



LUND UNIVERSITY

Standardization and Innovation within the Green Buildings field: Insights from Europe

ARNEZ WEGELIUS, MARKUS; HEDESTAD, PHILIP

Published in:
EURAS proceedings

2015

Document Version:
Publisher's PDF, also known as Version of record

[Link to publication](#)

Citation for published version (APA):
ARNEZ WEGELIUS, MARKUS., & HEDESTAD, PHILIP. (2015). Standardization and Innovation within the Green Buildings field: Insights from Europe. In K. Jakobs, K. Bergh Skriver, J. Jerlang, & G. Mainz (Eds.), *EURAS proceedings: The Role of Standards in Transatlantic Trade and Regulation* (pp. 431-448). Verlag Mainz.

Total number of authors:
2

General rights

Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Standardization & innovation in the green buildings field: insights from Europe. *Markus Arnez Wegelius & Philip Hedestad*

1 Abstract

A research project was conducted by the two PhD students *Markus Arnez Wegelius* and *Philip Hedestad* from the *Standardisation Research Centre*, within the *Institute of Economic Research* at *Lund University*, Sweden, and with the supervision of *Mr. Daniele Gerundino*, Strategic Adviser to the Secretary-General (ISO). The project was sponsored by *ISO (The International Organization for Standardization)*, *NIST (National Institute of Standards and Technology)* and *EURAMET (European Association of National Metrology Institutes)*. The purpose of the study was to investigate the relation between standardization and innovation within the field of Green Buildings, with a focus on insulation materials and HVAC (heating, ventilation and air conditioning). The research project analysed the activities undertaken by key stakeholders involved, in particular: research and development groups from industry, government agencies and academia, and leading standards experts involved in the field or in closely related areas. The analysis focused on describing existing or potential forms of relations between standardization and innovation, understanding the dynamics, attitudes and perceptions of the concerned parties, considering in detail success stories and failures, and from this information, conclude with recommendations on how to establish and exploit synergies between R&D and standardization. In total, 25 in-depth interviews were undertaken with experts and practitioners within the field.

2 Introduction

The environmental threat from the world's current resource depletion is widely accepted by now. One of the important responses aiming to meet environmental goals whilst pursuing economic development concerns the efficiency in using resources (Premalatha, Tauseef, Abbasi, & Abbasi, 2013). Especially energy consumption is of great concern. One step to mitigate the high level of energy consumption, and support efficiency, lies within the field of buildings. Residential and commercial buildings consume around 40% of all end-use energy (Ardente, Beccali, Cellura, & Mistretta, 2011; Bourdic & Salat, 2012; Troy, 2012), whilst in the U.K. as much as 50% (Palmer & Cooper, 2011). Also, in the U.K., over the last 40 years, the average building's energy consumption has increased. Moreover, between year 1976 and 2020, the building stock of the U.K. will increase with 50% contributing to further increase in energy consumption (CPA, 2010). The way we consume energy today is not sustainable, and low energy buildings are crucial to tackle this global problem (CBI, 2007; Vickers, Vaze, Corr, Kasperova, & Fergus, 2009; EC, 2011; DECC, 2012; Troy, 2012). One important way to do this is by implementing energy-efficient standards in buildings. Through the use of available innovations and building standards, the current energy consumption levels can be reduced by 27% (residential households) and 30% (commercial buildings) respectively (Ardente et al., 2011). The foundation of these energy-efficient standards rely on the knowledge and experience of experts which represent, ideally, all the interested and concerned parties, participating in technical committees through open and transparent consensus-based processes.

In this article, we have categorized the members of these committees into standardizers and researchers: we define as *Researchers* those who are employed within private corporations and whose primary work responsibility revolves around developing new innovative products that require standards, and *Standardizers* as those who are not employed within private corporations

(with the exception of private standardization consultants) and whose primary work responsibilities revolve around managing, enabling, promoting or spreading standardization.

Both standardizers and researchers benefit from identifying components related to the increase in energy performance of buildings (Jackson, 2011; Chegut, Eichholtz, & Kok, 2013). Standards fill an important role because they allow replicating and efficiently spreading efficient solutions to broad markets where they can benefit societies through their economies of scale. If standards would not exist, there would not be a quantitative minimum to relate to, and progression of low energy technologies in the field of Green buildings would not be possible.

Standards are an important bridge connecting producers and service providers with research (Blind, 2013). Since the creation of the first environmental certification system BREEAM¹ in the UK in the year 1990, a number of organizations worldwide have developed various green building codes and rating systems regarding the environmental and energy impacts of buildings (Smith, Fischlein, Suh, & Huelman, 2006; Bonde, 2013). In the relation between standardizers and researchers, the researchers must first create an innovation – which, if the right conditions exist, can be formalized into a standardized set of specifications, which, in turn, can be connected to a certification schema. Due to the short product cycles of innovation in high-technology sectors, both standardizers and researchers have a shared interest of collaborating (Audretsch & Feldman, 2003; VEDC, 2009). An efficient standards development structure will benefit both standardizers and researchers in pursuit of common interests (Lam, Zhang, Wang, Dong, & Zhang, 2013). We set out to learn more about how concerned parties in standards development perceive the process of issuing standards - and, in particular, this report focuses on the interaction between standardizers and researchers.

We do this by examining the relation of standardizers and R&D institutes from a brief theoretical point of view, which we later used as contextual assistance to perform in-depth interviews with our respondents. All of the interviewees in our sample are, or have been, involved in standards development within insulation and HVAC, or on a higher level – standards development within the field of Green Buildings. We seek to describe and analyse the drivers and difficulties that arise in standards development between R&D institutes and standardizers. Finally, we discuss our findings in relation to provide new insights on how standards development should be conducted between standardizers and R&D institutes.

