Creating Impactful Standards:

Assessing the importance of RRI dimensions on standard development

Master thesis submitted to Delft University of Technology in partial fulfilment of the requirements for the degree of:

MASTER OF SCIENCE

In Complex Systems Engineering and Management

Faculty of Technology, Policy and Management

by

Almar Meijer

Student number: 4113314

To be defended in public on 11/05/2021

Graduation committee

Chairperson	: Prof.dr.mr.ir. N. Doorn, Ethics/Philosophy of Technology
First Supervisor	: Dr.G. van de Kaa, Economics of Technology and Innovation, Associate Professor
External Supervisor	: MSc. M. Wiarda, Economics of Technology and Innovation, PhD-candidate

Preface

I hereby present my master thesis “Creating impactful standards: Assessing the importance of RRI dimensions on standard development”, an exploratory study combining interviews with a questionnaire administered to standardisation experts at NEN. This thesis has been written in partial fulfilment of requirements of the Complex Systems Engineering and Management program. The research was conducted from November 2020 to April 2021.

My research topic and questions were chosen together with my supervisors, Geerten van de Kaa and Martijn Wiarda. The research was quite challenging, since the current pandemic made access to respondents for the interviews and questionnaire more difficult. Fortunately, thanks to the help of Arnoud Muizer, I was able to contact experts at NEN in order to finish the thesis within the allotted timeframe.

Generally, I would like to thank NEN for their time and expertise. Without their willingness to help me, I would not have been able to conclude my research. Furthermore I would like to thank Neelke Doorn, for the words of encouragement and motivation throughout the research.

I would also like to thank Geerten van de Kaa personally for his patience, his assistance with the standardisation section and his assistance with the overall structure of the research.

Lastly, I would like to thank Martijn Wiarda for his close involvement in my thesis. Luckily, he was active with research into a similar topic. In my opinion, his insights and regular feedback have helped me a tremendous amount in getting the most out of this research.

Abstract

Responsible Research and Innovation (RRI) has seen a recent surge in policy uptake, but currently lacks guidance on clear institutionalisation in practice (Burget et al., 2017; Owen et al., 2021). Formal standards have tremendous potential as a possible instrument in order to meet societal challenges due to the anticipatory and inclusive nature of standardisation processes. Yet standardisation present an under researched field of study in relation to RRI. The goal of this study is to test the relative importance of typical RRI dimensions and their criteria in formal standard development processes, since it is not clear if the concepts of RRI are important to organisations (Stahl et al., 2017).

In order to test the relative importance of RRI dimensions, core concepts and their applicability were explored in the context of standardisation through a series of semi-structured interview with NEN professionals. Subsequently, a questionnaire was administered among standardisation professionals at NEN. Respondents were asked to rank the relevant RRI criteria. A BWM analysis was performed to make pairwise comparisons between RRI criteria to calculate their overall weights. Results indicate that the diversity of participation, consensus and the role of information are considered most important, followed by the identification of standards' impact.

This suggests that adoption of standards requires a wide variety of participants relevant to the standards context to enable broad support. This is further supported by the need for consensus and openness to protect participants' interests and increase trust in the process. Lastly, the study suggests the need for standards to be impactful for them to be used and useful.

Executive Summary

Responsible Research and Innovation (RRI) is a field of research that has in recent years gained a lot of traction (Owen & Pansera, 2019) as the result of growing (ethical) concerns for emerging technologies, for example nanotechnology (Wickson & Forsberg, 2015). RRI was introduced as a means to govern technology and innovation in the face of uncertainty and ignorance, as they become more embedded socially and politically (Stilgoe et al., 2013). RRI aims to reduce the risk of path dependencies after technology enters the marketplace RRI forms a departure from current risk-based governance of innovation, as it shifts the focus to the process instead of the outcomes (Stilgoe et al., 2013). RRI emphasizes the importance of defining purpose, motivation and direction of innovation before path-dependencies occur.

RRI can be characterised by four core criteria, which have come to define responsible innovation processes (Burget et al., 2017; Fraaije & Flipse, 2020; Lubberink et al., 2017; Stilgoe et al., 2013). These dimensions are referred to by Stilgoe et al., (2013) as: anticipation, reflexivity, inclusion and responsiveness. Transparency can be added as a fifth dimension as it is explicitly mentioned in von Schomberg's (2011) original definition of RRI.

Standards have tremendous potential as an instrument of RRI, since they can be used to meet societal challenges and needs. Due to the anticipatory nature of standards development (Wiegmann et al., 2017), there is a potential to identify alternatives ahead of time and reflect on underlying values. RRI can help in the challenge to implement differing ethical technological values, such as privacy and security in technical standards, by means of engaging stakeholders to enforce these values (van de Kaa, 2013). According to Forsberg (2012) standardisation forms the medium through which stakeholders from various key domains, i.e. society, industry, science and policy, come together and exchange ideas and develop products/services.

However, the institutionalisation of RRI in standards development is challenged by many issues. Many researchers have found that there are a number of challenges for RRI in standardisation, ranging from limited stakeholder involvement due to financial and resource constraints (Forsberg, 2012), to issues regarding information asymmetries and competitive advantage (Blok & Lemmens, 2015; Brand & Blok, 2019; Inigo et al., 2020). And finally, risk asymmetries between companies that carry the financial burden and liability of innovation projects (Inigo et al., 2020). These issues ultimately affect the legitimacy of standardisation processes (Forsberg, 2012; Inigo et al., 2020).

This begs the question as to how organisations value core concepts of RRI in relation to standards development. The objective of this research is to explore the relative importance of typical RRI dimensions in standard development processes, since it is not clear if the concepts of RRI are important to organisations (Stahl et al., 2017). Another objective of this research was to yield a policy recommendation, a design aimed at institutionalising an aspect of RRI in standards development processes, see chapter 8.

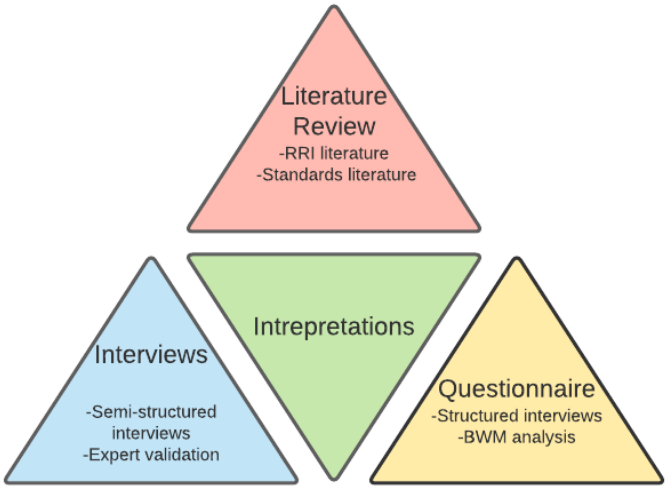
The scope of this research extends to NEN, the national standardisation body of the Netherlands and its set of committees. In order to meet the goal of this research, three sub goals were defined.

Firstly, the link between RRI and standardisation literature was explored through a comprehensive literature review. This resulted in a subset of criteria that describe the essence of RRI dimensions and an explanation for their importance on standards legitimacy, see chapter 2 and 3. Furthermore, a set of exploratory interviews was used to bridge the gap between the RRI literature and the practical context of standardisation, see chapter 4.

Secondly, exploratory interviews were used to find a definition for the quality of standardisation processes.

Thirdly, the relative weights of RRI dimensions on the quality of standardisation processes were determined through a BWM analysis of a questionnaire, wherein the standardisation experts at NEN were asked to rank the relative importance of RRI dimensions and criteria, see chapter 5 for an overview of the criteria weights.

The triangulation methodology used to meet the sub goals is depicted in the figure below.



Semi-structured interviews with NEN standardisation experts indicates that the definition of quality in the standardisation process is quite standardised. It was found that quality of standardisation constitutes:

A consensus-based and transparent process with all parties concerned.

Inclusion

Respondents have indicated that a*ll parties concerned* directly relates to the inclusiveness of standardisation processes. Inclusion refers to diversity and fair representation of participants relevant to the context (Q1). Respondents also include the creation of tools for people to engage and meaningfully contribute in standardisation processes. To respondents, inclusion also means a sufficient body of participants to ensure financial viability of committees, single member committees are less desirable for NEN. Inclusion extends to both committee members, but also general stakeholders, who are consulted in public consultation rounds.

Respondents mentioned that a *consensus-based process* is essential to meaningfully engage with participants, as it serves as a safeguard for their interests (Q2). Feedback is considered very important by respondents in treating and discussing ideas equally (Q3).

Transparency

A *transparent process* is referred to as openness of information, motivations and interests (Q16). Furthermore, respondents relate it to clear and consistent use of a format. Respondents mentioned that, sometimes personal spaces are required for parties to express underlying interests and motivations. Non-disclosure agreements are in place to enhance the transparency and safeguard the interests of stakeholders.

Anticipation

Anticipation was not directly mentioned by respondents as a core quality of standardisation processes, but is still considered important. Anticipation is referred to as the alignment of NEN towards socially desirable topics and projects (Q6). The aim is to identify where interests overlap and common grounds can be found, and impacts can be identified (Q5). However impact assessment of standards are generally not included within the scope of committees. Respondents indicated that in some committees anticipation plays a bigger part than others. Some standardisation processes are initiated through governmental mandate, by posing certain questions or indicating the intention of potential regulation. In these cases the social desirability and impacts are predefined by governments, which shifts the attention of the standardisation process away from the outcomes, toward the necessity of the standard.

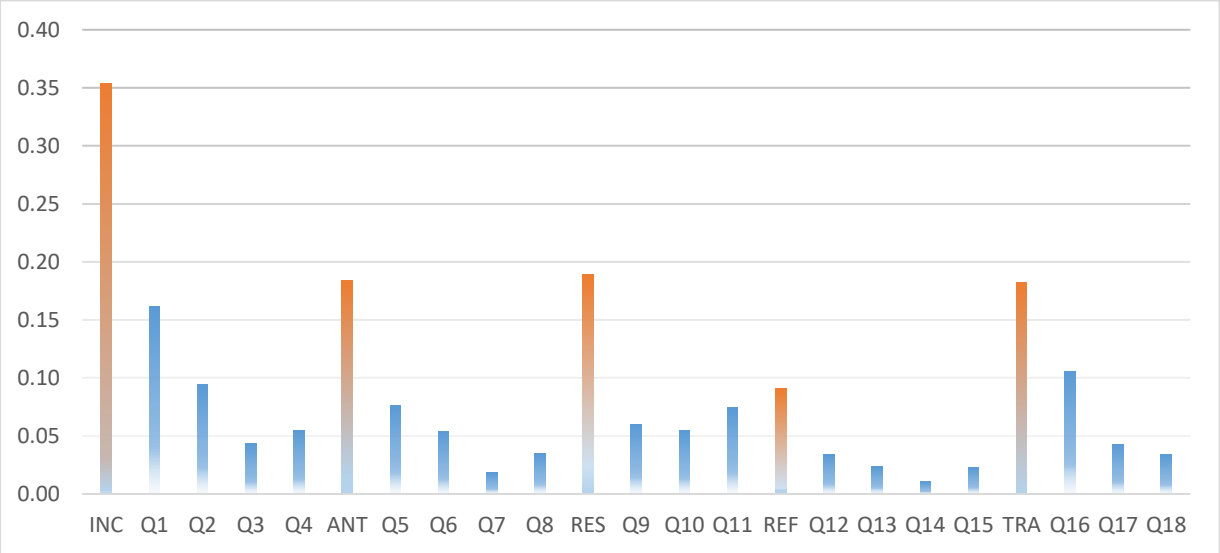
Responsiveness

Respondents refer to responsiveness as stimulating certain socially desirable themes (Q9). Standards are responsive toward ongoing insights and new requirements (Q10). Corrigenda or addenda help to continuously adapt a standard in the short term. In the long term, standards can be reformulated.

