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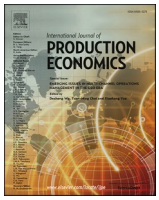

Adoption of quality standards for corporate greenhouse gas inventories: The importance of other stakeholders☆,☆☆

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ABSTRACT

This paper studies factors for the adoption of quality standards. The identified factors are applied to a typical example of such a standard; a new standardized measurement and calculation methodology for corporate greenhouse gas inventories. Standardization of these methodologies fosters innovation, as it will provide innovators and regulators in this field with qualitatively superior and more homogeneous emissions data. This will allow for the creation of better substantiated and more focussed innovations and regulations. A framework of 31 factors that determine the adoption of quality standards was first established from extant literature. The framework consists of tangible and intangible standard characteristics, standard supporting alliance, standard creating process, standard support strategy, and stakeholders. Factor weights were determined by applying the Best worst method, and interviews with experts in the field of greenhouse gas accounting were conducted. The existing literature on success in standardization is mainly concerned with compatibility standards; this paper contributes to the existing standardization literature by focusing on quality standard adoption factors. Counterintuitively, the most important factors for adopting quality standards are not related to strategic considerations or the standard's tangible technical characteristics but to pressure from customers and support from governmental bodies.

1. Introduction

Global warming can bring about drastic and irreversible changes to our physical environment, biosphere, and human systems. Scientists predict adverse effects on food and water supplies, global health and security, and radical changes to livelihoods, industry, and infrastructure related to our planet's warming (Pachauri et al., 2014). One of the most significant contributors to global warming appears to be the elevated anthropogenic greenhouse gas concentrations (IPCC, 2007). However, despite general knowledge about greenhouse gas (GHG) emissions' adverse effects, global emissions keep rising annually: The Global Carbon Project forecasted in December 2019 that the global GHG emissions for that year would have increased about 0,6% compared to 2018's emissions (Friedlingstein et al., 2019). This is well above the 7,6% annual reduction required every year for the next decade to reach the Paris Agreement target of limiting the global temperature rise to 1,5 °C (UNEP, 2019).

One of the tools employed to combat climate change through the reduction of emissions is GHG emissions accounting. GHG inventories can be created on multiple levels, including the company-level and (supra)national-level. Previous research into GHG accounting has exposed a lack of comparability and compatibility of corporate GHG inventories (Ehrler and Seidel, 2014; Jose, 2017; Kauffmann and Less, 2010). This is attributable mainly to the use of different methodologies to measure, calculate, and aggregate emissions data.

A standardized methodology for calculating and measuring GHG emissions for corporate GHG inventories would help to mitigate this problem. This standard would function for GHG accounting, similar to how the International Financial Reporting Standard (IFRS) functions for financial reporting. This will help organizations to choose the most appropriate methodology for their situation and facilitate communication regarding the quality of GHG inventories. Thus, a quality standard is

☆ The research presented in this article was conducted by Coen Hoogerbrugge as part of his Master Thesis, see: https://repository.tudelft.nl/islandora/object/uuid%3A8e7f12c9-5491-4b24-8294-154c83717501.☆☆ TU Delft regards Theses as unpublished works and therefore have no official publication status. For more information see: https://d2k0ddhflgrk1i.cloudfront.net/Library/Themaportalen/Library%20voor%20wetenschappers/Publiceren%20en%20verspreiden/DelftV2.pdf.

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needed. Quality standards play roles in many different sectors, from healthcare and tourism to food and water supplies (Boel-Studt et al., 2019; Chemnitz, 2007; Fulponi, 2006; Gara et al., 2017; Handschuch et al., 2013; Herzfeld et al., 2011; Huang et al., 2004; Kotsanopoulos and Arvanitoyannis, 2017; Partalidou and Iakovidou, 2008; Whittaker et al., 2011). Despite the ever-increasing number of quality standards in use, standardization literature mostly focuses on compatibility standards, and only a tiny part of the standardization literature is concerned with quality standards. Therefore, this research addresses this knowledge gap by focusing on quality standards and the factors that influence their adoption.

The main question raised in this article is: '*Which factors affect the chances that quality standards for GHG accounting reach widespread adoption according to experts?*'. Expert interviews were used to determine the importance of the factors for the success of a standardized methodology for corporate greenhouse gas inventories. The standardization literature was reviewed to arrive at a list of factors for adopting quality standards and, by applying the Best Worst Method (BWM), experts evaluated the importance of these factors.

This research is novel in several ways. First of all, it focuses on the previously underexposed topic of factors for quality standard adoption. A novel framework is created which outlines the most critical factors that standard setters can use to influence the widespread adoption of quality standards for greenhouse gas emission inventories. This framework combines insights from existing studies into the factors that influence the adoption of quality standards that standard setters can use to increase the chance of adoption, and it enables future research to assess the chances that quality standards reach widespread adoption. In terms of practical contributions, the importance of the factors in the framework for a proposed new standardized GHG accounting methodology is established. This can aid organizations seeking to develop the proposed standard in the future to make sure they address all critical aspects and prioritize their resources appropriately.

2. Theoretical perspective

Discussions regarding the success of standards usually apply the concept of 'dominant designs', a term introduced in the 70s of the last century (Abernathy and Utterback, 1978). It refers to the emergence of a design principle adopted on such a large scale that anyone aspiring to play a significant role in the corresponding market must adhere to it (Utterback, 1994). An example is the shape of power plugs and sockets. If a company decides to equip their revolutionary new product with a power plug that does not correspond to the type of sockets present in a market, it is fair to assume that it will not be a great success. In 1990, Anderson and Tushman (1990) proposed an evolutionary model of technological change. They recognized that dominant designs emerge from market demand, the market power of a dominant producer, the market power of a dominant user, the authoritative power of an industry committee or government, or the formation of an alliance of a group of firms around a standard.

The economists above generally believe that dominant designs and technologies emerge evolutionarily. Over the years, many academics have raised hypotheses into why some technologies succeed in diffusing widely, sometimes even attaining market-dominance, and others fail to do so. The focus of that research mainly lies on compatibility standards (Krechmer, 1996) because of their strategic significance in developing and marketing computer operating systems and software, value-added data networks, local area networks, television, and optical disks (David and Greenstein, 1990). With this surge in importance for compatibility standards came an increase of academic interest as well; much research was performed into the factors that influence the selection and adoption of compatibility standards (Argam et al., 2011; M'Chirgui, 2015; Suarez, 2004; van de Kaa et al., 2011).

Various scholars have combined insights from different literature streams to come up with frameworks of success-determining factors for compatibility standards. Suarez (2004) indicates key factors for success in different phases of a standardization process. van de Kaa et al. (2011) propose a comprehensive list of success-determining factors in interface-format battles. Gallagher (2012) and M'Chirgui (2015) assess the importance of different factors in the historical standard battle between HD-DVD and Blu-Ray. Both articles emphasize the importance of the composition of a standard-setting alliance as a key factor to attain dominance in standardization contests. Some authors have attempted to determine the importance of factors for standard dominance using Multi-Criteria Decision-Making (MCDM) models, and apply the attributed weights to historical or ongoing standardization contests (van de Kaa et al. (2018); Van De Kaa et al. (2014b)).

All the articles mentioned in this section so far focus on compatibility standards and technological developments. Dominance for these types of standards is often obtained through widespread acceptance and adoption in a market. The process of reaching a standard in the market is often referred to as 'de facto' standardization. This research, however, aims to identify success-determining factors for quality standards. The literature on this topic is scarce and primarily focuses on specific factors for quality standard adoption.