3 Theoretical foundations

Insights from academic research into *standardization* are important in understanding the challenges and drivers as to why organizations develop standards, and thus have served as guidance in our study. These derive from organizational and behavioural theories, to know what drives actors in standards development to engage into these projects. Scholars such as Allen & Sriram (2000), Farrell and Saloner (1986; 1988), Blind (2002), and Okhmatovskiy and David (2012) emphasized that network externalities, installed base and coordination mechanisms impact heavily the establishment of standards. Studies have shown that standards seem to be more effective than other policy tools in terms of reaching the previously mentioned goals (Blind, 2002). For this reason, it has been observed that certain traders choose to replace externally imposed requirements with alternative standards (Okhmatovskiy & David, 2012). As global markets have become more multifaceted with many actors along the supply chain, standards are no longer restricted to national boundaries. Standards have become a critical facilitator to enable international trade, as well as facilitate data exchange and knowledge

¹ the Building Research Establishment Environmental Assessment Methodology, developed by the Building Research Establishment (BRE)

sharing among geographically dispersed participants within global corporate networks of production and innovation (Ernst, 2005a; Ernst, 2005b).

The strongest motivation to adopt standards is related to profitability. When it came to pursuing ISO 9000, companies sought certification in order to enjoy both operational and marketing benefits, which impact on costs, revenues, and, by inference, profit. Chow-Chua, Goh, and Boon Wan (2003) indicated that the two most common benefits of the ISO 9000 certification are increase in productivity and access to overseas. When discussing the standard ISO 14001, Babakri et al. (2003) stated that standards fill an important role as assisting several actors in a supply chain, providing these with a common language between companies and their suppliers.

Moreover, Rayner and Porter’s (1991) investigation of various impacts on 20 SMEs from the use of standards found that 70 % of these firms cited marketing advantages as the principal benefits: customer retention, customer acquisition, entry into new markets and fewer dissatisfied customers were the specific outcomes of certification. The vast majority of firms (85 per cent) felt their expectations had been met or exceeded by the use of standards (Rayner & Porter, 1991).

<i>External benefits</i>	%
Retention of existing customers	40
Gaining of new customers	20
Entry of new markets	5
Fewer dissatisfied customers	5
<i>Subtotal</i>	70
<i>Internal benefits</i>	
Greater control of business	15
Better internal discipline	10
<i>Subtotal</i>	25
<i>Quality cost benefits</i>	
Reduce scrap and wastage	5
<i>Total</i>	100

“Benefits Actually Achieved” in Rayner & Porter (1991), p. 19

Two-thirds of the firms felt that they would not have succeeded implementing and following standards without the help of consultants, or that certification would have taken longer, without such help. Overall, working with consultants helps SMEs to successfully employ standards (Rayner & Porter, 1991).

Before heading into the methodological section of our research, we provide the following definitions that we have used throughout this study, of the three main concepts in standards development.

- **Standardization:** *Producing 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 the achievement of the optimum degree of order in a given context” (ISO / IEC Guide 2:2004)*

- **Product Innovation:** *A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics (OECD)*
- **Research & Development:** *Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (OECD)*

4 Research Design

The purpose of this paper is to investigate the relation between standardization and innovation, by conducting interviews with experts in the Green Building field (with focus on insulation materials and heating, ventilation, air conditioning (HVAC) systems) and involved in standardization.

4.1 Interview Selection

The sample that we selected for the interviews comprises: professionals employed within standards developing organizations; researchers from highly innovative private enterprises; as well as researchers from independent research organizations and universities; and experts in the field from other relevant organisations, such as trade associations.

The final interviewees were selected primarily from lists of participants in technical committees of ISO, CEN or national standards bodies, covering insulation and HVAC systems. They were obtained from staff of national standard bodies and of ISO (special thanks to Anna Caterina Rossi, Technical Programme Manager at ISO). Secondly, contacts were identified through research and directly contacting highly innovative firms within the Green Buildings industry across Europe (Austria, Belgium, Denmark, Finland, Germany, Netherlands, Norway, Sweden, and the United Kingdom). Out of the 56 interview requests that were sent out to standards developers around Europe, we were able to conduct 25 in-depth interviews.

4.2 List of Respondents

The complete list of interviewees is listed below.

Name	Position	Type of Organization	Name of Organization	Country	Standardization Activities	Category
Anonymous II	Consultant	Private Corporation	Undisclosed	United Kingdom	Promotion of thermal insulation standards.	Standardizer
Christer Sjöström	Chairman, part founder, owner	Private Corporation	Aerogel AB	Sweden	Former chair of ISO TC59/SC14	Researcher
Erwin Kuperus	Research Manager	Private Corporation	KINGSPAN	Netherlands	Member of CEN/TC 88/WG 6	Researcher
Anonymous I	Marketing Segment Manager	Private Corporation	Undisclosed	Spain	Member of CEN/TC 88	Researcher
Hans Joachim Motzfeldt	Key Account Manager RTI Nordic	Private Corporation	ROCKWOOL Technical Insulation	Norway	Member of CEN TC 127 and CEN TC 88	Researcher
Jan Byfors	CTO	Private Corporation	NCC	Sweden	Chairman of SIS	Researcher

Joakim Jeppsson	Research & Development Manager	Private Corporation	Skanska	Sweden	Non-defined	Researcher
Luc Heymans	R&D Manager	Private Corporation	Promat Research and Technology Centre	Belgium	Member of CEN TC 88	Researcher
Rasmussen Erik	Director of Public Affair	Private Corporation	ROCKWOOL	Denmark	active in ISO/TC 163 and SC 1	Researcher
Roger De Block	Directeur Normalisation	Private Corporation	Saint-Gobain Insulation Activity	Belgium	Convenor of CEN TC 3	Researcher
Schuurmans Agnes	Research Manager	Private Corporation	ROCKWOOL	Netherlands	active in CEN/TC 88	Researcher
Tina Karlberg	City Account Manager	Private Corporation	Siemens	Sweden	No official membership known	Researcher
Vincent Briard	Head of Sustainability, Products & Buildings	Private Corporation	Knauf Insulation	Belgium	Convenor of CEN TC 3 – Mineral Wool	Researcher
Zlabinger Karl	Manager	Private Corporation	ISOVER	Austria	active in CEN/TC 88	Researcher
Annet van der Horn	Standardization Consultant	NSB	NEN	Netherlands	Member of ISO TC 163/WG 4	Standardizer
Dirk Kostmann	Team Coordinator	NSB	DIN	Germany	Secretary of ISO/TC 163/SC 1	Standardizer
Navid Gohardani	Project Manager/ Technical Specialist	NSB	SIS	Sweden	Chairman of ISO/TC 163	Standardizer
Nyomee Hla-Shwe Tun	Project Manager	NSB	BSI	United Kingdom	Secretary of ISO TC 163 and of ISO TC 205	Standardizer
Brian Anderson	Technical Director	Research Organization	BRE	United Kingdom	Member of ISO TC 163 and CEN TC 89	Researcher
Chris Sanders	Project Manager	Research Organization	BRE	United Kingdom	Chairman of CEN TC 89 WG 9 & 10. Active in BS 5250 and ISO TC 163/SC 2/WG 14	Researcher
Kari Thunshelle	Senior Project Manager	Research Organization	SINTEF	Norway	Convenor of ISO TC 59/SC 13/WG 8	Standardizer
Ari Ilomäki	Manager	Trade Association	Rakennusteollisuus / NSB	Finland	Chairman of CEN TC 350	Standardizer
Lars Myhre	Technical Manager	Trade Association	Boligprodusentene	Norway	Chair of ISO TC163/SC2	Researcher
Arild Gustavsen	Senior Research Scientist	University	NTNU	Norway	Member of CEN TC 263/G9	Researcher
Bjørn Petter Jelle	Senior Research Scientist	University	NTNU	Norway	Member of ISO 9050	Researcher

