Facilitating standardization in corporate greenhouse gas accounting

Identifying success-determining factors that can be influenced in the process of creating a standardized corporate greenhouse gas accounting methodology

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Coen Hoogerbrugge

Student number: 4973461

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Graduation committee

Chairperson   : Dr. G. van de Kaa, Section Economics of Technology and Innovation
Second Supervisor   : Dr. ir. E. J. L. Chappin, Section Energy and Industry
External Supervisor : Mr. E. Mul, Enterprise Architecture at Royal Dutch Shell

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Preface

Before you lies the product of months of hard but fulfilling work. I would like to thank all those how have contributed to the creation of this thesis. First of all, I want to express my gratitude to my first supervisor, Geerten van de Kaa, who has patiently provided me of guidance and valuable feedback throughout the entire process that lies behind us. I would also like to thank my second supervisor, Emile Chappin, for his clear feedback and suggestions at decisive moments during my research. Particular appreciation goes out to Erwin Mul, who has given me the opportunity to be a part of a very interesting project. Big congratulations to Erwin and the rest of the team on the launch of the Open Footprint Forum in cooperation with the Open Group, I encourage anyone who is interested in the shift to a low-carbon society to read up on this initiative. I have absolute faith that the project will be a resounding success and will be following developments closely. During this research I have had the opportunity to interview some very intelligent people, who took time out of their busy schedules to provide me with the information required to create this thesis. Many thanks go out to all of them for their time and effort.

To my family and friends, thank you for your support, both during this research and the rest of my studies. Special thanks to my parents and my (not so) little brother, of whom I have learned so much and who have always had my back. My apologies go out to my girlfriend Daphne, who has had to suffer from a lack of attention over the past months, I hope to make it up to you soon. It has been an amazing experience to complete my bachelor's degree in Industrial Engineering & Management in Groningen and now my master's degree in Complex Systems Engineering & Management in Delft. I feel privileged to have been able to study at these outstanding academic institutes surrounded by the brightest students and staff.

We are living through a strange chapter of humanity's history. The world has been brought to a practical standstill at the hand of Covid-19, which has inadvertently also significantly brought global GHG emissions down. We are at a crossroads with regards to the future of environmental policy; we can bring our industries back to their old levels of emissions as soon as possible to reduce the financial consequences of this health crisis, or we can use this moment to reshape our society in a more environmentally sustainable fashion. I hope that the calls to action from the scientific community and the increasing body of evidence that is compiling regarding the effect of global warming will not fall on deaf ears. Either way, I hope and believe that greenhouse gas accounting will be an increasingly important aspect of the way we conduct our business in the future. If this research can play a role, however minor it may be, in the development of an accurate, reliable, and transparent way of accounting and reporting greenhouse gas emissions in the future, I would be thrilled.

Coen Hoogerbrugge
Amsterdam, September 2020

Executive summary

The past years have shown devastating examples of the destruction that climate change can cause, from an increase in frequency and intensity of hurricanes, floods, and droughts to a decrease in polar ice. Widespread consensus in the academic community has been reached regarding the main contributor to global warming, anthropogenic greenhouse gas emissions. One of the tools that is employed in the fight to reduce these emissions, is greenhouse gas accounting. By keeping accounts of the greenhouse gas emissions of organizations and countries, stakeholders can be informed about a country's or organization's carbon intensity and tailored policies can be created and adapted to maximize their efficacy. An important issue that is identified regarding corporate greenhouse gas accounting, is the lack of a generally accepted standardized set of calculation and measurement methodologies for corporate greenhouse gas inventories. Such a standard has the potential to improve the perceived reliability of reports regarding greenhouse gas emissions, and to increase the compatibility and comparability of greenhouse gas inventories of different organizations. The goal of this research is to identify and assess the different factors that standard setters can use to influence the widespread adoption of such a standardized calculation and measurement methodology for greenhouse gas inventories.

The main research question to answer in this research was formulated as follows.

What aspects of the standardization process for a standardized methodology for corporate GHG inventories should a standard setter focus on to increase the probability of widespread adoption?

A multi-method research approach has been employed, combining both qualitative and quantitative research methods to establish an answer to the formulated question. The first step was to create a framework of factors which influence the probability of widespread adoption for quality standards and can be manipulated by standard setters. This framework is based on case studies regarding the adoption and diffusion of a variety of different types of quality standards, to make the framework applicable to different kinds of quality standards. A framework of 31 factors, divided over 6 categories was established for further analysis.

In order to verify the framework and determine the importance of the factors for the specific case of the proposed standard, representatives with expertise in the field of environmental accounting from the most important stakeholder groups that were identified were interviewed and asked to weigh the different factors based on their importance. The Best-Worst Method (BWM), a multi-criteria decision-making method, was used to compute the weights of importance the experts attributed to the different factors. The resulting weights of importance, averaged over all respondents, can be used to provide recommendations regarding the standardization process to organizations seeking to establish the proposed standard. The top 10 factors with the highest average weights of importance are presented in Figure 1, the 90% confidence intervals of the results are plotted around the average weights.

The ten highest ranked factors are in order of importance; *'pressure from customers', 'support by governmental bodies', 'international acceptance of the standard', 'perceived neutrality', 'compatibility with incumbent practices', 'stakeholder and third party involvement', 'support by NGO's related to the standard', 'reputation of the standard supporters', 'implementation costs'* and *'support by consultants and auditors'*. It is striking that only two of these factors (implementation costs and compatibility with incumbent practices) relate to the standard content, whereas all others relate to stakeholders related to the standard or the way the standard is perceived. The results demonstrate the important role of stakeholder management and alliance composition.

One of the takeaways from the resulting weights of importance is that the four factors relating to stakeholders, all rank in the top 10 highest valuated factors. This leads to the conclusion that it is paramount to actively involve these groups in the standard setting process and to keep them committed. Strategies for stakeholder involvement and engagement and the creation of participant buy-in and perceived ownership should be worked out to increase the probability that this aspect of the standardization process is successful.

Another recommendation based on the results relates to the importance of international acceptance. To increase the chance of the standard being recognized and approved worldwide, it will be important to ensure a global coverage of participants in the standardization process. Involvement of companies, NGO's, regulators, and other organizations from different parts of the world will increase the chance of achieving a worldwide accepted standard.

The results also indicate the importance of perceived neutrality and independence of the standard setter. This can be reached by only involving organizations which are independent, but in view of the required resources and critical mass for success of the standard, this is an improbable option. The other way to reach perceived neutrality is by involving enough respectable independent organizations in the standardization process to compensate for the organizations which do have commercial interests. By involving highly regarded NGO's and governmental organizations and providing them with demonstrable authority in the process, the public opinion of the standard and its creators is more likely to lean towards neutral and independent.

Several limitations were identified regarding the conducted research. First, very little is known about the possible form the proposed standard may take. Therefore, a broad framework was created with generic factors. Consequently, ambiguity existed regarding the interpretation of the factors, which led to widely varying evaluations of the factors by the different experts. This can be mitigated in future research by focussing on specific aspects of the standardization process, rather than attempting to consider all the different types success-determining factors which can be influenced by standard setters. For the proposed standard, it would for example be recommended to investigate the different ways in which different stakeholders can be engaged and involved.

Secondly, because the data collection for this research was performed through interviews, the number of respondents that could be involved was limited. The opinions of eight experts are aggregated in the results of this research, which is a rather small sample size. It is difficult to say how well the averaged weights of importance resulting from this research represent the 'true' weights of importance, if those even exist. Future research, based on surveys, could be used to increase the sample size, thereby providing more robust results. The results of such a research could be used to verify the resulting weights of importance from this research.

This research contributes to the body of standardization literature in two ways

1. It established and tested a comprehensive framework of factors that can be used by standard setters to influence the adoption rate of quality standards. This framework can be used as a starting point for future research into quality standard success.
2. The research proposes a new subclassification of quality standards. The definition of quality standards is so broad, that it incorporates highly dissimilar standards. A subclassification scheme for quality standards is proposed to enable more focussed research to be performed in this field.

This research provides organizations seeking to create a standardized methodology for corporate GHG inventories with a list of aspects that should be considered in the standardization process. The attributed weights of importance for the success-determining aspects can help to substantiate decisions and compromises which will have to be made during the process of creating this methodology.
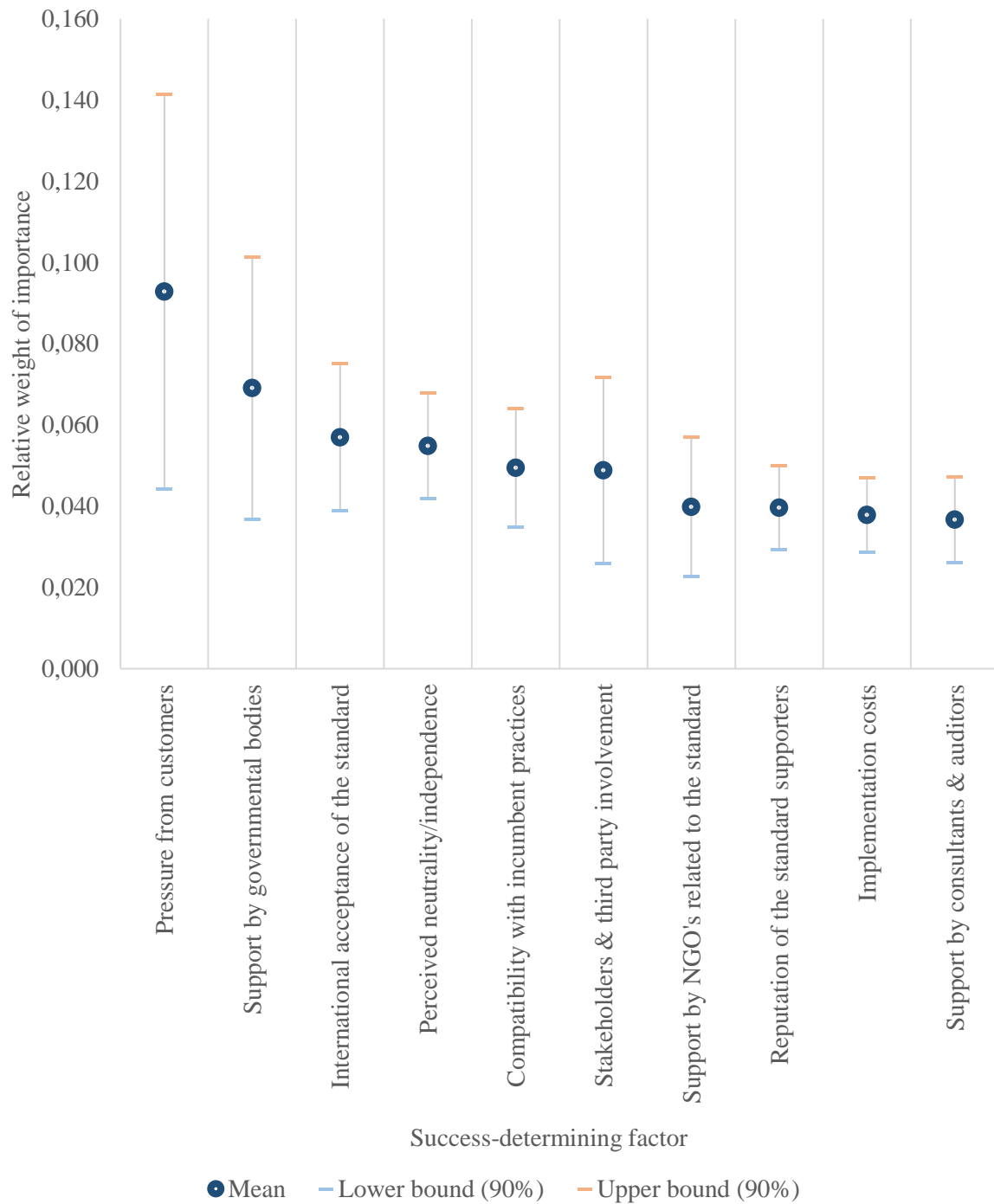
Figure 1. The weights of importance for the 10 most important factors and their 90% confidence intervals.

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AHP	Analytical Hierarchy Process
BWM	Best-Worst Method
CDP	Carbon Disclosure Project
CR	Consistency ratio
CSR	Corporate Social Responsibility
ERP	Enterprise Resource Planning
EU ETS	European Union Emissions Trading Scheme
FSC	Forestry Stewardship Council
GHG	Greenhouse gas
GRI	Global Reporting Initiative
GWP	Global Warming Potential
IASC	International Accounting Standards Committee
IPCC	Intergovernmental Panel on Climate Change
IFRS	International Financial Reporting Standard
MCDM	Multi-criteria decision-making
MNC	Multinational corporation
MSC	Marine Stewardship Council
NGO	Non-governmental organization
OECD	Organization for Economic Co-operation and Development
SASB	Sustainability Accounting Standards Board
SDO	Standard-developing organization
SME	Small and medium-sized enterprises
TCFD	Task Force on Climate-related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1. Introduction

Humanity is facing one of its most pressing challenges so far, global warming. It has the potential to bring about drastic and irreversible changes to our physical environment, our biosphere, and our 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 the warming of our planet (Pachauri et al., 2014). Many of these effects are already becoming visible, such as the loss of arctic sea ice (Collins, 2019) and an increase in severity and frequency of extreme weather events (De Sario, Katsouyanni, & Michelozzi, 2013; Field, Barros, Stocker, & Dahe, 2012).

The largest contributor to anthropogenic (i.e. human induced) global warming is currently believed to be the elevated emission of greenhouse gasses. The United Nation's Intergovernmental Panel on Climate Change (IPCC) remarked that it was *'very likely'* that *'the observed increase in globally averaged temperatures since the mid-20th century is due to the observed increase in anthropogenic greenhouse gas concentrations'* (IPCC, 2007). When talking about greenhouse gasses, we generally refer to the four gasses and two groups of gasses identified under the Kyoto Protocol, respectively carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulphur hexafluoride (SF_6) & perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs).

In December 1997, over 160 parties to the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Kyoto protocol. This treaty imposed the first legally binding limits on emissions of Greenhouse Gasses (GHGs) with the aim to constrain the negative effects of global warming. The Kyoto protocol was succeeded by the Paris Agreement in April 2016, in which 196 parties pledged to *'hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels'* (United Nations, 2015). Despite having identified and recognized GHG emissions as the main cause of global warming and the establishment of the aforementioned treaties, global emissions keep on rising. The Global Carbon Project estimated in December 2019 that the global GHG emissions for that year would have increased approximately 0,6% compared to 2018's emissions (Friedlingstein et al., 2019). Even though this is lower than the 1,1% increase in 2018 and the 2,2% increase in 2017, it 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).
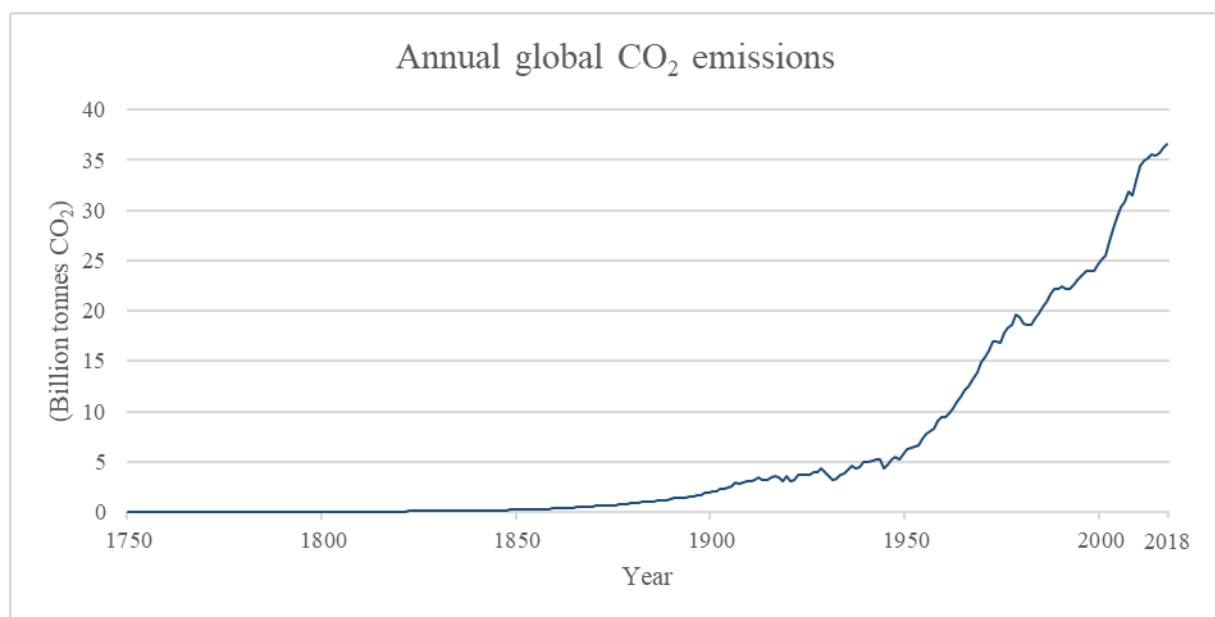
Figure 2. The annual global CO2 emissions can be seen to increase sharply in the past 50 years.
Source: Carbon Dioxide Information Analysis Center (CDIAC); Global Carbon Project (GCP)

1.1 Greenhouse gas accounting

One of the tools that is being employed in the effort to reach the goals set out in the Paris Agreement is GHG emissions accounting and reporting. As Cowie, Eckard, and Eady (2012) argue, *'we need to be able to quantify emissions in order to make informed decisions and monitor the success of these actions.'* In the past decades, more and more companies have been disclosing GHG emissions in their annual reports or in separate sustainability reports. Like financial accounting, GHG accounting can be performed either for regulatory or voluntary reasons. Some companies file environmental reports to comply with governmental regulations, others choose to do so to comprehensively inform their shareholders or to identify potential areas for saving energy and money. Under directive 2014/95/EU of the European Parliament and the European Council, member states are required to adopt legislation that obligates large[1] European companies to include consolidated non-financial information in their management reports. This includes, but is not limited to, *'the use of renewable and/or non-renewable energy [and] greenhouse gas emissions'* (EU Parliament & EU council, 2014). A directive leaves member states with a certain amount of leeway to adapt its content when it is implemented in national legislation. As Jeffery, Tenwick, and Bicciolo (2017) write, this leads to considerable divergence in requirements for non-financial disclosure set out by different European countries.

This brings us to one of the big challenges concerning corporate GHG reporting, the lack of comparability and compatibility. Due to the diverging legislation on environmental disclosure and compliance in different countries and different sectors and the multiplicity of methodologies used for creating greenhouse gas inventories and reports, it becomes difficult for stakeholders to rely on the information that is provided. Literature points out that the plurality of methodologies for GHG inventories leads to three main problems that undermine its efficacy: reduced comparability for investors, reduced actionability for governments and reduced reliability for consumers (Jose, 2017; Kauffmann & Less, 2010). This is problematic as these three stakeholders should be the main drivers for companies in their transition towards a more environmentally sustainable future. Over the past decades several efforts have been made to harmonize the field of greenhouse gas accounting, with varying degrees of success. Despite these efforts there is still apparent disharmony of the methodologies applied for creating corporate GHG inventories. Companies report their GHG emissions based on varying, sometimes proprietary, guidelines and methodologies. It can therefore be concluded that a universal standard has not yet emerged, Section 3.1 provides empirical evidence for this statement.

1.2 Research problem

There is a large variety of standards for corporate greenhouse gas inventories, the GHG Protocol Corporate Standard by the WRI and the WBCSD is the dominant standard in this field, but it leaves ample room for improvement. Companies divert to country-specific, sector-specific, or proprietary guidelines for guidance on the available and appropriate methods for data collection and processing, leading to low comparability between their inventories. In the effort towards a universal standardized methodology for corporate greenhouse gas inventories, an abundance of choices and trade-offs will have to be made and priorities will have to be set. A framework that reveals the most critical factors for success of the envisioned standard that the standard setter can influence will be a highly beneficial tool in this regard. Research into the factors that influence success of standards has in the past mainly been focussed on compatibility standards or technological innovations (Keil, 2002; van de Kaa, van den Ende, de Vries, & van Heck, 2011; van den Eijnden, 2019). The proposed standard can be characterized as a quality standard, no meta-research into the success factors for this type of standards was found, making it difficult to prioritize resources in standardization processes concerning quality standards.

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[1] Public interest entities with an average number of 500 employees or more during the financial year (EU Parliament & EU council, 2014).

1.3 Research objective

The Open Footprint initiative, which is initiated by Shell, aims to create an opensource data platform for corporate environmental data, to increase compatibility and comparability of GHG inventories. As a part of that initiative, this research looks at the creation of a standardized methodology for corporate GHG inventories. Creating and diffusing standards is a resource intensive endeavour but can provide a critical step in reaching environmental goals. The aim of this research is to provide those wanting to create a standardized methodology for GHG accounts with knowledge about which aspects of the standardization process they can and should focus on to increase the probability of widespread adoption of the standard. These insights can help the standard setters to prioritize the available resources effectively.

1.4 Research questions

The main research question that will be answered during this thesis is:

What aspects of the standardization process for a standardized methodology for corporate GHG inventories should a standard setter focus on to increase the probability of widespread adoption?

A set of sub-questions has been formulated, to ensure a structured path towards answering the main research question. By answering each of the following sub-questions, an answer to the main research question will be constructed:

Sq 1.   *What are the different factors that influence the adoption of private quality standards and can be manipulated by standard setters?*

The first question is supposed to give an overview of all the different factors that have determined success or failure for quality standards in the past.

Sq 2.   *What are the most important stakeholders in the creation of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?*

The second question is used to identify the groups of actors that are related to the standardization process of the proposed standard and whose opinion should be included in the assessment of the factors arising from the first sub-question.

Sq 3.   *What is the relative importance of the factors identified in Sq 1. for the widespread adoption of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?*

The last question is used as assessment of the factors. First, it provides validation of whether the factors that were identified in Sq 1. are indeed the most important success-determining factors. And secondly, the attributed weights for the different factors enable standard setters to make a distinction between the factors based on their importance.

1.5 Research approach

To answer the main research question a mixed method research approach was employed. A combination of qualitative and quantitative research methods was used to create a framework of success-determining factors and to relate that framework to the case of a standardized methodology for corporate GHG inventories. In this section the data that was required to answer each of the sub-questions is identified and the research methods that were used to obtain and analyse that data are presented.

Sq 1.   *What are the different factors that influence the adoption of private quality standards and can be manipulated by standard setters?*

This sub-question was answered through an extensive literature research. Empirical case studies examining the diffusion and adoption of a wide variety of quality standards were collected from

academic databases and investigated. From this literature a long list of factors that influenced the adoption of those quality standards was created, which was later reduced to a workable size. This list was discussed, amended, and verified through individual interviews with two experts in greenhouse gas accounting working for Shell.

Sq 2. *What are the most important stakeholders in the creation of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?*

In order to identify the most salient stakeholders, a structured stakeholder analysis methodology for IT standardization situations, constructed by de Vries et al. (2003), was applied. This analysis was performed in an interactive workshop session with members of the Open Footprint team at Shell.

Sq 3. *What is the relative importance of the factors identified in Sq 1. for the widespread adoption of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?*

The last sub-question was answered through a series of semi-structured interviews with experts on environmental accounting from a variety of different backgrounds. The experts each represented one of the groups of stakeholders identified in the second sub-question. During the interviews, the experts were asked to compare the factors they were presented with in terms of importance on the basis of the Best-Worst Method (BWM), a multi-criteria decision-making method put forward by Rezaei (2015), and to comment on the rationale behind their attributed weights. This resulted in quantitative weights of importance for each of the identified factors and a list of qualitative remarks substantiating the importance attributed to the factors.

1.6 Thesis structure

In chapter 2 the theoretical background for this research is presented. It contains an overview of prior research into the factors that influence success in standardization, an examination of the different classes of standards identified in literature and an overview of prior research into quality standards. Chapter 3 outlines the current common practices in GHG accounting and reporting by looking at the external communication of 100 of the largest corporations in the world and the WRI/WBCSD Greenhouse Gas Protocol. Chapter 4 presents the research methodology with more in-depth elaboration on the applied research methods. The framework of success-determining factors, the stakeholder analysis and the attributed weights of importance resulting from the interviews are presented in chapter 5. Each of the research sub-questions are answered in chapter 6. Chapter 7 contains a discussion regarding the performed research; it contains among others a statistical interpretation of the attributed weights, an interpretation of the unit 'weight of importance' and it proposes a new classification of quality standards. Finally, chapter 8 provides the conclusions related to the main research question of this research, it outlines the contributions and limitations of this research and it provides recommendations for future research.

2. Theoretical background

2.1 Factors that determine success in standardization

Through the years, many academics have investigated why some standards succeed in diffusing widely and sometimes even attaining market-dominance, and others fail to do so. Academic databases, such as Scopus, Web of Science and Google Scholar, were employed to explore the academic literature related to this subject. A massive body of literature is concerned with studies of specific standardization processes and the aspects that influenced the adoption rate of the standard in those particular situations. A selection of these factors will be discussed later in this research. For this part of the research two types of literature were considered; (1) meta-analyses combining multiple prior studies to create frameworks of factors that influence the success of standards, and (2) case studies applying frameworks of success-determining factors to specific standardization situations to assess the importance of those factors. Search queries like *'standard success'*, *'standard dominance'*, *'standard battles'*, *'dominant design'*, *'factors for success of standards'* and *'determinants for success of standards'* were used to collect articles.

30 years ago, Anderson and Tushman (1990) proposed their evolutionary model of technological change. It stated that a technological breakthrough leads to an era of ferment, in which there is a battle for dominance amongst competing designs or standards. After this era of ferment, the resulting dominant design is elaborated during an era of incremental change until the next technological breakthrough. 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. This was the first article that was found to accumulate the work of others to create a framework of factors that determine standard success and much of the more recent literature that was found is based on this article.

Schilling (1998) takes the framework proposed by Anderson and Tushman (1990), and adapts it to focus on factors that that cause two types of lockout for companies; (type I) in which a company produces products according to a certain standard that is subsequently rejected by the market because the competing standard gains dominance, and (type II) in which a company is unable or barred from using the existing dominant standard in its products. Schilling combines literature from industrial organization economics, strategic management, and marketing strategy to identify factors that determine which of the competing standards attains dominance. The idea being, that if you can predict which standard among multiple competing standards will become dominant, you can prevent type 1 lockout. This provides a very good next step towards a framework that companies can use to improve the probability of success of a new standard.

Since Schilling, several scholars have published work on standard success and the factors that influence it. A selection of the most pertinent standardization literature available on standard success is listed in Table 1. Suarez (2004), van de Kaa et al. (2011) and Argam, de Vries, and Bode (2011) combine insights from literature on technology management, sociology of science and technology, marketing, evolutionary economics, industrial economics and institutional economics, in order to come up with frameworks of success-determining factors. Suarez (2004) identifies multiple phases in the process of technological dominance and indicates key factors for success in each of these phases. van de Kaa et al. (2011) propose a comprehensive list of success-determining factors in interface-format battles, based on 127 prior publications. And Argam et al. (2011) use a logistic regression model to determine the importance of marketing communications on standard dominance.

The other articles listed in Table 1 concern case studies in which frameworks of success determining factors are applied to specific cases, in order to assess the importance of the factors. The perspective of these articles differs widely from one another. Gallagher (2012) and M'Chirgui (2015) take a retrospective approach, in which they assess the importance of different factors in specific cases based

on the historical standard battle between HD-DVD and Blu-Ray. Both of these articles emphasize the importance of the composition of a standard setting alliance regarding the probability to attain dominance in standard battles. Van de Kaa, van Heck, de Vries, van den Ende, and Rezaei (2014), van de Kaa, Kamp, and Rezaei (2017), and van de Kaa, Janssen, and Rezaei (2018) determine the importance of different aspects of the standardization process by means of MCDM models, and apply the attributed weights to historical or ongoing standard battles. Van De Kaa, van Heck, et al. (2014) use three historical technology standard battles to evaluate the importance that experts attributed to different success-determining factors. Van de Kaa, Kamp, et al. (2017) and van de Kaa et al. (2018) both use the BWM to determine the importance of success-determining factors, these weights are subsequently used to predict the outcome of ongoing standard battles between respectively biomass thermochemical conversion technologies and business-to-government data exchange systems. Lastly, Ghaffari, Arab, Nafari, and Manteghi (2017) take an approach similar to the one in this research; they identify key success factors for technological developments in the remotely-piloted helicopters industry in order to make recommendations regarding the efficient allocation of resources. They conclude that factors associated with actors and networks form the most important category for that specific industry. A comparison between the results from the mentioned articles and the results of this research will be provided in section 7.5.

As can be seen from the table, nearly all of the available literature is concerned with compatibility standards or technological developments. David and Greenstein (1990) attribute the increased importance of compatibility standards to their strategical significance in the development and marketing of computer operating systems and software, value added data networks, local area networks, television, and optical disks. Our networked society is built on these types of systems and relies heavily on their compatibility. This could be an explanation for the dominance of compatibility standards in standardization literature.

TITLE	SOURCE	SUBJECT	TYPE	STANDARD TYPE
Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change	(Anderson & Tushman, 1990)	Technology standards	Framework	Technological development
Technological Lockout: An Integrative Model of the Economic and Strategic Factors Driving Technology Success and Failure	(Schilling, 1998)	Technology standards	Framework	Technological development
Innovation and competition in standard-based industries: a historical analysis of the US home video game market	(Gallagher & Park, 2002)	Home video gaming systems	Case study	Compatibility
Battles for technological dominance: an integrative framework	(Suarez, 2004)	Information & telecommunication	Framework	Compatibility
The influence of marketing communications on the dominance of standards	(Argam et al., 2011)	General	Framework	Compatibility
Factors for winning interface format battles: a review and synthesis of the literature	(van de Kaa et al., 2011)	Interface formats	Framework	Compatibility
The battle of the blue laser DVDs: The significance of corporate strategy in standards battles	(Gallagher, 2012)	Data storage formats	Case study	Compatibility
Investigation and evaluation of key success factors in technological innovation development based on BWM	(Ghaffari et al., 2017)	Remotely Piloted Helicopters	Case study	Technological development
Supporting Decision Making in Technology Standards Battles Based on a Fuzzy Analytic Hierarchy Process	(van De Kaa, van Heck, et al., 2014)	Technology standards	Case study	Compatibility
Determinants of success in setting standards coalition: empirical evidence from the standard war of the blue laser DVDs	(M'Chirgui, 2015)	Data storage format	Case study	Compatibility
Selection of biomass thermochemical conversion technology in the Netherlands: A best worst method approach	(van de Kaa, Kamp, et al., 2017)	Biomass conversion technologies	Case study	Compatibility
Standards battles for business-to-government data exchange: Identifying success factors for standard dominance using the Best Worst Method	(van de Kaa et al., 2018)	Business-to-government data exchange	Case study	Compatibility

Table 1. Selection of the literature focussed on factors that determine standard success.

