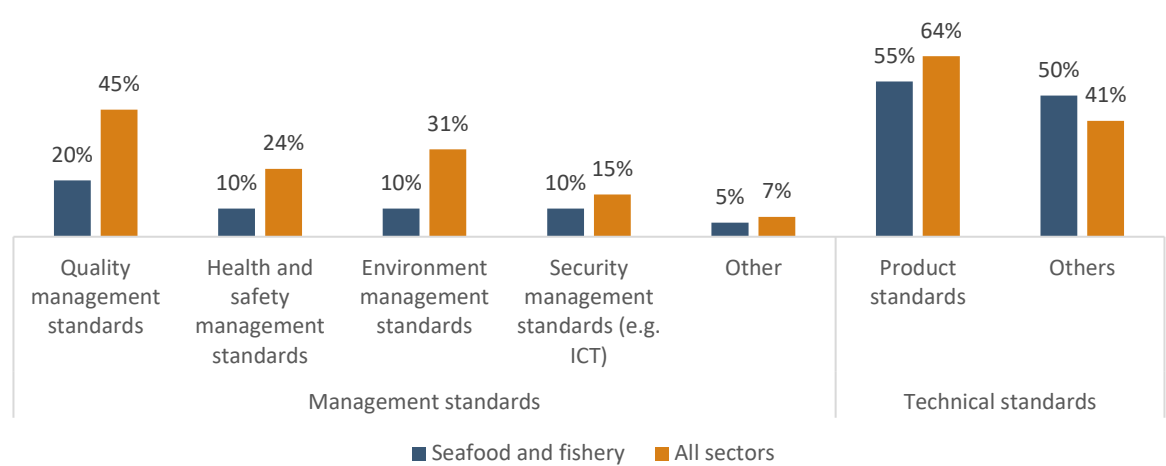
Figure 4-36: What standards are the most used in your company? (Multiple answers allowed - in percent), N=20



The use of management standards might relate to a wide range of standards areas. Therefore, the management standard variable was divided into smaller categories such as quality management standards, health and safety management standards, environment management standards, security management standards and other. The respondents were asked to report on which management standards their companies use. Multiple answers were allowed. A deeper dive into survey data indicates that the different management standards, listed in Figure 4-37, are of less importance for seafood and fisheries companies than for the rest of the surveyed companies.

The use of technical standards is closely related to the use of product standards. The use of technical standards was operationalised into the two sub-categories; product standards and other standards. The respondents were asked to report on which technical standards their companies use. Multiple answers were allowed. Fewer companies report that they use product standards, and rather make use of other standards. One of the informants representing a medium-sized company explained the preference for the use of other technical standards as something that is necessary especially during the busiest fishing season. The EU has regulations for product labelling that are difficult to apply and follow during periods when large amounts of fish are landed and processed. Fish cases, ready to be transported to the European market, are supposed to be labelled with information such as type of white fish, fishing equipment used, how the fish is processed etc. On days when a large amount of fish is received and processed in a company, labelling might become complicated and labour intensive. Thus, the company focuses more on ensuring product quality than the standardization document quality. In this situation, the respondent explains, the company uses their own standards for product quality.

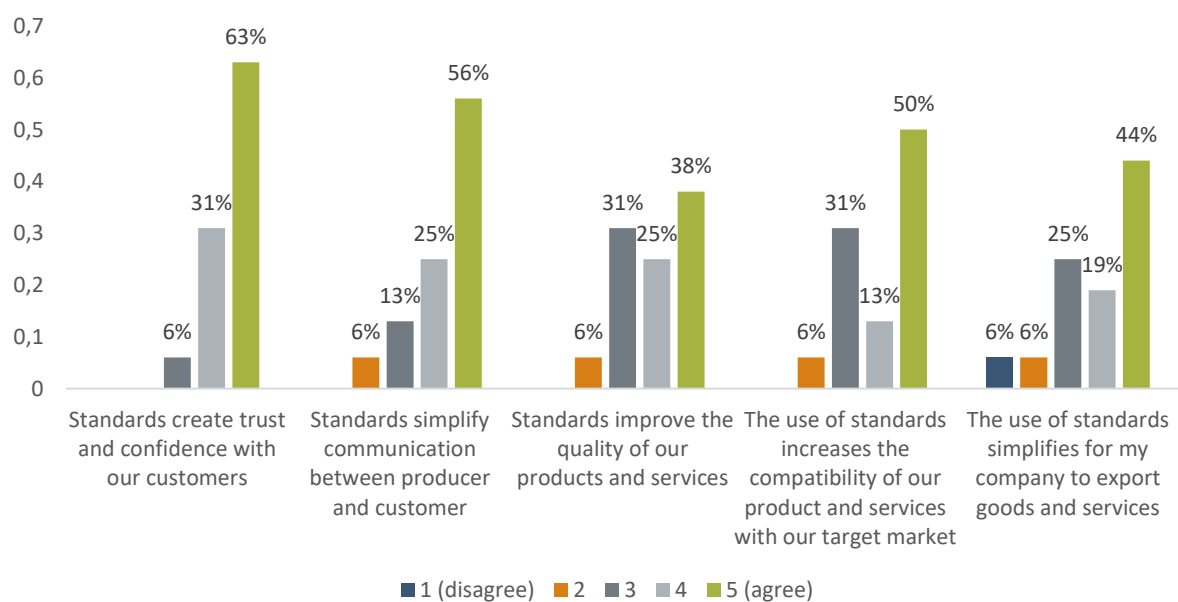
Figure 4-37: Distribution of standards used (Multiple answers allowed – in percent of total sample), N=20



Sales, marketing and market access

The survey results displayed in Figure 4-38 indicate that the seafood and fisheries companies benefit from the use of standards in different ways. The respondents' answers do not statistically deviate from the total sample, but rather follow the same major trends as the other seven sectors studied. On a set of statements related to benefits and sales, respondents were asked to evaluate each statement on a scale from 1 = disagree to 5 = agree. The seafood and fisheries respondents follow the general survey tendency; they do in general agree (reply 4 or 5) that standards simplify export and communication, create trust and confidence with customers etc.