Reflexivity

Reflexivity suggests a reflection on underlying interests and motivations of participants. Participants can be considered lay-experts by respondents, who present different needs for standards relevant to their context (Q12). Respondents indicate that inclusion and transparency add to reflexivity through the enrichment of the information exchange, which generates balanced and open discussions. Reflexivity is stated to be based on formalised iterations or rounds of negotiation and decision-making.

Criteria and Dimension Weights



Firstly, the *Diversity of participation* was found as the most important criterion on the quality of standardisation process, which is reflected in the definition. Standards lack inherent authority and thus, rely on their rate of adoption for success (Botzem & Dobusch, 2012). Since standards are aimed at adoption, inclusion is important in providing the necessary support for standards to succeed (Forsberg, 2012).

Secondly, this research suggests that participants of standardisation need to be empowered to make meaningful contributions. This refers to the principle of *consensus-based* standardisation processes. Consensus presents a democratic element that serves to 'safeguard' the interests of participants and increases legitimacy of the standardisation process.

Thirdly, transparency was found to be essential toward standardisation, since it directly affects trust in a process characterised by a lack of formal authority and self-organisation (Botzem & Dobusch, 2012). Its importance is also reflected in the definition of quality of standardisation processes.

Lastly, the research has revealed the importance of Anticipation. Respondents have indicated that "standards must have impact to be used and useful" and should be considered as the end goal of standardisation processes. *Identification of impacts* was found to be a very important criterion, but is surprisingly not represented in the core definition. Additionally, institutionalisation of Anticipation appear to be absent in standardisation processes.

Table of Contents

Table of figures

List of Tables

1. Research Introduction

The development of industry standards has played an important role in the diffusion and adoption of new technologies, processes and services (Grundström & Wilkinson, 2004). Consequently, it has also had a profound impact on the comparative advantage of firms, suppliers and producers of complementary products, services and processes (Grundström & Wilkinson, 2004). On a societal level the diffusion of technical knowledge has on average contributed to the economic growth of several European countries by an average of 1% of GDP (Blind, 2013).

Standards can be considered documented agreements that contain technical specificities to ensure that products, processes and services are fit for purpose (Allen & Sriram, 2000). The aim of standardisation "is to limit the number of solutions when using different options simultaneously is ineffective and inefficient" (Wiegmann et al., 2017, p. 1370). The development of standards through committees, also called 'de jure' or formal standardisation, is a process of cooperation and coordination through standards developing organisations (SDOs), consortia, open source initiatives and professional associations (Wiegmann et al., 2017). In committee based standardisation processes stakeholders voluntarily collaborate to define standards through a consensus-based decision-making process (Wiegmann et al., 2017).

In the formal standardisation literature relevant topics of research are market knowledge and complexity (Jain, 2012) . Standards are generally developed by committees ahead of market entry. The anticipatory nature of committee based standardisation requires parties to consider future market developments, which generally results in ambiguity of party interests and complexity (Jain, 2012).

A large majority of research into formal standards revolves around these political-economic aspects of firms (Jain, 2012), concerning questions of coordination within committees and the need for cooperation. Since decision making usually involves unanimous consent or majority rules, extant literature focus on the efficiency of standard committees to coordinate internal conflicts (Jain, 2012).

Belleflamme (2002) presented the formal standardisation process as a 'battle of the sexes' where, as opposed to market outcomes, coordination leads to better performance of standards, however they take longer to develop. David & Greenstein (1990) state that the degree of technology development and the level of investment by parties also influence the likelihood of standard adoption. Firm strategies will vary more wildly as economic involvement increases.

Other streams of literature have focused more on micro-institutional arrangements of SDOs, internal political dynamics, the degree of openness and the ability of parties to form coalitions. Degree of openness can stimulate the emergence of dominant coalitions and could create bandwagon effects (Farrell & Saloner, 1986). Generally these approaches have been used to analyse incentives for formal standardisation processes (van de Kaa & de Bruijn, 2015), where focus is placed on certain rules of the game for standardisation processes to achieve success.

The aim of this research is to review criteria of importance on the quality of formal standardisation processes identified in Responsible Research and Innovation literature, and research their applicability in the empiric context of standardisation committees.

1.1 Responsible Research and innovation: a new approach to innovation management

Responsible Research and Innovation (RRI) is a field of research that has in recent years gained a lot of traction (Owen & Pansera, 2019) as the result of growing (ethical) concerns for emerging technologies, for example nanotechnology (Wickson & Forsberg, 2015). RRI was introduced as a means to govern technology and innovation in the face of uncertainty and ignorance, as they become more embedded socially and politically (Stilgoe et al., 2013). RRI aims to reduce the risk of path dependencies after technology enters the marketplace by considering the purpose, motivation and direction of innovation more actively beforehand. RRI forms a departure from classical consequentialist governance of innovation as it shifts the focus to the process instead of the outcomes (Stilgoe et al., 2013).

Responsible innovation is now a term often referred to by EU policy as an instrument for achieving ethically acceptable and socially desirable modes of innovation (European Commission, 2012). Early definitions of RRI included elements that went beyond purely technical understanding of innovation. Common factors are societal and environmental benefit, involvement of private and public parties and the assessment of social, ethical and environmental opportunities and risks, alongside economic factors (Sutcliffe, 2011).

Over the years scholars have added to the concept definition and core concepts of RRI. One of the founding researchers of RRI, von Schomberg (2011), defines RRI as a *"*transparent and interactive processes that engages societal actors and innovators as they become more responsive to core values, such as ethical acceptability, sustainability and societal desirability of marketable products*"* (p.9). Stilgoe et al. (2013) add that RRI is about stewardship, whereby an active sense of engagement is required to bring about innovation.

A commonality among most RRI literature is the appearance of four core criteria which have come to define RRI processes (Burget et al., 2017; Fraaije & Flipse, 2020; Lubberink et al., 2017; Stilgoe et al., 2013). These dimensions are referred to by Stilgoe et al., (2013) as: anticipation, reflexivity, inclusion and responsiveness. Anticipation refers to a forward looking perspective aimed at exploring multiple avenues for innovation, minimising societal risk, as post hoc risk based models of governance have proven to be unable to deal with the pace of technological change and their impact on society.

Reflexivity includes the necessity to hold up a mirror to assess assumptions, values and expectations pertaining to innovation activities to open up the framing of issues (Stilgoe et al., 2013). Reflexivity goes beyond self-scrutinising of practises as it challenges value systems and modes of thinking. It can therefore be defined more as a public responsibility. Mechanisms to enforce reflexivity are found in for example codes of conduct and standards (Stilgoe et al., 2013).

A third criterion of RRI relates to inclusiveness of innovation processes. Inclusion is aimed at enabling a public dialogue with private and public parties in order to open up the framing of issues and create a sufficient base of support. The goal of inclusion is to enhance the quality of the dialogue (Stilgoe et al., 2013). Stilgoe et al. (2013) summarise three important elements of quality dialog First and foremost the intensity of the meetings is of importance, i.e. how early and how often participants are consulted. Secondly the "openness" relates to diversity of the group and how they are represented. The third element relates to gravity of the content matter, which becomes more enriched as involvement increases.

The last criterion pertains to responsiveness, which can be described as responding to new knowledge, values and adjusting course when a lack of control is recognised (Stilgoe et al., 2013).

More recent literature on conceptual dimensions identify more contemporary dimensions, for example sustainability (Burget et al., 2017). Burget et al. (2017) argues that social responsibility is a core concept of RRI and that it requires a bigger emphasis on resource-efficiency in order to produce more sustainable products and services.

Fraaije & Flipse (2020) identify transparency as an additional dimension of Responsible Innovation. Transparency fills a supporting role with respect to inclusiveness and reflexive innovation as it forms a requirement for the communication of decisions and underlying criteria as well as help distribution of responsibilities of participants clearly (Fraaije & Flipse, 2020). Transparency is a means to create trust between stakeholders to facilitate meaningful dialogue. Furthermore it can aid in the adoption of products by way of creating public support.

1.2 Potential for RRI through standardisation

RRI in standardisation has tremendous potential as standards can be aimed at meeting societal challenges and societal needs. Due to the anticipatory nature of standards development (Wiegmann et al., 2017), there is a potential to identify alternatives ahead of time and reflect on underlying values. RRI can help in the challenge to implement differing ethical technological values, such as privacy and security in technical standards, by means of engaging stakeholders to enforce these values (van de Kaa, 2013).

Furthermore the adoption of RRI could facilitate alignment between company interests and societal expectations, as well as regulatory requirements (Stahl et al., 2017). Innovation through standardisation has the innate ability to engage a diverse set of stakeholders through open access at an early stage (Coenen, 2016).

For the most part however RRI in standardisation remains an underdeveloped area of research despite its ‘significant impact’ on governance of innovation (Wickson & Forsberg, 2015). Wickson & Forsberg (2015) state that standardisation presents an important ‘interstitial space’ for the application of RRI, yet it has to date escaped the eye of mainstream research. According to Forsberg (2012) standardisation forms the medium through which stakeholders from various key domains, i.e. society, industry, science and policy, come together and exchange ideas and develop products/services that are fed back in to their respective domains, which in turn shapes their activities.

1.3 Challenges for RRI in standardisation: knowledge gap

There is a growing interest within the field of RRI that relates to conflicts or tensions in practice between the core criteria of RRI and the heterogeneity of interests of parties involved, which have been identified in standardisation. Brand & Blok (2019) have argued for existence of three core tensions between RRI criteria and commercial/economic factors.

Firstly, a natural tension exists between deliberative engagement and resource constraints. There is a natural trade-off between the inclusion of a wide variety of parties to facilitate mutual learning and the resource constraints. Forsberg (2012) underlines the significant resources required for participation in standardisation. First and foremost standardisation requires a lot of time to keep up

with the plethora of technical documents and drafts submitted as well as attendance for committee meetings. Furthermore, this further exacerbated by the financial aspect of meeting regularly in different locations and membership fees. Lastly, there is a significant knowledge requirement to contribute to a standardisation process, ranging from technical expertise of the subject matter as well as knowledge of the formal standardisation procedures (Wickson & Forsberg, 2015). Therefore stakeholders that do participate in standardisation are those that a have a significant financial interest and tend to come from industry primarily (Wickson & Forsberg, 2015).

A second tension identified by Brand & Blok (2019), relates to knowledge sharing routines and the nature of competitive advantage. Information asymmetries between market-parties are considered as important sources of competitive advantage (Brand & Blok, 2019). The inclusive and open nature of RRI could hurt the comparative advantage due to information asymmetries (Brand & Blok, 2019). Wickson & Forsberg (2015) found that this tension results in an overall lack of transparency as ''standardisation is as much about negotiation as about rational discussion, however the content of the actual negotiations are rarely documented or accessible, even to fellow members of the committees.'' (p. 1173) .