2.2 The classification of standards

In the previous section it was concluded that the majority of literature concerned with standard success is occupied with the study of compatibility standards. A gap in the literature is identified regarding the factors that influence the adoption of quality standards, which is what this research will focus on. This introduces the question of what a quality standard is exactly, and how it differs from other types of standards. This section will elaborate on that question and formulate an answer based on extant literature.

Different classifications have been proposed by various academics, companies, and organizations in pursuance of order in a quickly expanding field of standardization. The ISO, for example, has developed an 8-digit International Classification for Standards, aimed at organizing the more than 2300 standards they offer (ISO, 2015). This is a highly effective tool for guiding people through the vast number of standards they provide, but it is too specific for academic purposes, so researchers often turn to other classification mechanisms. One of the first scholars to perform a meta-analysis on the subject was de Vries (1998). He collected different classifications schemes that were used at the time and wrote a review article on the matter. One of the types of classification schemes he identifies is based on the subject-matter of the standard, it divides standards as follows.

1. Basic standards
2. Requiring standards
    2.1. Performance standards
        2.1.1.Interference standards
        2.1.2.Quality standards
    2.2. Solution describing standards
        2.2.1.Interference standards
        2.2.2.Compatibility standards
        2.2.3.Quality standards
3. Measurement standards

He proposes that quality standards "*set requirements for entity properties to assure a certain level of quality. . . . Quality standards are often related to the company's operations, and, in many cases the company is free to set or choose them*" (de Vries, 1998). This definition provides a good starting point when discussing quality standards but lacks specificity. 20 years later, Ho and O'Sullivan (2018) proposed a new classification of standards by combining classification systems from different standardization fields:

1. Terminology and semantic standards
2. Measurement and characterisation standards
3. Quality and reliability standards
4. Compatibility and interface standards
5. Variety-reduction standards

They assert that quality and reliability standards *"specify acceptable criteria along various dimensions, such as functional levels, reliability, efficiency, health and safety, and environmental impact, in order to improve their performances, expanding market share through performance assurance and reduction in transaction costs"* (Ho & O'Sullivan, 2018).

The definition proposed by Ho and O'Sullivan (2018) is more elaborate and more specific, which is why their definition of quality standards is believed to be more appropriate for this research. This definition will be used as criteria for the selection of case studies in the pursuit of factors that influence the adoption of quality standards. The factors that are contained in the framework must originate from case studies into standards which adhere to the definition proposed by Ho and O'Sullivan (2018).

2.3 Research into quality standards

After having defined what quality standards are, this section will provide an overview of the literature that was found relating to this type of standards. When searching for *"quality standard"* on Scopus, nearly all the papers that were found related to one of the following two topics:

1. Environmental quality standards
   Notably regarding air quality (Bravo Alvarez, Sosa Echeverria, Sanchez Alvarez, & Krupa, 2013; Chen, Wang, Xiao, Wu, & Zhang, 2015; Cochran, Pielke, & Kovács, 1992; Hamilton & Requate, 2012; Hogsett, Tingey, Lee, Beedlow, & Andersen, 2008; Ma, Wang, Yu, Zhang, & Cao, 2016; Sharratt & Edgar, 2011; Spickett, Katscherian, & Harris, 2013; You, 2013), and water quality (An, Kwak Ii, Nam, & Jung, 2014; Ghekiere et al., 2013; Moermond & Smit, 2016; Zhang & Yan, 2012).
2. Minimum quality standards for products
   Among others regarding cement (Tanaka, Kondou, Takahashi, & Kobayashi, 2015), passenger trains (Rothbauer & Sieg, 2011), medicine (Zhao, Ma, & Yu, 2017; Zhou & He, 2014), food (Kotsanopoulos & Arvanitoyannis, 2017) and drinking water (Gara, Fengting, Nhapi, Makate, & Gumindoga, 2017; Huang et al., 2004).

Further investigation of the literature showed that a wide variety of different kinds of standards are classified as quality standards; (minimum) product quality standards like the ones listed above, environmental quality standards, safety standards, service quality standards for sectors like healthcare (Whittaker, Linegar, Shaw, & Spieker, 2011), and standards to promote quality management. Despite the fact that all of these various types of standards fall within the definition by Ho and O'Sullivan (2018), they show significant dissimilarities regarding their subject, implementation and content. Despite the vast differences between these different types of quality standards, no further subclassification was found in extant literature. In section 7.6 such a system will be proposed to further define the different types of quality standards and enable more specific research into the different classes of quality standards.

The majority of the literature that was found regarding quality standards assesses the effects and/or efficacy of government- or regulator-enforced quality standards. Because these types of standards are imposed through the hierarchical position of a government or regulator, there is no need to assess the probability of success of the standard or the factors that influence it. It is certainly quite hard for a standard whose adoption is mandatory not to succeed. A lack of literature is identified regarding the factors influencing quality standard-adoption. The only sources that were found to discuss this topic were case studies regarding specific private quality standards, a selection of which will be discussed in section 5.1.1. Due to the increasing importance of quality and the standardization thereof, it is strange that these topics almost only get attention in scientific literature based on case studies. Little to no research into quality standards in general was found, and the adoption of quality standards was almost exclusively assessed for specific standards and geographical areas, leaving an interesting gap to fill with this and future research.

3. Current common practices in GHG accounting & reporting

The field of environmental accounting and reporting is a complex environment of regional, national, and supranational regulations, protocols, conversion factors and guidelines created by governmental organizations, NGO's, and corporations. To obtain a clear overview of the current situation, a thorough analysis was performed consisting of multiple components. First, in section 3.1 an analysis of the sustainability reports and annual reports of the 100 largest companies from the Forbes Global 2000 is presented, focussed on the methodologies they report using to create their GHG inventories. Section 3.2 focusses on the WRI/WBCSD GHG Protocol, one of the most dominant guidelines for GHG inventories. And finally, section 3.3 identifies areas of improvement in the current GHG accounting and reporting field.

3.1 Analysis of the 100 largest companies worldwide

To gain insight into the current standards and methodologies that are applied in corporate GHG accounting, the public reports of the top 100 companies from the Forbes Global 2000 list were analysed. 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, 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 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 excellent insight into the methodologies used by companies to create their GHG inventories.

An overview of the companies that were investigated and the corresponding methodologies and standards they reported using can be found in Appendix A. The guidelines that were most prevalently mentioned by the companies were the WRI/WBCSD Greenhouse Gas Protocol corporate standard (GHG protocol) (75 out of 100 companies), GRI 305:Emissions (61 out of 100 companies), and the ISO 14064-3:2019 standard (24 out of 100 companies). A closer look at these guidelines shows that the components of the GRI 305 standard related to greenhouse gas inventories are entirely based on the WRI/WBCSD Greenhouse Gas Protocol: *"The reporting requirements for GHG emissions in this Standard are based on the requirements of the 'GHG Protocol Corporate Accounting and Reporting Standard'"* (Global Reporting Initiative, 2016). And furthermore that the ISO 14064-3:2019 standard *"is consistent with best practice established in the Greenhouse Gas Protocol Corporate Accounting Standard"* (Weng & Boehmer, 2006). Due to the similarities in scope and near-complete alignment between these three standards, a reference to the GRI or ISO standard can be seen as a reference to the GHG protocol. If this simplification is applied, 90 out of the 100 companies that were analysed apply the GHG protocol itself, or a standard based on the GHG protocol. The WRI/WBCSD GHG protocol is thus the dominant standard with regards to corporate GHG inventories. Section 3.2 will dig deeper into the GHG protocol's features.

Apart from the three mentioned guidelines, a variety of other standards and conversion factor databases were identified. These could be divided into national guidelines, sector-specific guidelines, stock exchange-specific guidelines, reporting guidelines and emission factors. A flowchart outlining the components of the generalized process for corporate GHG inventories of the companies that were studied is provided in Figure 3. The corresponding components are explained in further detail below.
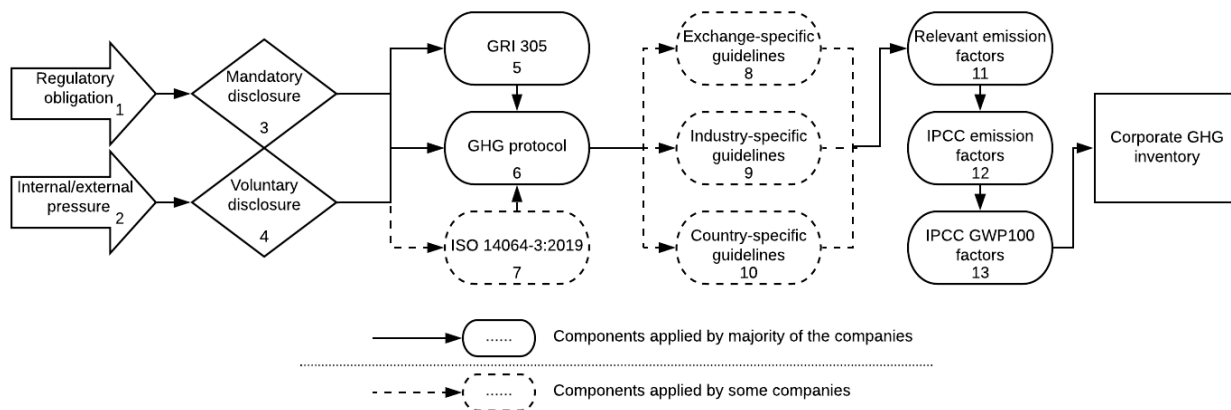
Figure 3. Flowchart of the generalized process for corporate GHG inventories.

1. Some countries obligate certain companies by law to disclose non-financial performance indicators, such as environmental data. An example is the directive 2014/95/EU, which has been adopted in national law by all member states (CSR Europe & GRI, 2017). This directive obligates public interest companies larger than threshold values of 500 employees, €20 million balance sheet total, or €40 million net turnover, to disclose non-financial statements containing, inter alia, a statement of the organization's GHG emissions (EU Parliament & EU council, 2014).

2. An increasing number of companies voluntarily choose to disclose corporate social responsibility (CSR) reports (Carey, Liu, & Qu, 2017; KPMG, 2017). An important component of these CSR reports is the disclosure of environmental information and GHG emissions. The increase in voluntary reporting can be attributed to internal motivation or pressure from investors, NGO's, and the public.

3. Some companies are obligated by law to disclose their GHG emissions.

4. Others choose to do so voluntarily, and therefore need to create a corporate GHG inventory.

5. The majority of the investigated companies applied the Global Reporting Initiative (GRI) standards, a set of reporting standards that helps businesses, governments and other organizations to understand and communicate their impact on issues such as climate change, human rights and corruption. The GRI 305 standard is dedicated to corporate emissions, for its part on GHG emissions it refers directly to the GHG protocol.

6. The WRI/WBCSD GHG Protocol is the dominant standard for greenhouse gas inventories. More on the GHG protocol in section 3.2.

7. ISO 14064-3:2019 is the International Organization for Standardization's (ISO) standard for greenhouse gas accounting. Part 1, related to GHG inventories, is based on, and aligned with the GHG protocol. As opposed to the GHG protocol, the ISO standard does have the possibility of external verification and certification, which is why it is often implemented in conjunction with the GHG protocol.

8. Some stock exchanges have specific reporting guidelines for listed companies, such as the HKex ESG Reporting Guide (HKEx, 2018). These guidelines outline what kind of environmental-, social- and governance-related information listed companies should report and where they should report it.

9. For certain, usually GHG emission-intensive, industries and sectors, specific guidelines with regards to GHG accounting and reporting are drawn up. One of the most frequently referenced guidelines for the oil and gas industry is the *American Petroleum Institute Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry* (Shires, Loughran, Jones, & Hopkins, 2009). These documents provide guidance for GHG emissions accounting related to industry- or sector-specific operations and processes and can be seen as extensions of generic standards like the GHG protocol. The website of the GHG protocol contains a list of sector-specific guidelines for the logistics-, aerospace-, waste-, construction- and pharmaceutical-sectors.

10. Some countries provide environmental accounting guidelines for businesses operating in their territory or settled in their territory, such as the USA's guidance on *Mandatory reporting of greenhouse gases; final rule* (US Environmental Protection Agency, 2009) or New Zealand's *Guidance for Voluntary, Corporate Greenhouse Gas Reporting* (Ministry for the Environment, 2016). The latter of which specifically recommends following the GHG protocol when accounting and reporting emissions. These national guidelines often relate to the possibility for verification of the GHG inventories in that country and the accepted emission and conversion factors that should be used.

11. Since most GHG emissions are still estimated through calculations based on e.g. inputs, processes, and temperature, rather than through direct measurements of the emissions, there are large numbers of emission conversion factors involved. Most notable in this regard are the conversion factors used to convert energy consumption to emissions. Since the energy mix changes from country to country and from year to year, these are often national emission factors that are re-issued each year. Companies should convert the electricity they have consumed by means of these emission factors for each of the countries they operate in. An example of these are the *UK Government GHG Conversion Factors for Company Reporting* (DBEIS & DEFRA, 2019).

12. The IPCC has published an abundance of conversion factors in their *2006 IPCC guidelines for National Greenhouse Gas Inventories* (Eggleston, Buendia, Miwa, Ngara, & Tanabe, 2006). It contains emission factors for among others the combustion of fuels, storage of waste and chemical processes. Even though these guidelines are focussed on national GHG inventories, the conversion factors that are mentioned are widely applied in corporate GHG inventories as well. The use of the IPCC guidelines is widespread, and it can therefore be seen as the international standard for conversion factors.

13. The IPCC has furthermore published a list with the 100-year time horizon Global Warming Potential (GWP) relative to CO_2 of all greenhouse gasses (Myhre et al., 2013). These factors are used to convert non-CO_2 GHG emissions to CO_2 equivalents, an often-used metric in GHG accounting. This conversion enables the comparison of different entities with different types of GHG emissions. The list published by the IPCC is the dominant international standard and is adopted by nearly all organizations which carry out this type of conversion.

3.2 Greenhouse Gas Protocol

The preliminary analysis presented in the previous section and further literature research leads to the conclusion that the Greenhouse Gas protocol is the dominant guideline for corporate GHG inventories. 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. Admittedly, the focus has so far been solely on large multinational companies, but despite this shortcoming it is still believed fair to conclude that the GHG protocol is the worldwide dominant standard for corporate GHG inventories. This chapter will elaborate on what the GHG protocol is, what it provides guidance for, and how it relates to other standards and guidelines.

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.

The GHG protocol provides guidance on the following matters when creating a corporate GHG inventory (Ranganathan et al., 2005):

- Setting organizational boundaries
- Setting operational boundaries
- Dividing different sources of GHG's into three scopes (see Figure 4)
- Tracking emissions over time
- Identifying emission sources
- Calculating emissions from specific sources

- Managing inventory quality
- Accounting for GHG reductions (Further elaborated in Greenhalgh et al. (2005))
- Reporting of GHG emissions
- Verifying GHG emissions
- Setting GHG targets
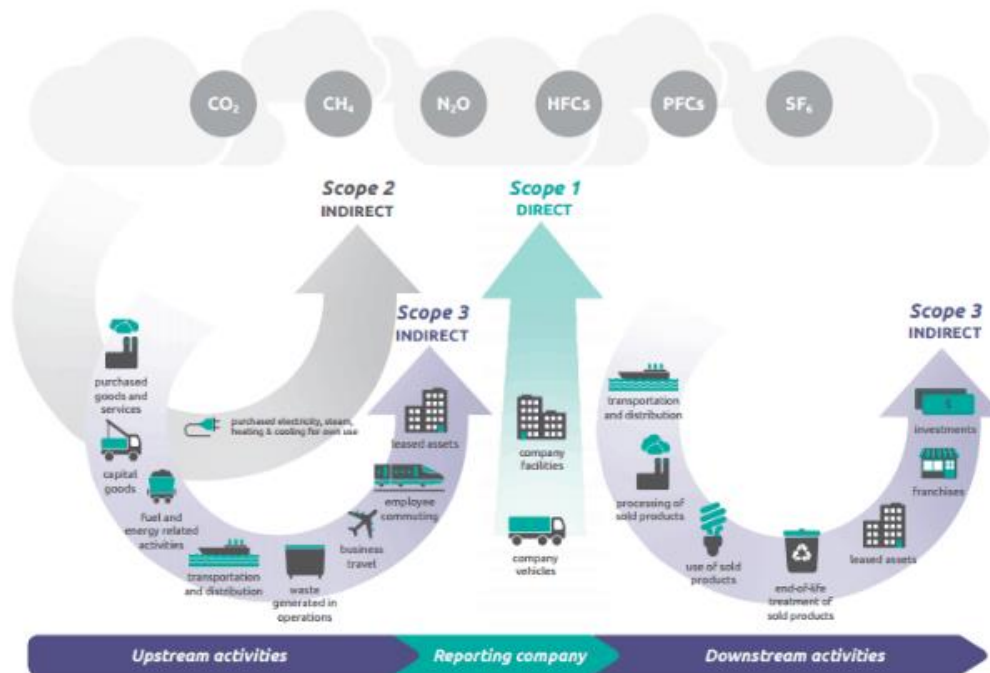
Figure 4. Division of GHG emissions into scopes according to the GHG protocol

3.3 Space for expansion of the GHG protocol

Upon inspection of the GHG protocol and discussion with HSSE reporting experts within shell, two main areas for improvement emerged.

First of all, 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 SMEs. Because of this lacking overview of methodologies, there is also 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.

Currently, 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). 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."*

Standardizing and harmonizing the calculation and measurement methods used for creating GHG inventories has the potential to influence global emissions in multiple ways.

1. Providing information on the applied methodologies and the effect this has on the quality of an organization's GHG inventory will increase the perceived reliability to the public and especially investors. This could lead to more environmental considerations when consuming and investing, thereby stimulating organizations to reduce their emissions (Jose, 2017).

2. Information about the collection of emissions data will become more accessible to SMEs, this will reduce the costs of implementation and improve the accounting and reporting practices in this segment of organizations. Hendrichs and Busch (2012) indicate that the environmental management guidelines and standards are too over-engineered for SMEs and require too much financial and human resources to implement. Providing SMEs with an overview of the methodologies available and indicating the required resources and the implications on quality, can serve as a tool to make more substantiated decisions regarding their GHG inventories.

3. According to Mamouni Limnios, Ghadouani, Schilizzi, and Mazzarol (2009), communication of product- or service-related footprints would make consumers aware of their responsibility in creating a more environmentally-friendly world through their consumption patterns. Due to the networked nature of our industry, such footprints would require coupling the GHG inventories of many different organizations. Even though the proposed standards would not solve the problem of attributing emissions to products or services, it would make communication regarding the quality of the different components used to comprise a product- or service-related footprint possible. This becomes especially important when considering long and heterogeneous supply chains. In this sense, the saying *"the whole is greater than the sum of its parts"* is only accurate if you know the quality of the parts that make up the whole footprint, otherwise we could better refer to a more vulgar saying regarding databases: *"Shit in. Shit out."*

This research will therefore focus on the standardization process of the methodologies that are used to collect, calculate and measure GHG emissions for corporate GHG inventories. The proposed standard is a sort of International Financial Reporting Standard (IFRS) for environmental accounting instead of financial accounting. It provides guidance on the employment of approved methodologies, and provides insight into their critical characteristics, like resource-intensity, requirements, and outcome-quality. This will help organizations to choose the methodology that is most appropriate for their situation and will facilitate communication regarding the quality of their GHG inventory.

4. Research methodology

This chapter outlines all the methods that were used for the different components of the research.

4.1 Framework of factors influencing quality standard adoption

4.1.1 Factor identification

A meta-analysis of the existing literature on quality standards was performed to identify success-determining factors. Papers containing case studies of various quality standards were collected through scientific databases like Elsevier's Scopus, Clarivate Analytics' Web of Science, and Google Scholar. These case studies concern both successful and less successful diffusions of quality standards and propose factors that influenced the resulting level of adoption of the standards under investigation. Due to the broad and ambiguous definition of quality standards, it was chosen to cast the net wide and to investigate as many different types of private quality standards as possible. This resulted in a list of 22 case studies, ranging from process-quality standards such as standards for health care (Brand, Ibrahim, Cameron, & Scott, 2008), group care (Boel-Studt, Huefner, & Huang, 2019) and management-quality standards like ISO 9000 (Castka & Corbett, 2015), ISO 14000 (Curkovic, Sroufe, & Melnyk, 2005) and ISO 26000 (Balzarova & Castka, 2012; Castka & Balzarova, 2008), to accounting- and reporting-quality standards (Carlson, 1997; Moratis & Widjaja, 2014; Phan, 2014), food-quality standards (Escanciano & Santos-Vijande, 2014; Fulponi, 2006; Reardon, Codron, Busch, Bingen, & Harris, 1999) and more. Case studies from vastly different types of quality standards were incorporated for two reasons:

1. The preliminary analysis showed that different interactions of factors are important in different standardization processes. Incorporating success-determining factors from a wide variety of different kinds of quality standards increases the chance to cover the most important success-determining factors for the proposed standard. Any irrelevant factors in the framework deriving from this choice will be categorized as such by the experts.
2. This allows for the creation of a generic framework that can be applied for further research into quality standards. It enables, for example, an assessment of the homogeneity of factors that influence the successes of these widely varying types of quality standards. Whether factors that are of grave importance in one type of quality standard also affect the adoption rate of other types of quality standards. It would be interesting to see, for example, whether trade barriers, which are common when food-quality standards are concerned, are of importance in other types of quality standards as well. This research and further work in this field can be used to assess which of these factors are generically applicable to different types of quality standards and which are more situation specific.

4.1.2 Factor categorization

One of the most comprehensive articles on success-determining factors in standardization is written by van de Kaa et al. (2011). In this article categories of factors are determined by combining four streams of literature: evolutionary economics, network economics, institutional economics, and technology management. Due to the multi-disciplinary approach that is taken, the five categories established in that article were taken as a starting point for the categorization of factors for this research. Because this research only focusses on factors that can be influenced by standard setters, it was chosen to disregard the category of *'environmental factors'* present in the categorization used by van de Kaa et al. (2011).

Secondly, due to the large number of factors arising from the literature related to the characteristics of the standard, it was chosen to adopt the distinction, made by Moratis and Widjaja (2014), between *'tangible standard characteristics'* and *'intangible standard characteristics'*. Their research considers determinants for the adoption of CSR reporting standards, which is similar to the proposed standard in a couple of ways; they are both voluntarily adopted standards aimed at companies related to corporate social responsibility. This distinction was adopted, because the unseparated category of *'standard characteristics'* contained too many factors which could not be reduced further. Both the creator of the

BWM and Miller's law assert that the amount of factors within a group that is being compared should be kept at 9 or less (Miller, 1994). It was not possible to include all the factors that were found and to comply with this requirement without making the distinction between tangible and intangible standard characteristics.

There were still factors identified in the literature, which could not be assigned to one of the previously identified categories. These factors related to the way in which the collaborative process to reach consensus regarding the standard is shaped. The last adaption that was therefore made, was to incorporate the '*standard creating process*' as a category. This category is used by van den Eijnden (2019) in her categorization of factors determining success for standardization of struvite installations. These categories allowed for the assignment of each of the identified factors to a distinct category, the six categories of success-determining factors used for this research are listed below.

- Tangible standard characteristics
- Intangible standard characteristics
- Standard supporting alliance characteristics
- Standard creating process
- Standard support strategy
- Stakeholders

'Tangible standard characteristics' relate to the measurable and quantifiable features of a standard. *'Intangible standard characteristics'* are the more subjective features of a standard; they are therefore more difficult to measure or quantify. *'Standard supporting alliance characteristics'* refer to the collective aspects of the organization or group of organizations that is releasing a new quality standard. *'Standard creating process'* refers to aspects of the collaborative process that is employed to create the new standard. *'Standard support strategy'* is the category of factors that relate to the marketing and promotion of the standard during the diffusion phase. The category *'Stakeholders'* contains the groups of stakeholders that were identified in literature to have the largest influence on the successful diffusion of a new quality standard.

The attribution of the factors to one of the categories was challenging, considering that some factors could be attributed to multiple categories. The first step to ensure consistency in the attribution of factors was to evaluate if the factors were clearly defined and categorized in the literature they derived from. If this was not the case, a judgment was made based on the definition of the factor as provided in this research.

4.1.3 Factor reduction

The examination of the investigated articles led to a list of approximately 90 factors, which were all assigned to one of the categories. Because it would be impossible to discuss and rank all of these with the respondents and obtain relevant results, the number of factors had to be reduced. Three steps were taken to reach a workable framework:

1. **Disregard market characteristics**

   In their research on factors that determine victors in interface format battles, van de Kaa et al. (2011) identify a category of factors relating to market characteristics. These factors are characterized as environmental factors, which *"can hardly be influenced by individual firms"* (van de Kaa et al., 2011). It is recognized that factors such as *"uncertainty in the market"* and *"the presence of rivals"* are paramount in determining the probability of standardization failure or success, but these factors are inherent to a market and are nearly impossible to change for a (consortium of) companies. Because this research focusses on factors that standard developers can influence to maximize the probability of widespread adoption for their standard, it is chosen to omit the identified environmental factors.

2. **Disregard the probability of success of the standard creation process**

   Many factors that were identified influence the probability of success of the multi-stakeholder process to create the standard content. This process shows vast differences with the diffusion of the standard, and many factors can be positive during the standard creation process, but negative during the diffusion and vice versa. A good example of this is size and homogeneity of the alliance; during the standard creation process, it is often considered advantageous to have a limited group of participants with homogeneous intentions. During the standard diffusion process on the other hand, it is considered favourable to employ a large multi-stakeholder process in which as many different types of opinions are incorporated as possible. To avoid confusion and to make sure that all respondents interpreted the factors in the same way, it was chosen to only focus on the process of standard diffusion and make success of the standard creation process a given. Only factors relating to the standard creation process which influence the standard diffusion were incorporated in the list of factors. This meant that factors like *"veto rights"*, which only influence the standard creation process, were removed, and factors like *"transparency and openness of the process"*, which can also influence the adoption rate of the standard, were included.

3. **Merge factors with high similarities**

   Factors that contain a high level of similarity or overlap were combined to reduce the number of factors that remained. An example of this is the merging of 'support by the regulator' and 'support by governmental bodies'. In certain sectors, like the food sector, there are non-governmental regulators present, which explains why these two factors were both identified. In many other markets however, among which the field of corporate environmental accounting, the only regulators are governments or governmental bodies, it was therefore chosen to combine these.

These steps resulted in a framework of 29 factors, divided over 6 categories. This list was subsequently verified in separate interviews with the Group and External HSSE Reporting Manager and the Project Lead of the Open Footprint Initiative at Shell in semi-structured interviews. They approved of the list as containing the most important factors for success of the proposed standard which could be influenced by the standard setter and added two that were previously not identified. The resulting framework can be seen in section 5.1.

4.2 Stakeholder analysis

Once the framework containing the success-determining factors was completed, the focus was shifted to the surveys for the Best Worst method. To get as good an idea as possible of the importance of the different factors, it was decided to perform the interviews with a wide variety of stakeholders that are relevant for the standardization of corporate environmental accounting methodologies. Including interviewees from different backgrounds allowed for the incorporation of differing, sometimes even conflicting, viewpoints arising from different experiences in environmental accounting or standardization.

A structured stakeholder identification methodology was used to identify the actors that are relevant for the standardization of corporate greenhouse gas accounting methodologies. De Vries et al. (2003) introduce a stakeholder identification and classification method designed for formal IT standardization processes, although they do argue that *"the method may be applied wider to include consortia"*. The process of creating the proposed standard cannot exactly be classified as an IT standardization process, which caused certain components of the methodology to be less relevant. Nevertheless, the stakeholder analysis was generic enough to be applicable to the situation of the proposed standard. The methodology consists of two phases, which should be performed in succession. The first is aimed at identifying the relevant stakeholders; companies or organizations that can affect the standardization process or are

affected by it. The second is aimed at classifying the identified stakeholders based on their salience in the standardization process.

4.2.1 Stakeholder identification

Stakeholders are defined by Freeman (1984) as *"any group or individual who can affect or is affected by the achievement of the organization's objectives."* This definition is adopted and adapted to relate to a standard, instead of an organization. The first part of the methodology is a search heuristic that aids in the identification of stakeholders and prevents certain groups from being overlooked. It proposes nine search directions to be explored:

1. Production chain
2. End users and related organizations
3. Designers
4. Physical system
5. Inspection agencies
6. Regulators
7. Research and consultancy
8. Education
9. Representative organizations

The outcome of the first phase is a long list of stakeholders. These stakeholders are all related to the standardization process in some way, but from this first step it is not yet clear what their exact relation is.

4.2.2 Stakeholder classification

The second part of the methodology consists of classifying the stakeholders' salience based on three variables proposed by Mitchell, Agle, and Wood (1997). The three variables are:

1. **Power**: Does the stakeholder have the resources to alter the standardization process or the success of the resulting standard?
2. **Legitimacy**: Is the stakeholder formally entitled to participate in the process, or do the other stakeholders accept or support the participation of this stakeholder?
3. **Urgency**: Has a stakeholder been active in pursuing his goals regarding the standardization?

Each of the stakeholders resulting from the first part of the methodology receives a binary score (yes/no) for each of the variables, indicating whether a stakeholder does or does not possess that characteristic. Since each of the stakeholders must hold at least one of the characteristics to be considered a stakeholder, this leads to 7 different classes of stakeholders as presented in Figure 5.

1. Dormant stakeholder
2. Discretionary stakeholder
3. Demanding stakeholder
4. Dominant stakeholder
5. Dangerous stakeholder
6. Dependent stakeholder
7. Definitive stakeholder
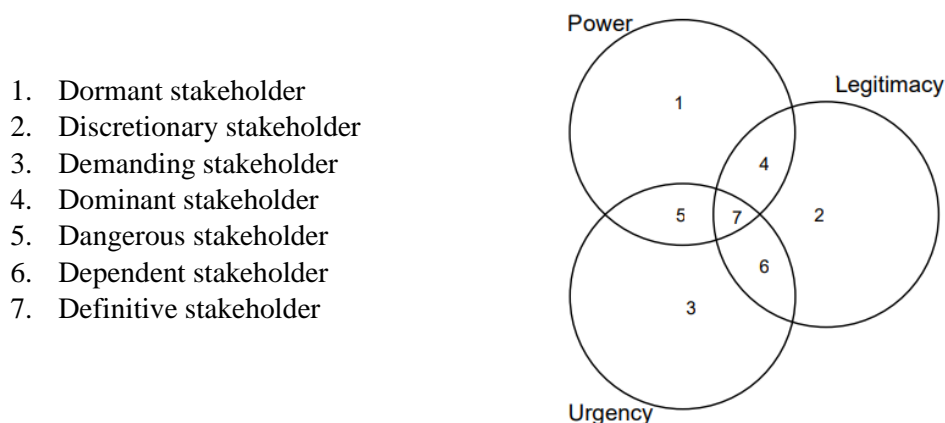
Figure 5. Classification of stakeholders based on the three variables for salience by de Vries, Verheul, and Willemse (2003).