Figure 4-38: Sales, marketing and market access (In percent), N=20



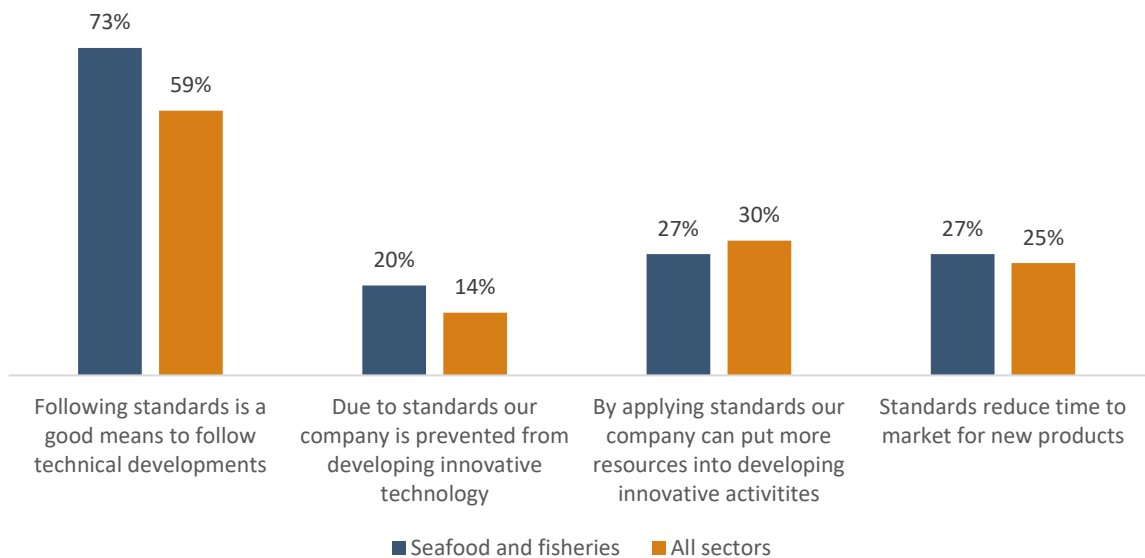
Regarding the questions on sales, marketing and market access, only three of the respondents used the comment section of the survey to elaborate on their answers. One of the respondents represents a non-commercial business actor, and the questions were therefore not relevant. The two other respondents explained that “the standards that are most important for us are in general statutory”, and “standards contribute to simplification, efficiency, control and predictability, better quality, better and more effective interaction etc.”. In addition to relatively sparse data from the open response field in the survey, the small number of respondents within the seafood and fisheries sector makes it difficult to conduct reliable regression analyses regarding sales, marketing

and market access. Benefits identified in this survey are similar to the results from the UK standardization survey on the food and drink manufacturing sector (Hogan et al. 2015). The UK study concluded that the food and drink manufacturing sector benefits from standards regarding more efficient production processes, quality of input products and components, food safety management and more efficient product development and testing, helping companies to meet food safety regulations and customer requirements and entering new markets.

Production and supply chain efficiency

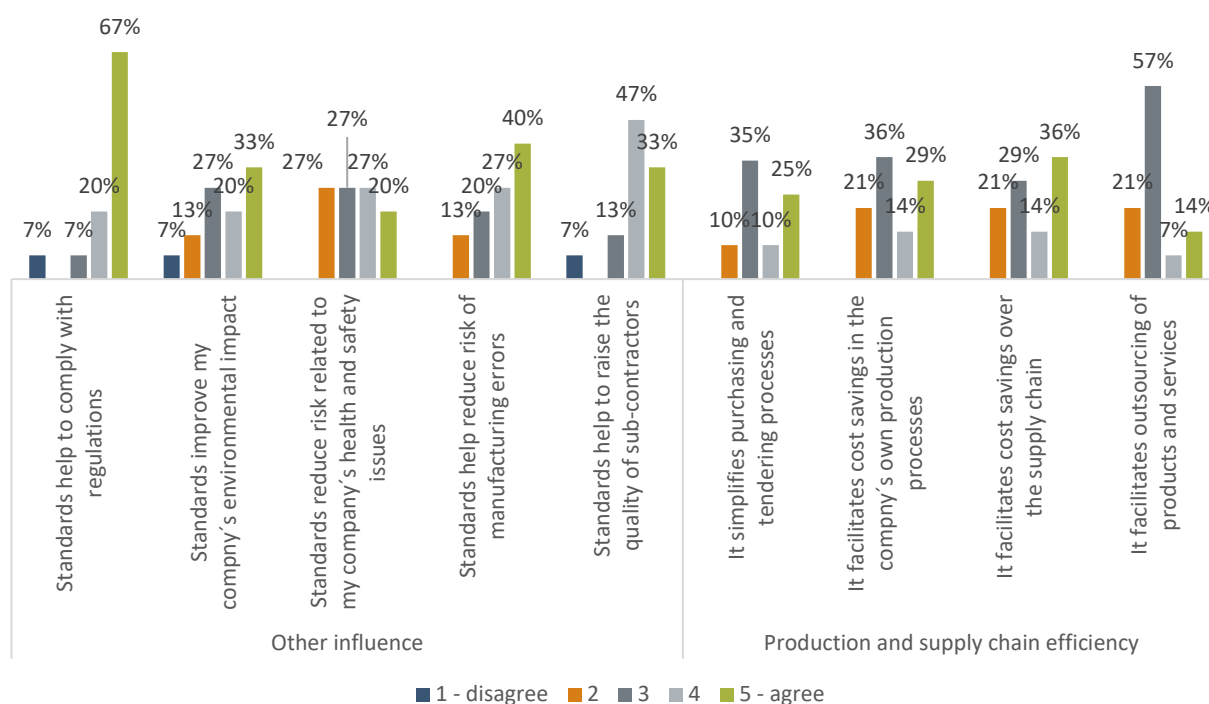
Figure 4-39 presents the survey response on issues regarding the relationship between the use of standards and innovation. The figure presents different statements with the aim of illuminating different insights on the question “In what way do standards affect your company’s ability or willingness to develop innovative solutions?”. The figure is based on data from the companies that confirmed “yes” on different dimensions of how standardization affects companies’ ability or willingness to develop innovative solutions. It is important to highlight that there are only 15 seafood and fisheries companies who have replied to the statements in this question. With few respondents covering the question, it is difficult to draw solid conclusions on how standards affect seafood and fisheries companies’ ability or willingness to develop innovative solutions.

Figure 4-39: In what way do standards affect your company's ability or willingness to develop innovative solutions? (in percent), N=15



The seafood and fisheries respondents confirmed the major survey tendency with regards to different perspectives on production and supply chain efficiency. In general, Seafood and fisheries companies experience cost savings related to tasks across value chains and internal production processes. Figure 4-40 presents the respondents’ views on statements related to production and supply chain efficiency. Standardization affects companies’ innovation efforts related to the value chain. The respondents within the Seafood and fisheries sector do especially agree on statements such as the use of standards facilitates cost savings over the supply chain, and the use of standards simplifies purchasing and tendering processes. The respondents also express that they find that standards help to comply with regulations and reduce risk of manufacturing errors.

Figure 4-40: Production and supply chain efficiency (In percent), N=20



One respondent from the case study claimed that following standards may entail a risk for fisheries companies in that they concentrate more on written documents than real product quality as defined by the fish's look, smell, catching equipment used, packing and storage etc. Despite the doubts of the case study respondent with regard to whether it is possible to follow and apply standards in extremely intense and busy production circumstances, the survey respondents (55 percent) agreed that following standards is a good means to comply with technical standards. Only three of the twenty respondents had experienced that standards prevented their companies from developing innovative technology. Still, only four respondents confirm that by applying standards their company can put more resources into developing innovative activities, and four respondents report that standards reduce time to market for new products. A concluding remark from the analysis of the seafood and fisheries data sample is that these companies find standardization necessary to operate in markets and good to routinize production. At the same time, standards do not seem to influence companies' innovation strategies.

One respondent from the case study claimed that following standards may entail a risk for fisheries companies in that they concentrate more on written documents than real product quality as defined by the fish's look, smell, catching equipment used, packing and storage etc. Despite the doubts of the case study respondent with regard to whether it is possible to follow and apply standards in extremely intense and busy production circumstances, the survey respondents (55 percent) agreed that following standards is a good means to comply with technical standards. Only three of the twenty respondents had experienced that standards prevented their companies from developing innovative technology. Still, only four respondents confirm that by applying standards their company can put more resources into developing innovative activities, and four respondents report that standards reduce time to market for new products. A concluding remark from the analysis of the seafood and fisheries data sample is that these companies find standardization necessary to operate in markets and good to routinize production. At the same time, standards do not seem to influence companies' innovation strategies.