To ensure an understanding of the relation between standardization and innovation from different perspectives, we decided to interview a variety of actors involved in standardization committees.

The largest group of interviewees are those who were employed within private companies (14 persons). They represent the main driver of research & development and innovation within the field, as their main interest is to develop innovative products, to increase sales and market share of their respective companies.

The second largest group of interviewees were persons employed within NSBs (National Standards Body) (4 interviews). Their perspective is of great value, as they are the most knowledgeable in the field of standardization and most aware of the benefits of standards. They try to provide and promote a friendly and effective environment for private companies to get involved in the standards development process. Their interest can be interpreted in creating relevant standards and increasing their usage in society.

The third group of interviewees includes individuals working within independent research organizations in the field of Green Buildings (3 interviews). Their involvement in standardization is noteworthy as they have neither a strong commercial interest in the end product nor are particularly interested in promoting standards per se, but rather are interested in influencing the general standardization process due to other non-monetary goals, in particular to ensure that standards (and therefore the products based on them) incorporate recent technological advances, to increase the value of their contribution to society as a whole.

The sample is completed by employees from trade associations on one hand (2 interviews), and universities on the other hand (2 interviews). The interest of trade association employees can be considered to be the promotion of the companies within their industry, and furthering their success in the marketplace, that is to say obtain an end standard that provides tangible benefits to the industry they represent. Regarding universities, their interest is similar to that of research organizations, with perhaps a stronger emphasis on ensuring that the latest technological advances are adopted.

4.3 Data Enquiry

Interviewing is the method of data collection used in the project. The two interviewers involved in the project were *Markus Arnez Wegelius* and *Philip Hedestad*.

Yin (2009) provided us with guidance in the interview process, advocating that interviews should be guided conversations rather than strictly structured enquiries, leading the researcher to simultaneously follow their own line of enquiry as guided by the theoretical framework as well as to ask the questions constituting the interview in a conversational and unbiased manner. Yin (2009) describes this as operating on two levels: “satisfying the needs of your line of inquiry (Level 2 questions) while simultaneously putting forth “friendly” and “nonthreatening” questions in your open-ended interviews (Level 1 questions)” (p.107).

The interviews that were conducted in the project were of the in-depth interview format (Yin 2009). During the in-depth interviews, there was a more extended discussion with the interviewee where the goal was to not only enquire about the facts of the matter but also about their personal opinions and experiences about certain events, thus departing from a strict set of questions. Yin (2009) also suggests that in many cases the interviewee may assume the role of an ‘informant’, which often are critical to the success of a case study. Such informants differentiate themselves from other interviewees insofar as they can provide deeper insights into matters (describing the situation in which an event took place, the dynamics at work, any conflicts, etc. rather than stating the firm’s common policy guideline, for example). Moreover such persons may allow access to corroboratory or contrary sources of evidence. However there is a risk of the interviewer becoming overly dependent on the informant or developing too close of a personal relationship that their judgement may be clouded. Thus it is advised to obtain evidence from other sources simultaneously to better support the informant’s claims,

something that was considered in the project as different interviewee's statements were crosschecked with other interviews (when possible).

Interviews can be an essential source of case study evidence especially if such studies are focussing upon human or behavioural affairs. Nonetheless it should be kept in mind, that the interviews conducted, constitute only verbal reports and ideally, to further support the findings, should be triangulated with other more concrete sources of evidence.

4.4 Content Analysis

We partook in in-depth analysis of the interviews, the background information given but most especially the answers to the following keys questions included in the questionnaire:

- What are the benefits of using standards within R&D?
- What are the benefits for those working within R&D of participating in standards development?
- What are the drawbacks for those working within R&D in using standards?
- Are there barriers in achieving optimal results in R&D and standardization?
- Any recommendations you propose to improve the relation between R&D and standardization?

The answers for the previous questions were then collected from each interview and analysed qualitatively to provide the arguments as expressed in section 4: Analysis. This information is further analysed and represented in a quantitative manner, in the form of graphs. The answers received from all respondents to the previous five questions, were categorised in a quantitative manner and then further divided into the two groups of respondents: Researchers and Standardizers (definition provided in the introduction section).

These graphs will form the basis of our findings, that is to say, describing existing or potential forms of relations between R&D and standardization, understanding the dynamics, attitudes and perceptions of the concerned parties, considering in detail success stories and failures and collecting recommendations from researchers and standards experts on how to establish and exploit synergies between R&D and standardization.

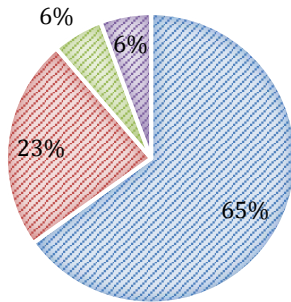
5 Analysis

From the in-depth interviews conducted, we have broken them down into five sub-questions to be accounted for, both quantitatively and qualitatively. The first two questions addressed the positive aspects of standards and standards development, whilst the third and fourth touched upon the potentially negative aspects of standards and standards development. The fifth and last question, was directed at the interviewees to express their opinion on future recommendations for standards development.