For example, Chua and Taylor (2008), Carlson (1997), and Phan (2014) focus on the diffusion of financial reporting standards and emphasize the importance of governmental support for the diffusion of standards in this realm. Green (2010) investigates the drivers behind the success of the GHG Protocol and argues that this can be attributed to procedural elements like *"transparency of the rule-making process and the willingness by WRI and WBCSD to include all interested parties."* Marimon et al. (2012) and Brown et al. (2009) assess the Global Reporting Initiative's global diffusion. Their main conclusions point to the importance of compromise; the ability to find a balance *"between individual and collective interests; between inclusiveness and broad consultation, and efficient pursuit of technical objectives; between holding a vision of social change and setting attainable instrumental goals; and between building a new institution and not challenging existing institutions and power relations"* (Brown et al., 2009). Some scholars have studied firms' strategic manoeuvring related to certification or quality standard adoption (Houde, 2018a; Rysman et al., 2020). For example, Rysman et al. (2020) argue that firms use certification to differentiate themselves from competitors. Houde (2018b) studies how the certification of products affects the consumer's willingness to adopt them. Other scholars studied ISO's management quality standards and have identified various reasons for the adoption of these standards. Their studies find that the most prominent reasons for adoption are to remove trade barriers (Balzarova and Castka, 2012), to improve a company's market position (Gamboa and Melão, 2012), or to achieve both (Castka and Balzarova, 2008; Castka and Corbett, 2015; Curkovic et al., 2005).

2.1. GHG protocol

In order to achieve an overview of reporting standards currently applied, a preliminary analysis of the public reports of the top 100 companies from the Forbes Global 2000 was executed. The Forbes Global 2000 is an annual ranking of the world's largest publicly listed companies based on sales, profit, assets and market value (Murphy et al., 2019). This selection of companies was chosen because it contains a varied group of multinational corporations in different industries and sectors, settled in a variety of different countries. Furthermore, an exploratory research of sustainability reports from different kinds of organizations showed that large multinational corporations usually offer far more comprehensive documentation regarding their GHG inventories than smaller companies.

The sustainability reports, (integrated) annual reports and CDP responses of the selected companies were inspected for references to standards, protocols and methodologies applied for the creation of GHG inventories. The Carbon Disclosure Project (CDP) is a not-for-profit non-governmental organization (NGO) aimed at improving environmental

disclosure by companies, cities, and governments. In 2019 over 8.400 companies disclosed information regarding their climate change performance to the CDP. Corporations' CDP responses on climate change offer an insight into the methodologies used by companies to create their GHG inventories.

The analysis resulted in the flowchart shown in Fig. 1. This preliminary analysis showed that the standard that is currently most widely adopted by the investigated companies for corporate greenhouse gas inventories is the Greenhouse Gas Protocol. Green (2010) states that virtually all GHG registries either use the protocol, have created a methodology based on the protocol, recommend using the protocol, or state that their method is consistent with the protocol. On the website of the GHG protocol it is indicated that 9 out of 10 Fortune 500 companies reporting to the CDP apply the protocol.

The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (GHG protocol) was developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) and published in 2001. It provides "*standards and guidance for companies and other types of organizations preparing a GHG emissions inventory*" (Ranganathan et al., 2005). The GHG protocol is a universal GHG accounting scheme initiated by the two mentioned non-governmental organizations and established in collaboration with numerous other firms, NGO's, and Governmental agencies.

Inspection of the GHG protocol, reading scientific literature discussing the protocol and discussions with Health, Safety, Security and Environment (HSSE) reporting experts within Shell, brought forward two main areas for improvement. First, the GHG protocol bases its judgement about which sources should and should not be included in the GHG inventory on the definition of materiality. It states that a source of emissions is 'material' if, by its inclusion or exclusion, it can be expected to influence any decision or actions taken by the user of the inventory (Ranganathan et al., 2005). This leeway for interpretation is not problematic for voluntary reporting purposes or governmental disclosure, it does however pose problems when considering carbon trading schemes, carbon taxation, or other situations in which significant amounts of money are potentially associated with the definition of materiality.

Secondly, the protocol does not provide guidance on the different measurement-, calculation- and estimation-methodologies (hereafter referred to as 'methodologies') that can be applied to collect emissions data. Some information on this matter is provided in sector- or industry-specific guidelines, but these are not available for all sectors and industries and are often not applicable to Small and Medium-sized Enterprises (SMEs). Because of this lacking overview of methodologies, there is little insight into the accuracy, reliability, and completeness of the resulting footprint data. The absence of an approved set of methodologies also forces organizations to turn to various guidelines, leading to a lack of comparability and compatibility between GHG inventories.

The methodologies applied by organizations vary from simple empirical emissions factors to complex process-based models, leading to GHG inventories of dissimilar quality (Cowie et al., 2012; He et al., 2022). In an analysis of environmental accounting practices performed by comparing the environmental disclosures of five major oil-companies, Dragomir (2012) notices that "*The most disturbing aspect of GHG emissions reporting is the ambiguity surrounding the methodologies applied for calculating and aggregating emissions.*" He goes on to conclude that "*the introduction of new estimation methodologies for existing [GHG] databases and the adoption of international standards are essential steps in promoting the transparency of corporate environmental performance.*"

3. Methodology

This research consists of three stages in which different methodologies are applied (see Fig. 2). The first stage consists of a literature search and two exploratory interviews to arrive at the relevant factors for quality standard adoption. It will be presented in section 3.1. The second stage consists of a stakeholder analysis to analyse which experts should be interviewed and is explained in section 3.2. The third stage contains an application of the Best Worst Method with 8 experts to arrive at weights per factor. It will be presented in section 3.3. All experts that were interviewed have expertise of Greenhouse gas accounting standards.

3.1. Literature analysis

Extensive literature analysis for factors that influence quality standard adoption was performed to answer which factors affect the chance that quality standards reach widespread adoption. Papers containing case studies of various quality standards were collected through Scopus and Web of Science. Due to the broad and ambiguous definition of quality standards, it was chosen to cast the net wide and investigate many different types of quality standards.

The search terms: 'Case Study' AND ('standard adoption' OR 'quality standard adoption' OR 'standard success' OR 'quality standard success') were used on the aforementioned scientific databases and filters were used: include English articles from scientific journals published after 1995. This resulted in a set of 939 results. Case studies that were published in the period 1995 to 2022 were included in order to strike a balance between preventing using outdated information and still having a sufficiently large list of case studies to base the research on. These articles were screened to see if they contained a case study of quality standard adoption which lead to a short list of 95 case studies. Each of these case studies was subsequently analysed to assess if they discussed

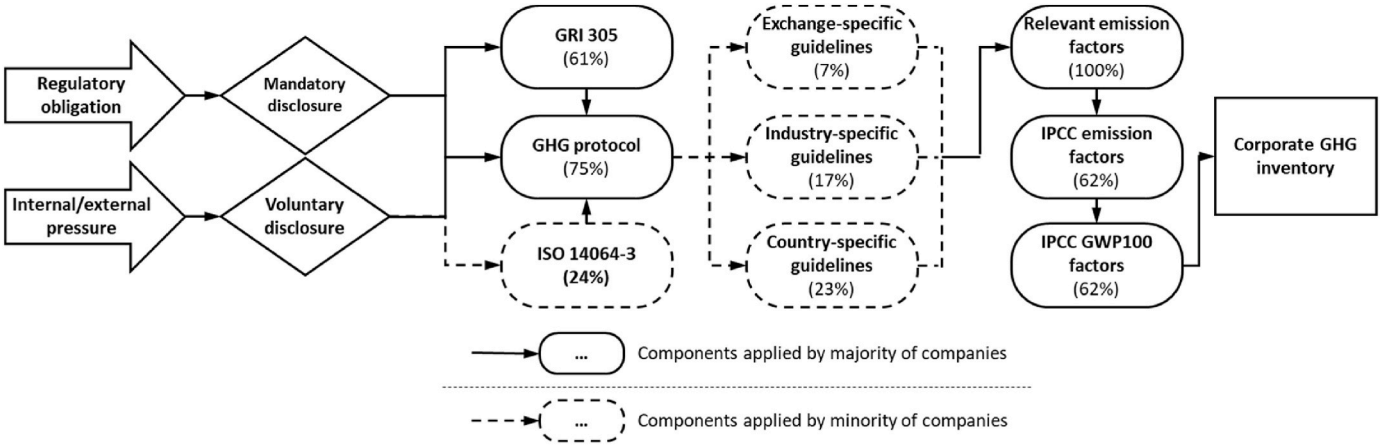

Fig. 1. Flowchart of the generalized process for corporate GHG inventories applied by the top 100 companies from the Forbes Global 2000. The percentage indicates how many of the investigated companies reported using it.