Case study: Norfra

Norfra is a Norwegian fish export company established back in 1984. Norfra is headquartered in Tromsø, and its two factories are situated in Nordvågen and Torsvåg. 12 employees work on exporting the products to foreign markets, while about a hundred employees work at the two production sites. The exports are white fish and king crab. Of this, 60-70 percent is fresh fish, 20-30 percent is salted fish, and 10 percent is king crab. The export market consists predominantly of European countries.

Norfra is a certified user of Standards Norway's standard NS 9406:2016, recognized as the "Skrei-standard". Skrei is young arctic cod caught around the Lofoten and Vesterålen islands in the north-west of Norway. Norfra also uses the ISO 22000 HACCP standard – a system that helps food business operators look at how they handle food and introduces procedures to make sure the food they produce is safe to eat. Furthermore, the company applies the NFC (Near Field Communication) standards as well as industry standards from the Norwegian Seafood Federation. The NFC standards include ISO/IEC 14443 and ISO/IEC 18000-3. ISO/IEC 14443 defines the ID cards used to store information, while ISO/IEC 18000-3 is a standard for wireless near field communication devices.

Standards help Norfra signal quality of their products to the market. For example, Skrei is known world-wide as an exclusive and expensive fish product. However, lots of ordinary coastal cod is sold as skrei both in domestic and foreign markets. Together with Standards Norway and the Norway Seafood Council (NSC), fish companies therefore developed the NS 9406:2016 standard defining the skrei product. During the skrei fishery the NSC runs strict controls on the cod that can be labelled as skrei. Skrei must be perfect, bled out at sea, rinsed with sea water, and packaged within strict deadlines, at the latest 24 hours after catch. The introduction of NS 9406 represents a change in the market that enables customers to identify the difference between skrei and ordinary cod by searching for Standards Norway's tag. Norfra does see the adherence to standards as a competitive edge. As such, it gives added value to the products.

5. Participation in standardization work

The standardization work is organized in projects run by committees. The committee work is facilitated by national or international standardization institutes. The committees are composed of relevant stakeholders for the given topic, including companies within the industry, other experts and public authorities.

In total, 40 percent of the respondents' companies have participated in the work of developing new standards. 38 percent of the survey respondents report that their company has participated in standardization work at the national level, while 23 percent have participated at the European level and 16 percent at the international level. Three out of four companies that have participated in standardization work are located in Norway and Finland. This reflects that the list of recipients of the survey for these countries had a higher share of people that had contributed in committee work, and should not be taken into account as an indication of Norwegian and Finnish companies being more active in standardization work.

Figure 5-1: Share of responding companies participating in standardization work (in percent), N=1179

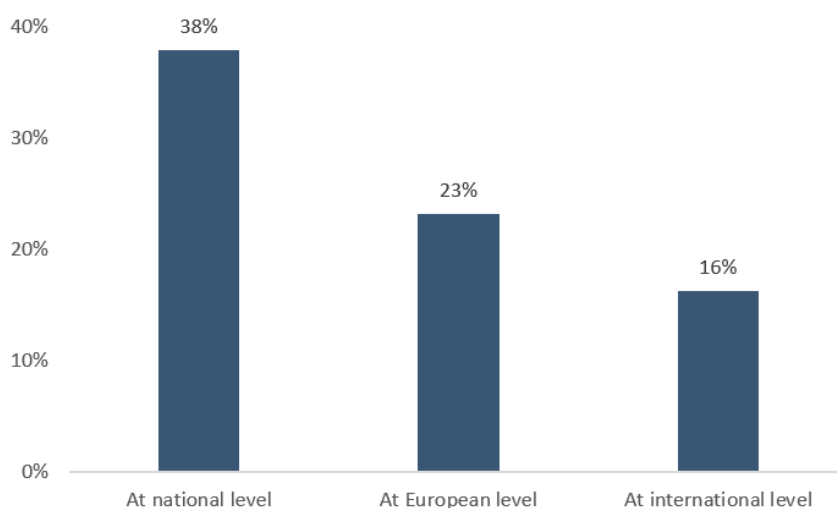
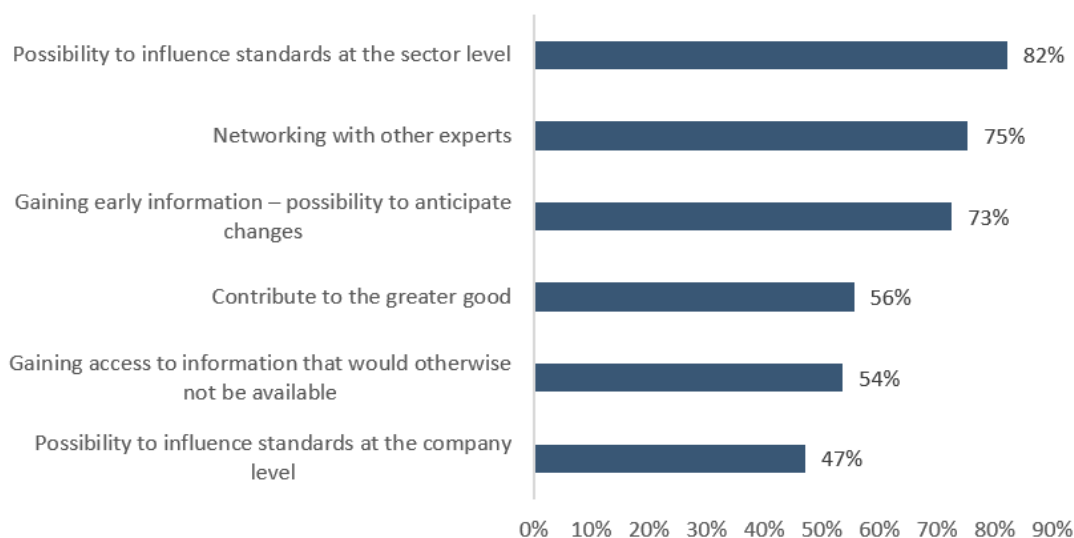


Figure 5-2 below presents the reasons why the respondents participate in the work of developing new standards. The figure is based on a set of statements where respondents whose company participates in standardization work at the national, European or international level were asked to confirm or disconfirm different reasons for participating. From the companies' side, the figure shows that the possibility to influence standards at the sector level (82 percent), networking with other experts (75 percent) and anticipating changes at an early stage (73 percent) are the most important reasons to participate in developing new standards. The results are in line with the views of a construction products and services company in Sweden participating in standardization work both nationally and internationally within different areas such as quality and environmental management and safety and security. The company emphasized that it sees participation as a necessary effort in establishing standards that suit the national conditions of Sweden. Participating in standardization is also seen as an opportunity for employees to constantly improve their knowledge about standards and, accordingly, to gain advantage on how to anticipate and adapt to relevant changes within the industry at an early stage. Several respondents also commented in the survey that an important reason for participating in the development of standards is to ensure that the standards do not create unnecessary costs for the companies in the sector.

Figure 5-2: Reasons to participate in developing new standards (In percent), N=1179



A respondent from a small company within the Swedish process industry argues that most standards are developed by large companies who have the resources to prioritize this work, while the views from smaller companies are not sufficiently taken into account, and in turn affect their competitiveness. Turning the argument around, a medium-sized Norwegian company within the petroleum industry argued that everyone should participate in standardization work, and that there are too many companies free-riding on the efforts made by others in developing standards. The responding companies in the survey illustrate the tendency that larger companies are more likely to participate in standardization work. Figure 5-3 below shows that while 60 percent of the large companies in the sample participate in standardization work, only 30 percent of the smaller companies with less than 50 employees do so. The same pattern, that larger companies are more active in standardization work, was found among British companies in the study on standardization in the UK by Hogan et al. (2015).