What are the benefits of using standards within R&D?

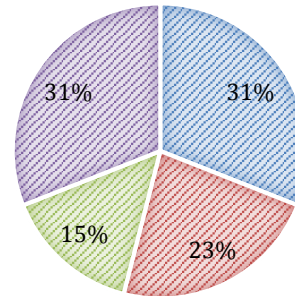
RESEARCHERS

- Harmonization of markets
- Trustworthy product or service
- Consumer protection
- Leverage innovation



STANDARDIZERS

- Harmonization of markets
- Trustworthy product or service
- Decrease costs
- Leverage innovation



As depicted in the above pie charts, both parties are in agreement that the ‘Harmonization of markets’ and the possibility to manufacture ‘Trustworthy product or service’ are dominant benefits of using standards in R&D. Standardizers also had beliefs that standards ‘Decrease costs’ and ‘Leverage Innovation’, not very supported by the researchers.

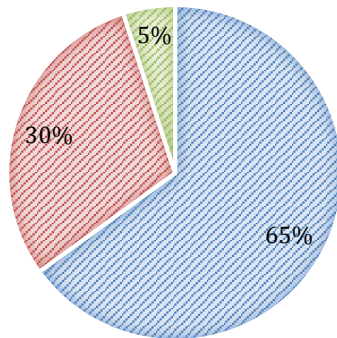
Starting with the researchers, *Schuurmans* expressed that a benefit of using standards – for incumbents – is that they represent a (legitimate) barrier to new entrants, because their products do not qualify to the standards of certain target markets. She developed her reasoning by explaining the case of standards for insulation materials such as EN 13162 and EN 13172, which ensure high quality for the consumer. Within the field of mineral wool, there has been a recent upsurge of new players in the market, especially from developing countries, which provide unstandardized, lower quality and cheaper products that often do not meet the customer’s demands and are marketed in a misleading manner. The above-mentioned standards, in her opinion, protected the customers from lower quality products that did not meet their requirements. According to *Briard*, even if he admits that ‘Harmonization of markets’ is a benefit, talking about “benefits of standards or not” in R&D is a non-issue. Customers, NGOs and legislators all demand that standards in insulation materials must be used, i.e. this is a market prerequisite. *Kuperus* went as far as talking about standards as “their Bible”. In his opinion, standards are fundamental to define product properties and to measure product performances – specifying how test methods and the different approaches that can be used (internal vs. external testing, etc.) Everything should have a standard to improve one’s organization and product. *Sjöström* explained his view on how standards have leveraged innovation in his recent business company, which focused on R&D in aerogel insulation. At the time of start-up, there were no standards that supported their type of cutting-edge R&D. Using already existing and established standards, provided guidance and greatly aided the direction of their research.

For the standardizers, it is noteworthy that 46% of them responded that benefits of using standards include ‘Decrease costs’ and ‘Leverage innovation’. This view, however, was not shared by the researchers. *Van der Horn*, a standards consultant, claimed that a benefit of standards is that they are adaptable and can fit into any type of organization. She continued, having the support of *Kostmann*, that countries and businesses that use standards will decrease their costs in terms of not having to adapt their product to various markets.

What are the benefits for those working within R&D of participating in standards development?

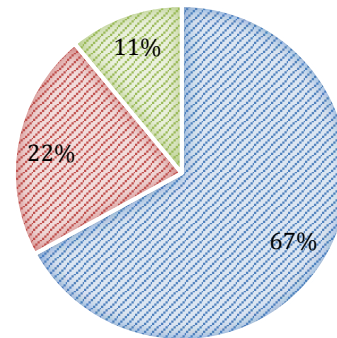
RESEARCHERS

- Influence the end-result
- Networking
- Getting more research funds



STANDARDIZERS

- Influence the end-result
- Networking
- Gaining insights about standards development



When it comes to the benefits of working with standards development, both researchers and standardizers agreed that ‘Influence the end-result’ and ‘Networking’ were the two key reasons why researchers should take part in standards development. The other interesting, although marginal, responses, concerned the possibility of ‘Getting more research funds’ and ‘Gaining insights about standards development’ as motivations to join standards development.

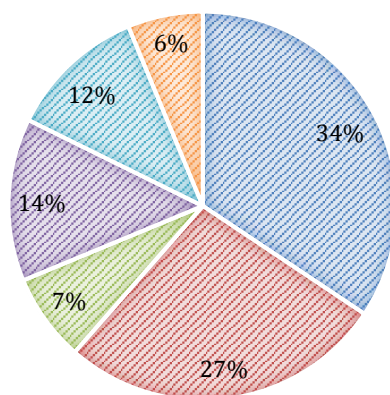
The researchers thought it was beneficial to engage into standards development to influence the end-result. Especially one, *Anonymous I*, felt that his presence in developing the standard EN 14315 was important. This standard was a “package of several” that involved many committee members and third party experts. Furthermore, *Anonymous I* worked in an industry and line of business with “high complexity” in its R&D. For these reasons, his contribution was through clarifying misperceptions existent in the committee represented of people from many different industries, as well as using his extensive knowledge of the field by advocating realistic standard goals for the future. ‘Networking’ was also important to numerous researchers. *Heymans* stressed the importance of an efficient network as business organizations expand their day-to-day operations to other industries and integrate their capabilities and resources with other business organizations. Some added that networking in standards development committees was a way to know more about the market and future requirements (*Kuperus; Myhre; Rasmussen; Sjöström*). According to *Shuurmans*, another benefit of engaging into standards development was to be granted more research funds. She meant that researchers are always short of money. By committing into standards development, one’s legitimacy in the eyes of administrative authorities issuing grants was enhanced.

Just like the above discussion of the groups of researchers, the standardizers could see the same benefits of engaging into standards development. *Van der Horn* also saw benefits for researchers, in learning how standard committee work is being conducted. In her opinion, many users of the standard EN 15603 protest without recognizing the extensive work that lies behind the issuance of that standard.

What are the drawbacks of using standards within R&D?