4.2.3 Execution of the stakeholder analysis

An open brainstorm session was held with four Shell employees, who were all members of the Open Footprint Initiative, to verify the preliminary analysis. The employees were first provided with the list of search directions and instructed to write down any actors they could come up with relating to a standardized methodology for measurement and calculation of GHG emissions. After this was aggregated into a single comprehensive list, they were asked to collectively assess the actors based on the three variables: Power, Legitimacy and Urgency. The resulting stakeholder analysis is presented in section 5.2.

4.3 Defining the dimensions of widespread adoption

Before we can start to weigh the factors that influence adoption for the proposed standard, we need to determine what dimensions are considered to assess this metric. In their research of success-determining factors in interface format battles, van de Kaa et al. (2011) use dominance over competing standards to define success. They define that a standard is dominant if more than 50% of new installations use the technology for a significant amount of time, in accordance with Suarez (2004). There is an important difference though, between the situation treated in this research and the one treated by van de Kaa et al. (2011). In the case of interface format battles there are a small number of standards competing for standard dominance, whereas the proposed GHG inventory standard would have to compete in a market where there are no major contenders for dominance yet. The proposed standard must compete with numerous proprietary and sector-, industry- or country-specific methodologies, which makes the proposed definition impractical.

Green (2010) takes a different approach in her assessment of the dominance of the GHG Protocol. She states that success is not merely the absence of competition but defined by the breadth of adoption. Since the proposed standard can be seen as an extension of the GHG protocol, it is decided to follow and expand on the definition of success used by Green (2010). The breadth of adoption will be evaluated in several dimensions:

- Geographical spread (adoption on all continents)
- Adoption across entities (adoption and recognition by companies, governments, NGO's, SDO's, emissions trading schemes, GHG registries, etc)
- Adoption among companies of different sizes (from small SMEs to large MNC's)
- Sectoral/industrial spread (from industries with low carbon intensities to high carbon intensities)

These four dimensions will be communicated to all interviewees, respondents and other experts when discussing the importance of the identified factors for the probability of widespread adoption of the proposed standard.

4.4 Best-Worst method

The method that was chosen to determine the weights of the different factors is a Multi-Criteria Decision-Making (MCDM) method, called the best-worst method (BWM). This method, proposed by Rezaei (2015), is a powerful MCDM method which has proven its value in many different types of real-world decision problems regarding water resource management (Chitsaz & Azarnivand, 2017), supplier selection (Rezaei, Nispeling, Sarkis, & Tavasszy, 2016), airline service quality assessment (Gupta, 2018), and many other situations. The method is based on pairwise comparisons between the extreme criteria (so the most and least important/desirable factor) and each of the other criteria. This method was chosen because (1) it has a high reliability and consistency when compared to 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 then full pairwise comparisons or other MCDM methods like Analytical Hierarchy Process (AHP). When referring to the 'best' or 'worst' criterion, we refer to respectively the most important and the least important factor.

MCDM problems can be visualized as matrix [P] shown in Figure 6a; $\{a_1, a_2 ..., a_m\}$ represent the different available alternatives, $\{c_1, c_2, ..., c_n\}$ correspond to the different criteria on which decisionmakers evaluate the alternatives and p_{ij} is the score that alternative i receives on criterion j. Because the different criteria are rarely perceived as equally important, the second component that is necessary is a vector of weights for the importance of the criteria, this vector is called w and is shown in Figure 6b. By combining the matrix with the vector as shown in Eq. 1, the resulting utility values V_i for each of the alternatives can be calculated.

$$P = \begin{array}{c} \\ a_1 \\ a_2 \\ \vdots \\ a_m \end{array} \begin{array}{c} c_1 \quad c_2 \quad \cdots \quad c_n \\ \begin{pmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & a_{mn} \end{pmatrix} \end{array} \qquad w = \begin{array}{c} w_1 \\ w_2 \\ \vdots \\ w_n \end{array}$$

Figure 6a. Generalized MCDM matrix [P]
Figure 6b. Criteria-weight vector w

$$V_i = \sum_{j=1}^{n} w_j p_{ij}$$

Eq. 1

This is the generic functionality of the majority of MCDM methods. What distinguishes the BWM is the way in which the criteria-weight vector w is determined. The BWM does this by pairwise comparisons between the criteria. When we consider n criteria and compare each of them with all the other criteria, it will lead to matrix [A]. Figure 7 shows this matrix, in which a_{ij} shows the relative importance of criterion i to criterion j.

$$A = \begin{pmatrix} a_{11} a_{12} ... a_{1n} \\ a_{21} a_{22} ... a_{2n} \\ \vdots \quad \vdots \quad \ddots \quad \vdots \\ a_{n1} a_{n2} \cdots a_{nn} \end{pmatrix}$$

Figure 7. Generalized matrix [A] showing the relative importance of the criteria

For this research it was chosen to assess the values of a_{ij} on a scale of ⅑ to 9, where 1/9 shows extreme importance of j over i, 1 shows similar importance of i and j and 9 shows extreme importance of i over j. The reciprocity of matrix [A] must be preserved through the requirements that $a_{ij} = 1/a_{ji}$ and a_{ii} is 1 for all i. This notion reduces the amount of pairwise comparisons necessary to find all the values of matrix A from n^2 to $n(n-1)/2$. Since every comparison a_{ij} can be expressed as $1/a_{ji}$ it is not necessary to ask respondents for the values either between ⅑ and 1 or between 1 and 9. Because people are generally more accustomed to working with integer values, it is chosen to ask respondents for values between 1 and 9 and to derive the values between ⅑ and 1.

The BWM then goes on to make a distinction between comparisons containing either the most or the least important criterion as '*reference comparisons*', and all other comparisons as '*secondary comparisons*'. In other words, all comparisons a_{ij} in which i is the best criterion and/or j is the worst criterion are reference comparisons, and all comparisons a_{ij} in which i and j are neither the best nor the worst criteria are secondary comparisons. The BWM utilizes the multiplicative properties of MCDM by asserting that it is possible to derive all secondary comparisons from reference comparisons. If for example x is the best criterion, and it is compared to y and z with a value of respectively $a_{xy} = 4$ and $a_{xz} = 7$, it can be calculated that $a_{yz} = 7/4$ ($a_{xy} * a_{yz} = a_{xz}$; $4 * a_{yz} = 7$; $a_{yz} = 7/4$). This leads to a further reduction of the amount of comparisons required to determine all the weights of importance from $n(n-1)/2$ to $2n-3$. A relatively low requirement for the number of comparisons is highly beneficial for this research, because it contains a high number of factors to be compared. The total amount of pairwise comparisons for this research that were required when the AHP would be applied is 82, much higher than the 53 pairwise comparisons required for the BWM. This reduction in time required for the quantitative assessments of the factors, increased the time available for the qualitative discussion regarding the rationale behind their attributed weights.

To determine the most consistent weights resulting from the attributed weights of importance the following problem must be solved.

$$
\begin{aligned}
&Min\ \xi \\
&s.t. \\
&\left|w_B - a_{Bj}w_j\right| \leq \xi, for\ all\ j \\
&\left|w_j - a_{jW}w_W\right| \leq \xi, for\ all\ j \\
&\sum_j w_j = 1 \\
&w_j \geq 0, for\ all\ j
\end{aligned}
\qquad \textit{Eq. 2}
$$

a_{Bj} and a_{jW} refer to respectively all the best-to-others comparisons and all the others-to-worst comparisons. Solving this problem leads to the most consistent weights of importance for each of the criteria in weight vector w^*. The resulting value of ξ^* is a measure for the consistency of the collective set of comparisons. The closer the value of ξ^* is to zero, the higher the consistency of the pairwise comparisons that were performed. This examination of the consistency of the provided comparisons will be further elaborated in section 7.1.
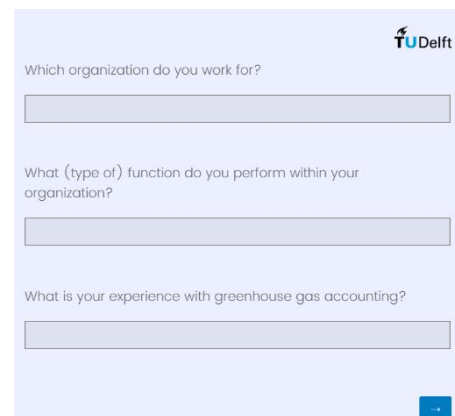
4.5 Data collection

The BWM provided the mathematical framework on which this research was built, but it does not prescribe how the information is to be elicited from the respondents. In consultation with the supervisors of this research it was decided to perform interviews, structured by means of a survey. The respondents filled out the survey that was provided to them, while being questioned on the rationale behind the values they attributed to the pairwise comparisons. Since it is nearly impossible to make pairwise comparisons between the 31 different factors all at once, the factors in each category were compared to each other category by category. Subsequently, when the internal weights within the categories were determined, pairwise comparisons between the different categories of factors were performed. Through multiplication of the weights of the factors within a category and the weights of that category, the resulting weights for each of the factors were determined.

4.5.1 Survey design

The survey that was used to attribute the weights to the comparisons between the identified factors was created in Qualtrics. Qualtrics is an experience management software provider, which boasts an immense toolbox to create, customize, distribute, perform, and analyse surveys and their responses. The survey opened with three general questions to provide background information about the respondents which can be seen in Figure 8.

After the background data of the respondent had been filled out, the analysis of the first category of factors began. The first step was to determine what the respondent viewed as the best and worst criterion, i.e. the most important and least important factor, within the first category. The corresponding questions were formulated as can be seen in Figure 9.

Figure 8. Screenshot of the survey questions regarding the respondents' background.

Figure 9. Screenshots of the survey questions to determine the most and least important factor of a category of factors.

After the most and least important factor of a category were established, respondents were presented with two matrices, which can be seen in Figure 10. In the first matrix they were asked to compare the factor they designated as most important to each of the other factors in the category on a scale from 1 to 9. A rating of 1 in this matrix indicates that the corresponding factor is equally important to the factor that the respondent indicated to be the most important, whereas a rating of 9 indicates that the most important factor is extremely more important than the corresponding factor. In the second matrix they were asked to compare the factor they designated as least important to each of the other factors on the same scale. A rating of 1 in this matrix indicates that the corresponding factor is equally important to the factor that the respondent indicated to be the least important, whereas a rating of 9 indicates that the corresponding factor is extremely more important than the least important factor.

Figure 10. Screenshots of the survey questions in which pairwise comparisons are made between the best/worst factor and the other factors.

When both matrices were filled out for the first category, the same steps were repeated for each of the other categories. Finally, when all factors had been pairwise compared category by category, the categories themselves were compared in the same way.

4.6 Interviews

The rationale behind collecting the required data through interviews was threefold:

1. The interview made it possible to discuss the explanation respondents had for their answers and ratings. This gave a qualitative foundation for the quantitative data that was provided.
2. Even though the Survey was intended to be as intuitive as possible, it can take some time to get used to the method of questioning. It was helpful to be present while the respondents filled out the survey to ensure that they understood the questions posed to them and the implications of the ratings they attributed.

3. Certain factors turned out to have been formulated in a way that they were open to interpretation. It was therefore helpful to be able to clarify the meaning of each of the factors in this research while the surveys were being filled out.

The use of interviews made sure that all the attributed ratings did indeed represent the viewpoints of the respondents and that the dataset was not polluted by erroneously interpreted questions. Before the interview, the interviewees were sent three documents which they were asked to read before the interview.

1. An introductory document outlining the research and the interview (Appendix B1)
2. A Consent Form through which the interviewees could indicate the agreed usage of their personal data and information (Appendix B2)
3. The Data Management Plan for the research (Appendix B3)

Each of the interviews lasted between 75 minutes and 90 minutes, which provided sufficient time to discuss the respondent's expertise in environmental accounting and standardization, to fill out the survey, to clarify the answers and ratings of the factors they provided, and to evaluate the factors in the framework, the setup of the survey and the interview.

5. Results

In this chapter, the results from the various components of this research are presented. Section 5.1 outlines the constructed framework of success-determining factors for quality standards. Section 5.2 contains the results of the stakeholder analysis that was performed. Section 5.3 presents the experts that were interviewed to determine the weights of importance. Section 5.4 shows the resulting weights of importance for each of the factors that were attributed by the respondents. And lastly, 5.5 and 5.6 provide practical and statistical interpretation of these resulting weights.

5.1 Framework of factors influencing quality standard adoption

5.1.1 Literature research

As explained in section 4.2, the framework of factors that influence the successful diffusion of quality standards was constructed through a thorough literature analysis. Empirical case studies of the diffusion of different quality standards were collected and analysed for success-determining criteria. Finding articles describing quality standards and analysing their success proved to be less straight forward than was expected, it is hypothesized that this is due to a lack of meta-studies regarding quality standards. The 22 papers that were used and some of their characteristics are outlined in Table 2. The analysed standards range from process-oriented management quality and healthcare quality standards to product-oriented food quality and water quality standards.

#	Subject	Title	Source
1	Greenhouse Gas Protocol	Private Standards in the Climate Regime: The Greenhouse Gas Protocol	(Green, 2010)
2	CSR reporting standards	Determinants of CSR standards adoption: exploring the case of ISO 26000 and the CSR performance ladder in The Netherlands	(Moratis & Widjaja, 2014)
3	International accounting standards	Advancing the Harmonisation of International Accounting Standards: Exploring an Alternative Path	(Carlson, 1997)
4	IFRS	What factors are perceived to influence consideration of IFRS adoption by Vietnamese policymakers?	(Phan, 2014)
5	IFRS	The rise and rise of IFRS: An examination of IFRS diffusion	(Chua & Taylor, 2008)
6	Global Reporting Initiative	The worldwide diffusion of the Global Reporting Initiative: what is the point?	(Marimon, Alonso-Almeida, Rodríguez, & Cortez Alejandro, 2012)
7	Global Reporting Initiative	The rise of the Global Reporting Initiative: a case of institutional entrepreneurship	(Brown, Jong, & Lessidrenska, 2009)
8	ISO 9001	The impacts and success factors of ISO 9001 in education: Experiences from Portuguese vocational schools	(Gamboa & Melão, 2012)
9	ISO 14000	Identifying the factors which affect the decision to attain ISO 14000	(Curkovic et al., 2005)
10	ISO 26000	ISO 26000 and supply chains—On the diffusion of the social responsibility standard	(Castka & Balzarova, 2008)
11	ISO 26000	Stakeholders' Influence and Contribution to Social Standards Development: The Case of Multiple Stakeholder Approach to ISO 26000 Development	(Balzarova & Castka, 2012)
12	Management standards	Management Systems Standards: Diffusion, Impact and Governance of ISO 9000, ISO 14000, and Other Management Standards	(Castka & Corbett, 2015)
13	Food quality standards	Private voluntary standards in the food system: The perspective of major food retailers in OECD countries	(Fulponi, 2006)
14	Food Quality standards	Global Change in Agrifood Grades and Standards: Agribusiness Strategic Responses in Developing Countries	(Reardon et al., 1999)
15	Food safety standards	Reasons and constraints to implementing an ISO 22000 food safety management system: Evidence from Spain	(Escanciano & Santos-Vijande, 2014)
16	Water quality standards	Potable Water Quality Standards and Regulations: A Historical and World Overview	(Kroehler, 2014)
17	EUREPGAP food quality	The Compliance Decision with Food Quality Standards on Primary Producer Level. A Case Study of the EUREPGAP Standard in the Moroccan Tomato Sector	(Chemnitz, 2007)
18	GLOBALGAP food quality	Adoption of food safety and quality standards among Chilean raspberry producers – Do smallholders benefit?	(Handschuch, Wollni, & Villalobos, 2013)
19	Marine Stewardship Council	Controversy Over Voluntary Environmental Standards: A Socioeconomic Analysis of the Marine Stewardship Council	(Wijen & Chiroleu-Assouline, 2019)
20	Forest quality certification	Confronting Sustainability: Forest Certification in Developing and Transitioning Countries	(Cashore, Gale, Meidinger, & Newsom, 2006)
21	Group Care Quality Standards	The group care quality standards assessment: A framework for assessment, quality improvement, and effectiveness	(Boel-Studt et al., 2019)
22	Health-care quality standards	Standards for health care: a necessary but unknown quantity	(Brand et al., 2008)

Table 2. The list of literature that was used to identify success-determining factors for quality standards.

The first two papers that were investigated look at standards in the corporate social responsibility (CSR) realm; Green (2010) seeks to explain the success of two NGO's in creating the dominant standards for calculating and reporting GHG emissions, the GHG protocol, and Moratis and Widjaja (2014) aim to identify determinants for the adoption of two competing CSR standards in the Netherlands. Interestingly enough, their conclusions are widely different. The first article attributes the success of the GHG protocol largely to procedural elements like *"transparency of the rule-making process and the willingness by WRI and WBCSD to include all interested parties"* (Green, 2010). Whereas the second identifies five categories of determinants for adoption of the standard, *'external market forces'*, *'organizational characteristics'*, *'intangible characteristics of the standard'*, *'tangible characteristics of the standard'* and *'characteristics of the standards organization'*, none of which is directly related to the standard creation process (Moratis & Widjaja, 2014).

The articles by Chua and Taylor (2008), Carlson (1997) and Phan (2014) are concerned with financial reporting standards. Chua and Taylor (2008) *"note that the crucial impetus at a national level for adopting IFRS has typically been from the government and/or government agencies,"* and Carlson (1997) points out the crucial necessity for governmental support in the process towards international harmonization of financial accounting rules. This is recognized by Phan (2014), who asserts that the pressure from financial governmental organizations like the World Bank and the International Monetary Fund are important motivators for the adoption of the IFRS in Vietnam. These three articles all demonstrate the significance of governmental support for financial accounting standards.

Marimon et al. (2012) and Brown et al. (2009) assess the global diffusion of the Global Reporting Initiative. Even though they both point out several factors they believe to have played an important role in the widespread adoption of the standard, they emphasize 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). These articles illustrate that the identified factors should not be blindly pursued, but that a balance should be sought between all these competing aspects of the standardization process.

Gamboa and Melão (2012), Curkovic et al. (2005), Castka and Balzarova (2008), Balzarova and Castka (2012) and Castka and Corbett (2015) investigate three different management standards proposed by the ISO. ISO 9000, which prescribes quality assurance programmes; ISO 14000, a family of standards related to environmental management; and ISO 26000, which provides guidance on CSR practices. A common denominator in these articles was the recognition of adoption of the standard as a tool for retaining or expanding a company's sales market. Company's either adopt these standards to increase their competitiveness in specific markets or are obliged to adopt them to continue trade with large MNCs or governments. It is not surprising that this driver behind standard adoption is particularly strong in certifiable standards which are published by a trusted international body, such as the ISO.

Fulponi (2006), Reardon et al. (1999), Escanciano and Santos-Vijande (2014) investigate food safety and quality standards. The main driver they identify behind the adoption of these standards for food retailers, agribusinesses and other food producers is to increase corporate reputation. Fulponi (2006) describes it as follows: *"Providing consumers with products that meet consistent quality and safety standards that go beyond the minimum requirements was seen as essential to building reputation, the key asset for current and future earnings flows."* Not surprisingly, this aspect is not discussed in Kroehler (2014)'s historical analysis of potable water quality standards across the world. The water supply is the responsibility of a monopolistic public utility in nearly every part of the world, and reputation is therefore not of great concern in this industry. *"The existence of sets of standards and examples of regulatory frameworks in place in a variety of countries, along with the guidance of WHO and UNICEF"* are described as the driving factors towards the adoption of quality standards in potable water supplies worldwide (Kroehler, 2014).

Chemnitz (2007) and Handschuch et al. (2013) analyse the adoption of two private food quality standards, respectively EUREPGAP and GLOBALGAP. The decision for adoption of these standards is described as a trade-off between implementation costs and market retention or expansion. Despite the voluntary nature of these standards, its adoption was *"quasi mandatory"* for trade in specific markets (Chemnitz, 2007). Costs on the other hand, are especially important for the smallholders under consideration in Handschuch et al. (2013).

Two environmental quality certifications, the Marine Stewardship Council (MSC) and the Forestry Stewardship Council (FSC), aimed at ensuring sustainable use of natural resources, are discussed by Wijen and Chiroleu-Assouline (2019) and Cashore et al. (2006) respectively. These case studies illustrate the importance of the reputation and the size of the standard setters. The initiators of the MSC are a perfect example in this regard, by combining the financial strength and buying power of the largest purchaser of frozen fish products worldwide, Unilever, with the legitimacy and independence of the world's largest non-profit conservation organization, the WWF (Wijen & Chiroleu-Assouline, 2019).

The last two articles that were incorporated into the framework, are concerned with group care quality standards (Boel-Studt et al., 2019) and health care quality standards (Brand et al., 2008). They both conclude that a properly managed multi-stakeholder process to create the standards, is of the utmost importance to *"provide the necessary clinical, management, methodological, legal and consumer perspectives and expertise"* for a robust standard (Brand et al., 2008).

5.1.2 Expert interviews

Two interviews were held to verify the framework that was created based on the available literature. The first interview was with the project lead of the Open Footprint initiative, who has extensive experience with GHG accounting from his work in Shell and experience with standardization from his work in the pharmaceutical industry. The second interview was held with the Group and External HSSE & SP Reporting Manager at Shell, who has been working on Shell's environmental accounting and reporting for the past 7 years. Both interviewees confirmed that all the factors that were listed were relevant for standardization processes in general and for the standardization process under investigation in this research. When asked if they thought the framework was complete, two alternative factors were proposed by the first expert. These have been added to the framework, they have been marked with an asterisk (*) in the list below.

5.1.3 Final framework

The final framework is presented below, these factors were used for further analysis in the research. It consists of 31 factors, which are divided among six different categories with four, five or six factors each.

Tangible standard characteristics:
- Compatibility with incumbent practices
- Implementation costs
- Progressive adoption
- Possibility for certification
- Industry and sector specific guidelines
- Accessibility of information

Intangible standard characteristics:
- The ability to provide an organization with more structure
- The ability to improve an organization's reputation
- The possibility to get started without external guidance
- Applicability to different size organizations
- International acceptance of the standard
- The ability to open new markets or retain old markets

Standard supporting alliance characteristics:
- Financial strength and market position of the supporters
- Reputation of the standard supporters
- Diversity within an alliance
- The participation of an official SDO
- Perceived neutrality/independence

Standard creating process:
- Coordination within an alliance
- Stakeholders and third-party involvement
- Substantive due process and rationale
- Transparent and open process
- Alignment of interests of participants

Standard support strategy:
- Financial support for the standard
- Periodical improvement of the standard
- Provision of operational support
- The presence of a community*
- Benefits tracking*

Stakeholders:
- Support by consultants and auditors
- Support by governmental bodies
- Support by NGO's related to the standard
- Pressure from customers

Table 3 contains more detailed explanations for each of the factors and refers to the sources the factors derive from. The numbers that are listed under *'Sources'* correspond to the numbers attributed to the sources in Table 2.

Factor	Description	Sources
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.	2, 19
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.	1, 2, 6, 12, 13, 14, 16, 17, 18, 19, 20, 21
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.	1, 5, 11,19, 21, 22
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.	2, 12, 14, 17, 19, 20
Industry- and sector-specific guidelines	The presence of industry- and sector-specific guidelines/appendices to supplement the standard comes up in literature as a decisive factor for the widespread diffusion of quality standards. The presence of these guidelines can convince potential adopters of the suitability for their situation.	1, 2, 7, 20
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.	2, 3, 7, 8, 15, 17

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.	2, 8, 12, 15
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.	1, 2, 4, 6, 8, 10, 13, 14, 15
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.	2, 15
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.	2, 3, 7, 14, 20
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 accepted standard therefore increases adoption.	2, 3, 5, 7
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.	6, 9, 11, 12, 15, 17, 18, 19, 20

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.	2, 7, 14, 19
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.	1, 2, 19, 20
Diversity within an alliance	A standard 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, resulting in a less biased or opportunistic standard. This leads to higher adoption rates of the standard.	1, 7, 19, 20
The participation of an official SDO	The participation of an official Standards Developing Organization (i.e. ISO or one of its national member organizations) in the alliance can promote adoption by providing legitimacy to the standard.	12
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 promotes adoption of a standard.	7, 19

Standard creating process		
Coordination within an alliance	Clear and strong coordination within the alliance of the collaborative standard creating process can lead to an improved perceived quality of the standard, increasing the adoption rate of the standard.	3, 7
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.	1, 2, 3, 7, 11, 19, 20, 22
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.	3
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.	7

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.	7, 15. 20, 22
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.	7, 19
Periodical improvement of the standard	Continuing reviews of the standard 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.	1, 2, 7, 19, 21, 22
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.	1, 2
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.	Interview 1
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.	Interview 1

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.	2, 4, 13, 14, 18
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.	1, 3, 4, 5, 6, 12, 13, 14, 18, 20, 22

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.	16, 19, 20
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.	18, 19, 20

Table 3. The success-determining factors, their explanation, and the sources they derive from.

5.2 Stakeholder analysis

The stakeholder analysis that was proposed by de Vries et al. (2003) and outlined in section 3.2 was performed to identify groups of actors that should be included in the interviews and the corresponding surveys for the BWM. Additionally, it provides a useful tool for standard setters to determine strategies for the different stakeholders that are identified. The stakeholders were identified through a brainstorm session with four Shell experts working on the Open Footprint project and their classification resulted from an ensuing discussion. The execution and results of this analysis will be presented in this section.

5.2.1 Stakeholder identification

The nine directions of the search heuristic were explored and discussed with experts within Shell.

1. *Production chain*
   This includes all firms in the production chain of the product or service that the standard relates to. For the proposed standard, the "product" is a greenhouse gas inventory and the main actors related to the construction of this product are **environmental accounting firms**. These firms help companies, organizations, and countries to quantify their impact on the environment through the creation and maintenance of emissions inventories.

2. *End users and related organizations*
   The central end users of the standard are organizations that will employ it to create their greenhouse gas inventories. There is a significant difference in interests depending on a company's size, and a large body of literature is dedicated to the difference in attitude of companies of different sizes towards GHG accounting standards. It is therefore chosen to divide this group into **large multinational corporations (Large MNC's)** and **small and medium-sized enterprises (SMEs)**.

3. *Designers*
   The design of an organization's greenhouse gas inventory is not prescribed by any organization, and the designers are therefore incorporated in the stakeholders listed under *'End users and related organizations'*.

4. *Physical system*
   This category is concerned with the interactions of a company's greenhouse gas inventory with other related systems. The most prominent interface that was identified was the interface with enterprise resource planning systems, leading to **ERP system providers** as an important stakeholder in this standardization process.

5. *Inspection agencies*

The rise in external verification of environmental reports and data shows an increasing importance for companies that are able to deliver auditing and certification services (Hillary, 1995). Therefore, **Environmental auditing/certification firms** are included as a stakeholder under this heading. Some countries have governing bodies that provide certifications for auditors, such as the Board of Environmental, Health & Safety Auditor Certifications in the United States. These inspection agencies share their interests with the auditors they certify, so they are therefore not seen as a separate stakeholder group.

6. *Regulators*
    Governments are nearly always the regulatory authorities when it comes to environmental accounting. The regulatory duties might be divided among different levels of authority, such as local, national, and supra-national, but these different levels are all comprised of governments or governmental bodies. **Governments** are therefore important stakeholders to take into account when considering environmental accounting.

7. *Research and consultancy*
    Apart from environmental accounting firms, which perform the entire environmental accounting duties for a company, there are also consultants which help companies to implement new (environmental) standards. These system integrators are often catalysts of standard diffusion, as they promote the standard to clients and help them with properly implementing the standard in their systems. For this reason, **consultancy firms** are also included as stakeholders.

8. *Education*
    There are universities that offer certification programmes and degrees in Environmental management, sustainable business, and other courses and degrees on the topic of environmental accounting. Related to those courses and degrees, there are many academics who perform research into environmental accounting. The academic and theoretical perspective of this group of stakeholders is decidedly different from the practical viewpoint of many of the other stakeholders that have been identified. **Universities** are therefore a valuable addition to the group of stakeholders related to the proposed new standard.

9. *Representative organizations*
    Some groups of stakeholders are represented through social interest groups dedicated to serving the collective interests of their members. In the situation of environmental accounting, these can best be described as **Environmental NGO's**; non-governmental organizations defending the societal interests in environmental governance.

5.2.2 Stakeholder classification

All the identified stakeholders can be classified by indicating if they have or lack Power, Legitimacy and Urgency relating to the standardization process. The result of the classification, which was executed in collaboration with four Open Footprint team members, can be found in Table 4. The rationale for the classification resulting from the brainstorm session and an explanation of the types of stakeholders is provided on the next pages.

(GROUPS OF) STAKEHOLDERS	POWER	LEGITIMACY	URGENCY	TYPE
LARGE MNC'S	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
ENVIRONMENTAL ACCOUNTING FIRMS	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
ERP PROVIDERS	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
GOVERNMENTS	Yes	Yes	No	DOMINANT STAKEHOLDER
ENVIRONMENTAL NGO'S	No	Yes	Yes	DEPENDENT STAKEHOLDER
ENVIRONMENTAL AUDITING/CERTIFICATION FIRMS	No	Yes	Yes	DEPENDENT STAKEHOLDER
SMES	No	Yes	No	DISCRETIONARY STAKEHOLDER
UNIVERSITIES	No	Yes	No	DISCRETIONARY STAKEHOLDER
CONSULTANCY FIRMS	No	No	Yes	DEMANDING STAKEHOLDER

Table 4. The classification of the identified stakeholders according to the variables proposed by Mitchell et al. (1997).

The first group of stakeholders contains the **definitive stakeholders**, they have power, legitimacy, and urgency to participate in the standardization process. These stakeholders will most likely be the driver behind the standardization process and little effort will be required to involve them. Large MNC's, Environmental Accounting Firms and ERP providers are part of this group.

Large MNC's possess all three of the mentioned variables. Through their market size and buying power they can greatly influence the adoption rate of environmental accounting standards. These corporations are often in possession of the know-how and experience required for creating effective standards which legitimizes their participation in the standardization process. And lastly, fear of being surprised with new environmental regulations and mandatory standards, means many large MNC's feel an urgency to participate in these standardization processes. The Open Footprint project, of which this research is a part, is proof of this felt urgency.

Environmental accounting firms influence to a large extent which standards they, and therefore their customers, choose to adopt. This gives them significant power over the diffusion success of a new standard. Furthermore, these firms carry the most experience in the execution of environmental accounting and the implementation of environmental accounting standards, legitimizing their seat at the table in the creation of the standard. And finally, the newly proposed standard influences to a large extent the services these companies perform, providing them with high urgency to participate in the process.