Figure 5-3: Share of companies responding that they participate in standardization work by company size (in percent), N=1179

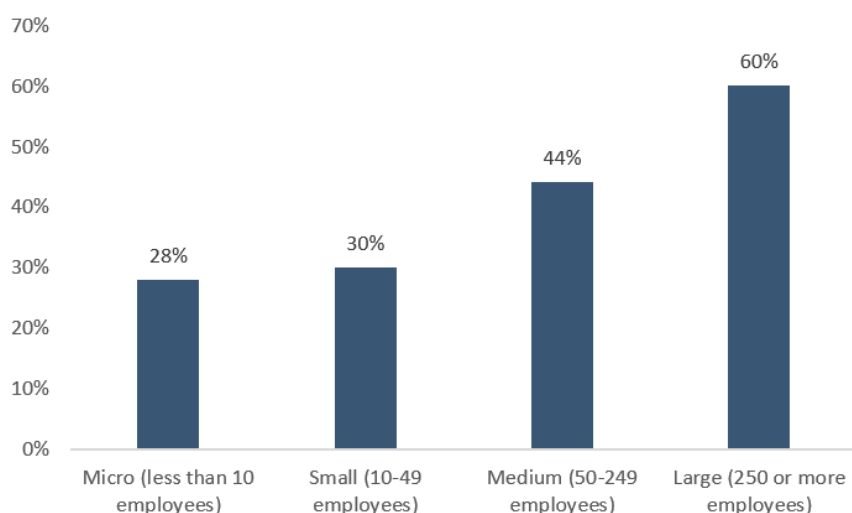
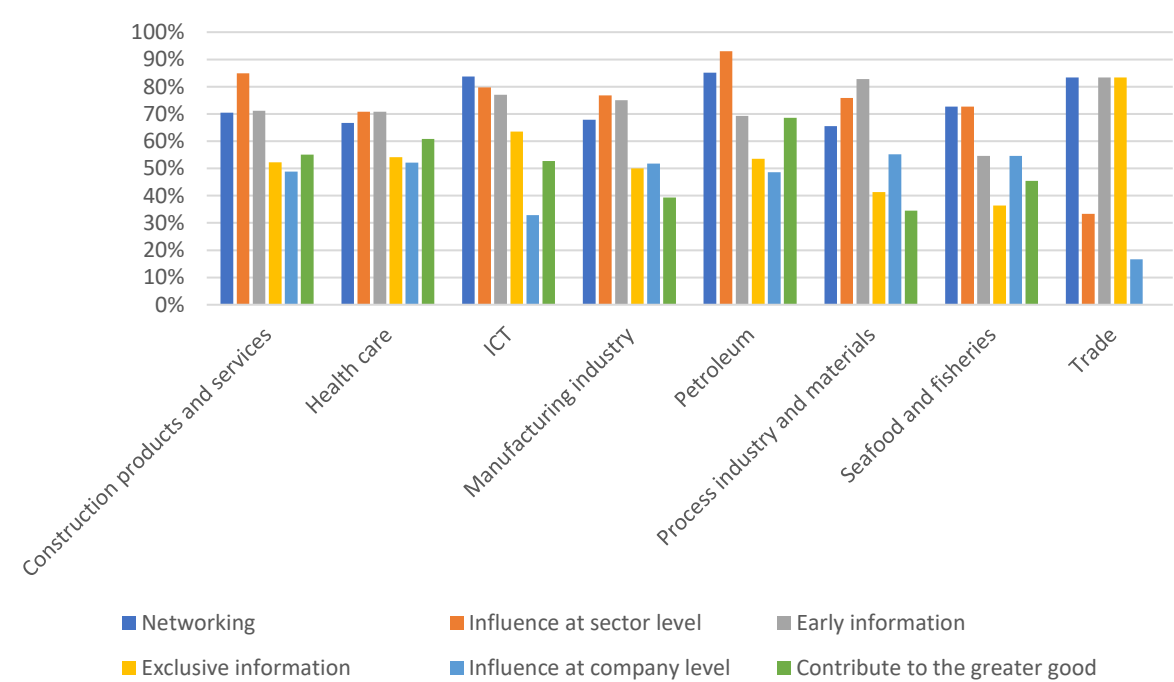


Figure 5-4 below reports the respondents’ arguments for participating in the work of developing new standards split by sector. The graph shows that the arguments regarding networking, influence at the sector level and gaining information at an early stage are the most important reasons across sectors. The only exemption is trade, which puts more emphasis on “gaining access to information that would otherwise not be available”, and less on the possibility to influence the development of standards at sector level. However, one should notice that there are very few respondents in the sample participating in standardization work in this sector and thus the results are probably less robust. A large company within the Norwegian petroleum sector also emphasized that the standardization work is valuable as marketing for the company. Within the ICT sector, two of the respondents emphasized that standardization requires in-depth skills and time to analyse a variety of options. Moreover, they emphasized that the competence needed for developing standards is not something that you get trained in in your regular job, and it can be too expensive for the company to use some of their most skilled people for this work. Thus, one of the companies argued that it is important that the companies are made aware of the benefits from standardization.

Figure 5-4: Reasons to participate in in developing new standards split by sector (in percent), N=1179



There is a tendency that the companies who participate in standardization work are more likely to have standards as an important part of their business plan and more likely to experience benefits from standardization. For example, 90 percent of companies participating in standardization work report that standards are an important part of their future plans, compared to 84 percent of the non-participating respondents. Moreover, while 83 percent of participating companies report that “benefits by far exceed costs” or that “benefits exceed costs”, 65 percent of the non-participating respondents state the same. A similar pattern was found in the survey conducted by Hogan et al. (2015) among British companies. In that survey, 69 percent of the respondents representing companies highly involved in the standards development process reported a net benefit from using standards, while only 45 percent of those not involved in developing standards agreed with the same statement. Thus, a larger share of the Nordic companies experiences a net benefit from standardization compared to those that were part of the British survey.

6. Concluding remarks

In the study, we have addressed two fundamental questions regarding the importance of standards and standardization in the Nordic countries:

- “What does the development of standards mean to all of us?”
- “What benefits do standards generate for my business?”

To address the first question, we introduce and test a model for how standardization is associated with changes in productivity in the Nordic countries. Increases in productivity mean that you can get more for the same amount of input. These efficiency gains can be used to raise living standards by improving people's ability to purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs. Thus we argue that productivity is the best indicator for a given society's welfare potential.

The results show that there is a positive and statistically significant relation between standardization and productivity across all the Nordic countries. The estimated “elasticity” of 10.5 percent between the doubling of the stock of standards and productivity growth for the Nordics is close to a consensus estimate from previous international studies. The average growth in the stock of standards has been close to 7 percent over the past four decades, which is associated with 39 percent of the labour productivity growth during the period.

While the study of the relation between standardization and macro-economic factors reveals highly interesting patterns, it does not explain why we observe this strong positive relation between standardization and productivity. To gain a better understanding of the benefits companies derive from standards, a large Nordic business survey with nearly 1200 respondents was conducted. To avoid hypothetical considerations, only companies with prior experience with standardization were sampled. As many as 87 percent of respondents to the survey reported that standards are an important part of their company's future business plans.