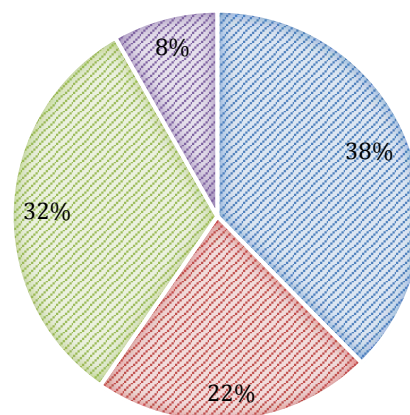
RESEARCHERS

- Time consuming
- Standards cost a lot of money
- The manufacturing firm is blamed if standards do not fulfil expectations
- Too many external consultants in standards development
- Many standards are unclear and vague
- Standards do not support most recent or radical innovation



STANDARDIZERS

- Time consuming
- Standards cost a lot of money
- Bias in standards development make it hard for standards to be a good fit in every organization
- There is nothing negative about using standards in product innovation



Once again, the majority of researchers and standardizers are in agreement on a certain characteristic of standards and standards development. In this case, they agree that the main drawbacks of the use of standards concern the fact that this activity is ‘Time consuming’ and that ‘Standards cost a lot of money’. The other answers differ amongst both groups.

Most researchers thought that the use of standards is ‘Time consuming’ and/or ‘Costly’. We can interpret these two reasons to be very connected and anchored in the same notion of consuming resources. Some of them say that using standards is time consuming because it takes a lot of time to search for standards applicable to their needs, implementing them, and finally adapting their organization to them (*Anderson; Anonymous I; Briard; de Block; Heymans; Kuperus; Motzfeldt; Shuurmans; Zlabinger*).

One of the researchers raised the issue of potential risks -- because manufacturing companies can get blamed when their products do not meet the requirement of a certain standards (*Shuurmans*). In her opinion, since anyone can participate in standards development, standards are bound to be set, in the end, with certain biases, not making them fit for all manufacturing companies within that market. *Shuurmans* also observed that there are too many consultants in standards development. She meant that consultants tend to make things more complicated and resource-driven than it actually has to be, out of self-interest as the more complex a test method is, the more work a consultant can get.

This view is complemented by that of *Jelle*, who thought that, in certain cases, standards are unclear and vague. This creates two problems; 1) It is difficult to successfully manage the standard in the organization; and 2) Consultants have to be hired to solve the issue of implementing the standard. Finally, *Briard* observed that sometimes standards can constrain

innovation. He meant that standards are only applied to proven and widespread technologies or processes. For more advanced product innovation, no standards are found to support it properly (due in part to the long timeframe of standards creation) – making it hard to commercialize products based on most recent or radical innovation.

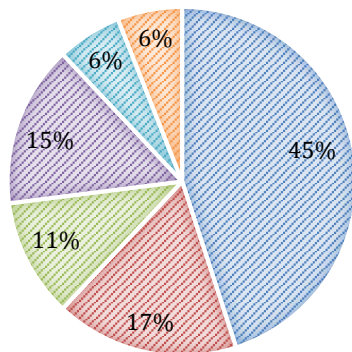
From the standardizers’ group, 65% agreed to what researchers had been saying about standards consuming time and money. Even though having admitted that the use of standards are costly in terms of time and resources, *Ilomäki* insisted that there is nothing negative about having to adjust oneself to certain standards in product development or manufacturing. According to him, the money and time spent on standards will pay off later on, as R&D firms save time and effort on leads and guides.

Several standardizers also noted that since standards development is managed through committees, which consist of individuals with differing interests, standards can become biased. Though they could not give a specific example of such a case, this was considered a potential significant drawback for using standards in product innovation (*Anonymous II; Gohardani; Ilomäki; Thunshelle*).

Are there barriers in achieving optimal results in R&D and standardization?

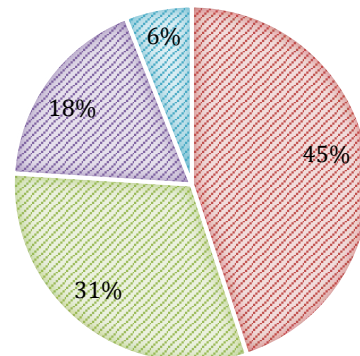
RESEARCHER

- Need to prioritize regular work
- Lack of funding
- Conflicting agendas of stakeholders
- Confidentiality concerns
- Threat of free-riders
- Complexity of standards



STANDARDIZERS

- Need to prioritize regular work
- Lack of funding
- Slow process
- Efforts in participating does not pay off for one's own firm



Time and money, according to both groups, seem to be the dominant barrier in achieving optimal results in standards development for both researchers and standardizers. On the left pie chart, 38% of the researchers did however mention other explanations to why standards development is not running optimally. These sub-explanations are ‘Conflicting agendas of stakeholders’, ‘Confidentiality concerns’, and ‘Threat of free-riders’. On the standardizers’ side, 45% indicated ‘Need to prioritize regular work’ and 31% ‘Lack of funding’ as barriers to develop standards that can fully meet the participants’ requirements.

For researchers, the most common response to barriers in standards development was the ‘Need to prioritize regular work’. One of them, *Heymans*, thought that being part of standards

development means a lot of work, which cannot be foreseen before entering into a committee.

This collided with his regular work. *Anonymous I* talked about how big of an investment it is to take part of a committee. In his firm, during the course of development of a standard, the funds necessary to take part in standardization became increasingly difficult to obtain. *Jeppson* believed that the different agendas of the members in a committee sometimes make it difficult to find a win-win consensus that ought to be the aim with these committees. In his opinion, strong interest groups form alliances in some committees to advance the solutions most favourable to them. *Andersson* could see difficulties arising in committees when individual representatives are unwilling to share confidential information. If standards are to be developed properly, whatever is good for the individual firm is not necessarily a good thing as standards aim to benefit everyone. *De Block* thought that for a company engaging or not engaging into standards development, could be equally beneficial, depending on the specific situation. After issuance, standards are available for anyone, even for passive “free-rider competitors”.