Lastly, Brand & Blok, (2019) describe a problem between the inclusive governance of RRI and decision-making structures of companies. Companies will lean towards commercial considerations because financial interests are the main objective of those with decision-making power (Brand & Blok, 2019). This also appears to have some influence on responsiveness of standards. Forsberg (2012) found that even though some standards emerge after long exhaustive negotiation they appear to stagnate after a while, unresponsive to new developments or insights.

A lack of responsiveness, transparency and inclusion is detrimental toward the legitimacy of standardisation (Wickson & Forsberg, 2015). Legitimacy contributes to the pursuit of both continuity, credibility and long term stability (Botzem & Dobusch, 2012). Legitimacy is therefore crucial to standardisation practises. This begs the question as to how participants of standardisation processes value core concepts of RRI in relation to standards development. This research will be aimed at addressing this particular question.

1.4 Research Question and methodology

The goal of this research is to explore the relative importance of typical RRI dimensions in standard development processes, since it is not clear if the concepts of RRI are important to organisations (Stahl et al., 2017). The scope of this research extends to NEN, the national standardisation body of the Netherlands and its set of committees.

The central research question is aimed at trying to explore the relevance of RRI process dimensions and their perceived importance by SDOs. The central research question is as follows:

What is the relative importance of RRI process dimensions on the quality of the standard development process as perceived by SDOs?

The main research question can be subdivided in sub-questions as follows:

- Which RRI process criteria can be discerned from the RRI dimensions defined in the relevant literature?
- How are the RRI criteria related to standardisation literature?
- How do SDOs define quality of standardisation processes?
- What is the relative importance of RRI process criteria on the perceived quality of a standards creation process?
- What practical implementations and recommendations can be discerned for standardisation processes to support RRI?

The first sub-question pertains to the identification of relevant criteria from the traditional RRI dimensions as proposed by Stilgoe et al. (2013). Recent efforts to construct a framework for RRI by Burget et al. (2017) and Fraaije & Flipse (2020) give way to analysing these RRI dimensions more formally, through a set of criteria or qualifiers. For this purpose, these papers will be used as a starting point for a literature review. Subsequently, in the second sub-question, these RRI dimensions will be related to relevant standardisation literature in order to gain understanding and to bridge the gap in formal discourse.

The third sub-question pertains to the definition of qualitative standard development within SDOs as well as the identification of important criteria specific to formal standardisation from the perspective of SDOs. A series of semi-structured interviews will help shape a more comprehensive definition for the quality of standard development processes as perceived by SDOs, which is necessary for exploreing the relative importance of criteria.

The fourth sub-question relates to a formal ranking of these criteria. In order to explore the comparative importance of these criteria a ranking method will be used, since RRI criteria are of a qualitative nature. In order to rank the most important criteria the Best Worst method (BWM) will be applied. The BWM is a multi-criteria decision-making (MCDM) tool that can be used to obtain a ranking of relevant decision making criteria by making pairwise comparisons of their respective weights. The linear BWM has been developed by Rezaei (2015; 2016) and is known for its simplicity and reliability, it requires fewer comparisons, while attaining a higher level of consistency than other pairwise comparison methods (Liang et al., 2020). The ranking of criteria will be facilitated by the use of a questionnaire that will be administered to NEN professionals through structured interviews

Societal relevance

From a societal standpoint this research is interesting for SDOs, as it adds to their general insight in the relevance of RRI related concepts on standards development processes. NEN currently lacks well-defined criteria that apply the quality of standards development processes, since their current service profile primarily focusses on goal oriented criteria. Furthermore this research can help to identify possible avenues for institutionalising the RRI process in practice, which is currently lacking (Burget et al., 2017; Owen et al., 2021).

Scientific relevance

From an academic standpoint this research aims to investigate the applicability of the conceptual framework derived from both practice and concerted academic efforts as well as test the framework in empiric context. This research can add to RRI literature by gaining more insight in the working of

RRI practices in standardisation context in general, since this research will attempt to generalise the importance of RRI on a SDO level instead of limiting itself to individual committees. Furthermore, this research aims to shed light in the trade-offs between certain RRI dimensions within the context of SDOs and explore the tensions between RRI dimensions versus political-economic aspects present in standards development. Lastly, the research aims to yield a clear and concise definition for quality of standardisation and its relation to RRI dimensions.

Relevance to CoSEM

The main goal of the Complex Systems Engineering and Management MSc program is design in socio-technical systems. A central theme is producing and embedding new artefacts/innovations in complex socio-technical systems. This requires the adoption of a societal perspective, including decision-makers, end-users and other relevant stakeholders. In this research the perspective of the SDO is adopted, through which the importance of RRI criteria as perceived by SDOs and stakeholders will be examined in light of standardisation committees. Subsequently a, BWM analysis, which is part of the MCDM toolbox, is used to rank the relevant criteria. Lastly, results will be used to make policy recommendations regarding the score of relevant criteria. The policy recommendation will be presented in the form of a process design, an artefact addressed at institutionalising an aspect of RRI in standardisation processes. The process design has both a policy and a clear technology component, since its aim is addressing the effective governance of technology and innovation.

1.5 Research Framework

In this section the general outline of research is showcased, see figure 1. What is now considered chapter one the research topic has been explored and its relevance argued, followed by the formulation of research questions and a general description of the methodology. Chapter 2 will represent the theoretical exploration of RRI and its concepts in more detail through a literature review. In this chapter all relevant RRI dimensions and subcriteria will be discerned and defined. In the following chapter RRI will be linked to the standardisation context. Chapter 4 will describe the general methodology, including the collection of data by means of questionaires administered through a series of structured interviews. Beforehand a series of semi-structured interviews will be conducted to gain a better understanding of the goals of SDOs, their definition of quality and the process of standard development. In chapter 5 the results will be presented followed by a discussions and limitations in chapter 6. General conclusions and contributions will be adressed in chapter 7. Lastly, chapter 8 will introduce a process design that is aimed at instutionalising an aspect of RRI in standardisation processes.

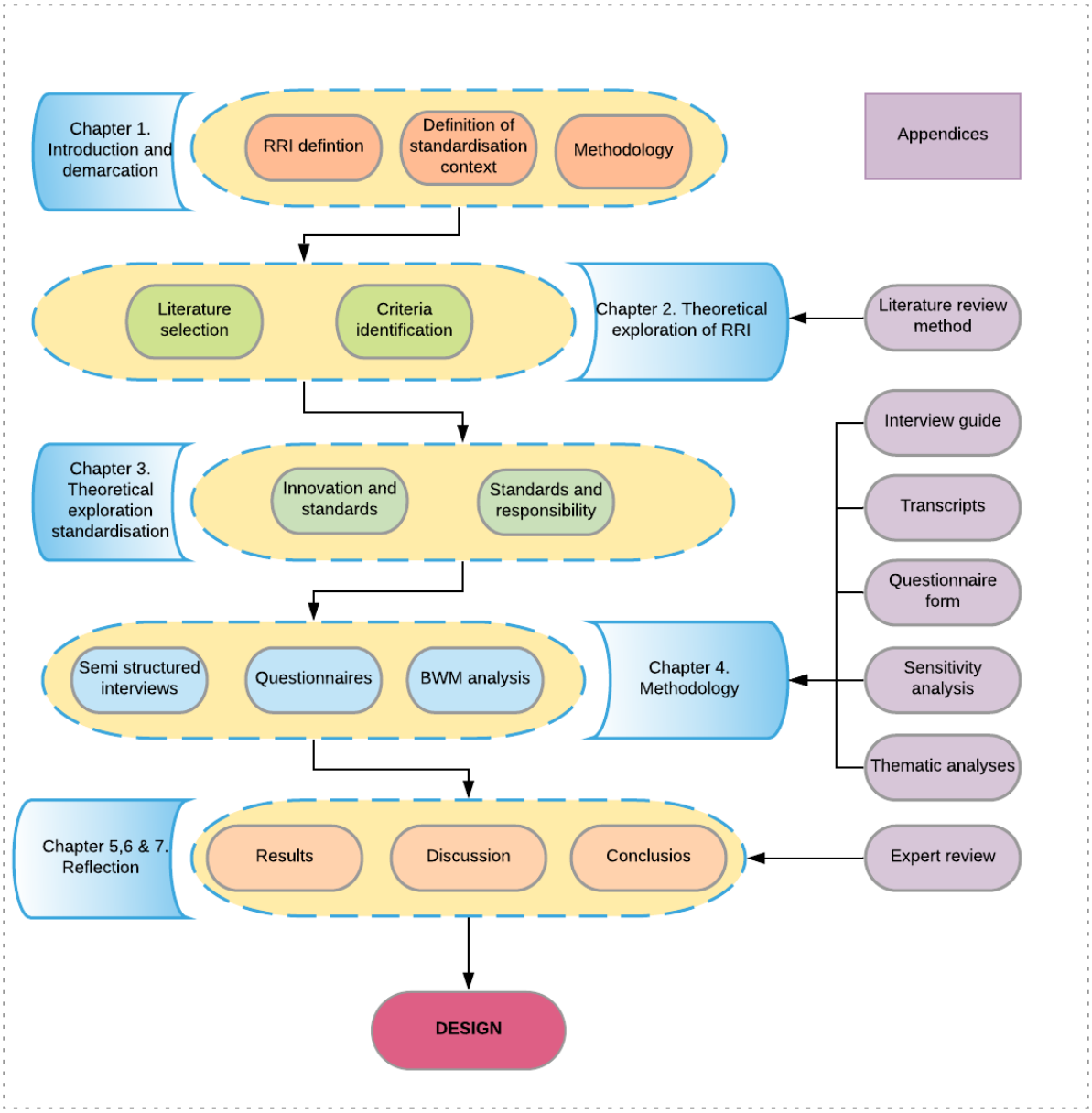


Figure 1; Research Framework

2. RRI and the governance of innovation

This chapter will start off with a general introduction into the origin and the need for RRI. Sections 2.1 to 2.5 present the result of a literature review into the core RRI dimensions. The literature review method is included in appendix A. Section 2.1 to 2.4 present the conventional RRI dimensions as proposed by (Stilgoe et al., 2013). Section 2.5 proposes transparency as a new RRI dimension. Table 1 will summarise and synthesize the relevant RRI criteria found in the literature review in a table.

The need for RRI

RRI was framed in the context of growing financial and environmental concerns to deal with impertinent issues stemming from innovation, and restore public trust in governments and science (Thapa et al., 2019). Essentially RRI is a design strategy intended as a "renegotiation of the contract between science and society" (de Jong et al., 2015, p. 75). RRI forms a departure from conventional division of moral labour, attributing moral responsibilities to science and moving its activities toward the public domain (de Jong et al., 2015). In order to bring about this change in moral responsibility, RRI can be characterised by three overarching goals, as discussed by (de Jong et al., 2015).

The first goal of RRI is aimed towards avoiding potential negative consequences and risks associated with innovation by pre-emptively assessing the purpose, direction and motivation of innovation (Stilgoe et al., 2013). Managing innovation has proven problematic when it comes to controlling outcomes (Stilgoe et al., 2013), due to path dependencies (David, 1985) and their impact in innovation pathways.

A second goal of RRI is to include societal values, environmental concerns and (ethical) acceptability in the purpose and motivation for innovation (de Jong et al., 2015).