Three quarters of respondents agree with the statement that they receive a net benefit from applying and using standards. Although a substantial share of the benefits of implementing standards is not captured by individual companies directly, but rather elsewhere in the value chain outside the boundaries of the company, most respondents consider standards as beneficial for their own business.

Companies, independently of sector or size, point to several types of benefits from applying standards in their business. However, according to this research, improved market performance, either through improved market access or higher quality products/services, is the most important reason for using standards. Two out of three respondents point out that standards reduce the risk of manufacturing errors within the company, and the same share of respondents claim that standards raise the quality of subcontractors. 84 percent of respondents also report that standards help them comply with regulations, saving the company administrative costs related to compliance as well as signalling to the market that it is a serious supplier that complies with regulations. In other words, standards create trust between buyers and suppliers, solve coordination problems in the market, enable efficient supply chains and sharpen competition. Moreover, six out of ten respondents emphasize standards as an efficient means to follow technical developments. These types of benefits from standardization can very likely explain a large part of the remarkably high estimates for the relation between the development of standards and productivity growth observed from the macro analysis.

Overall, standardization has undoubtedly improved economic performance, facilitated improved user experiences, and contributed to safer and more environmentally friendly work environments. Still, looking ahead: do we also expect standards to play a pivotal role in boosting future productivity growth, or should we expect decreasing returns to standardization as the major economic benefits of standardization have already been reaped? Since the beginning of the 2000s, the growth rate of the stock of standards managed by the Nordic standardization organizations has been steadily decreasing (see Figure 2-1). In the period 2000 to 2009 the average growth rate in stock of standards was about 7 percent, while in the period 2010 to 2014 it has been 3 percent. The reduction in the growth rate of standards is probably of a permanent character. The wave of new national standards stemming from adoption of the EN standards created as part of the New Approach has now passed and the demand for new harmonized standards has also stabilized as the legal framework regulating the

European single market has matured. Moreover, as the stock of standards becomes larger over time, keeping up the percentage growth *rate* would require an increase in the volume of standards produced. The key question is then: will the drop in the growth rate of stock of standards imply a smaller impulse on productivity growth from standardization in the future? We believe not. The productivity gains from standardization is more about the quality of the standards than the quantity of standards, and the largest productivity gains from standardization are probably within new emerging sectors and markets.

Our two case studies of start-up companies within Educational technology (EdTech) and Welfare technology, respectively, illustrate that there is an unsaturated demand for standardization related to products and services delivered on digital platforms. In fact, standardization is a key factor for reaping the full productivity gains from Information and Communication Technology (ICT). Standards within ICT enables interoperability of systems, products and services, set criteria to the sufficient quality (e.g. with respect to data security) and distributes technical information among developers. An important reason why the positive association between growth in standards and productivity is so robust across countries in the past is probably because standards address specific recurring problems in the market. As technological development continues, yielding new industries with innovative products and solutions, new recurring problems will arise. Thus, as the modern economies are changing more rapidly than ever before, the need for standards to coordinate the market is likely increase in the time to come.

References

AFNOR. (2009): "Impact Économique de la Normalisation." Paris: AFNOR

Antonin Arlandis, Stéphane Ciriani, and Gilles Koleda, "L'économie Numérique et La Croissance" (working paper, Coe-Rexecode, 2011), http://www.persee.fr/web/revues/home/prescript/article/tiers_0040-7356_1988_num_29_115_3718.

Blind, Knut, and Andre Jungmittag. (2007): "The impact of patents and standards on macroeconomic growth: a panel approach covering four countries and 12 sectors." *Journal of Productivity Analysis* 29, no. 1: 51-60. doi:10.1007/s11123-007-0060-8.

Blind, K., Bekkers, R., Dietrich Y., Iversen, E., Köhler, F., Müller, B., Pohlmann, T., Smeets, S., Verweijen, J., (2011). Study on the Interplay between Standards and Intellectual Property Rights (IPRs). European Commission: Luxembourg.

Blind, K. (2013). "The Impact of Standardization and Standards on Innovation. 2013." Nesta Working Paper No. 13/15.

Byrne, D. M., Oliner, S. D., & Sichel, D. E. (2013). Is the information technology revolution over?

Desirée van Welsum, Willem Overmeer, and Bart van Ark, (2013). Unlocking the ICT Growth Potential in Europe: Enabling People and Businesses (European Commission Digital Agenda for Europe)

DTI (2005): "The Empirical Economics of Standards" DTI ECONOMICS PAPER NO.12. London

Hesser, W., Feilzer, A. J., & De Vries, H. J. (2010). Standardisation in companies and markets. Hamburg: Helmut Schmidt University.

Hogan, Oliver, Colm Sheely, and Rajini Jayasuriya. (2015): "The Economic Contribution of Standards to the UK Economy" Report. CEBR. Accessed June 27, 2017.

Hogan, Oliver, Colm Sheely, and Rajini Jayasuriya. (2016): "The Economic Contribution of Standards in Ireland" Report. CEBR. Accessed June 27, 2017.

Jungmittag, A., Blind, K., & Mangelsdorf, A. (1999): "Economic Benefits of Standardization." DIN.

Jungmittag, A., Blind, K., & Mangelsdorf, A. (2011): "The Economic Benefits of Standardization." DIN

OECD (2017). OECD.Stat, database

OECD StatExtracts, Country Statistical Profile 2012 (Contributions to GDP growth: ICT capital)

Standards Australia (2006): Standards, Innovation and the Australian Economy. Canberra and Sydney.

Standards Australia (2012): The Economic Benefits of Standardisation.

Swan, P (2000): "The economics of standardization". Report. University of Manchester.

Swan, P (2010): "The economics of standardization: An update". Report. Innovative Economics Limited.

The Conference Board of Canada (CBoC). (2007): "Economic Value of Standardization." Standards Council of Canada.

van Welsum, Vermeer and van Ark (2012), Unlocking the ICT growth potential in Europe: Enabling people and businesses. http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=4243

Appendix

A1. Explanation of technical terms

Below follow explanations of technical terms commonly used in the report:

Productivity. Productivity is a measure of how effectively resources are utilized. A common productivity measure is labour productivity, measured as the ratio between value added and labour. "Total factor productivity growth" is the productivity growth that stems from other sources than increased use of labour or capital, sources such as increased innovation, spreading of knowledge, education, better physical and digital infrastructure and so on. We estimate the association between the growth in stock of standards and total factor productivity.

Statistical significance. Statistical significance is important when doing statistical hypothesis testing. If one finds a positive association between two variables, the level of statistical significance shows how unlikely this result is to occur given the null hypothesis that the two variables are independent. The null hypothesis – i.e. there is no correlation – is considered "highly unlikely" at a level of statistical significance of 95 percent or higher.

The validity of identifying statistically significant results depends on the quality of the data and the model used. The samples used in the analysis must be representative of the population you are interested in, and you must control for all relevant variables affecting both the explanatory variable and the response variable. If either the sample or the model are biased you could obtain a "false positive" finding, which means that you obtain a statistically significant estimate that in reality is false.