Sanders provided an example of how standards development can become too complex, an undesirable situation in which standards are either too simplified or too complex. He mentioned the EN 13788 standard, which is a simplified method of assessing moisture risk within buildings. It was devised to be very accessible and can easily be calculated on a spreadsheet, even for users with no technical background. However, this very simplicity led the community of practitioners to not trust the results from the application of the standard, as they were too vague and general. On top of that, there were claims of individuals misusing the measurements, and deliberately manipulating the measure to fulfil their interests. This in turn led to talks about removing it completely. In response to the problems experienced with EN 13788, a new standard was developed: the EN 15026. This new standard sought to address the issues of simplicity of results by developing the calculation method of moisture risk, with the goal of providing much more valuable, in-depth results. This method would only be accessible for those with strong knowledge and technical background of the field. However, this much more complicated and advanced calculation method requires very detailed technical information, which takes time and effort and is only possible with certain materials. Thus, EN 15026, too, resulted in not being very efficient in terms of balancing the value of its results to the ease of use, and thus did not become widely used in the community.

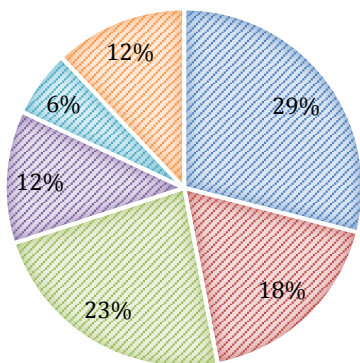
Recommendations to improve the relation between R&D and standardization?

For this last question, when asking the interviewees about any type of recommendation on how to improve the collaboration between researchers and standardizers, we received widespread answers.

For the researchers, *Jelle* thought that the time-to-market was far too long. By the time that standards reached their markets, new innovation had already been spurred. *Anonymous I* concurred and explained that “Standards development is so bureaucratic, it is almost as if standardization bodies do not want them to be implemented”. *Sjöström* stated that all parties in committees would benefit from issuing standards faster. The R&D firm can get their product, based on trustworthy standard(s), quickly to cover short-term revenue demands, and standardizers can enjoy more of their standards in action. *Zlabinger* who added that innovation is more important than standards, supported this position. According to him, it is mainly up to the standardizers to provide standards that are serviceable, as innovation drives standards development work, not the other way around. *Sjöström* continued by highlighting that SDOs should search and invite more innovative SMEs into standards development to provide up-to-date and recent input on their concerns vis-à-vis standardization.

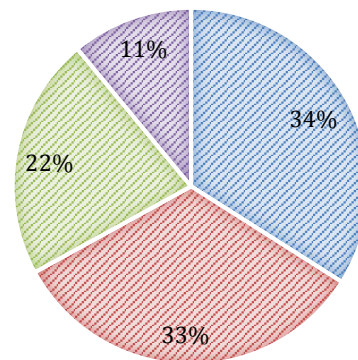
RESEARCHERS

- Accelerate standards development process
- Better financial support
- Include more independent actors in standards development
- SDOs to analyze market and actively invite innovative firms into process
- Minimize consultant involvement
- Make standards European, not national



STANDARDIZERS

- Aim for all parties should be shorter time to market for new innovations
- All parties should actively promote standardization and its benefits
- Joint R&D and standardization centers
- Align expectations between all parties already in the beginning



Rasmussen concurred and added that financial support should be given to experts from innovative SMEs to secure their commitment. Some wanted to include more independent actors, even though they could not exactly tell who these independent actors should be, in standards development, such as *Sanders*. He explained the balance of interests between stakeholders within the same technical committee should be ensured. In this specific instance, within a technical committee concerning roof insulation, diverging interests led to conflict. Disagreement arose within the committee, especially when it was put to light that 3rd party independents were actually paid by private companies to represent their interests. This was triggered by them putting forward poorly supported evidence for a certain technology provided by a private company, to the point that this evidence was subsequently rejected. Specifically, the claim made by the company concerned, was that if a certain product that they manufactured was installed, then there would not be a need for further roof insulation. The companies involved were greatly unsatisfied by this and legal action was threatened. *Shuurmans* found that consultants are too biased to be sitting in technical committees. Also, she felt that they push the development of standards which, later on, are hard to implement by companies. *Anonymous I* also thought consultants contribute to making standards “too bureaucratic”. *Zlabinger* recommended that large standardization organizations should integrate their collaboration more to make standards valid everywhere, not only locally (e.g. at national level).

As for the standardizers, some of them concurred that a shorter development period, in order to get the latest innovation to the market, would be a good solution for both parties. *Thunshelle* proposed joint R&D centres where product innovation and issuing of standards could liaise. *Gohardani* observed that the benefits of having standards are certain; everyone involved in a committee should do its best to spread the benefits of standards to new potential stakeholders.

In order to handle the fragmented wills of the committee members, *Hla-Shwe Tun* proposed that standards development committees should work more on establishing common benefits and goals from the beginning. This would spare committees much effort in trying to resolve their differences in a later stage. Of course, this would mean that a committee should be put together with great care.

6 Conclusions

Based upon the findings presented in the previous section, we can conclude that the Green Building community regard the relation between standardization and innovation as being, on the whole, positive.

Furthermore, according to our data, standardizers and researchers are mostly in agreement on the benefits of standards and standardization.

On the other hand, the drawbacks of using standards in R&D, as expressed by both standardizers and researchers, concern primarily the issue of insufficient or limited resources available – in particular, time (and cost) of expert participation in standards development, as well as duration and cost of expert time dedicated to standards implementation.

6.1 Recommendations

Drawing upon the empirical data collected during the interviews, we identified four potential areas of improvement in order to facilitate and promote the role of standards in R&D within the Green Buildings field: Ensure that stakeholder expectations are aligned; Expert time and efficient use of tools and services; Ensuring balanced participation of interests and resolution of conflicts; and Promotion of standardization and its benefits.

- *Ensure that stakeholder expectations are aligned*

The first category of recommendations is regarding the expectations of all stakeholders involved in the standardization committee.