A third consideration for RRI, mentioned by de Jong et al. (2015), is the distribution of impact. de Jong et al. (2015) state that "consequences [of innovation] are not bound to the innovation's location of origin" (p.78). This requires a shared understanding and a sense of collective responsibility (Stilgoe et al., 2013). Collective responsibility represents the notion that singular individuals might not act irresponsible, however the effect of complex and interconnected systems can lead to irresponsible outcomes through unforeseen dynamics, also known as 'the problem of many hands' (van de Poel et al., 2012).

Figure 2; *Retrospective and prospective orientation of responsibility*

Note: Reprinted from "Responsible research and innovation – A conceptual contribution to theory and practice of technology management", by L. Nazarko, 2019, *Business: Theory and Practice,* 20, p. 343. Copyright 2019 by Lukasz Nazarko. Reprinted with permission.

RRI can be seen as research stream, dedicated to determining the role of science in society (de Jong et al., 2015), bringing together multiple disciplines, e.g. Anticipatory Governance (Guston, 2013) , Technology Assessment (Schot & Rip, 1997) and Value-sensitive design (Friedman et al., 2006; Van

den Hoven et al., 2012). The intention is to reframe commonalities in the 'scattered field' of innovation management (de Jong et al., 2015).

RRI aims to institutionalise a more inclusive and value-based design strategy for innovation to reach the 'right impacts' (Owen et al., 2012). This goal inherently is contentious, since there is no consensus on what that entails.

Owen et al. (2012) argue for a responsible attitude in the form of care and responsiveness. Care and responsiveness, according to Owen et al. (2012) represent a proactive attitude toward socially desirable outcomes. Since reactive terms like liability and reasonable foreseeability are problematic in light of uncertain futures of innovation (Owen et al., 2012), see figure 2. As depicted in the figure 2 which deals with backwards looking definitions of responsibility, e.g. accountability and blame, when innovations have unintended outcomes. This is all part of a responsible attitude toward innovation characterised by reflexivity, inclusion, anticipation and responsiveness (Owen et al., 2012; Stilgoe et al., 2013).

In the next section the core dimensions of RRI anticipation, reflexivity, inclusion and responsiveness of RRI will be discussed in a comprehensive literature review. The summary and synthesis of the RRI literature review are presented in table 1.

2.1 Anticipation

Anticipatory processes in RRI have the aim to seek future outcomes and impacts of choices made in the present (Fraaije & Flipse, 2020). They consider contingencies of innovation, asking questions such as "what is known, what is likely, what is plausible and what is possible" (Stilgoe et al., 2013, p. 1570). Anticipation increases resilience of future innovation, identifying new pathways for innovation and manages its risks for society (Fraaije & Flipse, 2020), by dealing with uncontrollability and unpredictability of technological development (Jenkins et al., 2020).

Burget et al. (2017) argue that anticipation is the process of 'envisioning' future of research and innovation. Anticipation is often linked to 'anticipatory governance' (Sutcliffe, 2011) and technology assessment (Stahl et al 2013; Owen et al 2012), knowledge assessment (Owen et al., 2012) in order to choose technologies that are able to provide societal benefits and avoid potential negative consequences down the line. Ribeiro et al. (2017) state that the development of technology poses inherent threat to environment and society through a series of negative impacts, often called unintended outcomes or negative consequences. In an ideal case these need to be dealt with before technologies enter the market and are embedded in society.

2.1.1 Identification of impacts

A key part of anticipation, according to Lubberink et al., (2017), is gaining awareness of potential unforeseen consequences of innovation. Hence, RRI proves a useful coping mechanism for reducing uncertainty. Though generally the impact of innovation tends to be societal, there does appear a distinction in the way impacts reveal themselves.

Impacts are often social as innovations help alleviate some of the challenges faced in medicine, energy and materials (Sutcliffe, 2011). Divining social implications of innovation is sometimes impossible as future outcomes are not known or unknowable. Sutcliffe (2011) stresses the singular focus on

knowledge of potential negative impacts of innovation, since it may close off certain innovation pathways, but simultaneously may close of potentially useful innovations before their potential can be understood. Likewise the consideration of positive impacts of technology, for example renewable energy, might enable path dependencies with unknown future consequences. Therefore, anticipation requires a holistic view of innovation impacts (Sutcliffe, 2011).

Environmental aspects of innovation are largely focused towards meeting growing concerns such as climate change, resource efficiency and the availability of raw material (Kupper et al., 2015; Sutcliffe, 2011). Sutcliffe (2011) denotes that "*The ultimate gain of new technologies, to provide socially or environmentally beneficial solutions to intractable problems and drive the growth of European economies*" (p.7). Consequently, impacts can encompass economic effects as well.

2.1.2 Definition of desirable outcomes of innovation

Not only is it important to identify potential negative consequences of innovation, but it is also important to identify desirable outcomes as well (Fraaije & Flipse, 2020). Lubberink et al. (2017) propose that anticipation consists of two different key steps. The first step includes the engagement of stakeholders in a process to gain a shared understanding of innovation context (social- and market trends, technical development, rules and regulations).

The second step of anticipation consists of engaging of stakeholders in activities that enhance their vision of the future and make them align with their decision making processes for innovation. Part of these activities that enhance future vision are aimed towards understanding the social need of the problem addressed. Predefining socially desirable outcomes acts a supporting mechanism towards reflexivity and inclusion as it is aimed at the attempt to translate values to plausible visions of impact (Kupper et al., 2015; Stilgoe et al., 2013). Rose (2014) reveals the overall relationship between anticipation, reflexivity and transparency. Anticipation helps reflect and lay bare the motivations of projects as well as their implications. Furthermore, an anticipatory mind-set helps in identifying uncertainties of assumptions and limitations of current knowledge. Consequently, it helps define and communicate technology visions towards the public.

2.1.3 Identification of alternative pathways for innovation

Keeping an eye on alternatives for innovation transitions is also important to RRI practices. The exploration of other innovation pathways and their potential impacts and consequently allows us to 'explore promissory narratives' (Owen et al., 2012) in order to understand and identify new opportunities. Identifying alternative pathways for innovation requires a deep understanding of how present innovation processes shape technological futures (Kupper et al., 2015). Sutcliffe (2011) argues that RRI is necessary to maintain an open mind and not fall into the quick-fix mentality, which threatens to close future innovation pathways, by motivating goal and use. Some pathways could present us with unforeseen benefits down the line. RRI helps in that regard to reduce competency lock in by exploring and sharing innovation futures (Chadha, 2011).

2.1.4 Timing of anticipation

Anticipation is inherently a process that takes place at an early stage to explore positive impacts on society and avoid negative ones (Harsanto et al., 2020). In this definition the timing of anticipation is relevant. Stilgoe et al. (2013) describe the necessity of anticipatory processes to be as early as to still allowing for the ability to adapt innovation, but late enough such that we can distinguish a difference in impact. As timing is contextually sensitive, anticipatory activities ought to be repeated throughout

the innovation process (Wickson & Carew, 2014). Innovation can be considered a social experiment and therefore continuous anticipation is required (Jenkins et al., 2020). Burget et al. (2017) and Owen et al. (2012) add that identifying impacts and uncertainties early-on is impertinent to dealing with negative societal impacts, ensuring a sense of "co-responsibility".

2.2 Responsiveness

Responsiveness is often considered a core feature of responsible decision-making in RRI (Fraaije & Flipse, 2020) in order to deal with situations "*Where it is not possible or feasible to anticipate or prevent the negative social, ethical or environmental consequences of innovation"* (Sutcliffe, 2011, p. 16). Often responsiveness is related to care, which encompasses an attitude of responsibility towards technological futures (Jenkins et al., 2020). Owen et al. 2012 and Pellé (2016) argue that responsibility is an attitude one must foster, a 'virtue' and not an instrument towards attaining outcomes.

Responsiveness refers to an inclination for changing direction when societal needs or perspectives shift (Pellizzoni, 2004) and awareness of insufficient knowledge and a lack control (Stilgoe et al., 2013). Responsiveness is rather proactive than reactive in this regard (Harsanto et al., 2020) as it entails the active alignment of societal needs (Rose, 2014) and company interests (Lubberink et al., 2017). Lubberink et al. (2017) denote that the act of responsiveness comprises two important elements. Firstly, it requires companies to become aware of new information that would require the adjustment of innovation. Secondly, stakeholders in the innovation process is the need for response to these new insights and make changes in order to actually be responsive. From these two elements three characteristics of responsiveness can be discerned.

2.1.1 Adoption of societal and ethical perspectives

RRI is focused around incorporating societal and ethical considerations in order to shape a shared understanding of appropriate behaviours of stakeholders involved in innovation processes, like governments, companies and NGOs. The ultimate goal is to create trust trustworthy processes. (Sutcliffe, 2011).

2.1.2 Adaptation to contextual change

Societal needs and expectations evolve over time and it's therefore important for governments and businesses to be receptive towards change (Fraaije & Flipse, 2020). This poses a challenge in an ever complex environment where innovation can outpace the development of regulation or could have unforeseen consequences not known at present. Carefully defining an adaptive strategy to better deal with division of responsibilities and accountabilities is important to deal with incentives for effective governance of innovation (Kupper et al., 2015; Sutcliffe, 2011), and prevent 'organised irresponsibility' (Beck, 1992). Similarly, Burget et al. (2017) characterise responsiveness as the management of risk. Two steps can be identified in response to new innovation and the management of contextual change. Firstly, an apt response strategy is in order to deal with short, medium and long term effects. Secondly, a risk assessment based on scenario's (Stilgoe et al., 2013).

2.1.3 Substantive response mechanism

To face ever changing contextual changes in values, norms, perspectives and knowledge responses ought to be meaningful (Fraaije & Flipse, 2020). Substantive response mechanisms stimulate ways to

incorporate feedback and evaluate strategies in a meaningful way (Kupper et al., 2015; Wickson & Carew, 2014).

2.1.4 Predefinition of roles and responsibilities

Wickson & Carew (2014) describe responsiveness as the communication of responsibilities, delegation of activities and ownership of consequences in order to increase honesty and trust in the innovation process. Willingness of stakeholders to learn and adapt to new insights, as well as filling different roles, are important characteristics for successful innovation processes (Lubberink et al., 2017). Responsiveness enhances the alignment of stakeholder interests as it enables them to *"…appraise the progress toward their own goals and the shared purpose of the partnership*." (Le Ber & Branzei, 2010, p. 145).

2.3 Inclusion

The goal of RRI is to meet societal expectations of innovation, therefore the aim of RRI processes is to reflect the broad character of society by means of engaging differing stakeholders (Fraaije & Flipse, 2020). It can help identify risks and help define new avenues for socially desired outcomes (Sutcliffe, 2011). Owen et al. (2012) argue from a normative standpoint that innovation has a certain 'moral obligation' for public engagement. Stahl (2013) recognises that research and innovation have a way of impacting a wide variety of stakeholders, who should be included in the process. RRI can in this case support stakeholders by identifying, exploring and understanding of technology development, as opposed to a purely 'expert driven process' (Ribeiro et al., 2017).

Another argument for inclusion is instrumental in nature. Sutcliffe (2011) and Jenkins et al. (2020) argue that inclusion can add a layer of transparency for decision-making and accountability for the decision-makers.