"Associated with". In the report we use the wording "an increase in the stock of standards is *associated with* productivity growth". The term "associated with" is analogous to the more technical expression "correlation". The reason why we use the term "associated with" rather than "effect on" is because we cannot rule out that there is a two-way causality between our explanatory variable "stock of standards" and the response variable productivity. That is, when we find a statistically significant correlation between changes in the stock of standards and productivity growth, this could both stem from the stock of standards affecting productivity, as well as economic development affecting the stock of standards. When we say that doubling the stock of standards is associated with an increase of 10.5 percent in labour productivity, this means that we have observed that productivity growth goes hand in hand with growth in standards but that we cannot rule out that productivity has an effect on the growth in standards any more than standards affecting growth in productivity growth. Most likely economic growth and standardization interact in a symbiotic relationship.

Point estimate. In statistics, point estimation involves the use of sample data to calculate a single value which is to serve as a "best guess" or "best estimate" of an unknown parameter. The higher the level of statistical significance, the more precise is the estimate. When we say that the point estimate is significantly different from zero with a probability of 99 percent, this is the same as saying that the probability of the study rejecting the null hypothesis that there is no positive association between the variables is 99 percent.

Elasticity. In economics, elasticity is the measurement of the percentage change in an economic variable responds to a percentage change in another. An elastic variable is one which responds more than proportionally to changes in other variables. In contrast, an inelastic variable is one which changes less than proportionally in response to changes in other variables.

A2. Methodology and data for estimating the correlation between productivity and standardization

A simple Cobb-Douglas production function is our starting point for measuring the effects of standardization on labour productivity. By transforming the production function into a linear equation, we establish a production function that is conducive to econometric estimation. Hence, our initial econometric specification is identical to that of Hogan et al. (2015). As the equation below illustrates, the linearized production function enables us to re-state the function in per-worker terms. Thus, the linearized equations consist of output per worker (labour productivity), capital per worker (capital – employment ratio), in addition to total factor productivity.

$$y_t = a_t + (1 - \gamma)c_t$$

$$Y_t: \text{Output year } t$$

$$L_t: \text{Employed persons year } t$$

$$C_t: \text{Capital year } t$$

$$\text{Labor productivity} = \text{Total factor productivity} + \text{Capital-employment ratio}$$

$$y_t := \ln(Y_t) - \ln(L_t)$$

$$a_t := \ln(A_t)$$

$$c_t := \ln(C_t) - \ln(L_t)$$

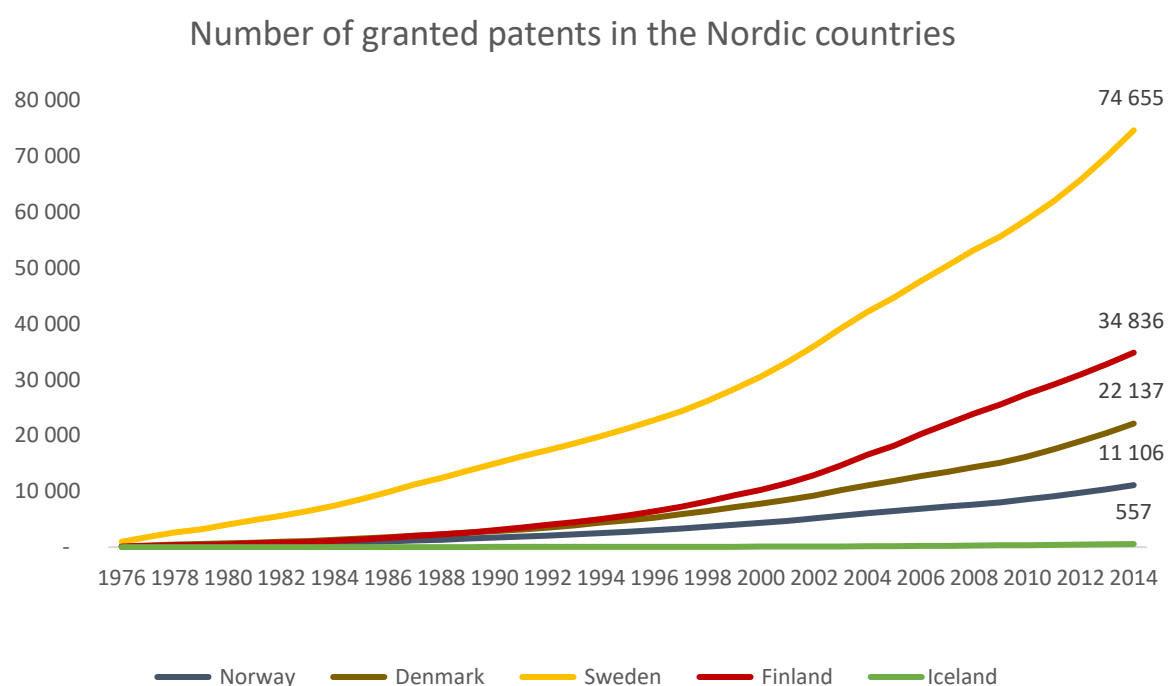
We use country-specific GDP²², capital and employment data from OECD’s statistical database, the two former variables measured in constant prices. There are some differences with respect to the length of these time series. The longest available time series is for the Danish economy, which reaches all the way back to 1966, while we only have access to time series measured in constant prices from 1993 and forwards for the Swedish economy.

²² Value added data, measured in constant prices, is used with respect to sector regressions.

A3. Development of patents in the Nordic countries

We extend the model used by Hogan et al. (2015) by adding patents to our model. Provided by the OECD-statistics database, we use the nation-specific patent statistics to control for research and development (R&D). The OECD's patent statistics cover the total number of granted patents by country, in addition to some selected industries. As with the net stock of standards variable, the patent-variable grows exponentially over time, which implies correlation between the two variables. The rather similar growth-behaviour of the two variables illustrates why it is difficult to disentangle the causal effect of standardization on labour productivity from the causal effect yielded by research and development.

Figure 0-1: Development of patents in the Nordic countries over time: Source: OECD



A4. Regression results on the national level

Country-specific estimates of the associated effect of standardization on labour productivity vary between 5 and 15 percent, the Swedish estimate being the highest and the Icelandic being the lowest in magnitude. The first row in Table 1 summarizes the results from the regressions performed on the Nordic and national aggregate level.²³ In the first column, labelled Nordic, all the Nordic countries are pooled together and treated as a single entity in the regression²⁴. Country-specific estimates follow in the remaining columns.

Table 0-1: Regression results on the national level

Variable	Nordic region	Denmark	Sweden	Norway	Finland	Iceland
	1976-2016	1976-2016	1993 - 2016	1976 – 2016	1980 - 2016	1997-2016
Net stock of standards	0.105*** (0.0138)	0.0891*** (0.0106)	0.147*** (0.0456)	0.133*** (0.0200)	0.108** (0.0510)	0.0466*** (0.0134)
Patents	0.0448*** (0.00913)	0.0670*** (0.0113)	0.0298 (0.0262)	0.0133 (0.0366)	0.0355 (0.0515)	0.0670*** (0.0204)
Capital-employment ratio	0.307*** (0.0185)	0.261*** (0.0764)	0.320*** (0.0690)	0.395* (0.205)	0.367*** (0.104)	0.460*** (0.139)
Financial crisis 2009	0.00264 (0.0122)	0.0143 (0.0159)	-0.0168 (0.0135)	-0.00702 (0.0328)	0.0329 (0.0345)	-0.0105 (0.0352)
Finland recession	- 0.0231 (0.0159)				-0.0118 (0.0234)	
Denmark recession	-0.00805 (0.0190)	-0.00375 (0.0116)				
Time-trend	0.00082 (0.0012)					
Constant	-0.136 (2.293)	1.497*** (0.509)	1.717*** (0.143)	1.078 (0.914)	0.823 (0.545)	-2.639*** (0.193)
R2	0.978	0.994	0.993	0.982	0.983	0.966
Number of observations	163	40	23	39	35	26
Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01						

²³ We applied an Augmented-Dickey Fuller (ADF) test and a Phillips-Perron test for residual-stationarity. The null hypothesis of a unit root is rejected, suggesting that the results yielding from Ordinary Least Squares (OLS) are non-spurious results. Hence, OLS estimation methods were used to estimate the model.