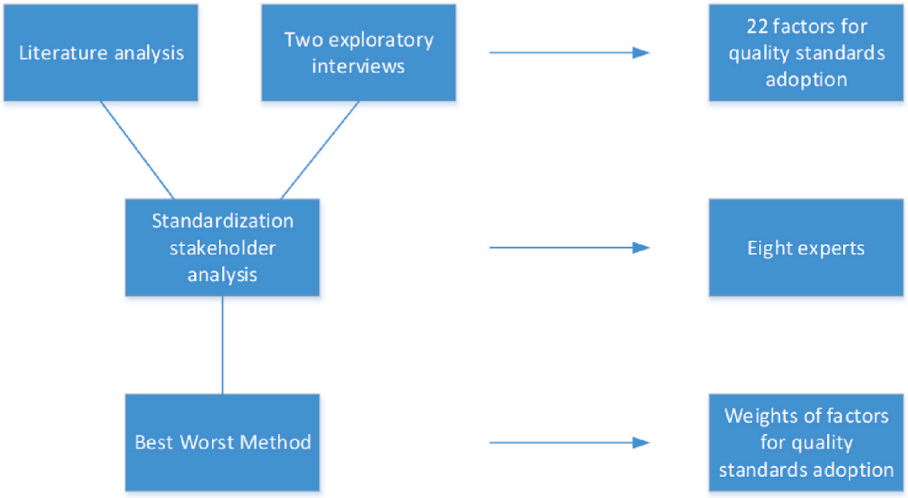

Fig. 2. A framework of research stages, synergies and outcomes.

factors for standard success and whether the standard it researched fell within the definition for quality standards, put forward by Ho and O'Sullivan (2018). They should "*specify acceptable criteria along various dimensions, such as functional levels, reliability, efficiency, health and safety, and environmental impact, in order to improve their performances*". This resulted in a list of 17 case studies, to which 5 additional case studies were added that met the requirements and had been found during exploratory background research into Corporate Sustainability and Responsibility-related quality standards and accounting quality standards performed ahead of the systematic literature review. The final list contained studies of process-quality standards for health care (Brand et al., 2008) and group care (Boel-Studt et al., 2019), of management-quality standards like ISO 9000 (Castka and Corbett, 2015; Gamboa and Melão, 2012), ISO 14000 (Curkovic et al., 2005) and ISO 26000 (Balzarova and Castka, 2012; Castka and Balzarova, 2008), of accounting- and reporting-quality standards (Brown et al., 2009; Carlson, 1997; Chua and Taylor, 2008; Marimon et al., 2012; Phan, 2014), of food-quality standards (Chemnitz, 2007; Escanciano and Santos-Vijande, 2014; Fulponi, 2006; Handschuch et al., 2013; Reardon et al., 1999). The additional papers that were included contained case studies from CSR-related quality standards (Green, 2010; Moratis and Widjaja, 2014), environmental labels like the FSC and MSC (Cashore et al., 2006; Wijen and Chiroleu-Assouline, 2019) and international accounting quality standards (Carlson, 1997). See Fig. 3 for a flow diagram depicting the systematic literature review.

Factors with high similarity were merged to reduce the number of factors that had to be assessed. The reduced framework was verified in semi-structured interviews with two experts from Shell. Both have more than 10 years of experience in environmental accounting and standardization, the first respondent listed in Table 1 is one of them. The factors where then grouped into categories based upon their similarity.

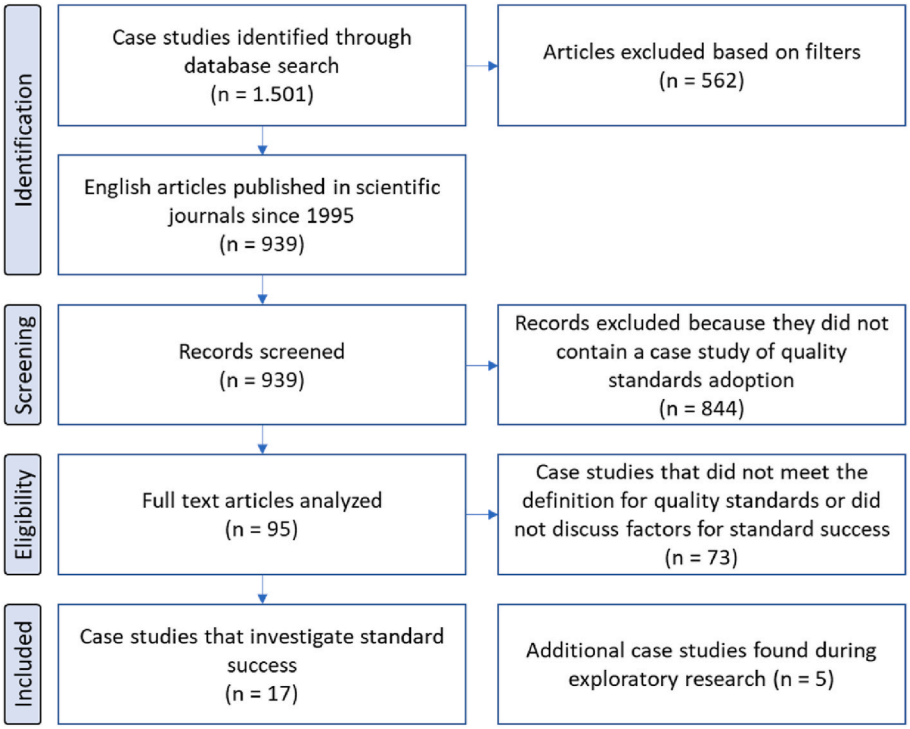

Fig. 3. Flow diagram for the systematic literature review.

Table 1
The professional data of the interviewees for this research.

Organization	Profession of respondent	Years of experience	(Group of) Stakeholders
Royal Dutch Shell	Group and External HSSE & SP Reporting manager	**13**	**Large Multinational Companies (MNC's)**
KPMG	Senior Consultant Sustainability	**6**	**Environmental accounting firms**
SAP	Corporate sustainability at SAP and Fellow at the Value Balancing Alliance	**16**	**Enterprise Resource Planning providers**
Ministry of Economic affairs and Climate[a]	Policy Coordinator and Economist at the Climate Directorate[a]	**20**	**Governments**
World Resources Institute & Greenhouse Gas Protocol	Senior Associate at the Climate Program	**13**	**Environmental NGO's**
DNV GL	Global Area Service leader, global head of R&D for Oil and Gas business area	**18**	**Environmental auditing/ certification firms**
University of Amsterdam	Professor at the Faculty of Economics and Business, Section Accounting	**16**	**Universities**
Ernst & Young	Associate Partner Climate Change & Sustainability Services	**19**	**Consultancy firms**

[a] The respondent from the Ministry of Economic Affairs and Climate participated on the personal title; his answers and remarks do not necessarily reflect his ministry's position.

3.2. Stakeholder analysis

After determining the factors that were to be evaluated, a stakeholder analysis was performed to determine the groups from which representatives should be interviewed. The stakeholder identification and classification method proposed by de Vries et al. (2003) was performed to identify the most salient stakeholders. Expert representatives from the different groups of stakeholders that were identified were approached for interviews. The interviewees all have expertise on greenhouse gas accounting standards and have at least 5 years of experience at leading companies in their respective fields. This approach was followed to ensure that all viewpoints were taken into account. The experts that took part in this research are listed in Table 1.