This necessitates involving stakeholders early and throughout the innovation process. Additionally, some researchers distinguish between the element of inclusion and deliberation. They define inclusion as stakeholder engagement: the process on who, how and when do stakeholders participate in RRI processes. The second part pertains to the question on how to keep stakeholders committed throughout the process (Lubberink et al., 2017).

2.3.1 Diversity of participation

Diversity of input is essential in meeting complex innovation challenges. Inclusion of a diverse and wide ranging set of actors can help build public acceptance and support of technological choice.

Since stakeholders are often included for the sake of solving knowledge related problems to innovation, referring to knowledge experts (universities, consultants) can be fruitful in obtaining common knowledge base (Lubberink et al., 2017).

Adding a sense of confidence to public parties, NGOs, governments and citizens is essential for the success of innovation. Correljé et al. (2015) posit that innovations are context specific, therefore involving people relevant to this context is considered a core element of diversity.

Lastly diversity can also mean multi-disciplinary. Some researchers have stated that including actors from different disciplines could enhance the effect of self-learning and critical reflection (Fraaije & Flipse, 2020; Wickson & Carew, 2014).

2.3.2 Empowerment of stakeholders

Participants need to be empowered to make meaningful contributions (Stilgoe et al., 2013). Lubberink et al. (2017) indicate that this can be done by providing decision-making power, as well as a means to voice concerns for process or outcomes. Framing issues collectively adds to inclusion in that it can reveal a broad spectrum of issues and enable to take collective "stewardship of innovation" (Stilgoe et al., 2013).

Kupper et al. (2015) state that empowerment can add a sense of commitment if stakeholders are able to participate from the outset in defining tools and methodologies to tackle issues.

Participants of RRI processes need to feel free to express themselves and have their voices heard. Empowering participants has the ability to break incumbent power dynamics and create a more level playing field (Fraaije & Flipse, 2020). In some case the willingness to share collides with existing power structure resulting from information asymmetries (de Bakker et al., 2014). de Bakker et al. (2014) propose safe discussion arenas or 'closed' spaces, characterised by confidentiality, which can paradoxically lead to more transparency as participants are more likely to share.

Consequently, this enables participants to make meaningful contributions and be a driving force for learning effects. This does mean that participants require active support from researchers to help them make meaningful contributions in fields of science and policy (Kupper et al., 2015).

2.3.3 Timing of involvement

An element of involvement is the intensity of stakeholder engagement. Stilgoe et al. (2013) define intensity as how early and how often stakeholders are involved in development and decision-making of innovation. Including participants from the outset, gives processes the chance meaningfully gain from its results (Kupper et al., 2015). Moreover, it gives certain development trajectories more freedom in changing direction, when a change of course is deemed necessary.

2.3.4 Learning through feedback

Outcomes of decision making must result in clear feedback on input from stakeholders. There must be a mechanism that shows how contributions had an impact on results and decisions (de Saille, 2015). Learning from the experiences of de Saille (2015), a feedback mechanism is required to ensure that participant concerns are considered, instead of simply giving a false sense of legitimacy.

Ultimately inclusion constitutes a learning process through which people can express interests and views. The primary objective is not to convince others of certain insight or values but to encourage the process of mutual learning (Wickson & Carew, 2014).

2.4 Reflexivity

Reflexivity is considered, by Burget et al. (2017), a conceptual dimension aimed at the reflection of values, beliefs and assumptions during research and development. This dimension encompasses the understanding of effects that values and motivations have on decision-making and outcomes. Values and motivations become more used and impactful when decision with regards to the future are made

or when uncertain options are present (Larson, 2000). Harsanto et al. (2020) include canvassing the limitations of knowledge to the reflexive process.

2.4.1 Recognising drivers

The first part of reflexivity is the cognition of motivations and interests that fuel assumptions in order to understand them. Fraaije & Flipse (2020) indicate that scientific norms have an indirect impact on decision making and that therefore methodologies and underlying research assumptions are considered. Reflexive processes consider the context of the organisational structure, since they have a profound impact on organisational culture. In short the institutional context in which decision-making takes place needs to be identified as well as the contextual limitations (Wickson & Carew, 2014).

Secondly, it is important to distinguish between first order and second order reflexivity. First order reflexivity encompasses activities, judgements, motivations, assumptions, limits of knowledge 'within the research system' (Schuurbiers, 2011). These elements are generally tied to the role of the stakeholder as representative of their organisation. Second order reflexivity considers the underlying values in decision making processes, innovation and theories (Schuurbiers, 2011). These can be considered personal motivations, values and beliefs.

2.4.2 Challenging drivers

A secondary element to reflexivity is not only to reflect on personal, scientific and institutional values, but also to challenge them in order to improve the critical attitude necessary to facilitate responsible innovation (Wickson & Carew, 2014). Burget et al. (2017) argue that inclusion is therefore instrumental toward reflexivity as involving public parties can help researchers reflect on ethical and other more societal considerations in their work.

Lubberink et al. (2017) argue that not only values and motivations should be scrutinised. They envision also a critical reflection on the presence absence and subjectivity of information. This includes an assessment of knowledge and abilities of stakeholders (Lubberink et al., 2017), and the identification of tensions between economic considerations and views societal desirability of research and innovation (Nazarko, 2019).

2.4.3 Understanding the impact of drivers

The third element of reflexivity calls for an evaluation of actions by stakeholders and whether they help in achieving the desired outcomes of innovation. This evaluation phase encompasses the motivation and elements of the innovation, in order to make sure the right metrics are taken into account to evaluate impact.

This element of reflexivity has similarities to anticipation as it includes a reflection of our understanding of how products, services and processes shape our society (Fraaije & Flipse, 2020). Part of the reflexive process is therefore attributed to understanding the impact of products services and processes on our society. Fraaije & Flipse (2020) distinguish the process of gaining 'understanding' between anticipation and reflexivity such is that anticipation is more focused on identification of impacts of the innovation, while reflexivity is more focused on understanding the impact of drivers on decision-making.

2.5 Transparency

Originally transparency is not considered directly when discussing the topic of RRI, since it doesn't stem from the original four process dimensions discussed in the seminal work of Stilgoe et al. (2013). However von Schomberg's (2011) original definition of RRI does include transparency as a core concept. Transparency plays a supportive role by clarifying and justifying assessment criteria, distribution of responsibilities and arguments for decision making (Fraaije & Flipse, 2020). Transparency acts as a safeguard to facilitate meaningful dialogue in the process of inclusion and create trust between stakeholders (Kupper et al., 2015). Moreover, transparency supports reflexivity of process since it requires stakeholder to reveal arguments for their decisions (Fraaije & Flipse, 2020). Hence, transparency be considered a core dimension in RRI.

2.5.1 Role of Information

Firstly the role of information must be presented towards stakeholders in the process, where objectives, goals, interests and methodology are (honestly) declared (Fraaije & Flipse, 2020). Furthermore, the decision-making criteria underlying choices made must be clear from the outset

2.5.2 Role of stakeholders

This part of the transparent process aims to make clear what is expected of stakeholders, which part they are involved in and to what extent they can influence decision-making. Furthermore it includes a feedback mechanism for stakeholders to explore the link between their input and the results in order to make sure stakeholder input is valued (Fraaije & Flipse, 2020).

2.5.3 Definition of process results and limitations

Complete transparency about individual values, interests and motivations is not always possible. Limitations are therefore part of the process, and are communicated to stakeholders. This also includes openness about uncertainties and a lack of knowledge (Kupper et al., 2015). Furthermore, transparency means clearly defining who benefits from the positive as well as the negative results of innovation (Kupper et al., 2015; Wickson & Carew, 2014).

Table 1; Synthesis of RRI criteria

Inclusion	
Diversity of participation	Diversity relates to involving actors relevant to the innovation context (Correljé et al., 2015). Diversity of participation means including actors from different disciplines (Fraaije & Flipse, 2020; Wickson & Carew, 2014). Diversity is also related to a sufficient amount of participants (Fraaije & Flipse, 2020).
Empowerment of stakeholders	Providing a decision-making power and the ability to exert influence on the process and outcomes of innovation (Lubberink et al., 2017).
Timing of involvement	How early and how often stakeholders are involved in the development and decision-making of innovation (Stilgoe et al., 2013).
Consideration of feedback	Mechanism that show how stakeholder contributions have an impact on results and decisions (de Saille, 2015).
Anticipation	
Identification of impacts	Gaining awareness of potential unforeseen environmental, economic and social consequences of innovation (Lubberink et al., 2017; Sutcliffe, 2011).
Predefining societal desirability	Enhancing desirable visions of the future and aligning them with decision-making processes for innovation (Lubberink et al., 2017).
Identification of alternative pathways for innovation	Reducing competency lock in by exploring and sharing innovation futures (Chadha, 2011).
Timing of anticipation	Identification impacts and uncertainties early in order to deal with (negative) societal impacts (Burget et al., 2017; Owen et al., 2012); continuous and repeated identification of potential consequences (Jenkins et al., 2020; Wickson & Carew, 2014).
Responsiveness	
Adoption of societal perspective	Shaping a shared understanding of appropriate behaviours of stakeholders involved in innovation processes. (Sutcliffe, 2011).
Adaptation to contextual change	Receptive toward changing societal needs and expectations (Fraaije & Flipse, 2020).
Substantive response mechanism	Evaluating strategies and incorporating feedback (Kupper et al., 2015; Wickson & Carew, 2014).
Reflexivity	
Recognising role specific drivers	Cognition of activities, judgements, motivations, assumptions (Schuurbiers, 2011); Canvassing the limitations of knowledge Harsanto et al. (2020) Cognition of scientific standards and methodologies (Fraaije & Flipse, 2020); Cognition of organisational culture and contextual limitations (Wickson & Carew, 2014).
Recognising personal drivers	Cognition of drivers, underlying values, that fuel assumptions and understanding them (Fraaije & Flipse, 2020);
Challenging drivers	Critical reflection on ethical- and other more societal considerations (Burget et al., 2017).
Understanding the impact of drivers	Understanding the impact of products services and processes on our society; making sure the right metrics are taken into account to evaluate impacts (Lubberink et al., 2017).
Transparency	
Role of information	Openness toward objectives, goals, interests and criteria underpinning the decision-making process as well as the procedures/methodology of the innovation process. (Fraaije & Flipse, 2020)
Role of stakeholders	Defining clear expectations for stakeholders, their roles and responsibilities (Wickson & Carew, 2014); Clear indication to what extent they can influence the innovation process (Fraaije & Flipse, 2020)
Defining process results and limitations	Openness toward limitations, uncertainties and a lack of knowledge (Kupper et al., 2015)

3. Standardisation and RRI

This chapter serves to bridge literature found in RRI dimensions with standardisation discourse. Section 3.1 will explore the relationship between standards and innovation. Section 3.2 will discuss the core qualities of standardisation processes with an emphasis on legitimacy. Lastly, in section 3.3 the relationship between RRI dimensions and the quality of standardisation processes will be explored.

3.1 Standardisation & Innovation

Innovation is a core concept in the conceptual definition of RRI (von Schomberg, 2011), which presents a major driving force for advancing and developing technology (Allen & Sriram, 2000; Tassey, 2000). To safeguard performance, safety and conformity to rules and regulations, standards have emerged as a requirement of many new products and processes. There exists a complex and dynamic dependency between standards and innovation (Allen & Sriram, 2000). This section will explore this relationship through a meaningful description of both activities and how they interact.