ERP systems are an important source of data for the greenhouse gas inventories of many organizations and various modules within these systems are available for environmental accounting. Through their choice of whether to integrate the new standard in their modules, the providers of these systems carry significant power regarding the adoption of the standard. On the other hand, if these providers fail to integrate emerging dominant standards timely it could lead to decreased sales of their systems, providing them with a sense of urgency to remain on the frontline of innovation and standardization. The sheer reach that ERP system providers have through their platforms and their experience with environmental accounting in nearly all sectors and industries legitimizes their participation in the process.

The second group of stakeholders contains the **dominant stakeholders**. These are stakeholders carrying power and legitimacy over the standardization process, but who lack urgent motivation to initiate or participate in the standardization process. These stakeholders will have to be engaged actively to participate in the standardization process. Governmental bodies are classified as a dominant stakeholder.

Local governmental bodies, national governments and supra-national governments hold tremendous power to influence the success of a standard. They can do this through their regulatory power, which allows them to make the use of a standard mandatory, and their buying power, which they can use by setting the use of the standard as a prerequisite for anyone who wants to provide products and services to the government. Their role as protector of the public interest also make them a very legitimate participant in the standardization process. The lack of fruitful initiatives in the realm of environmental accounting so far exhibits an absence of felt urgency for governmental interference.

The third group of stakeholders contains **dependent stakeholders**, these stakeholders have legitimacy and urgency for joining the standardization process, but they lack the resources to influence the standardization process unilaterally. Involving this group of stakeholders will generally require little effort, but they need the support from other stakeholders with more power to effectively influence the standardization process. Environmental auditing and certification firms and environmental NGO's can be classified as dependent stakeholders.

Environmental NGO's, like the World Resources Institute, are perceived by many as legitimate participants in these standardization processes due to their pledge to promote societal interests for conservation of the environment. Furthermore, their entire existence is built around their commitment to improve environmental practices, providing them with clear urgency to join standardization processes in this field. Since these organizations generally lack the resources to influence the process by themselves, they need to cooperate with more powerful organizations to provide them with the necessary mass.

Environmental auditing and certification firms are usually engaged after a standard has already been implemented by an organization, they therefore lack the power to influence the standard's adoption like environmental accounting firms do. They do however have a legitimate claim to a position in the standardization process, seeing as they will be the one validating the proper application of the standard. This also leads them to have a sense of urgency for taking part in the standardization process, so they can incorporate the standard in the services they provide as soon as the standard becomes available.

The fourth group of stakeholders contains the **discretionary stakeholders**, these companies are perceived to have a legitimate role in the process but lack the resources and the sense of urgency to participate in the standardization process on their own initiative. It can be useful to try to involve these stakeholders actively in the standardization process. SMEs and universities are a part of this group of stakeholders.

Small- and medium-sized enterprises lack the power to fundamentally influence the standardization process and therefore often feel that they have more urgent matters to focus their limited resources on. On the other hand, the success of a standard is dependent on the level of adoption among all companies, including SMEs, this legitimizes their place at the discussion table if the goal is to create a widely supported and adopted standard. The interests of SMEs can be included through representative organizations for groups of SMEs, these allow smaller companies to voice a collective opinion in the standardization process.

Universities that offer environmental (accounting) degrees or that have knowledge on standardization, have a legitimate position in the standardization process due to their academic expertise and perceived independence. They do however often lack the resources to actively participate and have a low sense of urgency due to their focus on academic research and education.

The last group of stakeholders contains the **demanding stakeholders**, these stakeholders do not have significant power or legitimacy to participate in the process but do feel a sense of urgency to participate. They will often try to participate in the standardization process, but too many demanding stakeholders can slow down the progress.

Consultancies that act as system integrators can be seen as demanding stakeholders. These companies will not want to dedicate the resources necessary to assert power over the standardization process. Furthermore, these firms could benefit from an increasing complexity of the standard and are therefore not perceived as legitimate stakeholders in the process. They do however feel an urgency to participate, because new standards provide them with opportunities for expanding their service offering.

5.3 Expert interviews

For each of the identified groups of stakeholders a representative was sought with expertise in environmental accounting and standardization thereof. This resulted in eight interviewees who were willing to participate in this research. An overview of the respondents is provided in Table 5. An elaborate introduction of the experts, their experiences and backgrounds can be found in appendix D1.

GROUP OF STAKEHOLDERS	NAME OF THE RESPONDENT	ORGANIZATION EMPLOYING RESPONDENT	FUNCTION OF RESPONDENT
Large MNC's	Anonymous	Royal Dutch Shell	Group and External HSSE & SP Reporting manager
Environmental accounting firms	Michiel Evers	KPMG Nederland	Senior Consultant Sustainability
ERP providers	Vikram Nagendra	SAP	Corporate sustainability at SAP and Fellow at the Value Balancing Alliance
Governments	Frans Duijnhouwer	The Dutch Ministry of Economic affairs and Climate*	Policy Coordinator and Economist at the Climate Directorate*
Environmental NGO's	David Rich	World Resources Institute & Greenhouse Gas Protocol	Senior Associate at the Climate Program
Environmental auditing/certification firms	Hans Axel Bratfos	DNV GL	Global Area Service leader, global head of R&D for Oil and Gas business area
SMEs	-	-	-
Universities	Brendan O'Dwyer	University of Amsterdam & University of Manchester	Professor at the Faculty of Economics and Business, Section Accounting
Consultancy firms	Rob Wortelboer	Ernst & Young Nederland	Associate Partner Climate Change & Sustainability Services

Table 5. The names, professions and employers of the respondents interviewed for this research.
* The respondent from the Dutch Ministry of Economic Affairs and Climate participated on his own title, his answers and remarks do not necessarily reflect the position of his ministry.

Representatives from all the identified groups of stakeholders were included in the interviews, except for SMEs. During the search for representatives from SMEs it became clear that under current regulations, SMEs must comply with hardly any requirements regarding their GHG accounting or reporting. In the EU for example, directive 2014/95/EU obligates companies to report non-financial performance measures through their official reporting channels (EU Parliament & EU council, 2014) and part of this non-financial reporting consists of environmental figures and GHG emissions. The

directive goes on to state that the directive only applies to 'large organizations' of 500 employees or more. This is far above 250 employees, the maximum number of employees a company can have to be classified as SMEs by EU recommendation 2003/361 (European Commission, 2003). Due to the absence of pressure on SMEs to perform GHG accounting of reporting, it is a complicated task to find a representative from this group with expert knowledge on the matter. Furthermore, the interests of SMEs of different sizes and from different industries, sectors and countries are vastly different, it is therefore nearly impossible to find someone who accurately represents this entire group of stakeholders. The Royal Association MKB-Nederland, the Dutch representative organization for SMEs was contacted by phone, to ask for their opinion on environmental accounting for SMEs. They stated that environmental accounting was something they were expecting to become relevant in the future, but which was not an issue of major concern yet. Consequently, no representative for the group of stakeholders related to SMEs was incorporated in this research.

All the other groups of stakeholders are represented by highly experienced representatives who are all employed by world-leading companies and organizations in their field. An overview of the backgrounds and experiences of each of the experts and a combined transcript of all the interviews can be found in appendix D. Because the interviews contained a lot of discussion regarding the definition of factors, the functionality of the BWM and the meaning of the ratings the respondents could provide, it was chosen not to include the entire transcripts of the conversations. The transcript in the appendix is confined to remarks the interviewees made about the factors or the research. To make the transcript available to an international audience, the remarks from the interviews that were performed in Dutch were translated to English. The translation in English was kept as close to the original Dutch remark as possible, to reduce the chance of misinterpretation.

5.4 Resulting weights of importance

The weights that the experts attributed to the factors and groups of factors in the surveys were analysed by means of the BWM, an explanation of which can be found in section 4.4. The BWM enabled the calculation of weights of importance for the different factors within each category and weights of importance of each category, for each of the experts. By multiplying the weight assigned by the respondent to a factor within a category with the weight that was attributed to that category, a resulting global weight of importance could be calculated. The resulting global weights can be compared to determine how the different factors relate to each other in terms of importance. The aggregated mean weights over all the respondents for each of the factors are given in Table 6. The codes next to the factors indicate the codes that will be used to refer to the different factors in the graphs and figures used in this report. The next chapter will elaborate on the practical interpretation of the results. All the weights of importance for each of the respondents are presented in appendix E.

Category	Factor	Code	Mean weight of importance
Tangible standard characteristics	Compatibility with incumbent practices	A1	0,049
	Implementation costs	A2	0,038
	Progressive adoption	A3	0,023
	Possibility for certification	A4	0,026
	Industry- and sector-specific guidelines	A5	0,029
	Accessibility of information	A6	0,020
Intangible standard characteristics	The ability to provide an organization with more structure	B1	0,017
	The ability to improve an organization's reputation	B2	0,028
	The possibility to get started without external guidance	B3	0,017
	Applicability to different size organizations	B4	0,019
	International acceptance of the standard	B5	0,057
	The ability to open new markets or retain old markets	B6	0,019
Standard supporting alliance characteristics	Financial strength and market position of the supporters	C1	0,031
	Reputation of the standard supporters	C2	0,040
	Diversity within the alliance	C3	0,020
	The participation of an official SDO	C4	0,036
	Perceived neutrality/independence	C5	0,055
Standard creating process	Coordination within an alliance	D1	0,025
	Stakeholders and third-party involvement	D2	0,049
	Substantive due process and rationale	D3	0,022
	Transparent and open process	D4	0,022
Standard support strategy	Financial support for the standard	E1	0,017
	Alignment of interests of participants	E2	0,032
	Periodical improvement of the standard	E3	0,017
	Provision of operational support	E4	0,021
	The presence of a community	E5	0,016
	Benefits tracking	E6	0,012
Stakeholders	Support by consultants & auditors	F1	0,037
	Support by governmental bodies	F2	0,069
	Support by NGO's related to the standard	F3	0,040
	Pressure from customers	F4	0,093

Table 6. The resulting weights of importance of all factors averaged over all respondents.

5.5 Practical interpretation of the results

In this section the resulting weights of importance for the factors and the remarks which were used to substantiate them will be examined. Comparisons with relevant literature will also be made to compare the results for this case with other cases. The different categories will first be discussed separately, the weights of importance of the factors within each group will be compared to evaluate to what extent the factors carry importance in the standardization of calculation and measurement methodologies for corporate GHG inventories.

5.5.1 Tangible standard characteristics

Figure 11 provides an overview of the mean weights of importance of the tangible standard characteristics averaged over all respondents of this research.

Compatibility with incumbent practices (A1) scores the highest on average within this category. Especially the experts working for environmental accounting and auditing firms ranked this factor much higher than the other factors. The expert from Ernst & Young (R2) noted: *"Practice learns that this leads to irritation for most companies; when they have to start doing different things side by side because of new accounting rules, that's when they usually throw the standard overboard."* The new standard should therefore be an addition to- or extension of the existing standards to avoid confusion. The respondent from the WRI recognized that radical change is detrimental, but he also took a different perspective in recognizing

Figure 11. Mean weights of importance of the tangible standard characteristics.

that if compatibility with the status quo is the only thing that matters, it can significantly reduce the pace of evolution and improvement. Moratis and Widjaja (2014) underwrite the importance of compatibility, or as they refer to it *"complementarity of the standard,"* as a decisive factor in their analysis of two competing CSR standards in the Netherlands.

The Implementation costs of the standard (A2) was evaluated as the second most important factor in this category. The experts noted that that implementation costs are a crucial parameter for potential adopters of a new standard. The expert from SAP noted that the Covid-19 situation that we are living through has pushed this factor even more to the front. The economic downturn has made budgets tighter and this has forced many companies to reduce expenses on environmental developments. Implementation costs are mentioned as a decisive factor in all of the studied standards which are aimed at smaller companies, such as food quality standards (Chemnitz, 2007; Escanciano & Santos-Vijande, 2014; Handschuch et al., 2013; Reardon et al., 1999). This indicates that keeping implementation costs at an acceptable level will be crucial to promote adoption among SMEs.

There was some disagreement about the necessity of industry and sector specific guidelines (A5) among the respondents. The expert from Shell noted that these are necessary because they ensure that a standard is applicable to the industry of a potential adopter, pointing out the dominance of specific guidelines in GHG-intensive industries. The expert from KPMG disagreed by mentioning that the GHG protocol grew to dominance without any sector- or industry-specific guidelines, thereby arguing that it is not a critical aspect for standard success. Others were more moderate in their opinion, but they did recognize the

importance of this factor. The expert from DNV GL indicated that *"you can have two standards which are practically the same, but if one is for a specific industry and the other is general, the one that is aimed at the specific industry will most probably be adopted."* He explained this be saying that it gives the impression that representatives from the industry were involved in the creation of the standard with industry- or sector-specific guidelines, which creates a feeling of ownership.

The respondent from Shell indicated that the possibility for certification (A4) usually becomes an issue at the later stages of implementation of the standard by an organization. The first steps are merely focussed on the adoption of the standard itself. Only after this is done successfully, companies might look at obtaining third party certification of the standard. The expert from DNV GL, a world-leading company in the field of assurance, verification and certification, admitted that his background might cause him to be biased, but he believed that the possibility for certification is one of the main motivations for companies to adopt a standard. The possibility for companies to communicate a standardized quality metric through certification was an important supporting argument for certifications.

The possibility for progressive adoption (A3) was assessed to be the second least important factor, and the accessibility of information (A6) the least important factor in this category. Three of the respondents indicated that the accessibility of information, which encompasses among others the languages in which the standard will be published, was not a major issue. They indicated that the choices regarding environmental accounting practices were usually made at the corporate level, where English is the dominant language. Furthermore they added that it might become more difficult for SMEs to adopt a standard if it is only provided in English, but that the big impacts on adoption are made in the industry, where the main language is English.

5.5.2 Intangible standard characteristics

Figure 12 provides an overview of the mean weights of importance of the intangible standard characteristics averaged over all respondents.

The resulting weights show that international acceptance of the standard (B5) is seen as by far the most important factor in this category. This was substantiated by the fact that international acceptance determines to a large extent the adoption by large multinationals, and those in turn influence many other organizations to adopt a standard as well. It is highly beneficial for large multinationals to be able to adopt one standard company-wide, since the amount of manhours and resources necessary to maintain one standard is far less than those required to maintain a different standard for each country or continent. The GRI is an example of a standard setting organization who has an international multi-stakeholder approach written into its strategic principles. It is argued that this laid the foundation for the worldwide adoption of its standards (Brown et al., 2009).
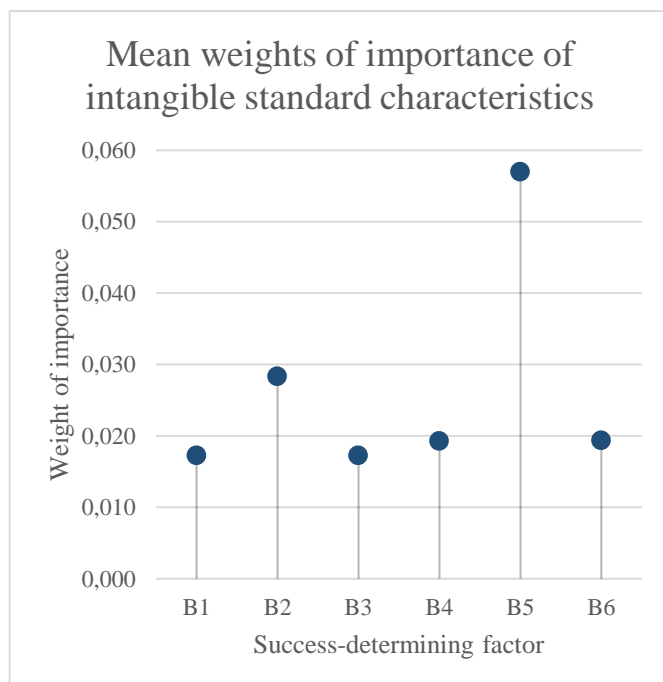
Figure 12. Mean weights of importance of the intangible standard characteristics.

The experts' attributed weights indicate that improving an organization's reputation (B2) is the second most important motivation to adopt the new standard, although many side notes were made regarding this factor. The respondent from KPMG argued that *"A company's reputation is not improved by*

implementing an accounting standard, but rather by improving its environmental performance." In another interview it was mentioned that environmental accounting standards were not necessarily implemented to improve reputation, but rather to prevent the risk of potential reputational damage in the future. Finally, a warning was issued by the professor of accounting from the universities of Amsterdam and Manchester, that if the focus is too much on the creation and adoption of accounting standards for reputational improvement, it could lead to loss of integrity in the standard development process and the standard selection process. Focussing too much on reputation may tempt standard setters to cut corners necessary for the development of a robust standard and may tempt companies to select standards that reflect their emissions positively, rather than realistically. Green (2010) argues that the GHG Protocol "*allowed adopters to publicize their good deeds, thereby burnishing their reputations as responsible corporate citizens.*" She describes the adopters as a 'green club' which offers exclusive reputational benefits. Creating this kind of reputational allure would be beneficial for the adoption of the standard.

The applicability to different size organizations (B4) and the ability to open new markets or retain old markets (B6) were next in the ranking. It was recognized that it is important to ensure that the standard does not require enormous amounts of resources and knowledge to promote adoption by smaller companies, but the widespread adoption of the standard is expected to be driven by large multinationals rather than smaller companies. The experts indicated that trade barriers based on the quality of an organization's environmental accounting was not something that they had experienced yet, and that it therefore was not very relevant at this moment. Some of them added that they saw a strong move towards supply chain responsibility and that they expected these kinds of requirements for trade to become an important issue in the years to come.

The ability to improve an organizations structure (B1) and the possibility to get started without external guidance (B3) were ranked as slightly less important than the preceding two factors. The argumentation for the low importance of B3 was similar to the argumentation for B4; the possibility to implement a standard without external guidance may be important for SMEs, but will not significantly influence adoption by large corporations, which are expected to be the driver behind the adoption.

5.5.3 Standard supporting alliance characteristics

The factor relating to the characteristics of the alliance supporting the standard that was ranked as the most important is perceived neutrality and independence of the standard supporters (C5). The expert from Shell argued that standards can be created with the best intentions and the best tools, but if the organizations supporting it are perceived to be biased, there is simply no way of convincing companies to adopt that standard. In the case of the Marine Stewardship Council (MSC), which was initiated by Unilever, convincing potential adopters of the independence from commercial interests was obviously a complicated task. Wijen and Chiroleu-Assouline (2019) describe the successful strategy applied in that situation: "*From the beginning, both organizations pledged to transition MSC within 2 years to an independent NGO. . . . This was a necessary*
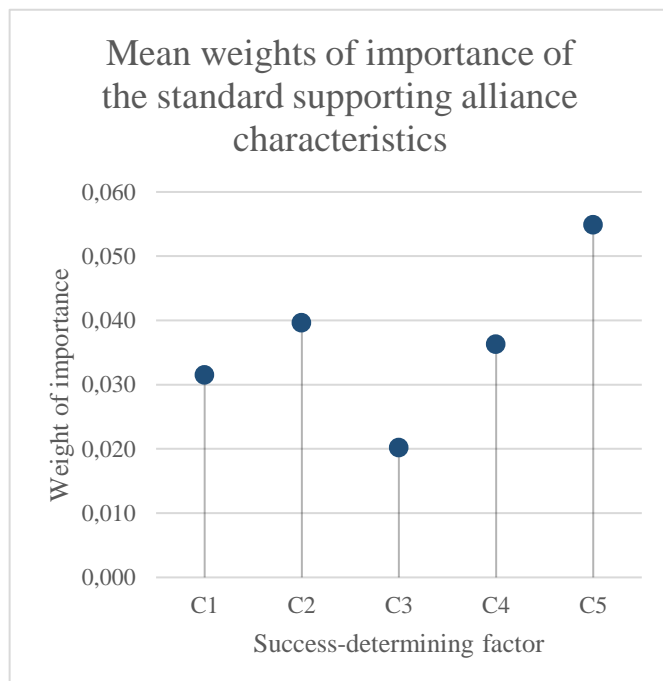
Figure 13. Mean weights of importance of the standard supporting alliance characteristics.

condition for its credibility as a neutral standard-setting and accreditation body and, therefore, for its acceptance by Unilever's competitors."

The reputation of the standard supporter (C2) was valuated as the second most important factor. But this was nuanced by the expert from SAP SE, who mentioned that companies with poor reputations are often eager to improve public opinion. This makes them willing to contribute a lot of effort and resources to these kinds of processes. It would therefore be unwise to disregard companies with suboptimal reputations when establishing an alliance for the proposed standard. For an example of how this is dealt with, we can again look at the previous case of the MSC, Unilever and WWF. Wijen and Chiroleu-Assouline (2019) argue: *"WWF's credibility was crucial for establishing a trustworthy label signalling a credence good like 'sustainable seafood'."*

The participation of the ISO or one of its national members (C4) was ranked slightly lower. The experts indicated that it could provide mass at the board level of companies and provide legitimacy to a standard if it is supported by these official SDO's. One of the respondents did remark a difference between a normal standard and a standardized methodology: *"If you are talking about a standard, the participation of an official SDO can be very important. On the other hand, if you are talking about a standardized methodology, . . . in my view the participation of an official SDO is not that important."* The point being that in the case of a standardized methodology the technical expertise of the members in the alliance is of more importance, to guarantee a technically sound standard.

The collective financial strength and market position of the alliance (C1) was deemed the second to least important factor, only surpassing the need for diversity within an alliance (C3). The respondents pointed out that diversity is not a hard requirement for the success of a standard, as long as the independence of the standard setters is guaranteed. The professor from the University of Amsterdam and Manchester mentioned that he had experienced that diversity within an alliance can lead to conflicts over the standard. It is worth mentioning that several of the experts indicated that they thought all the factors in this category were highly important and that it was difficult to distinguish between them in terms of importance.

5.5.4 Standard creating process

When considering the process through which the standard is created, stakeholder and third-party involvement (D2) was assessed as the most important factor. This was backed up by three main reasons; (1) it guarantees the practicability of the standard, (2) it creates support among those who contributed to the standard and (3) the contributors play a major role in building trust in the standard. Apart from adopting the standard themselves, contributors are more likely to actively promote the standard as well and to attract new adopters in this way. There are several standards in the field of environmental accounting and reporting which are believed to owe a large share of their success to the extensive stakeholder processes through which they were established. Two examples are the GHG protocol (Green, 2010) and the GRI, which
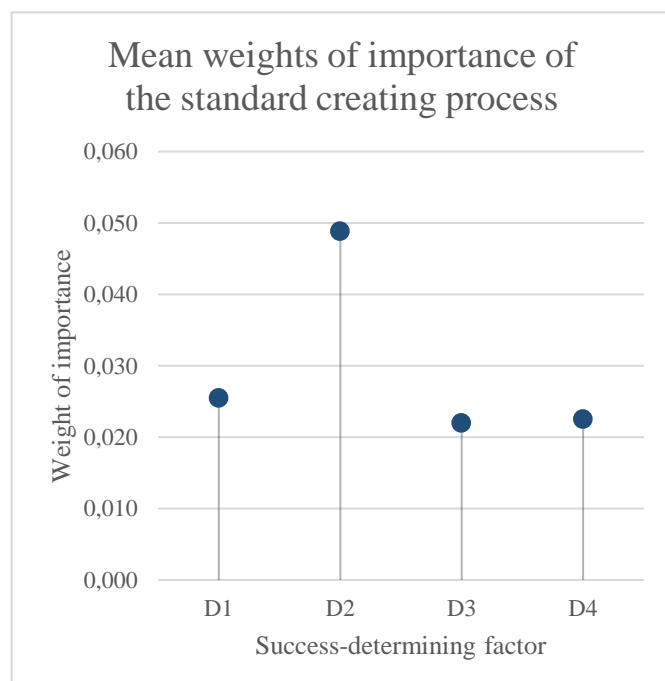
Figure 14. Mean weights of importance of the standard creating process.

was mentioned as an example by the expert from Ernst & Young and underwritten by Marimon et al. (2012).

The coordination within an alliance (D1) was ranked as the second most important factor in this category with just over half the weight of importance attributed to stakeholder and third-party involvement. It was argued that the coordination is paramount when considering the probability of success of a standard creating process, but that it does not carry that much weight when the standard is already created. The experts argued that coordination carried some importance, because good coordination can prevent dropouts from the process, and it can lead to a feeling of ownership of the standard among the participants according to the experts.

A transparent and open process (D4) and substantive due process and rationale (D3) were assessed to be the least important in this category, with the latter bearing infinitesimal less importance. Substantive due process and rationale was seen as a *"hygiene-factor"* by one of the experts. Meaning that it should be performed properly, otherwise it can have serious negative consequences for the standard, but that it is unlikely to have a significant positive influence on the adoption of the standard.

5.5.5 Standard support strategy

The factor related to the standard support strategy that the experts indicated to be most important was the alignment of interests of different stakeholders (E2). Organizations can have various incentives to get involved with the standard, which do not necessarily need to be in line with each other. Through alignment of the interests of all participants during the creation and diffusion process, conflicts can be avoided, and a clear message can be conveyed about the vision, the application, and the benefits of the new standard. One of the experts noted that there are different degrees of resolution at which agreements can be made; at higher levels it is easier to find common ground, whereas this might be harder at the more detailed level due to diverging interests. Finding the appropriate level of detail on which to make agreements is therefore an important aspect of standardization in an alliance. The cofounder of the GRI, Robert Massie,

Figure 15. Mean weights of importance of the standard support strategy.

underwrites the importance of deciding the right level of agreement as follows: *"You do not need to agree on the first principles. In fact, it is better to avoid having an explicit discussion of core values and the fundamental views on the social order. Instead, you focus on more instrumental ideas. This way people can agree on the actions at that level, they may even be willing to try to understand each other on the core level"* (Marimon et al., 2012).

The provision of operational support (E4) was ranked as the second most important factor in this category. The discussions with the respondents did however prove that they could imagine various different ways of providing this support. The GHG protocol, for example, contains a myriad of supporting documents which aid in the adoption and implementation. Green (2010) argues that the GHG protocol reduced implementation costs of its standard, because *"[i]t provided companies who wanted to implement GHG accounting with a ready-made way to do so, complete with software, a how-to guide,*

and technical support". Others pointed out that provisional support does not necessarily need to be provided by the standard setters themselves, but that consultants and other service providers will quickly fill any gaps in operational support that may arise.

Financial support for the standard (E1) and periodical improvement of the standard (E3) followed with practically the same weight of importance. One of the experts claimed that financial support was a necessity to create a high-quality standard, but that it carries less importance during the diffusion phase of a standard. Another told that periodical improvement of a standard can have a significant positive effect on the use of the standard in his experience, and that it is a necessity to keep the content up to date with changing regulations and requirements.

Slightly less importance was attributed to the presence of a community (E5), even though several of the respondents recognized its importance for standards. The community around the GRI was mentioned as an example by the expert from Ernst and Young. It contains various types of members; representatives of the IFRS, representatives from the business community, representatives from accounting firms, and governmental delegates. The active debate among these different important stakeholders creates a great source of discussion, feedback, and promotion for the standard.

The factor in this category that received the least importance from the experts was benefits tracking (E6). The potential benefit was recognized, but they remarked that there were certain aspects that made it difficult. First of all, companies are generally reluctant to share any of their data, especially on sensitive subjects such as environmental performance. Putting too much emphasis on the tracking and communication of performance data might create a barrier for adoption. Secondly, because it is a resource intensive exercise, benefits tracking is usually performed by independent companies, and therefore is not a prerequisite when creating a standard. An example of this in the environmental accounting domain is the CDP, whose data is used for benefits tracking by, among others, the GHG protocol.

5.5.6 Stakeholders

When considering the most important groups of stakeholders related to the creation and diffusion of a new standardized methodology for GHG inventories, the pressure of customers (F4) was ranked as the most important factor. This was attributed mainly to the increasing environmental awareness of customers, and the corresponding increase in quality of environmental information that big customers, like large multinationals or governmental agencies, are demanding from their suppliers. The immense buying power that these customers have, can push suppliers to adopt certain standards to retain their business. On the topic of the Forestry Stewardship Council certification, Cashore et al. (2006) confirm the importance of the pressure by customers by stating that *"All of the strategic timber customers of State Forests . . . such as Castorama, IKEA, Leroy*

Figure 16. Mean weights of importance of the stakeholders.

Merlin, OBI, British Premium, Intercell, etc., demand certificates as a pre-condition for contracts." It

is worth noting that this factor was ranked widely differently by the respondents, this will be discussed in further detail in the statistical interpretation of the results in section 5.6.

The second most important group of stakeholders according to the experts were governments and governmental bodies (F2). Governments obviously hold tremendous power when it comes to the adoption of these types of standards, both through their buying power and their regulatory power. The question that the experts were contemplating was mainly whether the experts anticipated that the government would use those powers to promote a private standard or not. The opinions on that matter were divided, some argued that the government is by far the most important stakeholder due to its ability to make a standard mandatory, others recognized this possibility but thought it improbable that that would happen any time soon. The expert from Shell argued that governments have the tendency to create their own standards, rather than to adopt existing private standards coming from the industry. In the case of the International Accounting Standards Committee (IASC), the lack of governmental support is indicated as a main reason for its failure to draw up successful accounting standards. Carlson (1997) writes on the subject: *"Given the broad global membership of the IASC, it is possible to conclude that the current method of mobilising harmonisation, without government support, is a flawed process, and unlikely to lead to harmonisation of financial reporting."* This implies the critical importance of the involvement of governmental support for these kinds of international standardization and harmonization processes.

Further down the ladder of importance the support of NGO's (F3) is found. Despite the relatively low weight of importance in its category, arguments were made as to why they do carry significant importance. Many companies value the endorsement of NGO's like the WRI, WBCSD, TCFD and the GRI highly from their perspective as a public organization. The lowest ranked factor in this category was the support of consultants and auditors (F1). There was some dispute about whether consultants and auditors create demand by advising standards to their clients, or whether they follow the market and incorporate services in their portfolio because a demand exists for them. This difference in perspective drastically changes the importance attributed to this group of stakeholders, which is also reflected in the attributed weights.

5.5.7 Categories

The collective influence of the factors in the category regarding stakeholders was evaluated as the most important by the experts. The support from consultants and auditors, governmental bodies and NGO's, and pressure by customers was perceived to be crucial for the successful diffusion of a standardized GHG accounting methodology.