Firstly, common feedback received from the interviewees was that due to different expectations, decisions would take a very long time to be reached, as they would often lead to lengthy discussions and debates about the direction in which the standard development would go. To prevent those situations, we advise the management of committees (Chair, Secretary, members of chair's advisory groups or similar entities) to identify clearly interests and goals of stakeholders from the beginning and even prior to initiate any standards work. These interests and goals can vary considerably and legitimately – however, their explicit and documented description as early as possible, would help taking effective decisions on how to orient standards development – e.g. by focusing, at least initially, on important and non-controversial aspects, or by isolating and prioritizing the most contentious issues, with a view to address them openly and objectively when it is indispensable, -- to avoid bottlenecks to pop-up later on in the process. This may prove a difficult task, but participants believe that it will save both time and money by enabling a smoother standardization process.

Secondly, we noticed a significant discrepancy between the views of the researchers and those of the standardizers. The data shows that there is often a lack of standardization know-how and recognition of the benefits among researchers and, in parallel, there tends to be a lack of awareness of the commercial and market concerns of researchers and their companies amongst the standardizers. This information asymmetry impacts the standardization process negatively by lengthening it (due to additional knowledge-sharing required) as well as producing inferior standards (as both parties do not possess each other's know-how). In response to this issue, we strongly recommend standardizers to be active advisors in private companies. This would entail

essentially a closer connection between standardization and research, where R&D institutes have a personal connection to a standardization body. A proactive approach (especially on the standardizers' side) would be important, aiming to describe the existing situation in each particular field, to provide a roadmap of future standards (planned or under consideration) and to highlight the expected impact and benefits.

Thirdly, numerous interviewees communicated that due to slow standardizations processes innovative companies would not be able to release their product or service as quick as they had hoped, due to the standards having not been finalized. This represents a general lack of efficiency for private companies, as sometimes large investments are being made whilst the time-to-market slips unacceptably into the future. Respondents expressed the need for a clear strategy to be developed, between the researchers and standardizers, to set clear priorities and to finalize those standards indispensable to getting the product or service out on the market as soon as possible.

- *Expert time and efficient use of tools and services*

A very important aspect underlined by most respondents has to do with making the standardization work more time-efficient for participants. The set of lines of actions indicated to this end can be categorized as follows: *Guidance; Leadership; Joint R&D and standardization centres; and Use of ICTs and social media.*

First, clear (or clearer) guidelines should be made available to newly-appointed managers of technical committees, to describe the key tasks to be performed and the expectations related to their roles, along with practical examples, possibly focused on their field. Tools and templates should be made available to all members to facilitate the collection of input (especially on critical aspects, such as those outlined under the previous section) and the completion of those tasks that they are supposed to perform. Remote assistance should be provided (e.g. by NSBs) to ensure good participation rates regardless of whether committee members do not have the necessary budget or time to attend meetings abroad, along with the planning of regular follow-ups and status meetings to ensure knowledge-transfer. Finally, "mentoring" could also be considered, in particular for new committee members who could be supported by experienced colleagues.

Second, a common criticism we received from members of technical committees, concerned leadership, namely non-active chairmen or convenors, and how their lack of proactivity leads firstly to a vastly lengthier process than required, but also to a general lack of morale and dedication, with members possibly even dropping out of the group entirely. Appointing and encouraging (also with incentives – concerning primarily various forms of recognition) active chairmen and convenors, providing the support of efficient and dedicated NSB, industry or other organization's staff, along with guidelines and other tools to help them in performing their tasks, could be very beneficial in accelerating and ensuring higher participation in the standardization process. Effective and rigorous monitoring of the performance of committee leaders should be practiced, leading, if needed, to replace non-active or non-compliant chairmen.

Moreover, an interesting, and to a significant extent new suggestion, concerned the possibility of creating joint standardization/R&D centres, or establishing partnerships between research laboratories and standards bodies or projects. Such partnerships could offer valuable services to standards projects: for example, in relation to the implementation of test methods, or testing of materials and/or products according to alternative approaches. This support would provide independent and objective evidence that standards committees could use in decision-making during the standards development process (to evaluate and select among alternatives) or after

the approval of a standard, to provide additional information and guidance on standards implementation in different conditions. Joint R&D and standardization centres could also be active as pre-competitive frameworks, supporting the development of new products as well as the development or application of particular standards: results and data generated by these organizations could be shared among the members of standards committees (and beyond) in various ways.

Lastly, information and communication technologies can be used extensively to reduce travel costs and to support various forms of remote collaboration, with a view to increase the participation in committees and to increase experts' productivity (e.g. web/video conferencing capabilities, and collaborative tools supporting editing and sharing of document, submission and handling of comments, etc.). It would also be beneficial to set-up informal networks to encourage knowledge sharing and to prevent vital information potentially being lost from the technical committees.

- *Ensuring balanced participation of interests and resolution of conflicts*

Good practices in the management of participation in technical committees, are also considered extremely important. Domination of a single type of stakeholder, often private corporations, has been noticed in certain number of committees. This, understandably, can have negative consequences on the development of a standard as it might benefit the private sector or even narrower interests, for example, rather than society at large.

This issue can be addressed, operationally, in two ways. On the one hand NSBs and other standards development organizations need to have in place well defined rules and to promote good practices regarding balanced participation of stakeholders. These might include checklists and criteria to be observed, along with specific minimum requirements for technical committees in specific sectors. On the other hand, NSBs and other SDOs need to define and apply consistently mechanisms to promote and support engagement of stakeholders – especially of less aware or disadvantaged categories of stakeholders.

The participation of neutral 3rd parties and of highly qualified SMEs should be pursued, possibly by actively recruiting such members (and, if possible, even contributing to their participation costs), with the goal of breaking the domination of a single type of stakeholder and increasing the overall benefit of standards to society as a whole.

Facilitating the participation of highly innovative SMEs (that often have limited budgets) early on in the standardization process, is expected to lead to improved standards. Participating since the early stages of standards development, innovative SMEs, which often work on pioneering technologies that could become dominant in the future, would help to broaden perspectives and to increase the spectrum of technologies (mature or emerging) covered by a standards. This would help to prevent the common situation in which a standard is developed for the dominant technologies in the market at a given time, and when a new technology arises, either a new standard is developed or the old standard is revised to cover it.