Standards

In the context of this research a 'standard' is considered a documented agreement that contains technical specificities to ensure that products, process and services are fit for purpose (Allen & Sriram, 2000). Standardisation can be described as a consensus-driven process developing requirements through stakeholder cooperation (Saltzman et al., 2008). Standards generally belong to four categories (Allen & Sriram, 2000).

Firstly standards can relate to processes or activities, specifying for example a consistent and reproducible methodology for testing certain products, services and processes (Allen & Sriram, 2000) through specification of quantities and units (De Vries & Verhagen, 2016). Secondly standards can relate to performance, also called performance standards (De Vries & Verhagen, 2016). Herein the performance of processes, products or services are specified (Allen & Sriram, 2000). Interoperability standards between systems is a third type of standard. It specifies the interaction between different interfaces, through the use of a common format, to ensure smooth operation using data or other means. Lastly, standards can relate to fundamental modes of measure, for example the metric system. These standards define solution for measuring enabling the ability to evaluate and compare function, price or other features of products and processes (Allen & Sriram, 2000; De Vries & Verhagen, 2016).

Blind & Mangelsdorf (2016) have investigated the motives for parties to collaborate in the context of standardisation. A prominent reason to join coalitions is to define technical specification as a way to avoid regulatory involvement by anticipating regulation (Blind & Mangelsdorf, 2016). Secondly, ensuring company interests are included is of great import to companies in order to avoid conflicts between standards and own interests.

Thirdly, it is interesting from a knowledge perspective, since strategic alliances are source for knowledge acquisition (Blind & Mangelsdorf, 2016). Their reasoning is to get ahead and keep track of competition simultaneously. Knowledge acquisition enables parties to gain access or establish new markets, through compatibility and complementary goods (Blind & Mangelsdorf, 2016). Sometimes knowledge acquisitions only relates to solving technical solutions and challenges, which can be company specific but can also be industry wide.

However it remains difficult to meet the needs for standardisation in case of emerging technologies (Featherston et al., 2016). Standardisation processes can be highly dynamic and complex due to requirements of technical expertise and the need for consensus (Featherston et al., 2016; Wickson & Forsberg, 2015). These elements challenge the role of information, which is generally distributed asymmetrically between stakeholders (Allen & Sriram, 2000; Tassey, 2000).

Innovation

Innovation can be described as a new product, service or process that is distinguishable by "uniqueness in form, function, or behaviour" (Allen & Sriram, 2000, p. 174) from previous versions. Wang et al. (2016) describe innovation as the activity of developing new products and processes through adoption, integration and implementation of new knowledge and technologies. Innovation is a tool for manufacturers to respond to new customer needs, which is vital for market competitiveness. (Manu & Sriram, 1996). Innovation is, however, more than an invention, as innovation requires commercialisation (De Vries & Verhagen, 2016).

When discussing innovation, a classic distinction is made between incremental and radical innovation (Dunphy et al., 1996; Henderson & Clark, 1990). Incremental innovation constitute small changes made by companies on "based on the firm's current technical capabilities" (Manders et al., 2016, p. 42), driven by basic or latent societal needs (Rothwell & Wissema, 1986). Radical innovation occur when companies challenge their organisational competence and technical trajectory (Manders et al., 2016) resulting in products, services or processes without a prior need (Dunphy et al., 1996).

Standards as social innovations

The common definition of innovation offered by RRI stems from an economic paradigm, with a utilitarian vision on social responsibility at its core (Blok & Lemmens, 2015). Martin (2013) suggests that, over recent decades, most innovation studies have focused more on radical products and process innovations, rather than more subtle incremental innovations. Even though RRI presents an attempt to move away from more risky forms of innovation (Martin, 2013), it can be argued that innovation from a RRI perspective is still conceptually ambiguous (Jenkins et al., 2020). Martin (2013) argues that some forms of innovation remain invisible, for example organisational innovations. Similarly, the financial crisis of 2008, which was eye opening to policy makers to "discuss, challenge and rethink linear models of science and innovation policy" (Owen et al., 2012, p. 752), was the product of changes in regulatory framework. These organisational and regulative innovations can be considered institutional innovations.

Social or institutional innovation present a more broad perspective on the concept of innovation. Institutional innovations are a social (interactive) process involving multiple actors for the creative transformation of knowledge or learning (Edwards-schachter & Wallace, 2017). Standards as such, present an institutionalisation of these social processes and can therefore be considered (institutional) innovations.

Standards and their effect on innovation

Standards have the ability to influence economic efficiency (Tassey, 2000). Though in the discourse on standardisation there is no consensus whether they contribute positively or negatively. ISO 9001 the leading certification on quality management is an example of the contradictory role standards can play on product innovation (Manders et al., 2016).

The first view argues that standards might pose a hindrance toward new break-through ideas, as standards are aimed at reducing uncertainty through uniformity and continuity and similarity of products and services (Thompson, 1965). Standards can negatively affect economic efficiency as a result of lock in effects (Arthur, 1989) as they promote older and obsolete technology in favour of superior new technology (Farrell & Saloner, 1985).

However, more recently, researchers are attributing a more positive role for standards in innovation. Funk & Luo, (2015) for example have found that standards can stimulate knowledge distribution by developing clear methodologies and language, which facilitates the creation and adaption of new technologies. Wang et al. (2016) also conclude through empirical research that standardisation has a significant and positive impact on innovation through dissemination of information. Standards help companies to adjust manufacturing processes and supply chains in response to changing end-user needs. Standards enable manufacturers to systematically formalise experience and knowledge (Wang et al., 2016).

Standards created by Standards Development Organisations (SDOs) through participation have shown to have a positive affect the formation of new patents (Tamura, 2016). Vice versa, the formation of new patents and public patents have a significant effect on participation in standardisation activities (Zi & Blind, 2015). De Vries & Verhagen (2016) argue that standards impact the innovativeness of a sector as a whole, as standards can spur multiple innovations. Measurement standards are enablers of diffusion of innovation, especially when the standards are obligatory.

Constructivist view on standards

Standards are predominantly discussed from a functionalist perspective in relation to the respective technology or innovation they accompany through their lifecycle (Blind & Gauch, 2009; Egyedi & Sherif, 2010) from market entry to market saturation.

However the functionalist view is limited as it only describes standards as a tool to reduce uncertainty, which is generally “weak on explaining empirical variance between fields with similar coordination benefits and actor constellations” (Botzem & Dobusch, 2012, p. 740). Botzem & Dobusch (2012) argue that this view largely neglects the organisational and cultural aspects of these ‘social negotiations’. The constructivist view states that inherent power differentials and lack of authority of standards require more emphasis on core qualities of standardisation process. Botzem & Dobusch (2012) purport there is a recursive relationship between standard creation and adoption processes based on their perceived legitimacy.

In the next section the concept of legitimacy will be introduced as a core quality of standardisation processes.

3. 2 Standardisation and legitimacy

In the discourse on formal standardisation, a key topic of research has been the legitimacy of standardisation processes (Botzem & Dobusch, 2012; Forsberg, 2012; Timmermans & Epstein, 2010; Wickson & Forsberg, 2015). Legitimacy is an important quality aspect of standardisation processes, since they lack formal authority and rely on 'self-selection' of knowledge, participants and governance structure (Timmermans & Epstein, 2010). Subsequently, legitimacy is essential to the adoption of standards and therefore increases credibility and safeguards the continuity of SDOs (Botzem & Dobusch, 2012). Discussing the importance of legitimacy is important in understanding how RRI process dimensions affect the quality of standardisation processes. In section 3.2, the core elements of legitimacy will be explored. Section 3.3 RRI dimensions and their relationship to legitimacy will be discussed in the context of standardisation processes.

A common definition of legitimacy is provided by Franck (1999), who defines legitimacy as *"*the aspect of governance that validates institutional decisions as emanating from right process*"* (p.1). Legitimacy constitutes a degree of desirability, properness and appropriateness, it therefore signals that standards are the product of right process (Botzem & Dobusch, 2012).

Input legitimacy

Forsberg (2012) recognises legitimacy as consisting of three core elements. Firstly, legitimacy constitutes 'input legitimacy', also called 'process legitimacy '(Hoel & Hollins, 2008), which relates to participation and engagement of stakeholders. Input legitimacy concerns the democratic elements of inclusion which represent a moral legitimacy (Suchman, 1995). This is especially important in the context of invisible ends, when showing good faith in the process is more feasible than 'right outcomes' (Suchman, 1995).

Standards, which have no inherent authority, rely on their rate of adoption or success and thus on a sense of moral legitimacy (Botzem & Dobusch, 2012). Input legitimacy relates to the structural characteristic in which decisions are made, which can be considered as morally acceptable through its democratic elements and consensus decision-making (Forsberg, 2012).

Werle & Iversen (2006) add that the 'openness' of input legitimacy exceeds parties of direct interest, but also encompasses stakeholders that could potentially be affected by the standard. Ideally this would constitute direct participation and proportional distribution of participants, however this is not always desirable or feasible (Werle & Iversen, 2006).

Throughput legitimacy

Secondly, legitimacy constitutes 'throughput legitimacy' (Forsberg, 2012). This is related to the design of standardisation processes (Forsberg, 2012). A key focus lies on the transparency of the process design. Transparency can also be described as a form of moral legitimacy, facilitating socially desirable and acceptable procedures (Suchman, 1995). However it can also add cognitive legitimacy, which is related to the comprehensibility of standardisation processes. Transparency not only means openness about how decision making is organised, but also means making the activities and behaviour more understandable, predictable and therefore more meaningful and inviting (Suchman, 1995).

Throughput legitimacy concerns the accessibility of information (reports, argumentations, analysis, and participant commentaries as well as suggestions) as well as a clear mechanism of quality control and decision making.

Output legitimacy

Lastly Forsberg (2012) describes 'output legitimacy' or 'product legitimacy' (Hoel & Hollins, 2008) as a way to define the legitimacy of a product process or service, with a focus on the outcomes of standards development. Output legitimacy indicates the capacity in which standards meet the expectations of end-users (Botzem & Dobusch, 2012).

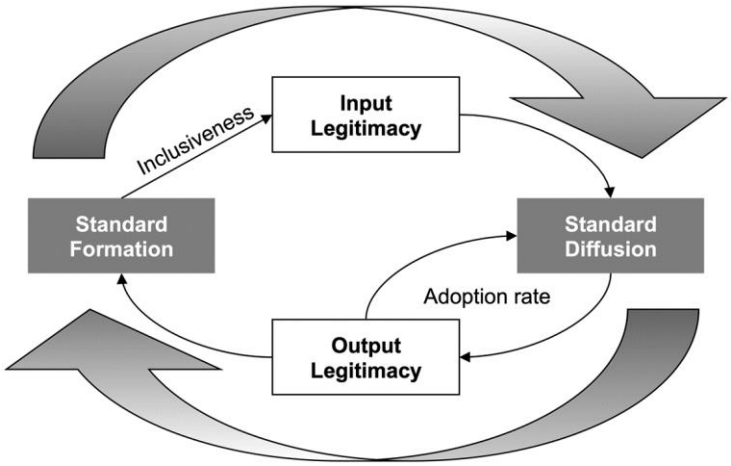
Since standards are ultimately aimed at adoption (Forsberg, 2012), broad support is required through this pragmatic form of legitimacy. Suchman (1995) defines pragmatic legitimacy as an instrumental form of legitimacy obtained through the exchange of support between supporters of, for example standards and the SDO.