3.3. Best worst method

An MCDM method was applied to determine the weights of the different factors. The Best eorst method, proposed by Rezaei (2015), was utilized. This method is based on pairwise comparisons between the extreme alternatives (so the most and least important/desirable criteria) and each other criteria. This method was chosen because (1) it has high reliability and consistency when compared with other MCDM methods (Rezaei, 2015); (2) it specifies a structured methodology for the respondents to provide the pairwise comparison data through its use of the most and least important factors as reference points; (3) it requires less pairwise comparisons than using complete pairwise comparisons or other MCDM methods. The five steps of the linear BWM were executed as follows (Rezaei, 2015).

Step 1. Defining relevant decision criteria $\{c_1, c_2, \ldots, c_n\}$. This was done through the creation of the framework of success-determining factors. Each of the factors (within a category) is a criterion for adopting a GHG accounting standard.

Step 2. Identification of the best and worst criterion. The experts were asked which factors they believed to be the most important and the least important within a category.

Step 3. Pairwise comparisons between the "Best" criterion and the other criteria. The experts were provided a matrix in which they had to indicate each factor's importance relative to the most important factor on a scale of 1 (equally important to the most important factor) to 9 (most important factor is extremely more important). This resulted in the best-to-others vector:

$$A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn})$$

a_{Bj} refers to the preference for the best factor B over factor j.

Step 4. Pairwise comparisons between the "Worst" criterion and the other criteria. Step 3 is repeated, but now each of the criteria (other than the best one) are compared to the least important factor on a scale from 1 (equally important to the least important factor) to 9 (Extremely more important than the least important factor). This resulted in the others-to-worst vector:

$$A_W = (a_{1W}, a_{2W}, \ldots, a_{nW})^T$$

a_{jW} refers to the preference for factor j over the worst factor W.

Step 5. Optimal weight determination by solving the following problem:

$$\min \xi^L$$

s.t.

$$\left|w_B - a_{Bj} w_j\right| \leq \xi^L, for\ all\ j$$

$$\left|w_j - a_{jw} w_W\right| \leq \xi^L, for\ all\ j$$

$$\sum_j w_j = 1$$

$$w_j \geq 0, for\ all\ j$$

This resulted in a unique solution of optimal weights for each of the factors in a category $(w_1^*, w_2^*, \ldots, w_n^*)$ and the consistency ratio (ξ^*). These steps were repeated for the categories themselves, which resulted in relative weights of importance for each category. By multiplication of the weight of factors within a category with the weight of that category (the local weights), the global weights of importance for each factor were calculated that allow for comparison of factors over different categories.

3.4. Interviews

Two rounds of interview were executed to collect the required data.

The first set of semi-structured interviews was conducted with two internal experts from Shell to discuss the preliminary framework of success-determining factors from the conducted literature analysis. The interviews lasted approximately 1,5 h and were recorded and transcribed. After an explanation of the goal of the research and of the standard that was under consideration, the respondents were first asked an open question to come up with the factors they thought would be most salient for standard adoption. This was done in order to prevent them from focusing too much on the framework that had been created. After discussion of their ideas, we went through the framework and discussed if there were any factors that they felt should be changed because they were e.g. overlapping, too broad or narrow.

The second set of interviews was held with the representatives of the different groups of stakeholders identified in the stakeholder analysis. These were structured interviews of 1–1,5 h in which the respondents

were asked to provide their pairwise comparisons between the different factors within a category and between categories of factors, as explained in the previous paragraph. The respondents had received an introduction into the methodology that would be applied and the definitions of the factors that would be assessed beforehand (see Table 2). Because many of the respondents were living abroad and due to COVID-19 restrictions, these interviews were held digitally and were recorded with consent of the participants and transcribed. The respondents provided their pairwise comparisons through a digital questionnaire which they filled in during the interview. After each set of pairwise comparisons (relating to the factors of one category or to the categories themselves), the respondents were asked to elaborate on their decisions and rationale. The respondents were not primed to discuss specific results or pointed to inconsistencies, but were asked more generally what the reasoning behind their provided answers was.

4. Results

4.1. Literature analysis

The literature analysis resulted in 29 factors, presented in Table 3. After conducting the interviews, two additional relevant factors were added from these interviews. All the factors that were elicited from the literature were analysed and, based upon their similarity, categorized into six groups: *'tangible standard characteristics', 'intangible standard characteristics', 'standard* supporting *alliance', 'standard creating process, 'standard* support *strategy',* and *'stakeholders'*. These categories stem, in part, from previous work on success-factors in de-facto standardization (Moratis and Widjaja, 2014; van de Kaa et al., 2011; van den Eijnden, 2019). The framework of success-determining factors, their corresponding categories, and their descriptions will now be presented.

4.1.1. Tangible standard characteristics

The first category of factors related to **tangible standard characteristics** is measurable and quantifiable features of a standard. This category contains *Compatibility with incumbent practices*, which refers to the compatibility of a new standard with related national, sector-specific, or other standards and protocols currently applied by organizations. This reduces the resources necessary for the implementation (Castka and Corbett, 2015; Moratis and Widjaja, 2014; Wijen and Chiroleu-Assouline, 2019). *Implementation costs* are the money, resources and time associated with implementing and maintaining the standard and achieving certification. High costs can be viewed as a barrier to adoption by companies. (Boel-Studt et al., 2019; Cashore et al., 2006; Castka and Corbett, 2015; Chemnitz, 2007; Fulponi, 2006; Green, 2010; Handschuch et al., 2013; Kroehler, 2014; Marimon et al., 2012; Moratis and Widjaja, 2014; Reardon et al., 1999; Wijen and Chiroleu-Assouline, 2019). *Progressive adoption* relates to the possibility for an incremental path of implementation. Companies can choose if, when, and how to implement components of the standard. This possibility will make a standard less disruptive than all-or-nothing standards (Balzarova and Castka, 2012; Boel-Studt et al., 2019; Brand et al., 2008; Chua and Taylor, 2008; Green, 2010; Wijen and Chiroleu-Assouline, 2019).

The *possibility for certification* from recognized third-parties is proposed by some scholars as extra motivation for adoption, leading to a higher chance of success for the standard. This could also include a harmonized certification spanning multiple countries, replacing different certificates in each country (Cashore et al., 2006; Castka and Corbett, 2015; Chemnitz, 2007; Moratis and Widjaja, 2014; Reardon et al., 1999; Wijen and Chiroleu-Assouline, 2019). The presence of *industry- and sector-specific guidelines* and appendices to supplement the standard comes up in literature as a decisive factor for quality standard diffusion. It is suggested to diminish the chances of competing (sector-specific) standards arising (Brown et al., 2009; Cashore et al., 2006; Green, 2010; Moratis and Widjaja, 2014). The *accessibility of information*

Table 2
Factors and descriptions.

Factor	Description
Tangible standard characteristics	
Compatibility with incumbent practices	Compatibility of a new standard with related national, sector-specific, or other standards, protocols and laws currently applied by organizations reduces the resources necessary for implementation and therefore has a positive influence on standard adoption.
Implementation costs	The costs, resources and time associated with implementing the standard; getting certified and maintaining the standard is proposed as a restricting factor for standard adoption.
Progressive adoption	An incremental path of implementation in which companies can choose if, when and how to implement components of the standard will promote higher adoption than an all-or-nothing standard that is highly disruptive.
Possibility for certification	The possibility to receive recognized third-party verification of the standard can be a motivation for adoption. This could also include the possibility for a harmonized certification spanning multiple countries, replacing different certificates in each country.
Industry- and sector-specific guidelines	The presence of industry- and sector-specific guidelines/appendices to supplement the standard. The presence of these guidelines can convince potential adopters of the suitability for their situation.
Accessibility of information	The accessibility and comprehensibility of the content of the standard and the information about it for companies and organizations of all sizes and sectors and from all countries and languages. For example: it helps adoption in areas where English is not commonly spoken if the content of a standard is available in different languages, and it helps adoption by smaller companies if the standard content is written in a terminology understandable to relative laymen.
Intangible standard characteristics	
The ability to provide an organization with more structure	The ability of the standard to provide structure to an organization's practices and procedures is mentioned as an important benefit of adopting quality standards. Adoption will therefore increase if a standard is able to provide this to its adopters.
The ability to improve an organization's reputation	The ability of a standard and/or certification to increase the perceived reputation of the company can be a reason for companies to adopt a quality standard.
The possibility to get started without external guidance	The necessity to seek guidance from a (consulting) company, NGO, or governmental organization is seen as a barrier to implementation of a standard. Absence of this barrier will help to reach different kinds of companies across the sector and size spectrum.
Applicability to different size organizations	The applicability of the standard to companies of all sizes, from small local shops to large MNC's, will help the global uptake of a standard. Standards focussed on large MNC's are often too complex and demanding for SMEs and standards aimed at SMEs do not provide enough guidance for MNC's. A standard that can cater to the entire spectrum will promote adoption.
International acceptance of the standard	The acceptance of a standard by companies and governments from all over the world despite differing levels of development will promote adoption. Adopting multiple different standards for different geographical areas increases the (transaction) costs involved. An internationally recognized and