Another aspect to be improved is how standardization bodies and committees deal with conflicts within the standardization process. Certain conflicts can create bottle-necks in the process or even stand-stills for extended periods of time, as stakeholders struggle to resolve those conflicts. Therefore, it would lead to great benefits if standardization bodies could develop conflict mitigation strategies and approaches to be passed on to the managers of technical committees. Joint standardization and R&D centres, as proposed in the last recommendation, could e.g. contribute by providing objective information (e.g. about methods, tests results, etc.), in support of committee decision-making.

- *Promotion of standardization and its benefits*

The last recommendation concerns the promotion of standardization within society as a whole. This is of vital importance, as there is a large community within research which is relatively ignorant of the benefits of standardization. Promoting such benefits, especially to industry, can be of great importance to enable a larger participation in standardization of the research community. This needs to be complemented with the dissemination of information about the practicalities of participation in standards development.

The authors welcome any feedback or discussion from readers. They are reachable on markus.wegelius@fek.lu.se and philip.hedestad@fek.lu.se. To find more information on the authors, visit www.lri.lu.se/markus.wegelius and www.lri.lu.se/philip.hedestad, and on the Standardisation Research Centre, visit www.lri.lu.se/research/src.

7 Bibliography

- Allen, R. H., & Sriram, R. D. (2000). The role of standards in innovation. *Technological Forecasting and Social Change*, 64(2), 171-181.
- Ardente, F., Beccali, M., Cellura, M., & Mistretta, M. (2011). Energy and environmental benefits in public buildings as a result of retrofit actions. *Renewable and Sustainable Energy Reviews*, 15(1), 460-470.
- Audretsch, D., & Feldman, M. (2003). Small-firm strategic research partnerships: The case of biotechnology. *Technology analysis & strategic management*, 15(2), 273-288.
- Babakri, K. A., Bennett, R. A., & Franchetti, M. (2003). Critical factors for implementing ISO 14001 standard in United States industrial companies. *Journal of Cleaner Production*, 11(7), 749-752.
- Blind, K. (2002). Driving forces for standardization at standardization development organizations. *Applied Economics*, 34(16), 1985-1998.
- Blind, K. (2004). *The Economics of Standards: Theory, Evidence, Policy*. Edward Elgar.
- Blind, K. (2013). The Impact of Standardization and Standards on Innovation. *Manchester Institute of Innovation Research*.
- Bonde, M. (2013). *Economic studies of Green Commercial Buildings in Sweden*. KTH Royal Institute of Technology.
- Bourdic, L., & Salat, S. (2012). Building energy models and assessment systems at the district and city scales: a review. *Building Research & Information*, 40(4), 518-526.
- CBI. (2007). *Climate Change: Everyone's Business*. CBI.
- Chegut, A., Eichholtz, P., & Kok, N. (2013). Supply, demand and the value of green buildings. *Urban Studies*, 22-43.
- Chow-Chua, C., Goh, M., & Wan, T. B. (2003). Does ISO 9000 certification improve business performance? *International Journal of Quality & Reliability Management*, 20(8), 936-953.
- CPA. (2010). An introduction to low carbon domestic refurbishment.
- DECC. (2012). The Future of Heating: A Strategic Framework for Low Carbon Heat in the UK.
- Den Butter, F. A. G., Groot, S. P. T., & Lazrak, F. (2007). The transaction costs perspective on standards as a source of trade and productivity growth. *Tinbergen Institute Discussion Papers 07-090/3*.
- EC. (2011). A Roadmap for moving to a competitive low carbon economy in 2050. *COM*.
- Ernst, D. (2005a). Complexity and internationalisation of innovation—why is chip design moving to Asia? *International Journal of Innovation Management*, 9(01), 47-73.
- Ernst, D. (2005b). Limits to modularity: reflections on recent developments in chip design.

Industry and Innovation, 12(3), 303-335.

Ernst, D. (2013). Standards, Innovation, and Latecomer Economic Development - A Conceptual Framework. *WORKING PAPER*, 134.

Farrell, J., & Saloner, G. (1985). Standardization, compatibility, and innovation. *The RAND Journal of Economics*, 70-83.

Farrell, J., & Saloner, G. (1988). Coordination through committees and markets. *The RAND Journal of Economics*, 235-252.

Guasch, J. L., Racine, J.-L., Sánchez, I., & Diop, M. (2007). Quality systems and standards for a competitive edge. Retrieved 5th of January, 2015, from

http://siteresources.worldbank.org/EXT/EXPCOMNET/Resources/2463593-1213887855468/69_LAC_Quality_and_Standards_Pub_Nov_2007.pdf.

Jackson, T. (2011). *Prosperity without growth: Economics for a finite planet*. Routledge.

Lam, K. P., Zhang, R., Wang, H., Dong, B., & Zhang, R. (2013). Development of web-based information technology infrastructures and regulatory repositories for green building codes in China (iCodes). *Building Simulation*, 6(2), 195-205.

Okhmatovskiy, I., & David, R. J. (2012). Setting your own standards: Internal corporate governance codes as a response to institutional pressure. *Organization Science*, 23(1), 155-176.

Palmer, J., & Cooper, I. (2011). Great Britain's housing energy fact file 2011. *DECC, London*.

Premalatha, M., Tauseef, S. M., Abbasi, T., & Abbasi, S. A. (2013). The Promise and the performance of the world's first two zero carbon eco-cities. *Renewable and Sustainable Energy Reviews*, 25, 660-669.

Rayner, P., & Porter, L. J. (1991). BS5750/ISO9000-The experience of small and medium-sized firms. *International Journal of Quality & Reliability Management*, 8(6).

Smith, T. M., Fischlein, M., Suh, S., & Huelman, P. (2006). Green building rating systems: a comparison of the LEED and Green Globes Systems in the US., 2009.

Suarez, F. F. (2004). Battles for technological dominance: an integrative framework. *Research Policy*, 33(2), 271-286.

Tassey, G. (2000). Standardization in technology-based markets. *Research Policy*, 29(4), 587-602.

Troy, A. (2012). *The very hungry city: urban energy efficiency and the economic fate of cities*. Yale University Press.

Vickers, I., Vaze, P., Corr, L., Kasperova, E., & Fergus, L. (2009). SMEs in a low carbon economy.

Yin, R. K. (2009). *Case study research: Design and methods* (5). Sage Publications, Inc.