The quality of a standard or its scientific robustness are often described as forms of output or product legitimacy (Forsberg, 2012). Scientific robustness concerns the scientific legitimacy of standards in light of uncertainty and diversity of knowledge (Forsberg, 2012). Forsberg (2012) concludes that the scientific robustness is directly related to the quality or comprehensiveness of internal discussions. This way standards hep in mitigating the lack of scientific consensus. Inclusion plays a pivotal role in scientific robustness, since it can enrich internal discussions. Werle & Iversen (2006) state that 'good standards' encompass more than just technical and commercial considerations, but also include socio-economic and socio-political views and interests.

Relation between input and output legitimacy

Botzem & Dobusch (2012) describe legitimacy not as an end state but as the product of a recursive relation between standard creation and diffusion. In the case of standardisation, standards are created through collaborative efforts and negotiations by means of inclusive arrangements. This creates a sense of input legitimacy which stimulates the diffusion and adoption of standards (Botzem & Dobusch, 2012; Forsberg, 2012; Wickson & Forsberg, 2015), see figure 3. The adoption of standards itself is related to output legitimacy, as adoption indicates that end-user expectations are met (Botzem & Dobusch, 2012). The feedback loop between standard diffusion and output legitimacy describes the network effects (David, 1985; Farrell & Saloner, 1985; Katz & Shapiro, 1985) affecting standard adoption (Botzem & Dobusch, 2012). The adoption rate of a standard influences its 'coordination power' which in turn stimulates the output legitimacy of a standard (Botzem & Dobusch, 2012). A higher output legitimacy increases the likelihood a standard will be diffused and adopted. Lastly a high adoption rate will increase the legitimacy of the standard formation process, which will stimulate the creation of new standards.

Figure 3; Relationship between output and input legitimacy



Note: Recursive cycle of transnational standardization. Reprinted from "Standardization Cycles: A Process Perspective on the Formation and Diffusion of Transnational Standards" by S.Botzem & L. Dobusch, 2012, *Organization Studies,* 33(5-6), p. 744. Copyright 2012 by Sebastian Botzem and Leonhard Dobusch. Reprinted with permission.

3.3 Standardisation and RRI

The process dimensions of RRI affect the quality of standardisation processes, since standardisation can be seen as an embodiment of collective responsibility, as proposed by Stilgoe et al. (2013). Collective responsibility represents the notion that singular individuals might not act irresponsible, however through complex and interconnected systems can cause irresponsible outcomes (Stilgoe et al., 2013). In essence, standards democratise 'the governance of intent' by identifying innovation in an inclusive manner (Owen et al., 2012). The previous section has argued a close relationship between legitimacy and responsibility. This section serves as discussion as to how the dimensions of RRI affect the quality of standardisation processes.

Inclusion

Since standards are aimed at adoption, inclusion is important in providing the necessary support for standards to succeed (Forsberg, 2012). Inclusion can therefore be considered a key quality of standardisation processes.

Standards are generally the product of multi-stakeholder deliberation, including NGO's and other public parties alongside private companies. This collaborative process possesses the innate ability to cross business boundaries (Inigo et al., 2020) as *"*leaving standardisation to industry players may lead to socially undesirable results." (p.150). Inclusion can create a more level playing field for standards by consideration/balancing of a more wide variety interests and opinions. Moreover inclusion can enforce the social contracting of standards through compliance mechanisms (Ponte & Chenys, 2013). Inclusion will deter participants from acting irresponsible since their own (input) legitimacy is at stake, i.e. their names are inadvertently connected to the outcome of the standard. These social contracts can therefore (partially) overcome power asymmetries between participants in standardisation (Giovannucci & Ponte, 2005).

At the international level inclusion is actively stimulated through codes of conduct (ISO, 2020). ISO for example embraces the concept of consensus building in its process for standards creation and stimulates the acceptance of decisions based on consensus.

Anticipation

The drafting of standards through multi-stakeholder engagement generally occur an early stage to define criteria of innovation. The anticipatory process of predefining criteria for standards enables standards to offset the risk of slower time to market as result of lengthy standards negotiations (Inigo et al., 2020). Furthermore, if criteria for standards are defined on a sector level there is a lower risk parties will break rank as the risk of reformulation increases. Companies that aim to break with standards or certifications under development, could face compliance issues later on if certification are adapted. In this sense anticipation is a means to increase the chance for successful collaboration and ultimately adoption of standards. Moreover, a formalised structure for anticipation can overcome the challenge of risk distribution, since impacts can be identified, negotiated and divided among participants (Inigo et al., 2020).

Anticipation can be found in the codes of conduct defined by ISO (2020), which indicate the necessity to "Work for the net benefit of the international community", (p. 5). Similarly, defining the scope, purpose and objectives are a necessary element for drafting standards.

Reflexivity

Reflexivity is necessary for standards creation, since the aim of consensus standards is the definition of social and ethical considerations in the innovation process (Inigo et al., 2020). This provides stakeholders a commonly defined benchmark to self-reflect their performance, which can enrich the internal discussion and increase output legitimacy. The process of recognising drivers is anchored in the consensus decision making process, where economic and socially desirable goals are explored. Reflexivity is stimulated in drafting procedures for standards, stipulating the rounds and iterations, ranging from submissions, voting and discussing suggestions (ISO/IEC, 2017). ISO/IEC (2017) standardisation procedures also enable stakeholders not represented in the committee to reflect and make suggestions toward working drafts through public commenting phases. Furthermore, reflection on interests and underlying motivations is stimulated through formalised feedback mechanisms, which enables learning effects. Considering other parties' motivations, values and expertise is a crucial step in the process of gaining "understanding" (Fraaije & Flipse, 2020).

Responsiveness

Standardisation is usually facilitated by SDOs through a formalised governance structure (ISO/IEC, 2017). Responsiveness actively stimulates this process of collective deliberation by predefining interaction, negotiation and decision-making in light of changing needs and expectations for standards. Formal stage-gates are an example of institutionalised responsiveness for standards, assisting the adaptation of standards and their time to market through clear certification and compliance setting (Inigo et al., 2020). Responsiveness toward new insights, needs and expectations for standards generates output legitimacy, since they indicate the capacity in which standards meet the expectations of end-users (Botzem & Dobusch, 2012).

Transparency

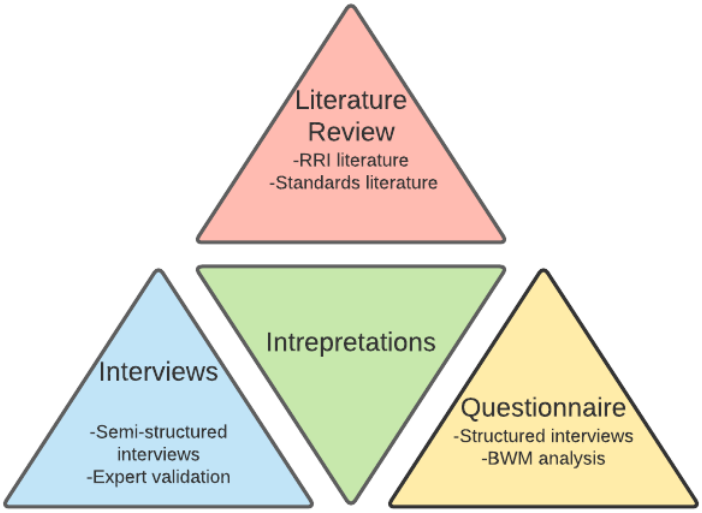
Transparency safeguards the quality of standardisation by reporting directly to consumers about product characteristics. A good example of this reporting mechanism are so called front-of-pack (Fop) labels, which “allow producers to communicate their certification to consumers and show their awareness and responsiveness towards particular socio-ethical issues” (Inigo et al., 2020, p. 146). In other words transparency the procedural legitimacy of standardisation processes as suggested by Botzem & Dobusch (2012). Transparency is essential toward standardisation, since it directly affects the trust parties have in a process characterised by a lack of formal authority and self-organisation (Botzem & Dobusch, 2012). For example, the ISO/IEC (2017) directive is largely dedicated toward a readable and understandable document to safeguard the transparency of decision-making, feedback mechanisms and procedures.

4. Methodology

This chapter serves as a discussion of the general research methodology that was used for collecting and analysing the data. Data was collected through mixed methods, consisting of both qualitative data and quantitative data. A mixed method research allows for triangulation, which is generally used to cross validate the results of the data, collected through a variety of methods (Kaplan & Duchon, 1988). In this research, triangulation is mainly used to capture the practical and theoretical aspects of RRI in standardisation context to help interpret the final results, see figure 4.

Section 4.1 will start with defining the overarching goal, objectives and questions of this research. In section 4.2 will the exploratory interviews used to bridge the gap between the RRI literature and the practical context of standardisation will be discussed. Section 4.3 will address the questionnaire that was used to explore the importance of RRI dimensions through structured-interviews. In section 4.4 the data collected from the questionnaire will serve as input for the Best-Worst Method, which is typically used to explore the relative ranking of certain actor preferences from a set of criteria. Subsequently the results will be tested in section 4.5 on convergence and be subjected to expert review.

Figure 4; Triangulation method



4.1 Research outline

The goal of this research is to explore the relative importance of typical RRI criteria in standard development processes, since it is not clear if the concepts of RRI are important to organisations (Stahl et al., 2017).

Since the research is aimed at exploring the perceived importance of RRI concepts on the quality of standardisation processes, there is a need for a clear definition of ‘quality’. In the next section the exploratory interviews are discussed that were used to define a clear and concise definition.

NEN was identified and chosen for research into SDOs in general, since they realistically represent the only SDO in the Netherlands. Furthermore, as the official National Standards Body (NSB), NEN presents an integrated organisation representing the interests of the Dutch Electro technical Committee and

the Dutch Standardisation Committee as an official member of ISO. Consequently, NEN has exclusive experience in both national and international standardisation context and therefore has key expertise (Shanteau et al., 2002), needed for answering the main question of this research. Another benefit for conducting research at NEN exclusively is the transferability of research findings due to consistency of the standardisation activities. NEN presents an integrated organisation in Dutch standardisation, which uses a fairly homogenous formal process for standards creation. Other standards creation bodies, like professional organisations and trade associations, were excluded.

During the research, a number of NEN standardisation experts were contacted for the purpose of conducting semi-structured interviews, a questionnaire and an expert review. These experts were identified beforehand through referral or 'social acclamation' (Shanteau et al., 2002) by an internal standards innovation coordinator. The selection of the experts by referral was based on purposeful sampling (DiCicco-Bloom & Crabtree, 2006). The experts share the similarity that they are directly involved in the creation of standards and have had at least 5 years of experience at NEN. Similarly they also have experience in the foreign standardisation context. Since the selection process of experts was non-probabilistic, a smaller sample size sufficed for the 'transferability' of findings (Saunders, 2012).

All data collection, analysis and storage are subject to a data management plan that has been approved by the TUDelft human resource ethics committee.

4.2 Exploratory interviews

In this section the goal and scope of the exploratory interviews as well as the choice of interviewing method are expanded upon to outline the process of interviewing NEN standardisation experts.