(*continued on next page*)

Table 2 (*continued*)

Factor	Description
	accepted standard therefore increases adoption.
The ability to open new markets or retain old markets	Countries, areas, and companies can demand specific quality standard certifications for goods to be traded or services to be provided. Organizations will be more prone to adopt a standard if it is required to retain their current market, or if it opens new markets for them to trade in.
Standard supporting alliance characteristics	
Financial strength and market position of the supporters	Organizations are more likely to adopt a standard from an alliance with a high collective financial strength, market size and buying power, because they trust that sufficient resources have been attributed to the development of the standard for a good quality and scalability. Standards require a critical mass of support for widespread adoption of the standard, having this critical mass in the standard setting alliance is a large advantage.
Reputation of the standard supporters	Organizations are more prone to adopt a standard from an alliance with a good collective brand reputation in a certain field, because they are less suspicious towards the standard content.
Diversity within an alliance	A standard committee that has a high diversity of different kinds of supporters (companies, NGO's, governmental organizations) and supporters from different sectors and industries is perceived to better incorporate the different stakes of all these parties in the standard, resulting in a less biased or opportunistic standard. This leads to higher adoption rates of the standard.
The participation of an official Standards Developing Organization (SDO)	The participation of an official Standards Developing Organization (i.e. ISO or one of its national member organizations) in a standards consortium can promote adoption by providing legitimacy to the standard.
Perceived neutrality/independence	The perceived independence from commercial interests of the standard supporters will take away the suspicion that the standard is a tool to increase a standard setter's market control. Therefore, perceived independence of the standard creators and supporters can promote adoption of a standard.
Standard creating process	
Coordination within an alliance	Clear and strong coordination within the standards setting alliance can lead to an improved perceived quality of the standard, increasing the adoption rate of the standard.
Stakeholders and third-party involvement	Openness to- and involvement of all stakeholders and other relevant parties in the standard creation process leads to a standard in which the interests of all the different stakeholders are represented. Also, allowing stakeholders to contribute to a standard often turns them into active supporters of the standard leading to higher adoption rates.
Substantive due process and rationale	Substantive rules and principles determined up front to protect the lawful course of the standard creation process and regarding the standard content can prevent disputes, lead to a more legally robust standard and improve adoption.
Transparent and open process	An open and transparent standard creating process that is available for review by anyone who wishes to verify the process, will increase the credibility of the standard and its creators and increase adoption.
Standard support strategy	
Financial support for the standard	Financial support for the creation of the standard will lead to a qualitatively superior standard, whereas financial support for the diffusion of the standard will make it possible to reach a larger market, both increasing the adoption of the standard.
Alignment of interests of participants	A previously established goal statement, in which the interests of the different participants/stakeholders are aligned will lead to a more consistent and qualitatively superior final standard, which will promote its adoption.
Periodical improvement of the standard	Continuing reviews of the standard's content and periodical updates by the standard creating alliance, also after diffusion, will lead to a higher quality standard that is adaptive to changing requirements from the market. Organizations noticing that their feedback is incorporated in a standard will feel more engaged with the standard, and this increases the chance that they will promote adoption by others.
Provision of operational support	The possibility for operational support for the implementation of the standard in an organization will decrease barriers for companies that lack the know-how to implement the standard or that lack experience with standards at all. This will promote adoption by smaller companies.
The presence of a community	The presence of an active community of adopters around the standard that is informed regularly on developments of the standard and can be used to review the standard content will promote standard adoption.
Benefits tracking	The tracking and communication of clear evaluation criteria and benefits gained through adoption of the standard will provide proof of the standards effectiveness, will help to retain adopters who become aware of improvements, and will increase the attractiveness to potential adopters.
Stakeholders	
Support by consultants and auditors	Support by organizations that can assist companies, which lack the resources to implement a standard themselves, to implement and maintain a standard will help increase adoption of the standard. Support by auditors means that external verification of the standard becomes possible and increases the legitimacy of the standard.
Support by governmental bodies	Support of a government or governmental regulatory bodies for the standard will lead to an increased sense of legitimacy of the standard and gives potential adopters a form of assurance that the standard aligns with potential future regulations. Governments can use their regulatory authority and buying power to promote standard adoption.
Support by NGO's related to the standard	Support by Non-Governmental Organizations that are related to the subject of the quality standard (e.g. the WWF or WRI for environmental accounting) gives potential adopters the feeling that the standard is not just created to support the adopting organizations, but is also effective in reaching it's other (e.g. societal or environmental) goals, which will promote adoption.

(*continued on next page*)

Table 2 (*continued*)

Factor	Description
Pressure from customers	Pressure from the consumers of a product or service to comply with a certain quality standard will lead to increased adoption rates of the standard. This can be any type of customer, e.g. final consumers, governmental organizations, or large retailers.

refers to the comprehensibility of the standard's content. This relates to supporting information for organizations and sectors in as many countries and languages as possible. For example, it helps adoption in areas where English is not the primary means of communication if the content of a standard is available in different languages, and it helps adoption by smaller companies if the standard content is written in terminology understandable to relative laymen (Brown et al., 2009; Carlson, 1997; Chemnitz, 2007; Escanciano and Santos-Vijande, 2014; Gamboa and Melão, 2012; Moratis and Widjaja, 2014).

4.1.2. Intangible standard characteristics

The second category of factors relates to **intangible standard characteristics**; subjective features of a standard more difficult to measure or quantify. This category contains *the ability to provide an organization with more structure*, which is mentioned in the literature as an important benefit of adopting quality standards (Castka and Corbett, 2015; Escanciano and Santos-Vijande, 2014; Gamboa and Melão, 2012; Moratis and Widjaja, 2014). Many scholars suggest *the ability to improve an organization's reputation* to be another reason for companies to adopt quality standards (Castka and Balzarova, 2008; Escanciano and Santos-Vijande, 2014; Fulponi, 2006; Gamboa and Melão, 2012; Green, 2010; Marimon et al., 2012; Moratis and Widjaja, 2014; Phan, 2014; Reardon et al., 1999). The necessity to hire a (consulting) company, NGO, governmental organization, or other company can be perceived as a barrier to adopting a standard. This factor is captured in *the possibility to get started without external guidance*. This barrier's absence will help reach different kinds of companies across the sector and size spectrum (Escanciano and Santos-Vijande, 2014; Moratis and Widjaja, 2014).

The *applicability to different size organizations* of the standard, from small local shops to large MNC's, will help the global uptake of a standard. Standards focussed on large MNC's are often too complex and demanding for SME's and standards for SME's do not provide enough guidance for MNC's. A standard that can cater to the entire spectrum will have a higher chance of being adopted by all parties (Brown et al., 2009; Carlson, 1997; Cashore et al., 2006; Moratis and Widjaja, 2014; Reardon et al., 1999). The *international acceptance of the standard* by countries worldwide with different development levels will promote adoption. Adopting multiple different standards for different geographical areas increases the (transaction) costs involved for companies; international recognition and acceptance of the standard can increase attractiveness (Brown et al., 2009; Carlson, 1997; Chua and Taylor, 2008; Moratis and Widjaja, 2014). Countries, areas, and companies can demand specific quality standard certifications for goods to be traded. Organizations will be more prone to adopt a standard if it is required to retain their current market or open new markets for them to trade. *The ability to open new markets or retain old markets* can be a strong promotor for widespread adoption of a standard (Balzarova and Castka, 2012; Cashore et al., 2006; Castka and Corbett, 2015; Chemnitz, 2007; Curkovic et al., 2005; Escanciano and Santos-Vijande, 2014; Handschuch et al., 2013; Marimon et al., 2012; Wijen and Chiroleu-Assouline, 2019). For example, by adhering to a quality standard, firms can target various market segments and differentiate themselves from competitors (Rysman et al., 2020).