The factors relating to the tangible characteristics of the standard and the standard supporting alliance characteristics were ranked slightly lower and received scores that were very close to each other. One expert mentioned that the composition of the alliance is a 'make-or-break' issue, which relies heavily on the strength, neutrality, and diversity of the alliance, and whether they can commit the required financial resources. He added that several
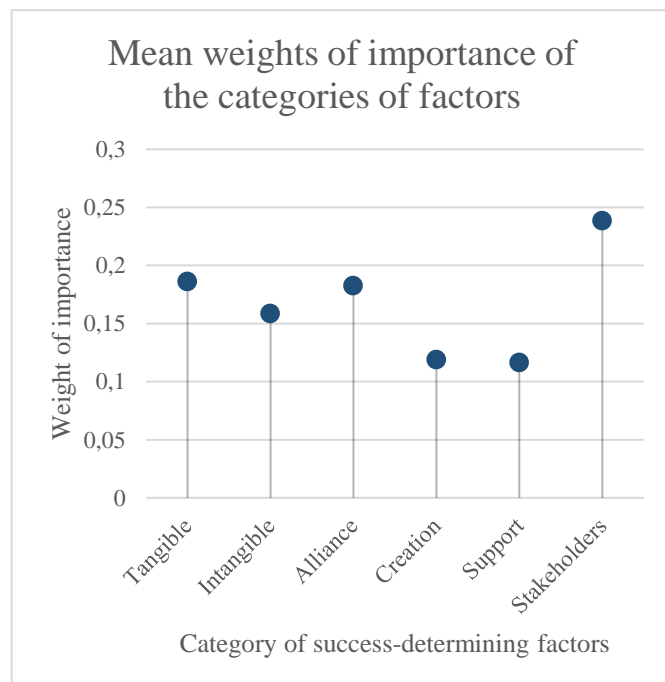
Figure 17. Mean weights of importance of the different categories of factors.

efforts that did not fulfil each of those requirements failed as a result.

The intangible standard characteristics received a slightly lower weight of importance compared to the previous two categories. One of the experts noticed that the factors in this category were related to the main drivers for many companies to adopt a standard, which would insinuate significant importance for this category.

The two categories with the lowest weights of importance were the standard creation process and the standard support strategy. The expert from the WRI suggested that if organizations assume that the standard creation process was transparent, open, and well-managed, they are not likely to dive into the minutia of how the process went down exactly. He continued to say that they make all documentation regarding their GHG Protocol standards available for the sake of openness, but that the other factors relating to the alliance composition and the perceived trust in the alliance are more important determinants in how the standard will be regarded. He went on to note that they do not employ a very active standard support strategy for the diffusion of their standards, due to the limited resources that are available. They rely more on pull-forces from the industry based on the inherent characteristics of the standard for the diffusion of the standard. This is underwritten by the respondent from Shell, who adds that if a standard provides significant benefits for an organization, there is no need for active marketing. The pull-factor from the industry is a far stronger force than the push-factor from the standard setting organizations.

5.6 Statistical interpretation of the results

The practical interpretation of the results of this research and the corresponding conclusions that have been drawn, were based exclusively on the weights of importance for the factors averaged over all the respondents. It has been assumed that the averaged weights of importance of our sample of respondents are an accurate representation of 'actual' weights of importance, if those even exist. In this section this assumption is contested based on a statistical analysis of the results and the averaged weights.

The need for this scrutiny of the results becomes apparent when the averaged weights of importance are plotted together with the weights of importance attributed by each of the respondents, like is done in Figure 18. It shows that there is good consensus on the importance of some of the factors, whereas others, like the importance of the pressure from customers (F4), are valued completely differently by the different experts. This raises questions about the accuracy of the results and the reasons for the large differences in valuation of the factors by the different experts.
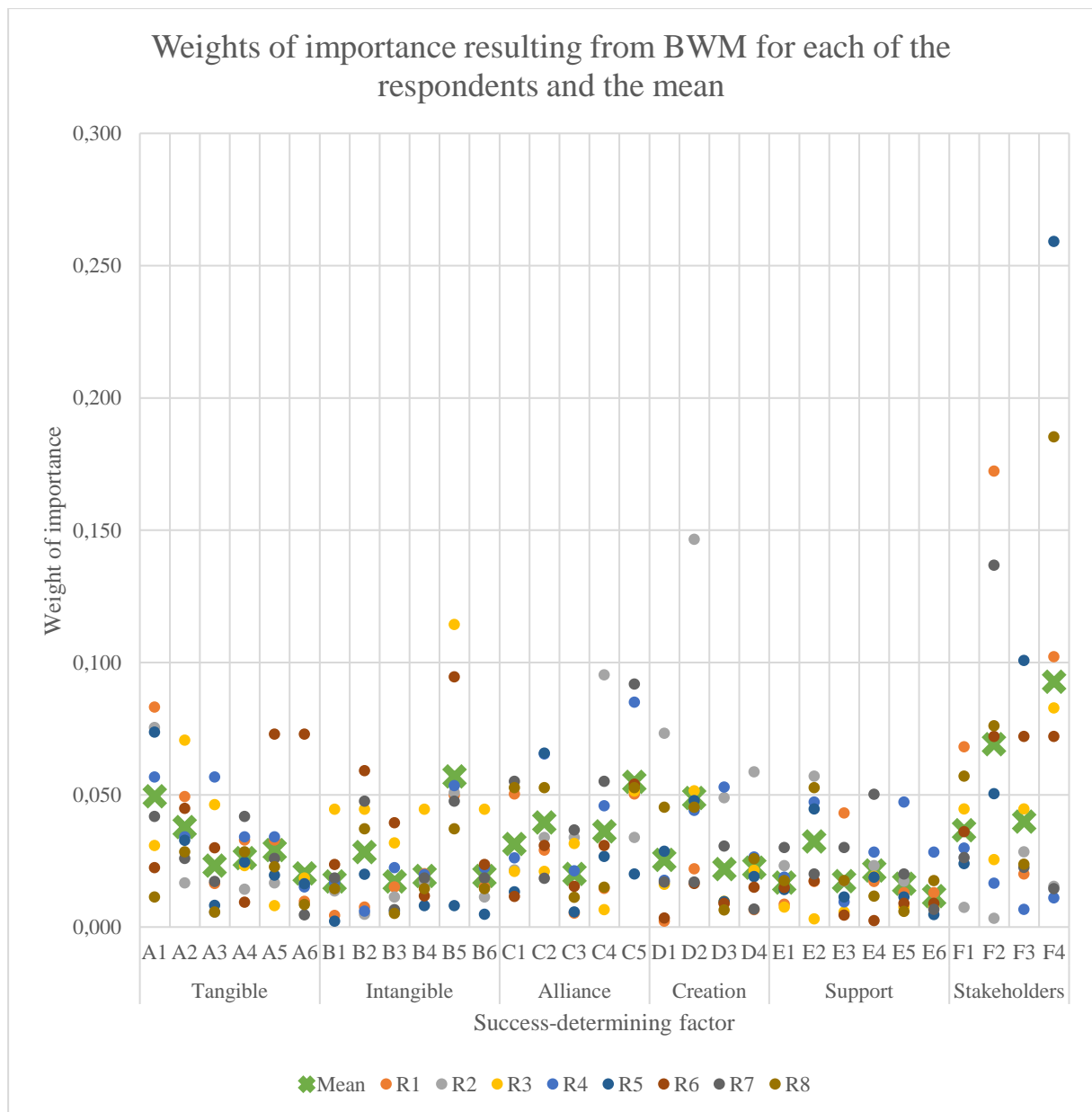
Figure 18. Graph displaying the mean weights of importance and the weights of importance attributed by all the respondents.

To assess the accuracy of the results the 90% confidence intervals of the average weights of importance were calculated based on the standard deviation of the weights and the number of observations. Eq. 5 was used to determine the confidence interval for each of the factors. The standard deviation is the square root of the sample variance (Eq. 4). The sample variance is the average of the squared difference from the mean of each of the observations (Eq. 3).

Sample variance:
$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$
Eq. 3

Sample standard deviation:
$$s = \sqrt{s^2}$$
Eq. 4

Confidence interval:
$$CI = \bar{x} \pm t * \frac{s}{\sqrt{n}}$$
Eq. 5

x_i = the weight of importance of observation i
$\bar{x}$ = the sample mean of the weights of importance
n = the sample size
t = t-value for the desired confidence level (z=1.895 for a confidence level of 90%)

When the 90% confidence interval is determined for all of the factors, and plotted with the mean weights, it results in the graph seen in Figure 19. A table containing the mean weight and the sample standard deviation for each of the factors can be found in appendix F.
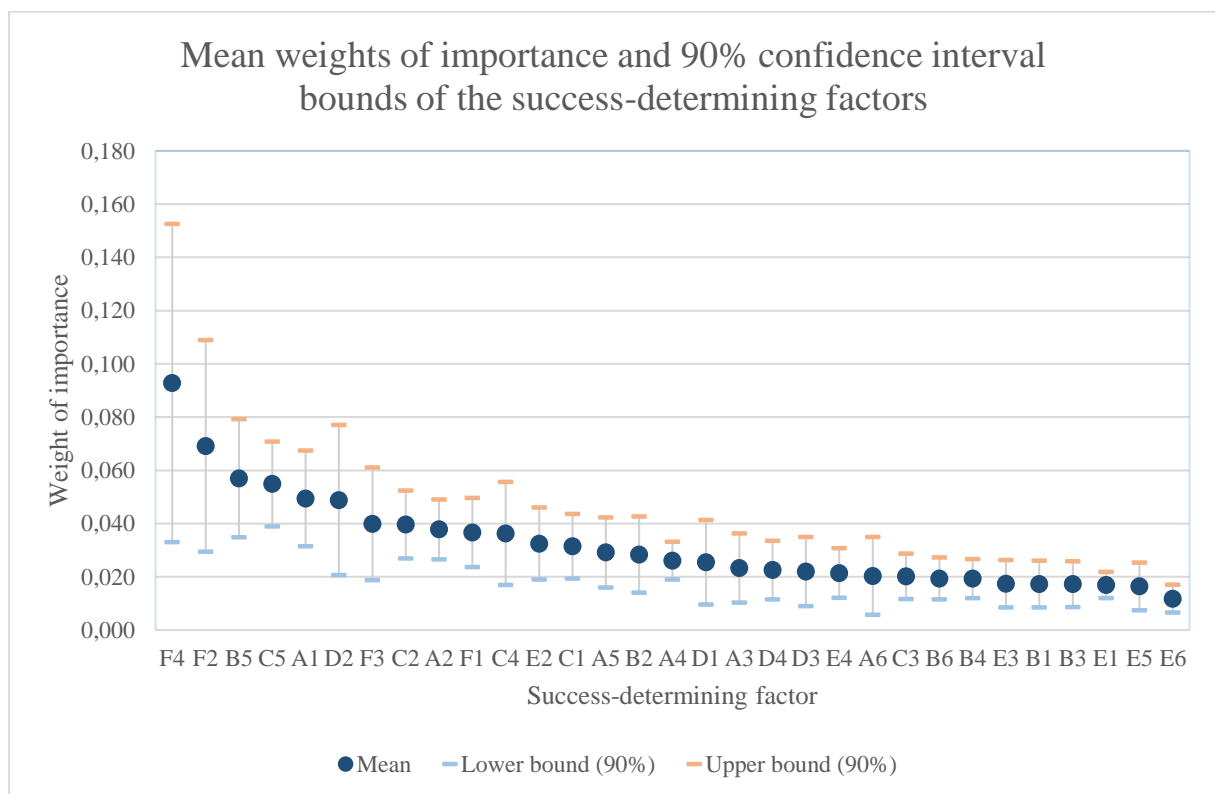
Figure 19. Graph depicting the mean weights of importance for each of the factors and their 90% confidence interval.

From Figure 19 it can be seen that much debate is still possible about the actual weights of importance of the different factors. Despite 90% being a permissive confidence interval in the academic world, for thirteen of the factors this interval spreads from less than half the value of the mean weight of importance to over 1.5 times the mean weight of importance. For the accessibility of information (A6), this interval spans from 28% to 172% of the value of the mean weight of importance. From a statistical point of view

this can be attributed to the relatively small sample size. By increasing the number of respondents, the confidence interval of the resulting mean weight will narrow, and conclusions can be drawn with more certainty.

Another factor which plays an important role in the uncertainty regarding the true mean weight of importance is the wide dispersion of the weights attributed by the respondents for certain factors. Some justifications for the disagreements among the respondents on these factors can be contemplated.

First of all, there is no universal truth regarding the questions that were posed to the respondents. All of the respondents answered from completely different professional backgrounds and experiences, with a different perspective of the problem at hand. It is to be expected that this difference in viewpoint leads to diverging evaluations of the importance of the factors. After all, that is the reason why experts from all the different groups of stakeholders that were identified were involved. This was done to eliminate the effect of outliers with "extreme" opinions and to try and provide a balanced mean weight of importance for the identified factors.

Secondly, it depends heavily on the interpretation of the proposed standard and the factors that were presented. This was illustrated in the interview with the expert from DNV GL; when asked about his valuation for the possibility for progressive adoption (A3), he pointed out that this relied heavily on the complexity of the standard and its implementation. For a highly complex standard which requires significant resources it would be of the utmost importance to build the possibility for progressive adoption into standard, especially if smaller companies are part of the target audience. For a standard that is quite straightforward and inexpensive to implement, it would be beneficial to make sure that all organizations implement the standard in the same way. Little is known about the form that the standardized methodology might take if it is ever established, and the different factors about which the experts were questioned influence the characteristics of the resulting standard to a large extent. It was therefore a difficult compromise between providing the respondents with enough information so they would be able to assess the factors correctly, but not too much as to influence their opinion. Respondents indicated in many cases that their answers were heavily reliant on the final form of the standard and the industry that was considered.

6. Answers to the sub-questions

In this chapter we will formulate concise answers to the research sub-questions based on the results presented in the previous chapter.

6.1 Sub-question 1

What are the different factors that influence the adoption of private quality standards and can be manipulated by standard setters?

The first sub-question was answered through thorough literature research, combined with expert interviews. This resulted in a framework of 31 success-determining factors which can be influenced by the standard setter. This framework, which can be seen below, was subsequently used in a case study for a new standardized measurement and calculation methodology for corporate GHG inventories. All of the respondents indicated that, in their opinion, the framework contained the most important factors for quality standard success which can be influenced by standard setters.

Tangible standard characteristics:
- Compatibility with incumbent practices
- Implementation costs
- Progressive adoption
- Possibility for certification
- Industry and sector specific guidelines
- Accessibility of information

Intangible standard characteristics:
- The ability to provide an organization with more structure
- The ability to improve an organization's reputation
- The possibility to get started without external guidance
- Applicability to different size organizations
- International acceptance of the standard
- The ability to open new markets or retain old markets

Standard supporting alliance characteristics:
- Financial strength and market position of the supporters
- Reputation of the standard supporters
- Diversity within an alliance
- The participation of an official SDO
- Perceived neutrality/independence

Standard creating process:
- Coordination within an alliance
- Stakeholders and third-party involvement
- Substantive due process and rationale
- Transparent and open process
- Alignment of interests of participants

Standard support strategy:
- Financial support for the standard
- Periodical improvement of the standard
- Provision of operational support
- The presence of a community
- Benefits tracking

Stakeholders:
- Support by consultants and auditors
- Support by governmental bodies
- Support by NGO's related to the standard
- Pressure from customers

6.2 Sub-question 2

What are the most important stakeholders in the creation of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?

The structured stakeholder analysis proposed by (de Vries et al., 2003) was performed to identify and classify the most relevant stakeholders for this standardization process. The result of this analysis can be seen in Table 7. They are ordered in terms of importance, the definitive stakeholders are the most important because they have power legitimacy and urgency, followed by the dominant stakeholders who lack urgency. The dependent stakeholders lack power but do contain legitimacy and urgency and therefore are important to consider. Discretionary stakeholders hold legitimate claims to be included in the standardization process. And demanding stakeholders are neither powerful nor legitimate, and therefore the least important group of stakeholders.

(GROUPS OF) STAKEHOLDERS	POWER	LEGITIMACY	URGENCY	TYPE
LARGE MNC'S	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
ENVIRONMENTAL ACCOUNTING FIRMS	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
ERP PROVIDERS	Yes	Yes	Yes	DEFINITIVE STAKEHOLDER
GOVERNMENTS	Yes	Yes	No	DOMINANT STAKEHOLDER
ENVIRONMENTAL NGO'S	No	Yes	Yes	DEPENDENT STAKEHOLDER
ENVIRONMENTAL AUDITING/ CERTIFICATION FIRMS	No	Yes	Yes	DEPENDENT STAKEHOLDER
SMES	No	Yes	No	DISCRETIONARY STAKEHOLDER
UNIVERSITIES	No	Yes	No	DISCRETIONARY STAKEHOLDER
CONSULTANCY FIRMS	No	No	Yes	DEMANDING STAKEHOLDER

Table 7. The classification of the identified stakeholders according to the variables proposed by Mitchell et al. (1997).

6.3 Sub-question 3

What is the relative importance of the factors identified in Sq 1. for the widespread adoption of a standardized calculation and measurement methodology for corporate greenhouse gas inventories?

Through conducting interviews and surveys, pairwise comparisons between the different factors were collected. The BWM was subsequently used to determine the weights of importance for the different factors of the framework were determined for a new GHG accounting methodology. The averaged attributed weights can be found in Table 8 and a visual representation of the weights for each of the factors can be seen in Figure 20.

Factor	Code	Mean weight
Compatibility with incumbent practices	A1	0,049
Implementation costs	A2	0,038
Progressive adoption	A3	0,023
Possibility for certification	A4	0,026
Industry- and sector-specific guidelines	A5	0,029
Accessibility of information	A6	0,020
The ability to provide an organization with more structure	B1	0,017
The ability to improve an organization's reputation	B2	0,028
The possibility to get started without external guidance	B3	0,017
Applicability to different size organizations	B4	0,019
International acceptance of the standard	B5	0,057
The ability to open new markets or retain old markets	B6	0,019
Financial strength and market position of the supporters	C1	0,031
Reputation of the standard supporters	C2	0,040
Diversity within the alliance	C3	0,020
The participation of an official SDO	C4	0,036
Perceived neutrality/independence	C5	0,055
Coordination within an alliance	D1	0,025
Stakeholders and third-party involvement	D2	0,049
Substantive due process and rationale	D3	0,022
Transparent and open process	D4	0,022
Financial support for the standard	E1	0,017
Alignment of interests of participants	E2	0,032
Periodical improvement of the standard	E3	0,017
Provision of operational support	E4	0,021
The presence of a community	E5	0,016
Benefits tracking	E6	0,012
Support by consultants & auditors	F1	0,037
Support by governmental bodies	F2	0,069
Support by NGO's related to the standard	F3	0,040
Pressure from customers	F4	0,093

Table 8. Codes and mean weights of importance for each of the factors.
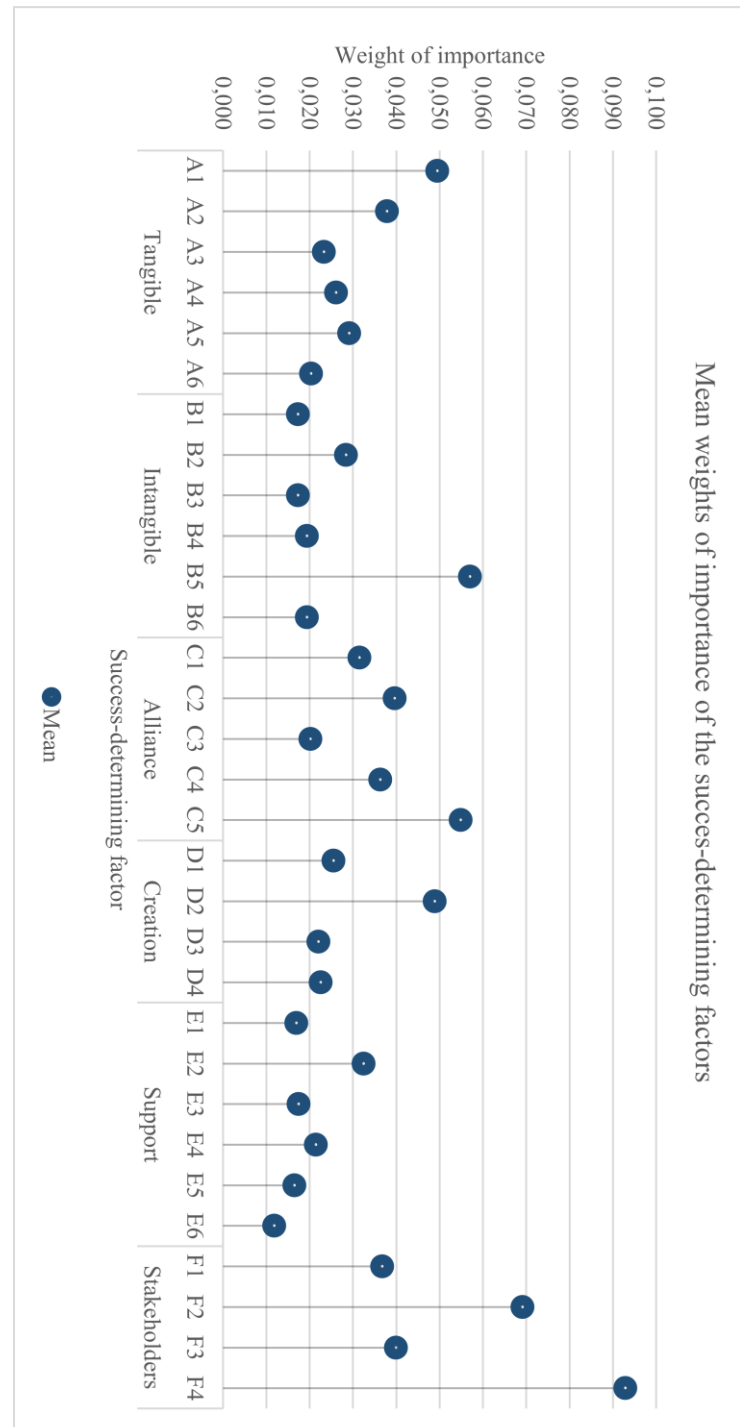
Figure 20. Graph showing the mean weights of importance for all the identified factors.

7. Discussion

7.1 Consistency of the provided weights

As explained in section 4.4, the resulting value of ξ^* from the minimalization problem in Eq. 2 can be used to calculate an indicator for the consistency of the pairwise comparisons that were made by the respondent. From the resulting ξ^* it is possible to calculate the consistency ratio (CR) by means of Eq. 6, the required consistency indices (CI) are shown in Table 9 (Rezaei, 2015).

$$CR = \frac{\xi^*}{CI}$$

Eq. 6

A_{BW}	1	2	3	4	5	6	7	8	9
CI	0,00	0,44	1,00	1,63	2,30	3,00	3,73	4,47	5,23

Table 9. The Consistency indices corresponding to the weight attributed to the Best-Worst comparison.

The resulting Consistency Ratios for each of the respondents can be found in Table 10. A lower value for ξ^* and therefore a consistency ratio that is closer to zero indicates a higher consistency in the weights that were attributed by the respondent. A recent article by Liang, Brunelli, and Rezaei (2020) proposes threshold values for the Consistency Ratios obtained from the BWM. These consistency thresholds are dependent on the weight attributed to the comparison between the Best and Worst criteria (a_{bw}) and the number of criteria that are being compared. The obtained values for CR were all beneath the maximum acceptable values, which are presented in Table 11. The weights that were provided by the experts are therefore deemed to be consistent enough for this research.

	R1		R2		R3		R4		R5		R6		R7		R8	
	ξ^*	CR	ξ^*	CR	ξ^*	CR	ξ^*	CR	ξ^*	CR	ξ^*	CR	ξ^*	CR	ξ^*	CR
TANGIBLE	0,069	0,018	0,171	0,033	0,111	0,037	0,049	0,049	0,140	0,047	0,067	0,022	0,064	0,017	0,054	0,033
INTANGIBLE	0,096	0,018	0,159	0,043	0,059	0,059	0,098	0,019	0,085	0,023	0,094	0,031	0,050	0,017	0,050	0,011
ALLIANCE	0,053	0,012	0,338	0,147	0,090	0,030	0,081	0,049	0,109	0,021	0,054	0,033	0,071	0,044	0,041	0,025
CREATION	0,111	0,025	0,448	0,149	0,130	0,080	0,063	0,063	0,091	0,056	0,031	0,014	0,048	0,029	0,053	0,018
SUPPORT	0,077	0,047	0,085	0,028	0,071	0,031	0,053	0,032	0,114	0,031	0,050	0,017	0,064	0,021	0,143	0,048
STAKEHOLDERS	0,088	0,024	0,162	0,054	0,032	0,032	0,052	0,032	0,099	0,019	0,000	0,000	0,105	0,023	0,125	0,042
CATEGORIES	0,086	0,023	0,109	0,036	0,071	0,031	0,051	0,031	0,091	0,024	0,033	0,014	0,057	0,057	0,026	0,026

Table 10. values for ξ^* and Consistency Ratios for each of the categories that were evaluated by the respondents.

		NUMBER OF CRITERIA						
		3	**4**	**5**	**6**	**7**	**8**	**9**
	3	0.209	0.209	0.209	0.209	0.209	0.209	0.209
	4	0.158	0.235	0.274	0.293	0.310	0.315	0.327
	5	0.211	0.285	0.302	0.331	0.348	0.361	0.374
A_{BW}	**6**	0.216	0.292	0.357	0.392	0.406	0.417	0.423
	7	0.209	0.331	0.373	0.393	0.404	0.411	0.430
	8	0.227	0.341	0.403	0.423	0.438	0.454	0.460
	9	0.212	0.365	0.406	0.423	0.445	0.459	0.475

Table 11. Threshold values for the Consistency Ratios of the BWM, proposed by Liang et al. (2020).

7.2 Interpretation of the 'weights of importance'

The BWM resulted in weights of importance, which were attributed by the experts that were interviewed. When averaged over all the experts, the weights of importance ranged from 0,093 for the highest ranked factor (Pressure from customers) to 0,012 for the least important factor (Benefits tracking). What is important to realize, is that these scores do not have a direct connection to the absolute importance of the factors that were assessed, they merely provide a measure for the relative importance of the factors. The BWM does not require respondents to signify the importance they attribute to the different factors, only to make pairwise comparisons. The resulting weights therefore do not convey any message about the importance of the collection of criteria under consideration. The weights could signify importance on a scale from 'very important' to 'critical', or, on the other side of the spectrum, on a scale from 'not important' to 'slightly important', or anywhere in between. The weights of importance cannot provide a definitive answer to this issue.

The interviews that were conducted do provide us with some insights to hold on to when interpreting the resulting weights of importance. David Rich, who has extensive experience with the creation and diffusion of standards from his work at the WRI and the GHG Protocol, mentioned during his interview: *"All of the factors are very relevant, which makes it a difficult task of choosing and rating. The identified factors are a really good compilation of all of these factors that are relevant."* Brendan O'Dwyer, a professor of accounting and sustainability accounting from the University of Amsterdam and the University of Manchester, underwrote David's remarks by saying: *"I have done some work into how standards diffuse and make their way into industries, and all of these factors are crucial."* Finally, Vikram Nagendra, who works at SAP and is fellow at the Value Balancing Alliance, commented that the identified factors *"resonate very well with the work that the Value Balancing Alliance is doing."* Considering the similarity between the mission of the Value Balancing Alliance and the proposed standard, this indicates that the identified factors are indeed representative of the most important aspects of standardization in this particular field. Taken together it seems fair to conclude that even the lowest weighed factors have the potential to influence adoption, and that the factors attributed the highest weights of importance carry very significant importance to the widespread adoption of the proposed standard.

7.3 Assessment of the framework

In this section a closer look will be taken at the framework of success-determining factors that was created. The lessons that were learned through employing it in this research will be discussed and recommendations for researchers and others aiming to use it in the future will be made.

This thesis is an exploratory research focussed on a standard which is still in the very early stages of development. The framework that was employed could therefore not be too detailed, as increasing detail would lead to a far more elaborate, and therefore unworkable, list of factors. The created framework matched the requirements for this research well. It contained the most important success-determining factors which could be influenced by standard setters and it enabled the pairwise comparisons to be made by the experts.

The broadness of the framework and the factors in it does come at a cost, it introduces ambiguity in the interpretation of the meaning of the factors. For example, during the creation of the framework it was chosen to merge all the factors relating to governmental and regulatory interference in the diffusion of the standard into one factor, *'support by governmental bodies'*. This tremendously reduced the number of factors that would need to be assessed by the respondents, but it also made differences in interpretation possible. Governmental bodies can support a new standard by making the standard mandatory, by making sure the government's regulation is aligned with the standard, by providing financial support or know-how on the matter to the standard setters, or simply through a governmental endorsement which legitimizes the standard. This also came up during the interviews; some respondents argued that governmental bodies were the most important stakeholders, because they had the power to make a

standard mandatory. Others said they did not believe the government would use that power for a privately created standard, leading to widely different weights of importance. Every factor in the framework can be scrutinized in this way and broken up into many sub-factors. The outcome of this research can therefore not be used as a turnkey guidebook on how to create the proposed standard, but rather to provide insights into the aspects of standardization that require more attention to determine how they can best be addressed.

The observant reader may have seen that the factor alignment of interests was listed in the category 'standard creation process' in the framework but was evaluated under the category 'standard support strategy' in the surveys and interviews. When the framework was created, the alignment of interests was interpreted in the literature it derived from to be related to the alignment of ideas regarding the standard diffusion. As the research advanced however, it became clear that the alignment of interests is more related to the standard creation process. When this became clear it was too late to reverse the decision that was made for this research, but for future research 'alignment of interests' is believed to be more accurately positioned in the category 'standard creating process'.

7.3.1 Omission of environmental factors

One of the most important choices that was made regarding the framing of the framework, was to disregard all environmental factors. Environmental factors are factors which influence the receptivity of a market for standardization and can hardly be influenced by a single firm (van de Kaa et al., 2011). This choice was made to focus the attention on aspects of the standardization process which can be influenced by the standard setting alliance. This reflected the assignment that was provided by Shell more accurately, to determine what steps the alliance should take to increase the probability of creating a successful standard. The views of the experts on this decision and its implications for the framework will be discussed in this section.

The expert from the WRI rightly remarked that the framework *"does not take the dimension of demand or pressure for new standards into account. . . . Why are companies looking to do this in the first place? Is there an expectation that everyone should inventory and report their greenhouse gasses?"* He directly emphasizes the environmental factors, and their effect on the success of standards. The expert from Shell remarked: *"If there is a clear need for standardization, a market does its own adoption work independent of the standard setting organization, it doesn't require being pushed on to organizations. If there is no crucial need, then it will not be effective regardless of the standardization process, the standard outreach activities, the standard support activities or who was involved. If there is a clear need and a standard fulfils that need, then it can even gain widespread adoption without some of these factors, but they all do contribute to adoption."* This perfectly illustrates the relation between environmental factors and factors that can be influenced by standard setters. Creating a standard in a market with unfavourable environmental factors will most likely not attain widespread adoption, even if all the firm-level factors are addressed perfectly. This does not mean that the firm-level factors cannot influence the probability of widespread adoption and should not receive attention in the standard creation process. It merely emphasizes the need to consider both types of factors during the standardization process. As Suarez (2004) argues: *"Typically, no single factor of dominance is strong enough to tilt the balance in favor of a particular technology; the final outcome is always the result of the interplay of several firm- and environmental-level variables."* A study of the environmental factors, to determine receptivity for standardization, should precede the determination of the factors that a standard setter can influence. It would be very interesting to create a framework of environmental factors to assess the receptiveness of markets to quality standards in future research, to complement the framework proposed in this research.