²⁴ Countries are weighted according to the number of employed persons in the economy as share of total employment in the Nordic region.

A5. Robustness test: Regression results based on industry level data

The ICS-codes listed in the datasets provided by the national standardization organizations, have been used us to allocate standards according to industries. We divide the economy into 21 industries, utilizing the NACE A21 industrial classification system, and allocate standards to industries based on the first three digits in the provided ICS-codes. This enables us to perform regressions on the industry level, which entails utilizing far more observations and variation compared to regressions performed on the national level. The table below compares findings for the Nordic region.

Table 0-2: Industry level and national level regression results

Nordic region	Industry level	National level
Capital-employment ratio	0.276*** (0.0132)	0.307*** (0.0185)
Net stock of standards	0.123*** (0.00597)	0.105*** (0.0138)
Patents	0.0299*** (0.0806)	0.0448*** (0.00913)
Financial crisis 2009	-0.0029 (0.0148)	0.00264 (0.0122)
Finland recession	- 0.029 (0.0186)	- 0.0231 (0.0159)
Denmark recession	0.0347 (0.0225)	-0.00805 (0.0190)
Constant	1.765*** (0.0463)	-0.136 (2.293)
Time-trend		0.00082 (0.0012)
R2	0.704	0.978
Number of obs.	2788	163
Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01		

Comparing the estimates from the two regressions is interesting for multiple reasons. First, it arguably gives insight with respect to the robustness and reliability of the estimates. Secondly, since larger industries are weighted heavier in the regression performed on industry level, it gives additional insight to the importance of standards for overall labour productivity. As the table above shows, the estimated elasticity of standardization increases with almost two percentage points when we run the regression on the industry level. Furthermore, the elasticity of patents decreases substantially. The combination of these two factors suggests that standards are relatively more important than what the regression on the national level suggests, at least in larger industries characterized by a high number of employees.

A6. Regression results for selected industries

In addition to estimating the effect of standardization on the national level, we perform separate estimations for selected industries across the Nordic countries. ICS-codes are used to allocate standards according to sectors²⁵.

The sectors are selected on two criteria: 1) the sector has historically been a frequent user of standardization and 2) the sector is dominated by private companies that compete in the market. The second criterion means that sectors dominated by public sector companies, such as health and education, are excluded. Although standardization is highly relevant for these sectors, it is impossible to estimate productivity effects since most of the service suppliers in these sectors do not set prices according to profit-driven motives.²⁶

We pool the Nordic countries together when we estimate the effects of standardization on labour productivity for the selected industries. Hence, the regression results reported in the table below should be interpreted as industry estimates for the Nordic region treated as one unit. Although it would be highly interesting to investigate specific sectors at a national level, the number of observations is unfortunately too small at the national sector level to get sufficiently precise estimates.

Table 0-3: Regression results for selected industries

Variable	Construction	Finance	ICT	Scientific services	Transport	Trade
Net stock of standards	0.069** (0.341)	0.250*** (0.567)	0.445*** (0.037)	0.018* (0.0099)	0.0949*** (0.0265)	0.206*** (0.0074)
Capital-employment ratio	0.252*** (0.0584)	0.207*** (0.404)	0.114 (0.0713)	0.239*** (0.0682)	0.129*** (0.0357)	0.227*** (0.0225)
Patents	0.149*** (0.0242)	No	No	-0,126 (0.0841)	0,0389 (0.0243)	No
Financial crisis 2009	Yes	Yes	Yes	Yes	Yes	Yes
Finland recession	Yes	Yes	Yes	Yes	Yes	Yes
Denmark recession	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	No	No	No	No
Constant	44.34***	-17.35*	-0.53**	3.20***	2.57***	1.24***

²⁵ As a given standard can be applied in several sectors, the sum of net stock of standards over industries exceeds the net stock of standards on the country level.

²⁶ Prices set by governmental bodies or other public agents do not reflect developments with respect to productivity in the same way as real market prices.

	(6.063)	(10.44)	(0.253)	(0.333)	(0.143)	(0.0603)
R2	0.59	0.91	0.95	0.32	0.79	0.94
Number of obs.	138	138	138	116	138	138

Despite not being causal, the estimates arguably provide additional insight into the effects of standardization on labour productivity. As the table above shows, the associated effect of standardization is positive and significantly different from zero across all industries. At first glance, one might conclude that standardization has had greatest effect within the ICT-, mining and quarrying, trade, and finance industries. However, as we do not have data on patents for these sectors, the estimates are likely to suffer more from bias than the rest of the listed industries. The latter statement is underpinned by the fact that when we ignore controlling for patents in industries where we have such data, the estimated effect of standardization increases quite significantly. For instance, when we do not control for patents in the construction industry, the estimated effect of standardization increases from 7 percent to almost 16 percent. When we do the same for the transportation industry, the estimated effect of standardization increases by four percentage points. These results suggest that a share of the effect of patents on labour productivity is likely incorporated in the estimated association of standardization within the industries for which we lack patent data. Hence, the magnitude of any estimate corresponding to the effect of standards on economic outcomes should be interpreted with caution whenever one is unable to control for patents.²⁷

Overall, the estimated effect of standardization is quite high across the selected industries, except for construction and transportation, where the effects seem more normal. See table above. We control for patents in all industries for which we have access to patent data. The only exemption is Scientific services, where we get a negative effect from standardization when we control for both standards and patents. In addition, we control for the economic trend over time for the industries in which the time-trend estimate is statistically different from zero with at least 90 percent probability.

²⁷ Patents and standards suffer from multicollinearity within the scientific services industry. This makes it impossible to distinguish the effect of standards from the effects of patents. When we control for patents, the effect of standards is estimated to be -12.5 percent, which we consider to be unreasonable. Hence, we choose to exclude patents from the regression.

A7. Sector definitions

The study covers eight different sectors defined according to NACE Rev. 2. NACE is the system for “statistical classification of economic activities in the European Community”. Notice that some sector definitions may be overlapping. For example, “Manufacture of refined petroleum products” is included in Process industry and materials for Sweden, Finland and Denmark while it is part of Petroleum production in Norway.