4.1.3. Standard supporting alliance

The third category of factors relates to the **standard** supporting **alliance**; the collective aspects of the group of organizations establishing and diffusing a new quality standard. The *financial strength and market position of the supporters* is part of this category. Organizations are more prone to adopt a standard of an alliance with a high collective financial strength, market size, and buying power because they trust that sufficient resources have been attributed to the development of the standard for good quality and scalability. Standards require a critical mass of support that will accelerate the standard's adoption (Brown et al., 2009; Moratis and Widjaja, 2014; Reardon et al., 1999; Wijen and Chiroleu-Assouline, 2019). Another characteristic of the alliance is the *reputation of the standard supporters*. An alliance with an excellent collective brand reputation in a particular field can foster trust in the standard and increase its attractiveness (Cashore et al., 2006; Green, 2010; Moratis and Widjaja, 2014; Wijen and Chiroleu-Assouline, 2019).

A standard with a high *diversity within its alliance* of different kinds of supporters and creators (companies, NGOs, governmental organizations) and supporters from different sectors and industries is perceived to incorporate all these parties' different stakes better. This results in a less biased or opportunistic standard, leading to higher adoption (Brown et al., 2009; Cashore et al., 2006; Green, 2010; Wijen and Chiroleu-Assouline, 2019). Participation of an *official SDO* in that alliance, such as ISO can promote adoption by providing legitimacy to the standard (Castka and Corbett, 2015). *The perceived neutrality and independence* from the standard supporters' commercial interests will take away the suspicion from potential adopters that a standard is a tool from a standard developing organization or alliance to increase their market control. The supporters' perceived independence can promote trust in the standard (Brown et al., 2009; Wijen and Chiroleu-Assouline, 2019).

4.1.4. Standard creating process

The fourth category of factors relates to the **standard creating process**; it contains aspects of the collaborative process employed to create a new standard. Precise coordination within the alliance of the standard creation process and communication thereof will lead to an improved perceived quality of the standard, with the potential to increase the adoption of the standard (Brown et al., 2009; Carlson, 1997). Openness to- and involvement of all stakeholders and third parties in the standard creation process leads to standards in which the interests of different stakeholders are represented as much as possible. Also, allowing stakeholders to contribute to a standard often turns them into active supporters of the standard leading to higher adoption (Balzarova and Castka, 2012; Brand et al., 2008; Brown et al., 2009; Carlson, 1997; Cashore et al., 2006; Green, 2010; Moratis and Widjaja, 2014; Wijen and Chiroleu-Assouline, 2019).

Table 3
Consistency ratio results.

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8
Categories	0,03	0,09	0,06	0,09	0,07	0,03	0,05	0,08
Tangible standard characteristics	0,07	0,07	0,06	0,14	0,11	0,05	0,05	0,17
Intangible standard characteristics	0,09	0,10	0,05	0,09	0,06	0,07	0,10	0,16
Standard supporting alliance	0,05	0,05	0,07	0,11	0,09	0,04	0,08	0,00
Standard creating process	0,03	0,11	0,05	0,09	0,13	0,05	0,06	0,18
Standard support strategy	0,05	0,08	0,06	0,11	0,07	0,14	0,05	0,09
Stakeholders	0,00	0,09	0,11	0,10	0,03	0,13	0,05	0,16

Substantive due process and rationale ensure proper rules and principles are determined upfront to protect the lawful course of the standard creation process and prevent disputes (Carlson, 1997). A transparent and open standard creating process available for review by anyone who wishes to verify the process will increase the standard's credibility and its creators and increase adoption (Brown et al., 2009). A previously established goal statement in which the interests of the different participants/stakeholders are aligned will lead to a more consistent and qualitatively superior final standard, which will promote adoption (Brown et al., 2009; Wijen and Chiroleu-Assouline, 2019).

4.1.5. Standard support strategy

The fifth category of factors relates to the **standard** support **strategy**; it contains aspects related to the marketing and promotion of the standard during the diffusion phase. Financial support for the standard influences the adoption in multiple ways. Financial support for creating the standard will lead to a qualitatively superior standard, whereas financial support for the diffusion of the standard will make it possible to reach a larger market. Financial support can come from various sources and is not necessarily related to the financial strength and market position of the standard setters (Brand et al., 2008; Cashore et al., 2006). Periodical improvement of the standard and periodical updates by the standard creating alliance and diffusion will lead to a higher quality standard that is adaptive to changing requirements from the market. Organizations noticing that their feedback is incorporated in a standard will feel more engaged with the standard promoting adoption by others (Boel-Studt et al., 2019; Brand et al., 2008; Brown et al., 2009; Green, 2010; Moratis and Widjaja, 2014; Wijen and Chiroleu-Assouline, 2019).

The provision of operational support for the implementation and maintenance of the standard in an organization will decrease barriers for companies that lack the know-how to implement the standard or lack experience with standards. This will promote adoption by smaller companies in particular (Green, 2010; Moratis and Widjaja, 2014). A community of adopters around the standard regularly informed on developments of the standard can share best practices and can be used to review the standard content can promote standard adoption. Benefits tracking, the tracking, and communication of clear evaluation criteria and benefits gained through adopting the standard can prove the standard's effectiveness. This will help to retain adopters who become aware of improvements and increase the attractiveness for potential adopters. The previous two factors arose from interviews with the Open Footprint initiative's project lead, who has extensive experience in standardization processes.

4.1.6. Stakeholders

The sixth category of factors relates to the **stakeholders**; it contains four groups of stakeholders identified as having the largest influence on widespread diffusion of a new standard. Support by consultants and auditors who can assist companies that lack the resources to implement a standard themselves to implement and maintain a standard can decrease barriers to adopting the standard. Support by auditors means that external verification of the standard becomes possible and increases the standard's legitimacy, thereby increasing the attractiveness of the standard (Fulponi, 2006; Handschuch et al., 2013; Moratis and Widjaja, 2014; Phan, 2014; Reardon et al., 1999). Support of a government or governmental regulatory bodies for the standard will lead to an increased sense of legitimacy of the standard and gives potential adopters a form of assurance that the standard aligns with potential future regulations. Support by Non-Governmental Organizations that are related to the subject of the quality standard can be perceived by potential adopters to indicate that the standard has a focus beyond only supporting the adopting organizations but also contributes to other goals (e.g., societal or environmental) (Cashore et al., 2006; Kroehler, 2014; Wijen and Chiroleu-Assouline, 2019). Pressure from customers of a company to comply with a certain quality standard can push companies to adopt those standards (Balzarova and Castka, 2012; Cashore et al., 2006; Chemnitz, 2007; Handschuch et al., 2013; Wijen and Chiroleu-Assouline, 2019).

4.2. Best worst method

The resulting Consistency Ratios for each of the respondents can be found in Table 3. A consistency ratio closer to zero indicates a higher consistency in the weights attributed by the experts. As the CRs are sufficiently low, the weights assigned by the experts are deemed to be consistent.

The resulting weights from the different experts for each of the factors can be found in Table 4. Local average weights are the average of the weights that were given the factors within each category while the global average weights are determined by multiplying the local weights with the weights that were given to each category. The results indicate that the two most important factors according to the experts are pressure from customers (0,08) and support from governmental bodies (0,07).