7.4 Assessment of the Best-Worst Method

Multi-criteria decision-making tools are generally employed to structure decisions between multiple existing alternatives, or to predict the outcome of such decisions, based on conflicting criteria regarding the characteristics of the alternatives. In these cases, the alternatives and their characteristics are known. The exercise is to determine which criteria should be evaluated and to determine how heavy each of these criteria should weigh in on the final decision. In this research the BWM has been used in a slightly different way. The determination of the appropriate criteria remained the same and resulted in the framework of success-determining factors. The determination of the importance of each of these criteria, which resulted in the weights of importance, also remained the same. The difference lies in the way in which the results are applied; not to select among alternatives, but rather to prioritize aspects in the standard creation and diffusion process of a new standard.

When the alternatives of a decision problem and their characteristics are known, the ranges for each of the criteria are known as well. In this case however, because no alternatives are known, there are no boundaries for the possible values of the criteria. It is difficult to determine the importance of a factor, if it is unknown what the range of values for the alternatives is. If the implementation costs for all alternatives range from *'free'* to *'cheap'*, the importance of that factor decreases in comparison to a situation in which the implementation costs range from *'free'* to *'very expensive'*. Future research based on choice modelling could help to determine the importance of the identified factors for different possible ranges of interpretations of the criteria.

One of the main reasons to adopt the BWM for this research was the relatively high data efficiency, compared to other MCDM methods, while still providing the possibility for a consistency check. This decision reduced the amount of pairwise comparisons required by more than 35% compared to AHP, the most popular MCDM method according to Pohekar and Ramachandran (2004). This provided significantly more time to discuss the rationale behind the attributed weights with the experts. The use of the BWM for any research that requires pairwise comparisons from multiple respondents is highly recommended due to this feature.

Because of the high number of factors that had to be evaluated, it was deemed impractical to make pairwise comparisons between all of them. To make comparisons between the factors from different categories possible, the weights for the factors within each category were multiplied by the weight attributed to that category. This process allowed comparison of factors which were never compared by the experts. It is difficult to say if these multiplied weights are an accurate representation of the weights respondents would have attributed if they had made pairwise comparisons. It would be interesting to evaluate the accuracy of the resulting weights of this research by employing a different methodology in future research which does allow comparison between all the factors, and to compare the results.

Another problem with the clustering of criteria, is that the weights of importance within a cluster always add up to 1. The distribution among the criteria is dependent on the attributed weights, but the sum of the final weights must be 1. This becomes problematic when different clusters do not contain the same number of criteria, which is the case in this research. The number of criteria in each cluster varies from 4 to 6, meaning that clusters with less criteria will receive relatively higher weights on average than clusters containing more criteria. When compensating for this difference, the weights of importance shift significantly and the hierarchy of importance changes as well. Figure 21 shows the difference between the old results, which are not compensated for the number of criteria in each category and the compensated mean weights of importance. It can be seen that the order of importance of the factors changes when compensating for the number of factors in each category.
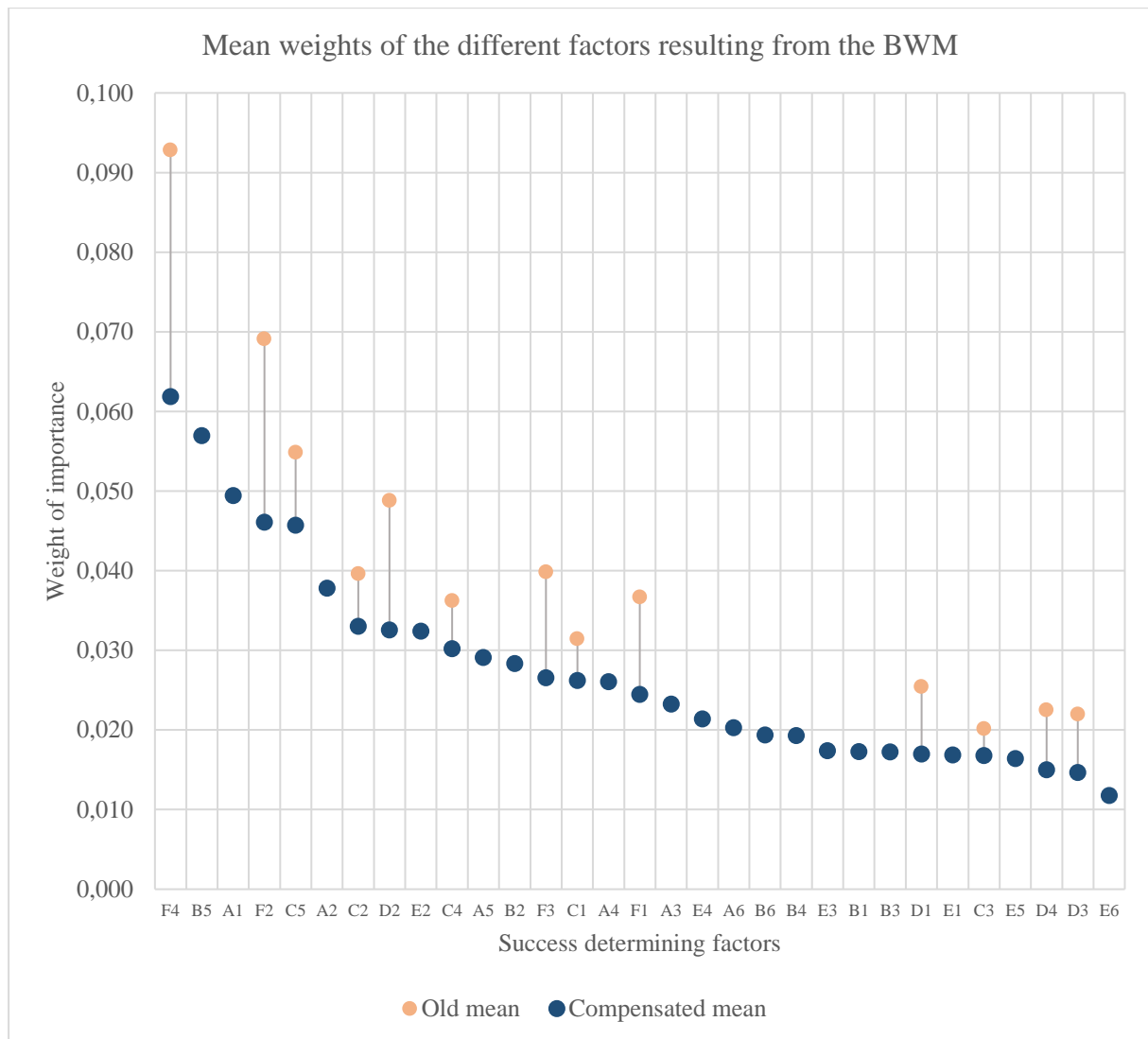
Figure 21. The mean weights of importance with and without compensation for the number of criteria within each cluster.

One practical issue, which some of the respondents pointed out during the interview, was that the switching of perspective from comparing with the most important criterion, to comparing with the least important criterion led to confusion. Where a rating of 1 in the comparison with the best factor meant that the factor was very important, this same rating of 1 in the comparison with the worst factor meant it was highly unimportant. Because this research was performed through interviews, the resulting confusion could be solved on the spot, and did not create any complications. It is however a characteristic of the BWM to be aware of when using it in a research that employs surveys, because misinterpreted questions could lead to flaws in the resulting dataset. It is advised to anyone who wants to use the BWM in a survey to carefully consider the phrasing of the questions and the presentation of the possible ratings.

7.5 Comparison with other case studies

In this section the results from this research will be compared with previous research into factors that influence the adoption and selection of standards to identify similarities and differences. Two factors make it particularly difficult to make one-on-one comparisons; (1) standardization processes for different standards require different criteria to be assessed and (2) nearly all previous work is focussed on compatibility standards or technological innovations. Despite these complexities, valuable lessons can still be learnt from comparing this thesis with preceding research.

When considering prior research into struvite installations (van de Kaa, van den Eijnden, & Doorn, 2020), biomass thermochemical conversion technologies (van de Kaa, Kamp, et al., 2017), power line communication technologies (van de Kaa, Fens, Rezaei, et al., 2019), residential grid storage technologies (van de Kaa, Fens, & Rezaei, 2019), electrical vehicle technologies (van de Kaa, Scholten, Rezaei, & Milchram, 2017) and photovoltaics technologies (van de Kaa, Rezaei, Kamp, & De Winter, 2014) a clear trend can be seen regarding the factors that are deemed most important in these categories. Table 12 provides an overview of the five factors that the mentioned studies indicated as most important In all of these studies the factor *'technological superiority'* is evaluated as the most important factor and in the studies that make a distinction between categories of factors, the factor related to the *'characteristics of the standard'* or the *'characteristics of the format'* are consistently ranked as the most important category of factors. The category of *'other stakeholders'* is evaluated to be the least important category by van den Eijnden (2019) and van de Kaa, Fens, and Rezaei (2019) and the second to last category by van de Kaa, Kamp, et al. (2017). This is in stark contrast to the rank of most important category attributed in this research. It should however be mentioned that the factors in the category *'other stakeholders'* in each of these mentioned studies are vastly different from the factors in the category *'other stakeholders'* in this research. Other research into business-to-government data exchange standards (van de Kaa et al., 2018) identified the format support strategy as the most important category for that standardization process. This category was among the lowest ranked in this research and many of the previous studies which were investigated.

The standardization processes with which the results of this research are compared are generally much more focussed on technology than the proposed standard. This could explain that the characteristics of the standard are perceived to be more important in these situations. In the case of a standardized methodology for corporate GHG inventories, the experts seem to value the support of other stakeholders and the composition of the standard setting alliance higher than for these technological innovations. As previously mentioned, it is difficult to draw general conclusions by comparing the results of these studies. The main take away from this comparison is that each situation is unique, with different relevant criteria and different relative importance for each of these criteria. This makes it difficult to apply the results of prior studies to a different standardization processes than the study was concerned with.

Source	subject	1st factor	2nd factor	3rd factor	4th factor	5th factor
[This research]	**Environmental accounting methodology**	Pressure from customers	Support by governmental bodies	International acceptance	Perceived neturality/ independence	Compatibility with incumbent practices
(van de Kaa et al., 2020)	**Struvite installations**	Technological superiority	Compatibility	Current installed base	Appro-priability strategy	Agenda settting
(van de Kaa, Kamp, et al., 2017)	**Biomass thermochemical conversion technologies**	Technological superiority	Financial strength	Pricing strategy	Regulator	Learning orientation
(van de Kaa, Fens, Rezaei, et al., 2019)	**Power line communication technologies**	Technological superiority	Flexibility	Compatibility	Regulator & Pricing strategy	
(van de Kaa, Fens, & Rezaei, 2019)	**residential grid storage technologies**	Technological superiority	Compatibility	Operational supremacy	Complementary goods & Pricing strategy	
(van de Kaa, Scholten, et al., 2017)	**Electrical vehicle technologies**	Technological superiority	Compatibility	Brand reputation & credibility	Pricing strategy	Network of stakeholders
(van De Kaa, Rezaei, et al., 2014)	**photovoltaics technologies**	Technological superiority	Pricing strategy	Timing of entry	Brand reputation and credibility	Flexibility
(van de Kaa et al., 2018)	**business-to-government data exchange**	Commitment	Timing of entry	Compatibility & Complementary goods		[5 factors with the same weight]

Table 12. Overview of studies into success-determining factors in standardization, and the five highest ranked factors in those studies.

7.6 Proposed new classification of quality standards

Through the literature research that was performed, many different types of quality standards were identified. To reiterate, quality standards are defined as standards which *"specify acceptable criteria along various dimensions, such as functional levels, reliability, efficiency, health and safety, and environmental impact, in order to improve their performances, expanding market share through performance assurance and reduction in transaction costs"* (Ho & O'Sullivan, 2018). This is a well-formulated, but rather broad definition, meaning that it defines many different types of standards as quality standards. This may lead to misinterpretation of articles regarding 'quality standards', since it is unclear what type of quality standards are considered. To improve the way in which the academic community communicates regarding quality standards, this section will propose a subject-matter based subclassification of quality standards.

The standards that were found to fall within the definition for quality standards of Ho and O'Sullivan (2018) can be divided in the four categories listed below, based on the issue the standard pertains to.

1. Product quality standards
2. Service quality standards
3. Process quality standards
4. Environmental quality standards

Product and service quality standards are basically the same type of standard with the difference being that one relates to the quality of a product and the other to a service. Product quality standards are often minimum quality standards which are required by law or by another type of regulator to sell, ship or use the related products. Product quality standards are defined as '*a set of objective, measurable specifications along various dimensions of a product that determine its quality*'. Examples of product quality standards can be created for any type of product and range from drinking water quality standards (Gara et al., 2017; Huang et al., 2004) and food quality standards (Kotsanopoulos & Arvanitoyannis, 2017), to cement quality standards (Tanaka et al., 2015) and passenger train quality standards (Rothbauer & Sieg, 2011).

Service quality standards are defined as '*a set of objective, measurable specifications along various dimensions of a service that determine its quality*'. Service quality standards are more difficult to establish due to the subjective aspect of the quality of services. Despite this difficulty, more and more service quality standards are emerging in healthcare (Whittaker et al., 2011), tourism (Partalidou & Iakovidou, 2008) and public utilities industries like electricity, telecommunication and water (Holt, 2005; Sappington, 2005).

Product and service quality standards are related to the final product or service which is being provided. Process quality standards, on the other hand, are concerned with the execution of a process rather than the final product. Process quality standards are '*guidelines describing various dimensions for the appropriate execution of a specific part of a process*'. Accounting standards, like the IFRS, are examples of process quality standards, they do not specify the outcome of the process, but dictate the proper execution of the process.

Environmental quality standards are a notably different type of standards compared to the previous three classes. Environmental quality standards are defined as '*acceptable parameters for specific elements of our environment to ensure the wellbeing of humans, animals, and plants*'. The EU Directive 2008/105/EC, titled '*Setting environmental quality standards in the field of water policy*', is described to "*set out environmental quality standards (EQSs) concerning the presence in surface water* of certain substances or groups of substances identified as priority pollutants because of the significant risk they pose to or via the aquatic environment*" (EC, 2008). This is just one example of the many quality standards worldwide depicting the acceptable concentrations of pollutants in our air, ground, and water.

Another type of standard which was often mentioned in relation to quality, were safety standards. This is a specific subgroup of product, service or process standards which are not merely established to guarantee the quality of a product, service, or process, but rather to ensure the safety of those involved. Since all the safety standards which were found can be classified as product-, service- or process quality standards, it was chosen not to create a separate class, but rather to make them a subclass of the three mentioned classes of quality standards.

Another possible subclassification which arose from the literature was the division between minimum quality standards and best-in-class quality standards. Minimum quality standards are often prerequisites for the provision, utilization or execution of a product, service or process, whereas best-in-class standards are voluntary standards which are adopted with the goal of improving an already sufficient product, service or process. Best-in-class standards are often connected to certification programmes, through which organizations can communicate their adoption of the standard.

The proposed standardized methodology for corporate GHG inventories can be classified as a process quality standard. It provides guidelines for the process of creating an accurate, reliable, and comparable account of an organization's emissions. In this research it was deliberately chosen to investigate as many different types of quality standards, in order to draw information from the literature on each of those types of standards. No environmental quality standards were included in the creation of the framework of success-determining factors because environmental quality standards are often imposed and adopted by governments, rather than companies. The literature on environmental quality standards is therefore not believed to contain useful insights for standard adoption by companies.

If this classification had been available before the conduction of this research, the choice could have been made to only include case studies regarding process quality standards in this research. In hindsight it is believed to have been beneficial that this choice has not been made. Insights which were very prominent in the literature on standards in the food industry, such as the possibility for trade boundaries conditional on the implementation of quality standards, were not present in the investigated literature on process quality standards. Several experts indicated that they thought this could become a phenomenon in the near future in GHG accounting. This is just one of the examples of factors deriving from literature on product or service quality standards, which provided insights to the proposed standard.

This does not imply that the classification cannot be used for other research, several examples of studies in which this could be useful can be contemplated. The emergence of service quality standards across sectors would be an excellent example of a research in which the proposed subclassification could help to determine which types of standards to incorporate. It is hoped that the proposed subclassification can aid in future research into the different kinds of quality standards.

8. Conclusion

In the concluding chapter the different components of this research will be brought together to determine the implications for the creation of a standardized methodology for corporate GHG inventories. The theoretical and practical contributions of the performed research will be discussed. And finally, the limitations of this research and recommendations for future research will be discussed.

8.1 Main research question

The goal of this research was to formulate a comprehensive answer to the following research question:

What aspects of the standardization process for a standardized methodology for corporate GHG inventories should a standard setter focus on to increase the probability of widespread adoption?

Standardizing GHG accounting practices is a difficult endeavour in a highly complex environment. It is therefore to be expected that there is no clear-cut answer to the main research question. One of the takeaways from this research is the number of different groups of stakeholders related to the proposed standard. Nine groups of stakeholders were identified which have power, legitimacy and/or urgency to participate in the standardization process, each of these groups in turn consisting of numerous companies, organizations, and individuals. The interviews showed that these stakeholders hold widely varying perceptions and opinions regarding the proposed standard. These varying perspectives will make it a difficult task to create a standard which is widely supported among all the stakeholders that have an influence on its success. This insight, combined with the fact that the category '*stakeholders'* was ranked as the most important category of success-determining factors, leads to the recommendation to create an elaborate strategy for stakeholder management. The involvement of representatives from the identified stakeholders at an early stage in the process will allow them to express their opinion at the start of the process and prevent resistance to previously made decisions. These stakeholders consist of both large and small corporations, governments, environmental accounting firms, ERP providers, environmental NGO's, environmental auditing and certification firms, universities, and consultancy firms. This will increase the probability of achieving broad support for the new standardized methodology.

This research, however, has a broader focus than stakeholders alone. It attempts to induce a more general view of the factors that are of importance in the standardization process by interviewing experts in the field of environmental accounting. The statistical interpretation of the results indicates that much uncertainty still exists regarding the accuracy of the attributed importance of the different factors. This results from (1) the small sample group, (2) the varying opinions of the experts and (3) inherent characteristics of the research methodology and the BWM. Nevertheless, the opinion of the interviewed experts is the best approximation available of the importance of the different aspects for the standardization of GHG accounting methodologies. Conclusions and recommendations will therefore be based on the averaged resulting weights of importance for the evaluated factors. The five most important factors that emerged from the surveys that the experts were asked to fill out will now be discussed. The discussion will contain recommendations for how these aspects can be incorporated in the standardization process of the new GHG accounting methodology.

1. Pressure from customers

The pressure from customers was assessed as the most important driver for adoption of the standardized environmental accounting methodology. These customers encompass end consumers as well as industrial purchasers and governmental procurement agencies. Mobilizing end consumers to change their consumption behaviour, based on whether a company has adopted a standard, will be difficult. Certification mechanisms like the Forestry Stewardship Council and the Marine Stewardship Council, which are specifically created to communicate information regarding the sustainability of the source of a product, have succeeded in creating awareness among end consumers. Adoption of the proposed standard does not inform consumers of the environmental performance of a company, but only of the

way it keeps track of its emissions. It is therefore implausible that the proposed standard will provoke a change in the consumption behaviour of end consumers similar to the MSC or FSC certifications.

It is thus recommended to shift the focus to establishing support among large corporations and governments. Support by these groups can be used to create pressure on their suppliers to adopt the standard. Several of the experts indicated that they noticed a shift towards enhanced supply chain responsibility on environmental matters. Many large corporations like Unilever, Shell and GM have issued statements regarding ambitions to "green" their supply chain. The standard setters could try to take advantage of this momentum by persuading large corporations to promote adoption of the standard in their supply chains, or even to use it as a prerequisite for trade. This could benefit these companies by increasing visibility into the GHG emissions in their supply chains. Similarly, governments could be lobbied to make the use of the standard a mandatory prerequisite for doing business with governmental organizations. This would be a highly effective tool for promoting adoption of the standardized methodology among companies of different sizes and from different geographical areas.

2. Support by governmental bodies

Governmental support can be provided in many different forms, from making the standard mandatory for companies, to a simple endorsement which legitimizes the standard in the eyes of potential adopters. There was no consensus about which type of support could be expected among the experts, but the general idea was that there was a low probability of the standard being made mandatory. Even the GHG Protocol, which has been the dominant GHG accounting standard for over a decade, has not been made mandatory by governmental bodies anywhere in the world. It is therefore assumed that the support would probably consist of governmental approval of the standard, a recommendation in legislature to use the standardized methodology, or alignment of laws with the standard. Even just governmental legitimization of the standard could reduce the perceived probability for companies of having to adopt another standard in the near future, thereby removing the prospect of future switching costs. Lobbying with governmental representatives on supranational and national levels of government could increase the probability of governmental support for the environmental accounting standard. The standard setters could use the lobbies of large corporate backers and the credibility of participating NGO's to persuade governments to support the standardized methodology for corporate GHG inventories.

Governments could profit from the standard in a couple of ways. First, the increased compatibility of GHG inventories created with a standardized methodology could improve the accuracy of national GHG inventories, thereby providing more insight into the efficacy and efficiency of environmental policies. Additionally, promoting a single standardized methodology could also improve the viability of governmental interventions such as GHG taxation or GHG emissions trading schemes. An example is the carbon border tax, which was proposed in the European Green Deal of 2019 (The European Commission, 2019). Implementation of such a tax requires that the carbon footprint of imported products be determined in a standardized way. The proposed standardized methodology for GHG accounting could provide a solution to that problem.

3. International acceptance of the standard

This aspect is particularly important for large multinational companies, which the interviewed experts expected to drive the adoption of standardized methodology. Environmental accounting is currently a compliance issue, rather than a commercial issue that companies are willing to spend extra money on. Adopting a single standardized methodology that is accepted in all countries an organization operates in has the potential to reduce these compliance costs.

International acceptance can be achieved by actively striving for an alliance which contains representatives from all parts of the world. The involvement of representatives from national and supranational governments from all continents in the standard creation increases the chance of international recognition of the standardized methodology. Chua and Taylor (2008) argue that *"[i]nternationality connotes many dimensions. One of these is that the standard is not closely aligned*

with the economic or political institutions of any particular nation; that it is independent of political allegiances." This highlights the need for any standard setting organization to prevent the impression that it is more related to any nation or union of nations. This can only be achieved through active management of the composition of the standard setting alliance and its supporters.

4. perceived neutrality/independence

Along the same lines as the last factor, the standard setting organization should also prevent the impression that its standards benefit the commercial interests of the standard setter disproportionally. As discussed earlier, this can be achieved through the involvement of independent parties in the process. For the proposed standardized GHG accounting methodology, potential independent organizations could be NGO's like the WRI, WBCSD, Greenpeace or the Global Carbon Project, governmental agencies, or trusted accounting standard-setting bodies like the International Accounting Standards Board. To persuade these organizations to participate, they will have to be convinced they are not used as façade by the other members of the standard setting alliance. Real control over the standardization process will therefore need to be assigned to these members, to increase the probability of winning over their support.

5. Compatibility with incumbent practices

The field of environmental accounting is riddled with different standards for corporate GHG inventories, only a fraction of which have been discussed in this research. The overview of environmental accounting and reporting standards applied by the 100 largest companies in the world in Appendix A illustrates the multiplicity of guidelines in this field. Aligning the content of the standard with all of these would lead to a standard which is either too complex to use, or too general to generate any improvement over the current situation. It is therefore recommended to align the standard with the most dominant standards currently in use, such as the GHG Protocol, the GRI standards and the ISO 14000 series. Further research into the most prevalent environmental accounting standards and practices worldwide would need to be conducted to determine with which of these the new standardized methodology should be aligned to maximize the probability of widespread adoption.

Similar problems arise when considering compatibility with legislation on GHG accounting. The requirements for compliance of different countries vary so widely, that it is not possible to create a methodology that satisfies all of these. Two examples that show this disparity in legislation between countries are the different ways of implementing the same directive on non-financial disclosure between EU members (CSR Europe & GRI, 2017) and the divergence of environmental accounting legislation between the USA and Canada (Bandhauer, Curti, & Miller, 2005). The GHG Protocol has resolved this issue by creating a 'policy neutral' standard (Ranganathan et al., 2005). This is possible because the GHG protocol provides general guidelines for GHG inventories, rather than prescribe specific methodologies. For a standardized methodology it is not an option to be made policy neutral, so a different solution will have to be found. Two possibilities come to mind. The first is to convince all governments to align their requirements, but this is highly unlikely to succeed. The second is to provide country-specific appendices on how to make sure the methodology is applied in compliance with local regulations. Even though this does reduce the harmonizing effect of providing a standardized methodology, it is believed to be the most feasible solution for now.

These were the five factors that were evaluated as most important by the experts that were interviewed for this research. Multiple respondents however noted that they believed all the factors in the framework to be of influence on standard adoption. Only considering the highest ranked success-determining factors would therefore not be a good idea. The framework containing factors that influence the probability of widespread adoption of quality standards can be used as a checklist of aspects that should be kept in mind when creating a standard. All respondents, many of which had extensive experience in the field of environmental accounting and/or standardization confirmed that the list contained the most important standard determining factors which can be influenced by standard setters. Creating standards

in a complex field like environmental accounting requires many different factors to be considered and compromises to be made. Trade-offs between inclusiveness and efficiency of the standard creation process, between breadth of applicability and specificity, between comprehensiveness and resource intensity, between independence and the need for financial resources. The insights of this research are not meant to provide decisions between aspects of the standardization process which can be followed blindly, but rather as a guidance in the process of determining the appropriate compromises between conflicting factors. The goal should thus be to satisfy all identified factors as far as possible, and to compromise where necessary.

Discussions with many experts in the field of environmental accounting, have led to the belief that there is indeed a demand for a standardized methodology for corporate GHG inventories and that it has the potential to have a beneficial effect on global GHG emissions if it succeeds. This belief should be tested in a research regarding the environmental factors around environmental accounting, which could verify the apparent receptivity for standardization. It has also led, on the other hand, to the understanding that the process to create such a standard is tremendously complex. A lot of research, work and resources will be necessary to harmonize the international field of environmental accounting.

8.2 Theoretical contributions

This research has contributed to the existing body of standardization literature in a couple of ways.

- First, this is the first known meta-research into the factors that influence the adoption of quality standards. Quality standards are becoming increasingly prevalent due to the growing requirement for consistency in products, services, and processes, combined with the reduced costs of data collection. The creation of a framework containing factors which can be influenced by standard setters that influence the adoption rate of quality standards can inspire new research and provide new insights into the dynamics of this type of standards.
- The extant literature on quality standards is combined to propose a new subclassification scheme. Through the literature analysis that was performed, it became clear that the term quality standards is used for widely different types of standards in the standardization community. The new classification scheme can be used to improve the way in which quality standards are discussed in literature, by providing more precise definitions of the type of quality standards considered. This enables more specific research into different classes of quality standards and comparisons among the different identified classes of quality standards.

8.3 Practical contributions

This research has provided organizations seeking to create a quality standard with a checklist of aspects that should be considered in the standardization process. Certain components might be irrelevant based on the subject of the standard or the situation, but the framework does capture a generally accepted list of success-determining factors.

For organizations seeking to create a standardized calculation and measurement methodology for corporate GHG inventories, this research provides an expert-verified framework of success-determining factors. It furthermore gives insight into the relative importance of these different factors which can be used for strategizing and coordination of the standardization process. Recommendations regarding aspects which deserve extra attention, based on the resulting weights of importance, are provided in this research as well.

The stakeholder analysis that was performed can be a helpful tool for the stakeholder strategy for the proposed standard. The stakeholder identification provides insights into the different actors that are related to the standardization process, and the stakeholder classification provides information on the position of these actors in relation to the standardization process. The classification can be used to

determine how different actors should be approached, which stakeholders should be actively pursued, which should be tolerated, and which should be restrained from participating.

8.4 Limitations

Some limitations have already been mentioned earlier in the discussion, the most important ones are listed here.

- The small sample size, leading to uncertainty regarding the accuracy of the results.
- Ambiguity regarding the form of the proposed standard and, correspondingly, the meaning of the factors that the experts were asked to weigh.
- The absence of possible interpretations of the factors. There is no indication of the ways in which the different factors could take shape in the final shape. If these were added it could have changed the importance of the factors.
- The calculation of global weights by multiplication of the weights within a category with the weight attributed to that category leads to doubt regarding the accuracy of the resulting weights of importance.
- The difference in average weights between clusters containing different numbers of criteria, which leads to over-valuation of clusters with lower number of criteria.

8.5 Recommendations

Building on the content of this research, numerous directions for future studies can be contemplated. Some of these have already been proposed throughout the discussion and conclusion and some additional propositions will be made in this section.

First of all, 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 factors in the framework for different quality standards and making a prediction regarding the rate of adoption of that standard. This prediction could then be compared to empirical adoption rates of that standard. One of the potential subjects that comes to mind, is the standard battle between ISO 26000 and the CSR performance ladder in the Netherlands, described by Moratis and Widjaja (2014). This would be an appropriate case study to assess the validity of the framework because the characteristics of both quality standards are available, and the adoption rates are documented properly.

One of the perspectives which was difficult to incorporate in this research and therefore regrettably had to be omitted, was that of SMEs. Due to the current insignificance of environmental accounting and reporting to smaller companies, it was not possible to find a representative from this group of stakeholders. 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 does not necessarily need to come from more stringent governmental regulations, but can also result from increased demands for environmental information by large industry players, trying to improve the overview of their supply chain. Future research could investigate the influence on smaller companies of growing demands on environmental disclosure. And assess the perspective of these smaller companies towards environmental accounting and reporting.

For further research into the proposed standard it is recommended to focus on a smaller selection of the success-determining factors from this research. A possibility is to elaborate more on the factors in a selection of the categories to make them less ambiguous. This would allow breaking the factors in the framework into narrower-defined sub-factors and to assess those. The results of this research suggest that it is of the utmost importance to thoroughly examine the different stakeholders which are involved in the standardization process for a standardized calculation and measurement methodology for corporate GHG inventories. A possible follow-up research could focus on these stakeholders and try to

determine what kind of support would be valuable from each of the stakeholders, at what phase in the standardization process this support would be required, what kind of strategies could be employed to obtain that support and how much resources it would require to succeed in obtaining the necessary support.