Table 0-4: Sectors defined by NACE

Sector	NACE Rev. 2 code	NACE Rev. 2 text
Construction products and services		
	16.10	Sawmilling and planing of wood
	16.21	Manufacture of veneer sheets and wood-based panels
	16.22	Manufacture of assembled parquet floors
	16.23	Manufacture of other builders' carpentry and joinery
	22.23	Manufacture of builders' ware of plastic
	23	Manufacture of other non-metallic mineral products
	25.99	Manufacture of other fabricated metal products n.e.c.
	28.92	Manufacture of machinery for mining, quarrying and construction
	41-43	Construction
	71.11	Architectural activities
	81.22	Other building and industrial cleaning activities
Manufacturing industry		
	22	Manufacture of motor vehicles, trailers and semi-trailers
	25	Manufacture of fabricated metal products, except machinery and equipment
	26	Manufacture of computer, electronic and optical products
	27	Manufacture of electrical equipment
	28	Manufacture of machinery and equipment n.e.c.
	29	Manufacture of motor vehicles, trailers and semi-trailers
	30	Manufacture of other transport equipment
	31	Manufacture of furniture
	33	Repair and installation of machinery and equipment
ICT		
	26.20	Manufacture of computers and peripheral equipment

	26.30	Manufacture of communication equipment
	58.21	Publishing of computer games
	60.10	Radio broadcasting
	60.20	Television programming and broadcasting activities
	62-63	Computer programming, consultancy and related activities; information service activities
Healthcare		
	21.10	Manufacture of basic pharmaceutical products
	21.20	Manufacture of pharmaceutical preparations
	26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment
	32.50	Manufacture of medical and dental instruments and supplies
	46.46	Wholesale of pharmaceutical goods
	47.74	Retail sale of medical and orthopaedic goods in specialised stores
	47.75	Retail sale of cosmetic and toilet articles in specialised stores
	86	Human health activities
	87-88	Social care (excl. child care)
Petroleum production		
	06.10	Extraction of crude petroleum
	06.20	Extraction of natural gas
	09.10	Support activities for petroleum and natural gas extraction
	19.20	Manufacture of refined petroleum products
Process industry and materials		
	17	Manufacture of paper and paper products
	19	Manufacture of coke and refined petroleum products
	20	Chemical industry
	21.10	Manufacture of basic pharmaceutical products
	21.20	Manufacture of pharmaceutical preparations
	24	Manufacture of basic metals
Trade		
	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
	46	Wholesale trade, except of motor vehicles and motorcycles

	47	Retail trade, except of motor vehicles and motorcycles
Seafood and fisheries		
	3	Fishing and aquaculture
	10.2	Processing and preserving of fish, crustaceans and molluscs

A8. Questionnaire – Web survey

Intro

This web survey will be used to research and deepen the understanding and the use and effects of standards on Nordic companies. The survey is part of larger study on the impact of standards and how increased use of standards influence the specific industries in the Nordic countries. We hope that you will contribute to this understanding by answering a few questions. It will take you about 8-10 minutes to participate in the survey.

Section 1: Basic company information

For analytical purposes, we would like some basic information regarding the company you represent.

1. **The company I work in is of the following size:**
(Single answer)
 - a) Micro (less than 10 employees)
 - b) Small (10 – 49 employees)
 - c) Medium-sized (50 – 249 employees)
 - d) Large (250+ employees)
2. **The company I work in operates in the following markets**
(Single answer)
 - a) The domestic market only
 - b) The domestic market + foreign markets (export product or service abroad)

Section 2: The use of standards

3. **What is your role in the company? Several answers allowed.**
 - a) Procurement
 - b) Management
 - c) Sales
 - d) Product and Service Development
 - e) Other, please specify:
4. **What type of standards are the most used in your company? Several answers allowed.**
[classification to be worked out by the working group]
 - a) National, European (EN) or international (ISO, IEC)
 - b) Consortia standards
 - c) Public/governmental standards

- d) Company specific standards
- e) Don't know
- f) Other, please specify

5. What type of standards are used in your company? Several answers allowed.

- a) Management standards
- b) Technical standards

Q6 is only to respondents who choose 5a.

6. What type of management standards do you use in your company?

Matrix question; Multiple answers allowed

- a) Quality management standards
- b) Health and safety management standards
- c) Environment management standards
- d) Security management standards (e.g. ICT)
- e) Other types of management standards, please specify

[Q7 is only to respondents who choose 5b]

7. What type of technical standards do you use in your company?

Matrix question; Multiple answers allowed

- a) Product standards
- b) Other technical standards, please specify

Question number 8: On a scale 1 to 5, how important is following and applying standards to your company's plan for the future?

Section 2: Sales, marketing and market access

In the following you will be presented with statements regarding how standards affect sales, technical barriers to trade and market access. Please indicate whether you agree or disagree on a scale from 1-5.

Matrix question; Scale: 1= disagree – 5= agree

- a) Standards help our company overcome technical barriers to trade
- b) Standards create trust and confidence with our customers
- c) Standards simplify communication between producer and customer
- d) Standards improve the quality of our products and services
- e) It increases the compatibility of our products and services with our target market
- f) It simplifies for my company to export goods and services

8. Please elaborate: _____

9. Has standards helped your company in increasing sales?

Matrix question; Scale: 1= disagree – 5= agree

- a. Standards have helped my company increasing sales to existing domestic customers
- b. Standards have helped my company gaining new domestic customers
- c. Standards have helped my company increasing sales to existing international customers
- d. Standards have helped my company gaining new international customers

Section 3: Production and supply chain efficiency

10. In the following you will be presented with statements regarding how the use of standards affects the production efficiency in your company and its supply chain. Please indicate whether you agree or disagree.

Matrix question; Scale: 1= disagree – 5= agree

- a) It simplifies purchasing and tendering processes
- b) It facilitates cost savings in the company's own production processes
- c) It facilitates cost savings over the supply chain
- d) It facilitates outsourcing of products and services

11. Please elaborate: _____

12. In what way do standards affect your company's ability or willingness to develop innovative solutions?

Matrix question; Yes/No

- a) Following standards is a good means to follow technical developments
- b) Due to standards our company is prevented from developing innovative technology
- c) By applying standards our company can put more resources into developing innovative activities
- d) Standards reduce time to market for new products

13. Please elaborate: _____

Section 3: Other influence of standardization

14. In the following you will be presented with some general statements about standards and standardization. Please indicate whether you agree or disagree.

Matrix question; Agree/Disagree

- a) Standards help to comply with regulations
- b) Standards improve my company's environmental impact
- c) Standards reduce risk related to my company's health and safety issues
- d) Standards help reduce risk of manufacturing errors
- e) Standards help to raise the quality of sub-contractors

15. Please elaborate: _____

16. Does your company participate in standardization?

Matrix question; Yes/No/Don't know

- a. At national level
- b. At European level
- c. At international level

[Q17 is only to respondents who choose "yes" on 16 a-c]

17. The main reasons for participating are:

18.

- a. Possibility to influence standards at the sector level
- b. Possibility to influence standards at the company level
- c. Gaining early information – possibility to anticipate changes
- d. Gaining access to information that would otherwise not be available
- e. Networking with other experts (nationally/at European level/at global level)
- f. Contribute to the greater good

19. Please elaborate: _____

20. Using and implementing standards means both benefits and costs. Overall would you say that:

- a) Benefits by far exceed costs
- b) Benefits exceed costs
- c) Benefits equal costs
- d) Benefits are smaller than costs

21. Overall, what would you say is the most important reasons for your company to use standards?

(please rank the three most important effects from 1-3)

- a. Improved market access
- b. Reduction of risk (accidents, production errors, social responsibility)
- c. Improved product/service quality
- d. Improved production efficiency
- e. Improved environmental performance

22. There are costs related to buying, implementing and acting in accordance with standards. Which of these costs is dominant in your company?

- b. Buying standards
- c. Implementing standards
- d. Acting in accordance with standards over a longer period
- e. Other, please specify:

[last page] Thank you!

The survey will be over when you hit the button "End survey". We are grateful for your time and participation.

If you have any questions regarding the survey, please contact your national expert.