5. Discussion and conclusion

This paper has developed a framework with factors that influence the adoption of quality standards and applied it to the case of a new GHG accounting standard. The framework was verified by experts and proven to be accurate. It contains 31 factors that affect the adoption of a quality standard. The two factors that were assessed to be most important for adopting a standardized environmental accounting methodology were pressure from customers and support from governmental bodies.

5.1. Interpretation of the results

The results indicate that pressure from customers is the most important factor. Great examples of this factor in other cases are the Forestry Stewardship Council (FSC) and the Marine Stewardship Council (MSC) certifications. Cashore et al. (2006) argue that large customers, like Ikea and Leroy Merlin, are the main drivers behind FSC certification's success. Similarly, Wijen and Chiroleu-Assouline (2019) states that the MSC certification's adoption rate gained momentum after large customers like Walmart, McDonalds and Sainsbury adopted it and pressured their upstream suppliers to comply. The expert working at Shell verified this in an interview and added that they *"see that manifesting in the requests that [they] are getting from Walmart, BMW, the US government"*. In all examples where consumers put pressure on companies to adopt a standard found, the consumers were large customers like large multinationals or governments. It could be debated that end-consumers forced these large customers to adopt the standard, but no proof has been found to support this argument.

In the literature on standardization contests that focuses on compatibility standards, the importance of pressure from customers can also be observed. Various authors have shown that when a large customer (big fish) supports a standard, that standard can gain instant market dominance (Suárez and Utterback, 1995). For example, it has been suggested that IBM can be considered the big fish for the MS-DOS operating system standard (van de Kaa et al., 2011).

The second most important factor, according to the experts, is support from governmental bodies. The importance of governmental support for a quality standard has been recognized widely in the literature. Green (2010) argues that governmental support for the GHG Protocol reinforced perceived legitimacy and usefulness to business groups. In the International Accounting Standards Committee (IASC) case, the lack of governmental support is indicated as the main reason for its failure to draw up successful accounting standards (Carlson, 1997). The experts that were interviewed did not agree on the kind of support governments were likely to give but did agree that any form of endorsement would be highly beneficial for the adoption of the quality standard. Having governmental support for a quality standard means that compliance regulation will most likely be aligned with the standard and reduces the

Table 4
Weights of importance attributed by the experts for all evaluated factors.

Categories and Factors	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Local average weight	Global average weight
Tangible standard characteristics	0,25	0,22	0,16	0,18	0,20	0,11	0,23	0,14	0,19	
Compatibility with incumbent practices	0,09	0,37	0,27	0,42	0,16	0,11	0,25	0,52	0,27	0,05
Implementation costs	0,18	0,22	0,16	0,19	0,36	0,27	0,15	0,11	0,20	0,04
Progressive adoption	0,12	0,07	0,11	0,05	0,23	0,05	0,25	0,04	0,12	0,02
Possibility for certification	0,04	0,15	0,27	0,14	0,12	0,27	0,15	0,10	0,15	0,03
Industry- and sector-specific guidelines	0,29	0,15	0,16	0,11	0,04	0,22	0,15	0,11	0,15	0,03
Accessibility of information	0,29	0,04	0,03	0,09	0,09	0,08	0,07	0,11	0,10	0,02
Intangible standard characteristics	0,25	0,11	0,16	0,05	0,32	0,12	0,14	0,11	0,16	
The ability to provide an organization with more structure	0,09	0,04	0,12	0,05	0,14	0,04	0,12	0,13	0,09	0,01
The ability to improve an organization's reputation	0,23	0,07	0,30	0,41	0,14	0,21	0,04	0,04	0,18	0,03
The possibility to get started without external guidance	0,16	0,14	0,04	0,12	0,10	0,07	0,16	0,10	0,11	0,02
Applicability to different size organizations	0,05	0,18	0,12	0,16	0,14	0,21	0,14	0,16	0,14	0,02
International acceptance of the standard	0,38	0,44	0,30	0,16	0,35	0,14	0,38	0,47	0,33	0,05
The ability to open new markets or retain old markets	0,09	0,14	0,12	0,10	0,14	0,34	0,16	0,10	0,15	0,02
Standard supporting alliance	0,14	0,15	0,26	0,13	0,13	0,18	0,24	0,21	0,18	
Financial strength and market position of the supporters	0,08	0,34	0,21	0,10	0,16	0,29	0,11	0,11	0,17	0,03
Reputation of the standard supporters	0,22	0,19	0,07	0,50	0,16	0,29	0,27	0,11	0,23	0,04
Diversity within an alliance	0,11	0,04	0,14	0,04	0,24	0,06	0,09	0,11	0,10	0,02
The participation of an official SDO	0,22	0,10	0,21	0,20	0,05	0,08	0,19	0,56	0,20	0,04
Perceived neutrality/independence	0,38	0,34	0,36	0,15	0,39	0,29	0,35	0,11	0,29	0,05
Standard creating process	0,04	0,04	0,07	0,11	0,10	0,12	0,14	0,35	0,12	
Coordination within an alliance	0,08	0,06	0,24	0,27	0,16	0,37	0,13	0,19	0,19	0,02
Stakeholders and third-party involvement	0,38	0,56	0,24	0,45	0,52	0,37	0,31	0,59	0,43	0,05
Substantive due process and rationale	0,20	0,22	0,43	0,09	0,10	0,05	0,38	0,07	0,19	0,02
Transparent and open process	0,34	0,17	0,10	0,18	0,22	0,21	0,19	0,15	0,19	0,02
Standard support strategy	0,06	0,11	0,16	0,11	0,05	0,12	0,18	0,14	0,12	
Financial support for the standard	0,26	0,08	0,19	0,13	0,15	0,14	0,11	0,16	0,15	0,02
Alignment of interests of participants	0,30	0,15	0,13	0,43	0,06	0,43	0,26	0,39	0,27	0,03
Periodical improvement of the standard	0,08	0,38	0,19	0,11	0,11	0,14	0,05	0,12	0,15	0,02
Provision of operational support	0,04	0,15	0,32	0,18	0,38	0,10	0,16	0,16	0,19	0,02
The presence of a community	0,16	0,12	0,13	0,11	0,15	0,05	0,26	0,12	0,14	0,02
Benefits tracking	0,16	0,12	0,04	0,04	0,15	0,14	0,16	0,05	0,11	0,01
Stakeholders	0,25	0,36	0,20	0,43	0,20	0,34	0,06	0,05	0,24	
Support by consultants and auditors	0,14	0,19	0,13	0,06	0,23	0,17	0,47	0,14	0,19	0,04
Support from governmental bodies	0,29	0,48	0,68	0,12	0,13	0,22	0,26	0,06	0,28	0,07
Support by NGO's related to the standard	0,29	0,06	0,11	0,23	0,23	0,07	0,10	0,52	0,20	0,05
Pressure from customers	0,29	0,28	0,07	0,60	0,42	0,54	0,17	0,28	0,33	0,08

probability that companies will have to adopt other standards. This makes it very interesting for companies to adopt a standard that their government backs. The regulator's importance as a factor for standard success has also been demonstrated in the prior literature that focuses on battles between compatibility standards. However, its effect is different; it is argued that the regulator can prescribe standards that can prematurely end a standardization contest favouring the standard prescribed (Bekkers et al., 2002).

Neo-institutional theorists have stressed that firms adopt norms and rules because they are pressured to do so by other stakeholders (coercive pressures) (DiMaggio, 1983). It appears that this is also the case for quality standards adoption as both support from governmental bodies and pressure from customers appears to affect the choice to adopt standards. This observation also aligns with the results of research into the adoption of other types of standards such as XBRL, a business reporting language, by Henderson et al. (2011). Here co-ercive pressures, in this case through a governmental mandate, is also indicated to have the strongest impact on adoption. Teo et al. (2003), and York et al. (2018) also show significant impacts of coercive pressures in their studies on the adoption of Financial Electronic Data Interchange systems and a voluntary certification for green buildings respectively.