Furthermore, it would be relevant to assess the feasibility of complying with the different factors that were identified. This could take the theoretical recommendations taken from this research and assess their practicability. Is it even possible to compel governmental bodies into supporting a new private standard? Can the new standard be made compatible with all incumbent practices and standards? Can customers be compelled to change their consumption behaviour to pressure companies into adopting the standard? All of these are new studies in themselves that would contribute greatly to the development of the proposed standard.

The last recommendation stemming from this research is related to the environmental factors which influence standard adoption. The firm-level factors investigated in this research and environmental factors can be seen as two sides of the same coin; a standard will most probably not be successful if either of the two is not favourable. This research has demonstrated how extensive only one of these aspects of standardization can be and it is therefore recommended to keep them separated in future research. There are of course many research directions where it is unwise to do so, but where possible, separating them helps to focus more on either facet of the standardization process.

8.6 Reflection

During the first stages of the research for this thesis, there were some difficulties with establishing a research which fulfilled the requirements set by the TU Delft and would contribute to Open Footprint Initiative. Through discussions with my supervisor from Shell (Erwin) and my first supervisor from the university, Geerten, we have managed to create a thesis which does both those things more than adequately. This research combined a topic which has interested me for a long time, sustainability, and a topic which I was less familiar with, standardization. The knowledge that I have gained in this field over the course of this research has strengthened my belief that standardization does indeed have an important role to play in our transition to a more sustainable society. Standards and comparable metrics are crucial to creating accountability for the actions of governments, companies, and individuals.

During the last months, many people have sceptically asked me why Shell should be the one to start this movement, considering its background in one of the most polluting industries there is. I recognize the irony behind an oil and gas company initiating an initiative to reduce GHG emissions, but do not think this should be a reason to rule it out. I think that Shell has made a very important step towards creating comparability and compatibility of corporate greenhouse gas emissions by initiating the Open Footprint initiative. This is however only the first of many steps that will have to be taken to reach its goals.

My hope is that other organizations will see the potential societal benefit behind creating accountability for a company's GHG emissions. Not only the emissions in its own factory, but also the emissions in its supply chain. Only then, when we can internalize the environmental costs of the GHG footprint of products and services, will we be able to actively combat climate change. I hope that politicians and board members of large corporations will realise the urgency for creating a system of accountability, so people and organizations become aware of their burden on the environment.

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Appendices

Appendix A: Environmental accounting and reporting standards used by the 100 largest companies on the Forbes 2000 list

Company	Year	GRI 30X	WRI/WBCSD GHG Protocol	ISO 14064	IPCC GWP100	2006 IPCC guidelines	CDP	Alternative standards and guidelines
ICBC	2018	X					X	'Guidelines for carbon dioxide emissions accounting and reporting of Beijing enterprises'
JP Morgan Chase & Co	2018	X	X				X	
China construction bank	2018	X			X		X	'China Corporate Energy Conservation and GHG Management Programme', '2015 China Regional Power Grid Baseline Emission Factor'
Agricultural bank of china	2019	X	X		X		X	'2015 China Regional Power Grid Baseline Emission Factor'
bank of America	2018	X	X		X		X	'US EPA Climate Leaders', 'EPA Emission Factors for Greenhouse Gas Inventories'
Apple	2018		X		X		X	
Ping An insurance group	2018	X	X				X	
Bank of China	2018	X						'HKEx ESG guide'
Royal Dutch Shell	2018	X	X		X	X	X	
Wells Fargo	2018	X	X		X		X	'US EPA Climate Leaders', 'SASB standards', 'TCFD recommendations', 'The Climate Registry: General Reporting Protocol'
ExxonMobil	2018							'API's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry', 'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
AT&T	2019	X	X		X		X	'US EPA Climate Leaders'
Samsung	2019	X	X	X	X		X	'Korea GHG and Energy Target Management System Operating Guidelines'
Citigroup	2018	X	X		X		X	
Toyota	2019	X	X		X		X	
Microsoft	2019	X	X		X		X	
Alphabet	2019		X		X		X	
Volkswagen Group	2019	X	X		X		X	'German CSR Directive Implementation Act'
Chevron	2018		X					'API's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry', 'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
Verizon	2018		X		X	X	X	'US EPA Climate Leaders'

Company	Year	GRI 30X	WRI/WBCSD GHG Protocol	ISO 14064	IPCC GWP100	2006 IPCC guidelines	CDP	Alternative standards and guidelines
HSBC Holdings	2019		X				X	'HKEx ESG guide'
PetroChina	2017	X					X	'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
Allianz	2018	X	X				X	
BP	2019	X						'Oil and Gas Climate Initiative's (OGCI) methane intensity target', 'TCFD recommendations', 'SASB Index'
Total	2019	X			X		X	'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
Berkshire Hathaway (Energy)	2019							
China Mobile	2018	X	X				X	'HKEx ESG guide', 'Baseline emission factor of China power grid in 2017 published by China NDRC'
Amazon	2019		X	X				
Walmart	2019		X	X	X		X	
Santander	2019	X	X					'DEFRA 2019'
China Merchants Bank	2018							
UnitedHealth Group	2018		X		X		X	
Comcast	2019		X		X	X	X	
BNP Paribas	2014		X	X	X		X	'Defra voluntary reporting guidelines 2017', 'bilan carbone'
Sinopec	2019	X		X				'HKEx ESG guide'
Softbank	2019						X	'Environmental Accounting Guidelines 2005 (Japanese Ministry of the Environment)'
Daimler	2019	X	X				X	
Johnson & Johnson	2019	X	X		X		X	
Bank of Communications	2017	X			X		X	'HKEx ESG guide', 'China Corporate Energy Conservation and GHG Management Programme'
Gazprom	2018	X			X	X	X	'Gazprom Standard Methodology Guidelines'
RBC	2019		X	X			X	'The GHG Indicator: UNEP Guidelines for Calculating Greenhouse Gas Emissions for Businesses and Non-Commercial Organizations'
Nestlé	2019		X		X		X	'Measuring eco-efficiency – a guide to reporting company performance WBCSD'
Mitsubishi UFJ Financial	2018		X		X		X	'Japan's Law concerning the Promotion of the Measures to cope with Global Warming'
Intel	2018	X	X	X	X		X	'US EPA Climate Leaders', 'IEA guidelines', 'The Climate registry: General reporting protocol'

Company	Year	GRI 30X	WRI/WBCSD GHG Protocol	ISO 14064	IPCC GWP100	2006 IPCC guidelines	CDP	Alternative standards and guidelines
Goldman Sachs	2018		X		X		X	'US EPA Climate Leaders', 'SASB standards'
TD Bank Group	2018		X	X	X	X	X	'DEFRA 2019'
Sberbank	2015							
Morgan Stanley	2018		X		X		X	
Boeing	2019		X		X		X	'EPA mandatory Greenhouse Gas Reporting', 'The Australia National Greenhouse and Energy Reporting Act', 'UK CRC Energy efficiency scheme', 'GHG Reporting Guidance for the Aerospace Industry'
Petrobras	2018		X	X	X	X	X	'Brazil GHG Protocol Programme', 'Canadian Association of Petroleum Producers', 'EPA Mandatory Greenhouse gas reporting', 'ARPEL guideline 22', 'API's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry', 'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
Nippon Telegraph & Tel	2019	X	X		X		X	'Japan's Law concerning the Promotion of the Measures to cope with Global Warming'
Rosneft	2018	X	X		X		X	'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting'
Procter & Gamble	2019	X	X		X		X	
Pfizer	2019		X		X		X	'TCFD recommendations'
Industrial Bank	2018	X	X					
General Motors	2018	X	X	X	X		X	'US EPA Mandatory Greenhouse Gas Reporting Rule'
BMW Group	2018	X	X	X		X	X	'EU ETS: The Monitoring and Reporting Regulation'
Itaú Unibanco Holding	2017		X	X	X	X	X	'Brazil GHG Protocol Programme'
Alibaba	2018							
IBM	2017	X	X		X		X	
Novartis	2018	X	X		X		X	
Postal savings bank of China	2019	X				X	X	'China Corporate Energy Conservation and GHG Management Programme', 'Baseline Emission Factors for Regional Power Grids in China 2017 (Ministry of Ecology and Environment of the P.R.C)'
Facebook	2019		X					
Siemens	2019	X	X		X		X	
Shanghai Pudong development	2018	X						
Japan Post Holdings	2019		X		X		X	'Japan's Law concerning the Promotion of the Measures to cope with Global Warming', 'TCFD recommendations'

Company	Year	GRI 30X	WRI/WBCSD GHG Protocol	ISO 14064	IPCC GWP100	2006 IPCC guidelines	CDP	Alternative standards and guidelines
Sumitomo Mitsui Financial	2018		X				X	'Japan's Act on the Rational Use of Energy'
Banco Bradesco	2019			X	X		X	'Brazil GHG Protocol Programme'
Anheuscher-Busch InBev	2018	X	X		X	X	X	
Walt Disney	2018		X		X		X	
Reliance industries	2017	X	X					'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting', 'TCFD recommendations'
CITIC	2018	X						
Sony	2019	X	X	X	X		X	Japan's Law concerning the Promotion of the Measures to cope with Global Warming'
Cisco systems	2019	X	X	X	X		X	'US EPA Climate Leaders', '2019 country-specific emission factors for Australia, Brazil, Canada, India, and United Kingdom', '2017 IEA factors'
Tencent	2019							'HKEx ESG guide'
Honda Motor	2019	X	X		X	X	X	'Japan's Law concerning the Promotion of the Measures to cope with Global Warming, Act on the Rational Use of Energy'
Enel	2018	X	X		X	X	X	'EU ETS: The Monitoring and Reporting Regulation'
United Technologies	2018	X	X		X		X	
Commonwealth Bank	2018		X		X		X	'New Zealand's Guidance for Voluntary, Corporate Greenhouse Gas Reporting', 'Australia's National Greenhouse and Energy Reporting Act'
China State Construction Engineering								
DowDuPont	2018	X	X	X			X	
Equinor	2019	X	X	X	X	X	X	'NOROG 044 - Recommended guidelines for emission and discharge reporting', 'US EPA Climate Leaders', 'Canadian association of petroleum producers: calculating GHG emissions', 'US EPA mandatory greenhouse gas reporting rule', 'API's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry'
American Express	2019	X	X	X	X		X	'US EPA Climate Leaders'
MetLife	2018	X	X	X	X	X	X	'US EPA Climate Leaders'
AXA Group	2018		X				X	'Bilan Carbone'
PepsiCo	2018	X	X			X	X	'The Climate Registry: General Reporting Protocol', 'US EPA Climate Leaders'
Bank of Nova Scotia	2019	X	X	X	X		X	

Company	Year	GRI 30X	WRI/WBCSD GHG Protocol	ISO 14064	IPCC GWP100	2006 IPCC guidelines	CDP	Alternative standards and guidelines
Roche Holding	2018	X	X		X		X	
ING Group	2019	X	X		X		X	
Lloyds Banking Group	2019		X		X		X	
Eni	2018	X	X	X	X	X	X	'EU ETS: The Monitoring and Reporting Regulation', 'US EPA Climate Leaders', 'API's Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry', 'IPIECA's Oil and Gas Industry Guidance on Voluntary Sustainability Reporting', 'CCAC OGMP Partnership guidelines'
Oracle	2019	X	X		X		X	
China Citic Bank	2018	X		X		X	X	'China Corporate Energy Conservation and GHG Management Programme', 'Technical Guide for the Preparation of the List of Air Pollutant Emissions by Road Vehicles (for Trial Implementation)'
China Evergrande Group	2018							'HKEx ESG guide', '2017 Coefficient, Material Balance Calculation Methods for Industries not Included in Emission Permit Management', 'China Regional Power Grid Baseline Emission Factor for Emission Reduction Project for 2017'
UBS	2019	X	X	X	X		X	'DEFRA voluntary reporting guidelines 2017'
AIRBUS	2018		X	X	X		X	
Lukoil	2018	X					X	'Methodology and Guidelines for Quantitative Determination of Greenhouse Gas Emissions by Entities Conducting Business or Other Activities in Russia'
Prudential Financial	2018	X	X		X		X	'US EPA Climate Leaders'
BASF	2019	X	X		X	X	X	'TCFD recommendations'
SAIC Motor	N.A.							
# of reported users		**61**	**75**	**24**	**62**	**18**	**80**	

Table 13. Overview of the environmental accounting and reporting standards the 100 largest companies from the Forbes 2000 list report using.

Appendix B: Interview documents

Appendix B1: Introductory document

Thank you for your willingness to help me with my research, your time is much appreciated! If possible, I would like to ask you to read this document before the interview. If anything is unclear or you have any questions, please do not hesitate to contact me, my contact details are provided at the top of this page.

Introduction

For the final thesis of my master's degree at the University of Delft, I am currently researching the possibility for a standardized set of calculation and measurement methodologies that companies can use for their greenhouse gas inventories. At the moment, there is a large variety of methodologies that are applied for creating corporate greenhouse gas inventories. This leads to low actionability for regulators and governments and low comparability for investors and consumers. By creating a standardized set of accepted methodologies with quality characteristics attached, these problems could be mitigated. It would also allow steps to be taken towards product- and service-related footprint, which has the potential to make environmental considerations a more integral part of our consumption behaviour.

The successful diffusion of such a standardized set of methodologies is dependent on many different factors. In order to make sure that resources are allocated effectively in this process, it is valuable to know the significance of each of these factors. In the first step of the thesis, potential success-determining factors where identified from literature on the diffusion of other (quality) standards and verified with experts in this field. This interview is intended to find the weights for each of the identified factors by means of the '*Best-Worst Method*' (BWM).

The interview

The BWM is a multi-criteria decision-making method that allows for the evaluation of a number of decision criteria. The first step of the BWM is concerned with finding the Best (most important) and Worst (least important) factors from a list of factors. The next step consists of pairwise comparisons between the most important factor and all of the other factors on a 9-point scale, leading from '*1. Equal importance*' until '*9. Extremely more important than*'. This step is then repeated by comparing the least important factor to all the other factors on the same scale. Importance for this research is defined as: *The extent to which a factor is necessary for the proposed standard to reach broad adoption. Broad adoption is evaluated by:*

- *geographical spread (adoption across all continents, by countries in different stages of development)*
- *adoption across entities (adoption and recognition by companies, governments, NGO's, ETSs, etc)*
- *adoption across different size organizations (from small SMEs to large MNC's)*
- *sectoral spread (least carbon intense industries to most carbon intense industries)*

In the previous phase, 31 factors were identified, divided over six categories. These categories will first be evaluated by performing the BWM on each of them separately, and finally the different categories will be compared to each other to determine their mutual importance. Please have a look at the identified factors on the next pages and let me know if anything needs more elaboration.

The only personal information that will be collected is the organization that you work for, your function within the organization and your experience with environmental (GHG) accounting. This is asked to ensure an even distribution among knowledgeable stakeholders. This information will be treated with the utmost care, but if you feel uncomfortable with this data being published in the final thesis, please let me know.

Your time and effort are much appreciated!

Factor	Description	Sources
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.	2, 19
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.	1, 2, 6, 12, 13, 14, 16, 17, 18, 19, 20, 21
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.	1, 5, 11,19, 21, 22
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.	2, 12, 14, 17, 19, 20
Industry- and sector-specific guidelines	The presence of industry- and sector-specific guidelines/appendices to supplement the standard comes up in literature as a decisive factor for the widespread diffusion of quality standards. The presence of these guidelines can convince potential adopters of the suitability for their situation.	1, 2, 7, 20
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.	2, 3, 7, 8, 15, 17

Factor	Description	Sources
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.	2, 8, 12, 15
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.	1, 2, 4, 6, 8, 10, 13, 14, 15
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.	2, 15
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.	2, 3, 7, 14, 20
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 accepted standard therefore increases adoption.	2, 3, 5, 7
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.	6, 9, 11, 12, 15, 17, 18, 19, 20

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.	2, 7, 14, 19
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.	1, 2, 19, 20
Diversity within an alliance	A standard 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, resulting in a less biased or opportunistic standard. This leads to higher adoption rates of the standard.	1, 7, 19, 20
The participation of an official SDO	The participation of an official Standards Developing Organization (i.e. ISO or one of its national member organizations) in the alliance can promote adoption by providing legitimacy to the standard.	12
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. This is why perceived independence of the standard creators and supporters promotes adoption of a standard.	7, 19

Standard creating process		
Coordination within an alliance	Clear and strong coordination within the alliance of the collaborative standard creating process can lead to an improved perceived quality of the standard, increasing the adoption rate of the standard.	3, 7
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.	1, 2, 3, 7, 11, 19, 20, 22
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.	3
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.	7

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.	7, 15. 20, 22
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.	7, 19
Periodical improvement of the standard	Continuing reviews of the standard 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.	1, 2, 7, 19, 21, 22
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.	1, 2
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.	Interview 1
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.	Interview 1

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.	2, 4, 13, 14, 18
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.	1, 3, 4, 5, 6, 12, 13, 14, 18, 20, 22
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.	16, 19, 20
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.	18, 19, 20

Appendix B2: Consent form template

Informed consent form interviews for thesis on standardization in GHG accounting

Consent form (insert name)

Taking part in the study

I have read and understood the information regarding the research and my participation in it, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves being recorded and having a transcription of that interview included in the final thesis.

Use of the information in the study

I understand that information I provide will be used for analysis and for inclusion in the final report of the thesis research

I understand that personal information collected about me that can identify me, such as my name, organization, and work-experience, will not be shared beyond the research team until the publication of the thesis.

I agree that my information can be quoted in research outputs.

I agree that my real name can be used for quotes.

Future use and reuse of the information by others

I give permission for the interview that I provide to be archived as anonymised transcript in a TU delft data repository so it can be used for future research and learning.

If you have read and accept these terms, you will be asked to provide verbal consent at the start of the interview. If you object to any of the points listed in this form, please indicate this at the start of the interview, and your consent will be adapted.

Information sheet:

Purpose of the research:

To determine the importance of factors that influence the success of quality standards on the global and widespread adoption of a standardized set of calculation and measurement methodologies for corporate GHG inventories.

Withdrawal from the study:

If, for any reason, the interviewee wishes to withdraw from the research, he/she can communicate this to c.v.a.hoogerbrugge@student.tudelft.nl until the 1st of September. If this is done, all records of the interview will be removed, and the interview will not be mentioned in the final thesis.

Data governance:

The interviews and the personal data of the respondents will be stored in private academic repositories. The only ones with access to this repository are Coen Hoogerbrugge and Geerten van de Kaa, the first supervisor of this research. After completion of the research all the collected material will be removed except for anonymised transcripts of the interviews, which may be stored in the TU Delft data repository. The data and the interviews will be treated in accordance with the verbally agreed on consent form. If respondents wish to be anonymized for the research this can be indicated when providing consent at the start of the interview.

Contact details:

Coen Hoogerbrugge, +316-20365791, c.v.a.hoogerbrugge@student.tudelft.nl

For any questions or remarks, please do not hesitate to contact me.

Appendix B3: Data Management Plan

Thesis on the standardization of methodologies for corporate greenhouse gas inventories.

General TU Delft data management questions

Name of data management support staff consulted during the preparation of this plan

Nicolas Dintzner, the Data Steward of the faculty of Technology, Policy and Management

Date of consultation with support staff [YYYY-MM-DD]

2020-06-22

1. Is TU Delft the lead institution for this project?

- Yes, leading the collaboration

The TU Delft is the leading institution, the research is performed at Royal Dutch Shell.

2. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

The responsibility for the handling of the data will fall to Geerten van de Kaa, the first supervisor for this research

3. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- SURFdrive
- Another storage system - please explain below, including provided safety measures

The interviews will be recorded through skype for business, which will save them to a local folder. They will then be transferred to a Surfdrive folder, which is shared with the first supervisor, and deleted from the local pc.
The Survey responses will remain stored on the qualtrics server, after which they will be extracted and moved to the SURFdrive.
Statistical summary, the statistical summary will be saved on the SURFdrive.
Interview audio recordings will automatically be stored locally and moved to the SURFdrive and removed directly afterwards.
Transcripts of the interviews will be stored on the SURFdrive.

4. How much data storage will you require during the project lifetime?

- < 250 GB

5. What data will be shared in a research data repository?

- Not all data can be publicly shared - please explain below which data and why cannot be publicly shared
- All data (and code) underlying published articles / reports / theses

The data will be shared, but it will be aggregated, meaning that no separate responses will be shared.
The Survey and responses will be extracted for further analysis, and the qualtrics account will be terminated after 3 months, automatically removing the data on it.
The statistical summary will be published by including it in the thesis report and removed from the SURFdrive.
The interview audio recordings will be removed after all the relevant information is transcribed.
Full transcripts will be saved on the SURFdrive and removed after writing the report.
Anonimized transcripts will be published by including them in the thesis report and removed from the SURFdrive.

6. How much of your data will be shared in a research data repository?

- < 100 GB

7. How will you share your research data (and code)?

- Data will be uploaded to the 4TU.Centre for Research Data

8. Does your research involve human subjects?

- Yes

It uses surveys and interviews filled out by respondents.

9. Will you process any personal data? Tick all that apply

- Video materials
- E-mail addresses
- Name and addresses
- Other types of personal data – please explain below

Video materials = Audio recordings of interviews
employment organization, function within organization and expertise in environmental accounting

TU Delft questions about management of personal research data

1. Please detail what type of personal data you will collect, for what purpose, how you will store and protect that data, and who has access to the data.

Please provide your answer in the table below. Add an extra row for every new type of data processed:

Type of data	How will the data be collected?	Purpose of processing	Storage location	Who will have access to the data
Name & email adresses, employment organization and employee function	Organization's websites & personal contacts	Identifying interviewees	SURFdrive	Geerten v/d Kaa (1st supervisor) and myself
Recordings of interviews	Skype recordings	Performing interviews	SURFdrive	Geerten v/d Kaa (1st supervisor) and myself
Experience/expertise in environmental accounting	Survey	Surveys	Qualtrics/ SURFdrive	Geerten v/d Kaa (1st supervisor) and myself

2. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

3. What is the legal ground for personal data processing?

- Informed consent - please describe the informed consent procedures you will follow

A consent form will be sent to interviewees, they can choose to sign it or to provide verbal recorded consent at the start of the interview.

4. Will the personal data be shared with others after the end of the research project, and if so, how and for what purpose?

It will only be shared separately (not the function connected to the organization), or the organization will be anonymized. (Shell would for example become MNC in oil and gas sector)

5. Does the processing of the personal data results in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data during your research (check all that apply).
If two or more of the options listed below apply, you will have to complete the DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA. If only one of the options listed below applies, your project might need a DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to get advice as to whether DPIA is necessary.

If you have any additional comments, please add them in the box below.

- None of the above apply

Appendix C: Sources of the success-determining factors in the framework

Factor \ Source	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Tangible standard characteristics																								
Compatibility with incumbent practices		X										X							X					
Progressive adoption	X				X						X								X		X	X		
Implementation costs	X	X				X						X	X	X		X	X	X	X	X	X			
Possibility for certification		X										X		X			X		X	X				
Industry and sector specific guidelines	X	X					X													X				
Accessibility of information		X	X				X	X							X		X							
Intangible standard characteristics																								
The ability to provide an organization with more structure		X						X				X			X									
The ability to improve an organization's reputation	X	X		X		X		X		X			X	X	X									
The possibility to get started without external guidance		X													X									
Applicability to different size organizations		X	X				X							X						X				
International acceptance of the standard		X	X		X		X																	
The ability to open new markets or retain old markets							X		X		X	X			X		X	X	X	X				
Standard supporting alliance characteristics																								
Financial strength and market position of the supporters		X					X							X					X					
Reputation of the standard supporters	X	X																	X	X				
Diversity within an alliance	X						X												X	X				
The participation of an official SDO													X											
Perceived neutrality/independence							X												X					
Standard creating process																								
Coordination within an alliance			X				X																	
Stakeholders and third-party involvement	X	X	X				X				X								X	X		X		
Substantive due process and rationale			X																					
Transparent and open process							X																	
Alignment of interests of participants							X												X					
Standard support strategy																								
Financial support for the standard																				X		X		
Periodical improvement of the standard	X	X					X												X		X	X		
Provision of operational support	X	X																						
The presence of a community																							X	
Benefits tracking																							X	
Other stakeholders																								
Support by consultants and auditors		X		X									X	X				X						
Support by governmental bodies	X		X	X	X	X						X	X	X				X		X		X		
Support by NGO's related to the standard																X			X	X				
Pressure from customers											X						X	X	X	X				

Table 14. Sources of the factors that were incorporated in the framework.

#	Title	Source
1	Private Standards in the Climate Regime: The Greenhouse Gas Protocol	(Green, 2010)
2	Determinants of CSR standards adoption: exploring the case of ISO 26000 and the CSR performance ladder in The Netherlands	(Moratis & Widjaja, 2014)
3	Advancing the Harmonisation of International Accounting Standards: Exploring an Alternative Path	(Carlson, 1997)
4	What factors are perceived to influence consideration of IFRS adoption by Vietnamese policymakers?	(Phan, 2014)
5	The rise and rise of IFRS: An examination of IFRS diffusion	(Chua & Taylor, 2008)
6	The worldwide diffusion of the global reporting initiative: what is the point?	(Marimon et al., 2012)
7	The rise of the Global Reporting Initiative: a case of institutional entrepreneurship	(Brown et al., 2009)
8	The impacts and success factors of ISO 9001 in education: Experiences from Portuguese vocational schools	(Gamboa & Melão, 2012)
9	Identifying the factors which affect the decision to attain ISO 14000	(Curkovic et al., 2005)
10	ISO 26000 and supply chains—On the diffusion of the social responsibility standard	(Castka & Balzarova, 2008)
11	Stakeholders' Influence and Contribution to Social Standards Development: The Case of Multiple Stakeholder Approach to ISO 26000 Development	(Balzarova & Castka, 2012)
12	Management Systems Standards: Diffusion, Impact and Governance of ISO 9000, ISO 14000, and Other Management Standards	(Castka & Corbett, 2015)
13	Private voluntary standards in the food system: The perspective of major food retailers in OECD countries	(Fulponi, 2006)
14	Global Change in Agrifood Grades and Standards: Agribusiness Strategic Responses in Developing Countries	(Reardon et al., 1999)
15	Reasons and constraints to implementing an ISO 22000 food safety management system: Evidence from Spain	(Escanciano & Santos-Vijande, 2014)
16	Potable Water Quality Standards and Regulations: A Historical and World Overview	(Kroehler, 2014)
17	The Compliance Decision with Food Quality Standards on Primary Producer Level. A Case Study of the EUREPGAP Standard in the Moroccan Tomato Sector	(Chemnitz, 2007)
18	Adoption of food safety and quality standards among Chilean raspberry producers – Do smallholders benefit?	(Handschuch et al., 2013)
19	Controversy Over Voluntary Environmental Standards: A Socioeconomic Analysis of the Marine Stewardship Council	(Wijen & Chiroleu-Assouline, 2019)
20	Confronting Sustainability: Forest Certification in Developing and Transitioning Countries	(Cashore et al., 2006)
21	The group care quality standards assessment: A framework for assessment, quality improvement, and effectiveness	(Boel-Studt et al., 2019)
22	Standards for health care: a necessary but unknown quantity	(Brand et al., 2008)
23	Interview with Erwin Mul, Project lead of the Open Footprint Initiative	
24	Interview with Group & External HSSE reporting manager at Shell	

Table 15. Numbers corresponding to the sources referred to in Table 14

Appendix D: Interviews

Appendix D1: Overview of the respondents.

#	Name	Organization	Function	Experience
R1	Michiel Evers	KPMG Nederland	Senior consultant Sustainability	After finishing his master's programme in Science and innovation management, Michiel has been working for the sustainability department at KPMG since 2014. He works on two branches of sustainability: assurance and advice. He has performed many projects related to assessing the societal true value of an organization's emissions, and he has years of experience with sustainability and sustainability reporting in many different sectors.
R2	Rob Wortelboer	Ernst & Young Nederland	Associate Partner Climate Change & Sustainability Services	As associate partner at EY, Rob provides assurance for non-financial information in the annual reports of large organizations. An important component of this work is the verification of GHG emissions. He has worked on audits for GHG accounts in annual reports and EU ETS accounts of companies in various sectors in the Netherlands. Furthermore, he has experience in compiling environmental accounts for companies using the various available standards.
R3	David Rich	World Resources Institute	Senior Associate in the Climate program	David works with the Greenhouse Gas Protocol at the WRI, where they develop Greenhouse Gas accounting and reporting standards. He has been with the WRI in that role since 2007. During that time, he has participated in the development of the corporate value chain/Scope 3 standard and the product life cycle standard for product carbon footprinting which were published in 2011. They then developed two standards focussed on governments, called the policy and actions standard and the mitigation goal standard published in 2014. He is currently working on a set of additional GHG accounting standards and guidelines for companies on carbon removal, land sector emissions and removals and bio-energy. The WRI and WBCSD convene, facilitate, and manage the standard setting processes for these standards.
R4	Brendan O'Dwyer	University of Amsterdam/ University of Manchester	Professor of accounting and sustainability accounting	Brendan did a PHD in sustainability accounting when he joined his first university in Dublin after having worked in financial accounting at EY as a registered accountant. He has published extensively in leading international academic journals in the areas of non-financial reporting, financial and non-financial assurance, corporate and NGO accountability, sustainability reporting and assurance, CSR advocacy, and the regulation of professions. His research is highly cited and has won several awards and honours. In July 2019 he received the Accounting, Auditing & Accountability Journal (AAAJ) Interdisciplinary Accounting Research Hall of Fame award in recognition of his distinguished service contributions to the progress of interdisciplinary accounting research. Much of his research is focussed on sustainability accounting and its role in society.
R5	Frans Duijnhouwer	Dutch Ministry of Economic Affairs and Climate Policy	Policy coordinator directie klimaat	Frans works as policy coordinator for the Ministry of Economic affairs and Climate Policy of the Netherlands. After having worked for the ministry as an economist since 2000, he is now the contact person for the reporting of Dutch national Greenhouse Gas inventories towards the European Union and the United Nations.
R6	Tanya Yatchenia	Royal Dutch Shell	Group and External Health, Security, Safety & Environment and Social Performance Reporting Manager	Tanya has started working at the Health, Safety, and Environment department at Shell more than 10 years ago. In those years she has worked on Shell's GHG accounting and reporting at the asset-, business- and group-level. She has vast experience with all the methodologies for measurement, calculation, estimation, and aggregation of GHG emission data employed within Shell and beyond to meet the expectations of the different stakeholders.

| R7 | Vikram Nagendra | SAP SE | Program Manager, Hana Enterprise Cloud | Vikram has been working at SAP for 16 years in different functions. The last 1,5 year he has been working as a General Manager for the Cobalt Provenance and Battery Value Chain project. He is a fellow at the Value Balancing Alliance, a non-profit corporate alliance in which SAP participates. Their mission is to create a global impact measurement and valuation standard for monetizing and disclosing impacts of corporate activity. They are exploring how the environmental and societal outcomes of a corporation can become part of financial accounting principles through standardization of the metrics involved. |
| R8 | Hans Axel Bratfos | DNV GL | Global Service Area Leader, Global Head of R&D, and Innovation for DNV GL's Oil & Gas business area | As Global Service Area Leader, Hans is responsible for maintaining and developing advisory services and laboratory services within DNV GL for the oil and gas industry. He has extensive experience with Joint Industry Projects (JIP), through which standards are often developed. In these JIPs, Industry players are invited to join in the process of developing a new standard or solving a shared problem for a specific industry. The projects Hans participated in range from subsea documentation to the qualification of digital twins. |

Table 16. Background information of the experts interviewed for this research.