Following these two factors with a similar weight of importance are (i) compatibility with incumbent practices, (ii) international acceptance of the standard, (iii) perceived neutrality/independence, (iv) stakeholder and third-party involvement and (v) support by NGO's. Even though each of these factors stems from a different category of factors, the majority relates to how the process and those involved are perceived, rather than the actual content of the standard. Perceived neutrality/independence, stakeholder and third-party involvement and support by NGO's all contribute to the trust a person has in the rigour and independence of the standard creation process. This strengthens the hypothesis that potential standard adopters are more likely to make their decisions based on their perception of the standard process and the organizations involved, rather than by digging through the entire content of the standard itself.

One explanation for the focus on support from stakeholders rather than the actual content of the standard could be attributed to the application of the standard. GHG inventories are at the moment mainly established for reporting and compliance reasons. It is conceivable that those applying the standard are more concerned with how the standard is perceived by the public and/or regulatory bodies than with the quality of the contents of the standard. In previous research into factors for compatibility standard dominance (van de Kaa et al., 2018, 2019a, van de Kaa et al., 2018; Van de Kaa et al., 2017b) and the establishment of a dominant design (van de Kaa et al., 2017a, 2019b, van de Kaa et al., 2017a; Van De Kaa et al., 2014a; Van de Kaa et al., 2017b, 2020) *"technological superiority"* of the standard is frequently listed as the most important factor. This leads us to conclude that it is possible that the importance of factors for the selection of standards depends on the function of the standard (to ensure interoperability or quality).

The results from this research suggest that complying with regulations and adhering to customer demands are stronger drivers for adoption than whether it creates meaningful information. As explained in the theoretical perspective, the current dominant standard in GHG accounting, the GHG Protocol has some sizeable flaws. A key source of discussion around the quality of the Protocol is related to the lack of (sector-specific) guidance it provides and the corresponding leeway this leaves for companies to select a methodology that leads to the most favourable outcome for the company instead of the broader society. This inevitably leads to a question around the added value of such environmental quality standards, and whether they do not provide polluting companies with tools to greenwash their impact, which is also put forward by Tarrant (2022). It should however be noted that these standards are being applied by companies in parallel with a growing set of legal frameworks, and actions to prevent greenwashing. Companies that abuse these standards to make misleading claims are increasingly held accountable by NGO's both in courtrooms and the court of public opinion. Well-known examples are the case brought against Shell by Milieudefensie and the case brought against a dozen oil majors by the city of Baltimore, but there are many more. Without these standards, it would be even more difficult to hold these companies accountable and create environmental policies, but it does underwrite the need for continued scrutiny of the standard and the way its implemented.

5.2. Theoretical contributions

We contribute to the literature on standards adoption in various ways. First, there are two key elements that distinguish this paper from previous research into factors that influence standard adoption. First of all, it is the first time that a specific focus was put on factors that influence the adoption of quality standards. Previous research was mostly focussed on compatibility standards or technological innovations (Hovav et al., 2004, 2011; Hovav and Schuff, 2005). Secondly, many of the preceding papers on factors influencing standard adoption are set in a business to consumer setting and study the perspective of the standard setter and the strategies it may pursue in order to influence consumers to choose for the standard. This paper, on the other hand, takes a business to business perspective and focuses on the perspective of the firm that may adopt a standard. This research has contributed to the existing body of literature by providing the first expert-verified framework of success-determining factors for quality standards in general and the case of a standardized calculation and measurement methodology for corporate GHG inventories specifically. Also, it provides insights into the relative importance of the factors.

Counterintuitively, it turns out that the most important factors for the adoption of quality standards are not related to the (tangible) technical characteristics of the standard or strategic considerations but to other aspects; in this case, primarily, the support and pressure from other stakeholders that are involved in the standardization process. An interesting area for future research is to study why this is the case. Network economists argue that a technologically superior standard will not always become adopted because of lock-in effects and network externalities (David, 1985). Could it be the case that quality standards could also lead to lock-in effects and why? Another reason could be that a common quality standard for the case under investigation has not arrived yet. Once standards are in place, their tangible characteristics might become more relevant for adoption; another area for future research.

5.3. Practical implications

A practical implication of this research is that it provides practitioners that seek to create quality standards with a checklist of aspects that can be considered in the standardization process for GHG inventory standards (so that standard adoption is reached). The results from this research stress the importance for such practitioners to dedicate sufficient resources to establishing a consortium of standard supporters that are highly regarded and perceived to be independent. Only then will there be chance that customers and governments, which are indicated to be the most important drivers for adoption of the standard, are convinced to support the standard. One of the ways in which this insight can be embedded in the standardization approach is by investigating the perspectives potential future adopters have of different parties that could take part in the consortium up front. That way the chance of a favourably received standard-setting consortium and resulting standard can be improved. Policy makers can also take lessons from the applied research, by using it to establish a favourable environment for the standardization of greenhouse gas inventories. This will increase comparability of GHG inventories and enable further mechanisms to tax and limit GHG emissions. The results indicate that by merely expressing support for a standard, governments can have a significant impact on its rate of adoption.

Furthermore, there is a great deal of uncertainty among stakeholders about the choice of a standard. This research has attempted to reduce that uncertainty by analysing which factors influencing standard adoption are relevant to this particular case and by showing which factors are important. Companies that are active in this context can use that knowledge and thus try to reduce the uncertainty associated with the decision. In addition, policy makers can use the results of this research. If they want certain standards to be chosen, then they have insight into factors for standard adoption through this research. They then know which buttons to turn to ensure that certain standards are adopted.

5.4. Limitations and areas for future research

One limitation is that the perspective of small and medium-sized enterprises was not considered in this paper. Due to the current insignificance of environmental accounting and reporting to smaller companies, little is known about how more stringent environmental requirements will influence these companies, which make up 95% of companies in OECD countries (OECD Observer, 2000). The increased demand for environmental data from these companies will not necessarily stem from more stringent governmental regulations, which are currently absent. It can also result from large industry players' increased demands for environmental information, which are trying to gain insights into their supply chain. Additional research into the influence on smaller companies of growing environmental demands and their perspective towards environmental accounting and reporting makes an interesting topic for future research.

When considering the proposed standardized measurement and calculation methodology for corporate GHG inventories, many future research directions come to mind. For example, it would be valuable to determine how aspects that are deemed important for the widespread adoption of the quality standard can be incorporated in the standard or the standardization process. Furthermore, it would be relevant to assess the feasibility of complying with the identified different factors. Is it possible to compel governmental bodies into supporting a new private standard? Furthermore, can the new standard be made compatible with all incumbent practices and standards, or will compromises have to be made?

This research employed an MCDM method to assess the importance of different criteria for adopting a standard. These methods are commonly used to compare alternatives, such as selecting the car that best fits your needs (Sakthivel et al., 2013) for predicting which biomass technology is most likely to prevail (van de Kaa et al., 2017a). No alternatives for standardized GHG accounting methodologies are assessed in this research because no alternatives are known to the authors. Future research could compare competing alternatives if and when they are established. Another option is to assess imaginary standards that are likely to develop, for example, one standard by the IFRS, one standard by an industry player, and one by governmental collaboration.

Furthermore, our results can inspire new research and provide new insights into factors for quality standards adoption. Specifically, future research could study the extent to which the list of factors that we have identified could be applicable to other cases of quality standards adoption. Our research framework (presented in Fig. 2) could be utilized in that novel research. Furthermore, it can be observed that the views of the experts differ on some aspects. It could be interesting to study why particular factors receive different weights which could lead to an increased understanding of the factors for this particular case; an area for future research. Finally, future research could study the extent to which the relevance and importance of factors for standard selection differs depending upon the function of the standard.

Finally, it would be valuable to examine the validity of the framework for other quality standards. This could be done by evaluating the weights of the criteria for different quality standards, predicting the rate of adopting a standard, and assessing if this corresponds to that standard's actual adoption rates. One of the main subjects that comes to mind is the standardization contest between ISO 26000 and the CSR performance ladder in the Netherlands, described by Moratis and Widjaja (2014). This would be a valuable case study to assess the validity of the framework because the characteristics of both quality standards are available, and the adoption rates are well known.

Data availability

Data will be made available on request.

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