Appendix D2: Combined transcript of the interviews

Factor	**Description**
Tangible standard characteristics	
Compatibility with incumbent practices	R1: This is the most important factor; it determines the ease with which a standard can be adopted by organizations. R2: By far the most important factor. Practice learns that this leads to irritation for most companies, when they have to start doing different things side by side with new accounting rules that is when they throw a standard overboard. A new standard should therefore be an addition to the existing standards or make use of them, but it should not replace them, because this will lead to confusion. R3: If the only thing that matters is the status quo, that would mean there would be no change ever, no evolution over time. If you develop a new standard and you only repeat what has already been standardized there will be no change over time. On the other hand, you don't want to go too far in the other direction, radical change is also not good, but if there is no change at all, what function does it serve to do it? There needs to be a balance between those two. R6: We should not be choosing something that is easy to follow, the incumbent practice might not be the best one, so we should keep an open mind. Shell would for example consider using a standard that is not compatible with the GHG protocol if there is a very strong drive for it, there does however need to be a very strong belief internally to move away from the GHG protocol.
Implementation costs	R1: Experience teaches that costs are one of the main determinants for standard adoption for many organizations. R7: Things have changed under Covid-19 circumstances, where the budgets are very tight. As a result, implementation costs have become almost equally important [Red. To the most important factor; compatibility with incumbent practices], but under normal circumstances it would be less important.
Progressive adoption	R7: This is something we absolutely incorporate in our offerings at SAP. First, we release a very basic version with which the customer can start the journey, which can then be expanded. This is also the product strategy at the moment within SAP. R8: This depends on the complexity of the standard; if things are very complex and costly, but important enough to justify the costs, then it would be nice, especially for small companies, to implement it gradually. But if it is quite clear, not expensive, then it is better to provide everyone with one method.
Possibility for certification	R6: Typically, certification would be voluntary, there is a hierarchy of approaches; first you start with 'do you have the system/standard', then you work towards certification in the end. Just because someone follows the standard, that does not mean they are automatically looking to audit the standard. This is more the longer-term view, but shorter term it is not the most important factor. R8: I might be a bit biased through my background at a company that provides certification, but I believe this is the most important factor. Our certifications and standards are developed with a clear reason in mind, not just to provide customers with certificates.
Industry- and sector-specific guidelines	R1: When the GHG Protocol was established it did not contain sector specific guidelines, these came later. They also do not necessarily have to be created by the standard setting organization. R6: This is the most important factor because it ensures that the standard is really applicable to every organization. The API compendium for example is a document building on the GHG Protocol that is focussed on the oil & gas industry. This is seen as the industry default approach, it has 800+ pages of information relevant to the industry. R7: I think it is important, especially for SAP. We are mostly in the services sector and many of the data guidelines are focussed on heavy industries, so we would definitely promote sector- and industry-specific guidelines. R8: It is important for organizations in certain industries to feel that standard is developed for that specific industry. You can have two standards which are practically the same, but if one is for a specific industry and the other is general, the one that is aimed at the specific industry will most probably be adopted. It gives the feeling that players from their industry had a say in the development of the standard, which creates a feeling of ownership.
Accessibility of information	R2: My feeling is that the English language is so dominant in the industry, that this will not pose a significant problem. This might not be the case for SMEs in some countries, but the big impact can be made in the industry and the working language there is English. R5: The English language is very dominant, and I expect all the companies that are targeted by this standard to have sufficient knowledge of it to be able to work with the standard. R7: From my perspective at SAP, because we are a large multinational, most of the environmental and societal impacts and usage of standards is done at the corporate level. And within the corporate level English

Factor	Description
	is the generally accepted standard language. However, for SMEs, which are not globally oriented, it could definitely be a challenge.

Intangible standard characteristics

Factor	Description
The ability to provide an organization with more structure	R1: If a standard provides a company with more structure it is a nice extra, but it is not a prerequisite for standard success.
The ability to improve an organization's reputation	R1: A company's reputation is not improved by implementing an accounting standard, but rather by improving its environmental performance, this will therefore not be a leading factor. R4: It might drive organizations to focus on superficial measurements; they may look for standardized methodologies, but will choose those that that let them present things in a certain way as opposed to having sufficient integrity with respect to what they are doing. When talking about reputation, I get concerned that you bring non-experts into this process, who are looking to present emissions in a certain way. If your focus is so much on reputation, then you may in fact lose the integrity in the methodology you develop. That is my perception from what I have seen in companies. If you start thinking about just your reputation, you will end up with a lot of work put into a flawed methodology, which needs to be better, because you have to think beyond reputation. If you perceive it as being the most important because of reputation, I am not sure that is going to be a factor that is going to assist you. I am not saying it is not going to help your reputation, but if that is your first focus, your main factor, you may end up with a rather poor methodology, or one that is less robust. If you do go with just the reputation, you may be inclined to cut corners and not be prepared to put the same level of resources into it. Reputation should emerge from the standard, not be the main issue. R5: In the end one of the most important reasons to adopt standards will be to avoid reputation damage.
The possibility to get started without external guidance	R1: Getting started without external guidance is important for SMEs, but over time, this will not significantly influence global adoption rates. R7: This would not be a dealbreaker for SAP. For me external guidance is not just hiring one of the big four that you pay a lot of money to. I think it is important for organizations of any size who want to join this journey of standardizing certain societal and environmental outcomes, such as GHG accounting, to conform to certain best practices and that almost always implies some form of external guidance already.
Applicability to different size organizations	R7: This is one of the defining criteria for the success of the Value Balancing Alliance; it should be possible for SMEs to adopt the work that is produced by the VBA as well. So, the exercise of the next years is to distil it down to a standard that even SMEs can work with. The challenges from an SMEs standpoint are the budgets and the complexity in the uptake, it should be simple and inexpensive enough for the SMEs to also apply the same methodologies. R8: The standards that we set often apply to suppliers of the large oil and gas players. The standards therefore need to be adapted to the characteristics of the suppliers and what kind of information they need to provide. This might of course be different for a standard that applies to all companies rather than a targeted standard for a specific problem, like the ones we deliver.
International acceptance of the standard	R1: International acceptance of the standard is very important, as this will determine to a large extent whether multinational companies adopt a standard. This becomes apparent when looking at the financial sector: there is a lack of an internationally recognized standards for the way this sector accounts and discloses environmental data regarding their portfolio, this leads to uncertainties for the different parties involved. R3: I do know of a couple of national standards that are probably effective, but I think that people prefer international standards, so I do think that that gives an advantage in terms of adoption. R8: The importance of international acceptance depends on the regime under consideration, but I think it is an important factor.
The ability to open new markets or retain old markets	R1: This might become an important factor in the future, maybe even in the coming 10 years, but as of now it does not play a significant role in the world of environmental accounting. R2: A lot is happening in the supply chains of companies; companies are creating CO2 footprints and accounts because it gives them opportunities in their supply chain and makes sure they can keep on serving their customer. A derivative of this development is that they will require accounting standards as well. R4: This point is very contingent on the industry you are dealing with, for some industries this maybe something that can open your markets or help retain old markets. R5: This is something that I do not see happening in the near future and is therefore not relevant yet. R6: I can see this becoming a problem with the carbon footprint of products that you sell. For example, what is the carbon footprint of natural gas coming from our asset in NAM, versus gas from Russia. I can see it becoming a big topic. It relates to the greening up of the value chain, which is still in very early stages, but I do see it happening already in Europe. I see this becoming relevant in the medium term, so somewhere

Factor	Description
	between 10 to 20 years. Climate change & climate risk is becoming higher on the agenda, so I do anticipate there is going to be more interest from stakeholders and regulators around this. R8: If you look at the oil and gas industry, they are becoming increasingly interested in this topic. They have had focus on their own (scope 1) emissions for a long time, at least in Europe. But now they are more and more concerned about scope 3 emissions, because that will become a ticket to trade, it is necessary for people to accept their product. That is a threat to these companies, so they will be increasingly accounting not only their own direct emissions, but also their indirect emissions. This will make that they will require higher quality emissions reporting from their suppliers as well as a prerequisite to do business.

Standard supporting alliance characteristics

Factor	Description
Financial strength and market position of the supporters	R1: These factors are crucial to reach a critical mass of support for a new standard.
Reputation of the standard supporters	R7: This is a difficult one, because companies with a negative reputation often do want to clear up their name. This means that they often participate actively in these kinds of alliances, and they bring a lot of effort and money to the table when they do so.
Diversity within an alliance	R1: The diversity within the alliance is not of such great importance, as long as the independence of the standard setters is clear. R4: Diversity might lead to conflicts over the standard, I have seen that happen in sustainability reporting. R7: In terms of diversity it is important to think down the lines of both diversity in sectors and also diversity of types of organizations such as companies, NGO's, and governmental bodies. R8: Very often we invite standardization organizations to be in the group for free as observers. This depends also on the type of acceptance you need, if you need acceptance for example in the EU, why not invite someone from the commission or a European standardization organization to join in on the process.
The participation of an official SDO	R2: The support of an official SDO provides mass at the board level of companies. If the accounting standard is aligned with the financial accounting standard setter, let us call it a new IFRS, then adoption would be almost guaranteed, because it is completely integrated. This is also necessary to demonstrate the legitimacy of the standard. R5: The participation of an official SDO provides legitimacy to the standard, which will help its adoption. R7: If you are talking about a standard, the participation of an official SDO can be very important. On the other hand if you are talking about a standardized methodology, which is more on the practice side, in my view the participation of an official SDO is not that important, but rather the members in the alliance.
Perceived neutrality/independence	R6: A company might have the best intentions and the best tools, but if people think that they are biased, it does not matter how far back you bend, they are not going to believe them. That is why this is important if you are trying to create a standard.

Standard creating process

Factor	Description
Coordination within an alliance	R1: Clear coordination is important for the process of creating the standard, but does not have a strong influence on the adoption of the standard once it has been created. R7: Coordination of the process is necessary, so participants do not drop out or become roadblocks. R8: For the adoption it is very important to create a feeling of ownership of a standard; if an organization feels that a standard might become written into regulation, organizations will adopt a standard earlier. Good coordination can increase the chance of your standard being chosen in such a situation.
Stakeholders and third-party involvement	R1: The involvement of different stakeholders and third parties guarantees the practicability of the resulting standard and is therefore very important. R2: You want the standard to be supported and when someone gets a standard thrown at them that they have not had the opportunity to contribute, they will drop it more quickly. If they have participated or at least had the chance to participate, this will increase the chance of success. When looking at sustainability reporting, the GRI is an example of a very intensive stakeholder process, that can be seen as a reason why nearly all companies now use the GRI as their reporting standard. R3: Who is involved and who contributes as part of the process is seen as a very important aspect for trust and adoption. These participants are in return more likely to adopt and promote the standard themselves, they will serve as adopters and messengers of the standard in their own organizations and their networks. R8: You can sit behind your desk and write the best standard ever, but if you then go and present it to the industry, they say: 'No, we don't think this is important to us.'. If I have interaction with the industry during the process and then provide them a standard in which they recognize their own contributions, this is what

Factor	Description
	organizations like to see, even if the standard is less perfect in my eyes. The fact that the industry takes time to contribute is a good indicator that the standard is important to them.
Substantive due process and rationale	R2: Sounds like a "hygiene"-factor, it is important, but can mostly differentiate negatively if it is performed poorly. R7: I think that's a good basis, especially when you bring large multinationals or a large group of companies together, you need a legal framework on which the companies agree to work, and to define the standard. So the legal process and the rationale is in my eyes the most important factor.
Transparent and open process	R7: I think that a transparent and open process, especially while creating the standard could be distracting, but I do not think it is that important.

Standard support strategy

Factor	Description
Financial support for the standard	R8: Financial support is necessary to develop a high-quality standard, but for the marketing and diffusion of the standards it is less important.
Alignment of interests of participants	R3: There are different degrees of resolution of the goal statement; if it is a very high level it is easier to do, and also important, but if you get into more detail the interests diverge and it is more difficult to agree to all the specific goals. It also comes down to the diversity of interest which is a very challenging issue, but if you have a diverse group; different companies in different sectors, NGO's, etc, you can get agreement on a high level, but when it comes to the particulars you will have some variation. This is also a factor that relates more to the standard creation, rather than the standard adoption.
Periodical improvement of the standard	R1: Continuous improvement of the standard is very important. This became evident when the scope 2 guidelines of the GHG Protocol were changed, this had significant effect on the use of the standard. These revisions are necessary to keep a standard up to date.
Provision of operational support	R1: The provision of operational support is important, but does not necessarily have to be provided by the standard setter. Consultants and other service providers will quickly fill any need for operational support that may arise. R3: The provision of operational support is also an important activity, in which we look what kind of activities or resources we can provide to help implementation. R6: We do not have people from the WRI and WBCSD walking around for example, but we do have consultants from other companies working left, right and centre to help us with the implementation of standards. If you need any help, you can find someone on the market to help you, either from the big four or more specialized consultancies. R8: Organizations like the GHG Protocol provide operational support in the form of supporting documents, not in the form of training or coaching.
The presence of a community	R2: The GRI is an example of a standard for which this is very important, especially if a they market a new standard. A community is necessary for people to discuss the new standard. It can be a source of feedback, and it can cause adopters to make others enthusiastic about the standard and ultimately activate others to adopt the standard as well. The community around the GRI contains multiple types of stakeholders, there are representatives from the IFRS, representatives from the business community, representatives from accounting firms for their generic knowledge, and often there are governmental delegates as well. Everyone is allowed to participate in these processes, but it can be seen that SMEs do not have a strong focus on the subject yet, neither from the companies themselves, nor from their representative organizations. This interest is rising, but the first steps in environmental accounting were set by large MNC's. It can be seen now that smaller companies are increasing their attention for the subject because larger companies are requesting it from them. R6: Within Shell there is a Carbon Community of Practice, where a lot about the standards relating to GHG is discussed. With other companies we do benchmarking, and we test the understanding of the standard. If we have questions, we either discuss them internally, or we go to the [organization behind the] API [Compendium] directly. Typically, we also have someone within Shell who was involved in the creation of these standards, you just have to know who it is and to find them.
Benefits tracking	R3: It would be valuable to do this for the GHG Protocol, but it is a resource intensive exercise, and we have to prioritize what activities we focus on. We have the standard development itself which is a key activity which is also very resource intensive. Our benefits tracking is mainly anecdotal through case studies of benefits companies or other actors have seen. I agree it is valuable, the challenge is: 'can we do all of that as a relatively small group?'. We have a complementary relationship with CDP, there is a lot of overlap with what you would find if you would do the same benefits tracking for the GHG protocol. So companies can look to the CDP for the same kind of information, they do not need to duplicate efforts. R7: Benefits tracking is mostly left to independent companies; it is shared, but the most important benefits are rarely shared publicly, so this is less important at the moment. Normally when it comes to adoption of

Factor	Description
	a new standard or methodology, that particular exercise is a few years ahead of finally disclosing the outcome to investors and stakeholders. There can be an agreement within the alliance, that some of the details can be shared among each other, but even then, the member companies will be quite hesitant. You need a lot of permissions to share data, so in my view; first of all it will take a few years to understand the benefits and what is shared then is not directly beneficial. For some of the sensitive industries, that would make their operations transparent by reporting emissions data, it can be a barrier for adoption if they have to share that data.

Stakeholders

Factor	Description
Support by consultants and auditors	R1: These might bear some importance, but they will support the standard anyway once demand for a certain service arises. R2: Consultants can make a standard succeed because they are present at so many different companies. In the end you want companies to implement these standards, so it becomes possible to compare them. If there are multiple service providers who say: 'it's a nice standard, but I don't believe in it', which they say with a reason, then that could be the end for the standard. If there is one possible standard, the consultants and auditors often make the decision to use that standard unilaterally, if more than one standard is applicable, it is often discussed with the client. Still, consultants are often the one to propose standards and are therefore important for the adoption.
Support by governmental bodies	R1: Governments are by far the most important stakeholder in this regard. They can use their authority to make the use of a standard mandatory, thereby promoting adoption. R2: Governments can play a big role if they make the use of a standard mandatory, but we are far from that happening. First there needs to be a generally accepted accounting set before they can make it mandatory. An example of how non-binding support can still influence adoption is the Paris agreement, which is not formally binding for corporations, but there are still many companies working on a net-zero strategy. They are doing this from an intrinsic motivation rather than it being imposed by the government. R5: Certain companies already have commitments to report their emissions, I see this standard as something that comes alongside that. I do not expect the government to make such a standard mandatory in the near future as part of the compliance regulations. R6: Governments usually set their own standards and then make them mandatory, and they all have their own tweaks in how they design their climate reporting programme. So following a policy neutral standard might not be enough to comply with local requirements. The EU ETS for example has very specific requirements around what you need to have; the documentation, the calibration of the equipment, what is in scope, what is out of scope. You do see however that the EU is pushing the industry to do something voluntarily and if they do not do it voluntarily, they will start to impose regulations. R6: In some jurisdictions they tell you which factors to use and which methodology, even though you may not agree with that methodology or factor. For example, instead of using actual measurements they force you to use emission factors, even though the result is going to be less accurate. Think of the heating value of a gas, you can go with a published factor, or you go and you measure the actual heating value. Things like this tend to be more prescriptive.
Support by NGO's related to the standard	R1: Support from NGO's can be a nice bonus for the standard, but it is not essential for the success of a standard. R2: IF NGO's like the WBCSD, WRI, TCFD and the GRI make agreements about which standards to endorse, this can have great influence on the adoption of that standard. R5: From their public position companies are very interested in the opinion of NGO's on these matters. R8: I think NGO's are the least influential in the adoption of a standard, when compared to the other actors.
Pressure from customers	R1: This can play a very important role, but is not displayed that much in environmental accountancy yet. R5: I think that companies are most afraid of their customers, if they start requesting the standard the companies will have a problem with that. R6: This is something we see more from big customers, for example government agencies, the automotive industry and the Walmarts of the world. They are getting a lot more conscious the carbon footprint of their suppliers. We also see that manifesting in the requests that we are getting from Walmart, BMW, the US government, etc. And we do this to our suppliers as well. R7: Customers can demand transparency, but it always comes to the standard itself. I think pressure from customers shows a trend but does not really change laws.

Categories

Factor	Description
Tangible standard characteristics	
Intangible standard characteristics	R3: These relate to why companies would want to implement a standard, the drivers for adoption.
Standard supporting alliance characteristics	R7: The composition of the alliance is very important, because it is a 'make-or-break' issue. There have been so many efforts in the past that do not check all these flags and consequently fail. If the alliance is strong, neutral, diverse and can put the money on the table, it could be a gamechanger.
Standard creating process	R2: The most important group of factors relate to the collective creation of the standard, the stakeholder involvement. R3: If people have a general sense that the process was transparent, open, and well-managed they may not in practice investigate the minutia of the process. We make things available in case people want to do so, but in practice it is more about these other factors of what is the entity developing the standard, is there trust and the neutrality of the whole initiative, and those factors imply that these procedural elements were followed, but by themselves they will not be the determining factor for adoption.
Standard support strategy	R3: We have seen a lot of adoption based on all the other factors, even though we, as a small initiative, put relatively little resources into the support strategy compared to the other elements. Not saying we have not done that at all, but we have emphasized that less in our own work and nevertheless seen very widespread adoption. There are factors that are unrelated to our own 'pushing it through', our own dedicated outreach and such. R5: The national inventory standards for member states are decided in endless negotiations at United Nations level. So, it is mainly national interests that play a role in the standard support strategy, they do not require any support or marketing. R6: If you have a standard that provides a lot of benefit due to its contents, you will plan to implement it and seek the resources to do so. The pull by the organization coming from the characteristics of the standard is more important than the push by the standard setting body. We will look at a standard and we will review it and see how many gaps we have against the standard and how we will fill those, but at the end of the day it is typically "this is what we need to do, how much effort does it take". We always first look at the goal or need we are trying to achieve and then try to find standards that aid is in reaching that goal.
Stakeholders	R2: Stakeholders are crucial to give content to the standard, which gives it the maturity, robustness, and status it requires. But the stakeholders in this regard are mainly related to help and support for the implementation, which is why it is the least important factor.

Alternative remarks content

	R1: Rating agencies play an important role, the quality of environmental reporting can influence the risk assessment. Other players like the GRI and CDP are also very influential in this field. R1: Data availability is very important, whether the data that is required by a certain standard is available to the user. Players in the financial sector say that a lack of regulations on emissions data makes that they are unable to provide reliable information on the footprint of their portfolio. R2: As long as there is no legal obligation to implement a specific standard the most important thing is that companies believe in a standard and back up the method they choose. Stakeholder management is crucial in this regard to involve people. Companies are without a doubt the most important stakeholders to take into account here. R2: Investors are a group of stakeholders that are becoming increasingly important in this field. Their interest in the matter results from what happens with climate risk in the financial sector. This can be seen from the TCFD, the early adopters of their methodology are banks and insurance companies, and through them it escalates all the way down to companies. If they use a standard for determining ESG ratings, and maybe ultimately impose the use of a standard on their customers, this could be a strong influence on the adoption of the standard. R2: In the end it is about comparability and harmonization, it would therefore be important to make sure that there is little choice for companies. R2: Materiality is an important notion, this means that companies should only focus on 'relevant' emissions, and not bother with insignificant sources. Materiality differs for each company, so the process to come to a materiality analysis is crucial. It will be necessary to tailor the definition of materiality to each type of company, so that no irrelevant information is required. If this is not done properly, people will not be willing to adopt the standard. R3: These factors relate to ease of implementation, it does not take the dimension of demand or pressure for new standards into account. Those are more focussed on: 'Why are companies looking to do this in the

Factor	**Description**
	first place? Is there an expectation that everyone should inventory and report their greenhouse gasses?' That is a separate question. Companies see various business reasons to do this, and there are expectations for them to do this. Then follows the step you are describing: How easy is it? Is it different from current practice? R3: All of the factors are very relevant, which makes it a difficult task of choosing and rating. The identified factors are a good compilation of all of these factors that are relevant. Even though they are all important it is good to prioritize, because it can be an overwhelming list. R3: If there is a clear need for standardization, a market does its own adoption work independent of the standard setting organization, it does not require being pushed on to people. If there is no crucial need, then it will not be effective regardless of the standard process, the standard outreach activities, the standard support activities or who was involved. If there is a clear need and a standard fulfils that need, then it can even gain widespread adoption without some of these factors, but they all do contribute to adoption. R4: The factors relating to stakeholders' characteristics are very interlinked, that makes it difficult to choose. The same goes for the standard creation process. R4: I have done some work into how standards diffuse and make their way into industries, and all of these factors are all crucial. R5: From the business community there is a clear requirement for attention not only for what comes from a company's own chimney, but also what they emit or reduce elsewhere in their supply chain. In that case you stop just looking at scope 1 but also take scope 2 and 3 into account, from that perspective projects like these are more important than to governments. Our national inventory is purely aimed at the "chimneys" in the Netherlands. R5: (On the possibility for an EU carbon border tax) It would be possible to assume a standard emission factor, as general departure point. If a company claims to perform better than that factor, they will have to prove it. That would be one of the alternatives for how that will work. R6: The factors depend very much on the size of the company; companies will be weighed differently by different groups. R6: Talking to people within Shell you will get a very specific angle; we are big, we do believe in standards, and we invest time and money into implementing them, but the challenge that other companies might have are very different from ours; the resources could be one, the availability of internal knowledge, the accessibility of external knowledge, the ability to adopt a standard, the credibility, etc. Therefore, it is good that you have looked at respondents outside of Shell as well. R7: The factors that were identified resonate very well with the work that the Value Balancing Alliance is doing. R8: From my answers you can see very clearly that I value customer expectations highly; the customer is king.
Feedback survey	
	R3: I found it difficult to quantify evaluations that are so qualitative in nature. R4: Part of my difficulty with the matrices has to do with the difficulty of choosing between the factors, because they are all very important, and I have to force myself to pick a most and least important one. R4: Choosing between these factors is difficult because they are very industry contingent, governments are e.g. more important in certain sectors than others. R7: It was a very interesting exercise, it stretched my mind.

Table 17. Combined transcript of the performed interviews.

Appendix E: Resulting weights of importance

		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Mean
Tangible standard characteristics	Compatibility	0,083	0,075	0,031	0,057	0,074	0,022	0,042	0,011	**0,049**
	Costs	0,049	0,017	0,071	0,034	0,033	0,045	0,026	0,028	**0,038**
	Progressive	0,016	0,006	0,046	0,057	0,008	0,030	0,017	0,006	**0,023**
	Certification	0,033	0,014	0,023	0,034	0,025	0,009	0,042	0,028	**0,026**
	Sector-specific	0,033	0,017	0,008	0,034	0,020	0,073	0,026	0,023	**0,029**
	Accessibility	0,010	0,017	0,019	0,015	0,016	0,073	0,005	0,009	**0,020**
Intangible standard characteristics	Improve structure	0,004	0,014	0,044	0,017	0,002	0,024	0,018	0,014	**0,017**
	Improve reputation	0,008	0,005	0,044	0,006	0,020	0,059	0,048	0,037	**0,028**
	Get started without external guidance	0,015	0,011	0,032	0,022	0,006	0,039	0,007	0,005	**0,017**
	Applicability to size	0,020	0,017	0,044	0,020	0,008	0,012	0,018	0,014	**0,019**
	International acceptance	0,050	0,051	0,114	0,053	0,008	0,095	0,048	0,037	**0,057**
	Ability to open new markets	0,015	0,011	0,044	0,022	0,005	0,024	0,018	0,014	**0,019**
Standard supporting alliance characteristics	Financial strength	0,050	0,022	0,021	0,026	0,013	0,012	0,055	0,053	**0,031**
	Reputation of the supporters	0,029	0,034	0,021	0,065	0,066	0,031	0,018	0,053	**0,040**
	Diversity within the alliance	0,005	0,034	0,032	0,021	0,006	0,015	0,037	0,011	**0,020**
	Participation official SDO	0,015	0,095	0,007	0,046	0,027	0,031	0,055	0,015	**0,036**
	Perceived neutrality	0,050	0,034	0,051	0,085	0,020	0,054	0,092	0,053	**0,055**
Standard creating process	Coordination	0,002	0,073	0,016	0,018	0,029	0,003	0,017	0,045	**0,025**
	Stakeholder & third party	0,022	0,147	0,052	0,044	0,048	0,016	0,017	0,045	**0,049**
	Substantive due process	0,009	0,049	0,010	0,053	0,010	0,009	0,031	0,006	**0,022**
	Transparent and open	0,007	0,059	0,021	0,026	0,019	0,015	0,007	0,026	**0,022**
Standard support strategy	Financial support	0,009	0,023	0,008	0,019	0,014	0,015	0,030	0,018	**0,017**
	Alignment of interests	0,017	0,057	0,003	0,047	0,045	0,017	0,020	0,053	**0,032**
	Periodical improvement	0,043	0,017	0,006	0,009	0,011	0,004	0,030	0,018	**0,017**
	Provision of support	0,017	0,023	0,019	0,028	0,019	0,002	0,050	0,012	**0,021**
	Presence of a community	0,013	0,017	0,008	0,047	0,011	0,009	0,020	0,006	**0,016**
	Benefits tracking	0,013	0,007	0,008	0,028	0,005	0,009	0,007	0,018	**0,012**
Stakeholders	Consultants & auditors	0,068	0,007	0,045	0,030	0,024	0,036	0,026	0,057	**0,037**
	Governmental bodies	0,172	0,003	0,025	0,017	0,050	0,072	0,137	0,076	**0,069**
	NGO's	0,020	0,028	0,045	0,007	0,101	0,072	0,023	0,024	**0,040**
	Customers	0,102	0,015	0,083	0,011	0,259	0,072	0,014	0,185	**0,093**
Categories	Tangible	0,224	0,145	0,197	0,231	0,175	0,252	0,157	0,105	**0,186**
	Intangible	0,112	0,109	0,324	0,141	0,049	0,252	0,157	0,123	**0,158**
	Alliance	0,149	0,218	0,132	0,244	0,131	0,143	0,257	0,184	**0,182**
	Creation	0,040	0,327	0,099	0,141	0,105	0,044	0,071	0,123	**0,119**
	Support	0,112	0,145	0,051	0,179	0,105	0,057	0,157	0,123	**0,116**
	Stakeholders	0,363	0,055	0,197	0,064	0,434	0,252	0,200	0,342	**0,238**

Table 18. Resulting weights of importance for each of the experts and averaged over all experts.

Appendix F: Mean weights of importance and standard deviations

Group	Factor	μ	s
Tangible	Compatibility	0,049	0,025
	Costs	0,038	0,016
	Progressive	0,023	0,018
	Certification	0,026	0,010
	Sector-specific	0,029	0,018
	Accessibility	0,020	0,020
Intangible	Improve structure	0,017	0,012
	Improve reputation	0,028	0,020
	Get started without external	0,017	0,012
	applicability to size	0,019	0,010
	International acceptance	0,057	0,031
	Ability to open new markets	0,019	0,011
Alliance	Financial strength	0,031	0,017
	Reputation of the supporters	0,040	0,018
	Diversity within the alliance	0,020	0,012
	Participation official SDO	0,036	0,027
	Perceived neutrality	0,055	0,022
Creation	Coordination	0,025	0,022
	Stakeholder & third party	0,049	0,039
	Substantive due process	0,022	0,018
	Transparent and open	0,022	0,015
Support	Financial support	0,017	0,007
	Alignment of interests	0,032	0,019
	Periodical improvement	0,017	0,012
	Provision of support	0,021	0,013
	Presence of a community	0,016	0,012
	Benefits tracking	0,012	0,007
Stakeholders	Consultants & auditors	0,037	0,018
	Governmental bodies	0,069	0,055
	NGO's	0,040	0,029
	Customers	0,093	0,083

Table 19.Mean results of the weights attributed by the respondents and the corresponding standard deviations.