Firstly, the aim of these interviews is to deepen the understanding of values and goals from the perspective of SDOs, to understand their role and activities in relationship to the concept of RRI. Secondly, the aim is to gain a better understanding of the process dimensions defined by Stilgoe et al. (2013) and their relation to formal standardisation discourse. The third and final goal of these interviews, is to explore a concise and comprehensive definition for the quality of standardisation processes. This is important as the quality of standardisation is directly relevant towards answering the main question of this research. Three semi-structured interviews with NEN standardisation experts were scheduled ahead of time and conducted in order to explore the relation between RRI and standardisation, with a duration ranging from 40-60 minutes. The experts have held long term positions within both national and international SDO's and are currently employed by NEN in different sectors. Two experts are active in the agriculture, food and sustainability sector. The third expert is active in public key infrastructures.

Interviews are part of the qualitative research methodology and present the most common form of data collection (Jamshed, 2014). They present a structured approach to record, achieve and challenge notions of important issues from a researcher's perspective. Though structure of interviews can vary depending on the intent of the research, ranging from unstructured and semi-structured to in-depth (Mason, 1994).

In this research the semi-structured method is chosen as the approach to delve into concepts relating to Responsible Research and Innovation in the context of standardisation. Semi-structured interviews are generally based on a series of open-ended questions (DiCicco-Bloom & Crabtree, 2006) through a semi-structured interview guide (Jamshed, 2014). An interview guide was used to explore relevant

topics comprehensively and to maintain direction during the interviews, see appendix B. The questions were unbiased, follow-up questions were used to move through the relevant concepts.

In order to capture the insights offered interviews were recorded and subsequently transcribed, since hand written notes can be unreliable as key talking points might be missed (Jamshed, 2014). It also enabled a stronger focus on the content and ability to navigate certain topics as well as the ability to produce a reliable transcription of the conversation. Interviewees consented toward the use of a recorder during the interview. The transcriptions can be found in appendix C.

Thematic analysis

The semi-structured interviews were subjected to a thematic analysis in order to systematically identify, select and review certain themes in the transcripts. The thematic analysis was used to find a clear and concise definition for quality elements of standardisation processes. Furthermore themes were used to define the five process dimensions from RRI literature in the context of standards creation. Subsequently the themes were used to validate and discuss the results from the BWM analysis in chapter 5.

Thematic analysis is a widely used method to analyse data from semi-structured interviews by identifying certain themes through an iterative process of reading and re-reading transcripts or other forms of collected data (Evans, 2018). The thematic analysis of this research consists of four steps:

- **Step 1:** Transcription of the semi-structured interviews.
- **Step 2:** Preliminary coding of initial read-through with regards to the RRI process dimensions
- **Step 3:** Review of the themes in relation to RRI process dimensions
- **Step 4:** Definition of themes for quality of standardisation

The results of the thematic analysis can be found in appendix D, where colour coding of the text indicates section belonging to a certain theme.

4.3 Questionnaires

In order to assess the relative importance of RRI dimensions on the quality of standardisation processes, a closed format was used for administering the questionnaire. A closed format relates to a fixed set of response options for the respondents. Furthermore a closed format, or forced choice format (Leung, 2001), presents a more accessible method of acquiring information on the effect of RRI dimensions on standardisation, since RRI remains a underdeveloped field of research in relation to standardisation (Wickson & Forsberg, 2015). Consequently, a closed format is also required for codification and recording of information for analysis through a Best-Worst method.

Questionnaires belong to the area of survey research, which are aimed at gathering data about characteristics, beliefs, attitudes or behaviours of a generalised research group through a standardised set of questions posed by means of sampling (Boynton & Greenhalgh, 2004; Leung, 2001; Mclafferty, 2010). Questionnaires are generally highly structured and present an efficient way to collect information for both qualitative and quantitative data analysis (Leung, 2001). Questionnaires are particularly useful for exploring complex social interactions and behaviours (Mclafferty, 2010).

The questionnaire was conducted through a series of face-to-face interviews. Face-to-face interviews present the most common and a flexible way of administering questionnaires (Mclafferty, 2010). It

allows this questionnaire to deal with ambiguity of interpretations of RRI dimensions by assisting the respondent if clarification is needed (Leung, 2001). This way longer and more complex questions can be asked (Mclafferty, 2010). Furthermore face-to-face allow for personal contact ensuring a higher rate of response (Mclafferty, 2010).

Saunders (2012) suggests that the number of participants necessary for a face-to-face structured interview would range from 5-25. A total of 9 experts in the field of standardisation were contacted to whom a series of fixed questions were asked.

The responses are presented on a Likert scale paired with quantitative labelling, see appendix E for the questionnaire. The Likert scale is ordinal in nature and ranges 1-9, where quantitative labels indicate in order in increasing importance from 1 (equally important) to 9 (much more important). Preston & Colman (2000) found that the 9 point scale has a high score on test-retest reliability and has a high level of validity. Moreover, there is a strong argument for using 9 point scales or less for their the ease of use (Preston & Colman, 2000). Lastly, Colman et al. (1997) have found that odd numbered scales enable respondents to select a neutral middle option, which is important if respondents are ambivalent towards the answers provided and enables them to avoid taking sides.

The questions were presented without a 'No-Opinion' (NO) option. Typically, NO options are added to questionnaires, since some questions might be susceptible to an acquiescence response bias (Lau & Kennedy, 2019). Response bias relates to respondents endorsing implicit more agreeable norms reflected through the questions regardless of the substance of the questions. However, in this case a NO option is not included, since forced-choice questions can have an increased rate of endorsement, which is often related to higher degree of salience (Smyth et al., 2006). If respondents must answer a question, they are encouraged to make an effort and enhance the cognitive process. This results in more meaningful answers, since the questions asked require a thoughtful response.

Moreover Krosnick (1999) argues that a NO option might increase the risk of satisficing. A NO option might discourage respondents from making truly meaningful statements, since they can avoid the cognitive process altogether. Task difficulty and low motivation (time, energy or other) are the reason for respondents to satisfice.

In this questionnaire respondents are asked about their opinion on complex RRI concepts and their impact on standardisation processes. Since the task difficulty of these questions is relatively high, a NO option would not necessarily enhance the reliability of the questionnaire (Krosnick, 1999). Furthermore a NO option could also have adverse effect on response bias, since respondents that are asked for an opinion "may not wish to appear uninformed and may therefore give an arbitrary answer" (Krosnick, 1999, p. 557).

4.4 BWM method

The input from the face-to-face questionnaires were analysed by using a ranking method called the best-worst method. The BWM is a multi-criteria decision-making (MCDM) tool that can be used to obtain a ranking of relevant decision making criteria by making pairwise comparisons of their respective weights. The linear BWM has been developed by Rezaei (2015; 2016) and is known for its simplicity and reliability. It requires fewer comparisons, while attaining a higher level of consistency than other pairwise comparison (Liang et al., 2020). BWM has seen a lot of use as a tool to address problems ranging from selection of thermochemical biomass conversion technologies (van de Kaa et al., 2017), environmental evaluation of airports (Kumar et al., 2020), quality assessment of airline baggage handling (Rezaei et al., 2018) and evaluation of offshore outsourcing initiatives (Yadav et al., 2018).

$$A = \begin{array}{c} \\ a_1 \\ a_2 \\ \vdots \\ a_m \end{array} \begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{pmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & p_{mn} \end{pmatrix} \end{array} \quad (1)$$

A typical MCDM problem be defined as can be seen above (1). A feasible set of alternatives are denoted by $\{a_1, a_2,\ldots a_m\}$, which are subject to a subset of criterions denoted by $\{c_1, c_2,\ldots c_n\}$. The performance of alternative a_i on criterion c_j is denoted by p_{ij}.

$$V_i = \sum_{j=1}^{n} w_j p_{ij} \quad (2)$$

Finding the optimal solution to a decision-makers problem is depicted in the formula above (2). The score of alternative a_i is denoted by V_i, which is the sum product of its performance p_{ij} times the weight of criterion c_j which is denoted by w_j ($w_j \geq 0$, $\sum w_j = 1$).

In order to find the weights w_j with respect to criterion c_j, Rezaei (2015) has developed a five step process. These steps are elaborated upon below:

Step 1 - Identification of criteria

Firstly, a list of criteria needs to be drafted in order to draw comparison. Criteria were identified and substantiated in chapter 2 and can be found in table 1. In this set there are 5 dimensions, which consist of the main 18 criteria derived from RRI literature.

Step 2 - Selection of best and worst criterion

Secondly, the 'best' and the 'worst' criterion need to be identified. Section 4.3 discusses how the opinions of experts were acquired by means of a questionnaire.

Step 3 - Best-to-others vector

The third step comprises the relative importance of 'best' criterion over the others. The questionnaire has asked respondents to rank the relative importance on a scale from 1-9 (where, 1 is equally important and 9 is much more important). This process can be formulated as follows:

$$A_B = (a_{B1},\ a_{B2},\ \ldots,\ a_{Bn}), \tag{3}$$

In the formula (3) above the A_b denotes the best-to-other vector, where a_{bj} presents the relative importance of criterion B to criterion j.

Step 4 - Others-to worst vector

Similarly, in step four the relative importance of the other criterions is ranked to the 'worst' criterion. The relative importance are once again ranked on a scale from 1-9 based on expert opinion obtained from the face-to-face questionnaires. This results in the others-to-worst vector below (4):

$$A_W = (a_{1W},\ a_{2W},\ \ldots,\ a_{nW})^T, \tag{4}$$

In this formula a_{nw} presents the relative importance of (other) criterion n compared to worst criterion W.

Step 5 - Solving for optimal weights

In the last step, the optimal weights are obtained by solving the following statements:

$$\begin{aligned} &\min \max_j \left\{ \left| \frac{w_B}{w_j} - a_{Bj} \right|, \left| \frac{w_j}{w_W} - a_{jW} \right| \right\} \\ &\text{s.t.} \\ &\sum_j w_j = 1 \\ &w_j \geq 0,\ \text{for all } j \end{aligned} \tag{5}$$

The optimal weights for the criteria are denoted by pairwise comparison, where each pair of w_b/w_j and w_j/w_w presents $w_b/w_j = a_{bj}$ and $w_j/w_w = a_{jw}$. Consecutively the optimal weights can be found by finding the maximum absolute differences of $w_j/w_w - a_{bj}$ and $w_j/w_w - a_{jw}$, see statement (5).

This problem can be transferred to include ξ:

$$\begin{aligned} &\left| \frac{w_B}{w_j} - a_{Bj} \right| \leq \xi,\ \text{for all } j \\ &\left| \frac{w_j}{w_W} - a_{jW} \right| \leq \xi,\ \text{for all } j \\ &\sum_j w_j = 1 \\ &w_j \geq 0,\ \text{for all } j \end{aligned} \tag{6}$$

The consistency ratio is denoted as ξ, which relates to the reliability of the comparisons. A lower consistency ratio means a higher reliability of the comparisons.

Since table 1 contains too many criteria to make reliable pairwise comparisons, the BWM analysis was conducted in a two-step process by clustering dimensions and criteria, see figure 4.2. Firstly the weights of the RRI process dimensions were determined by pair wise comparison. Secondly the criteria of the dimensions were subject to pairwise comparison to find the criterion weights. In order to calculate the global weights the dimension weights were multiplied by the criterion weights.

Figure 5; Clustering dimensions and criteria

4.5 Validation

In table 2, the consistency ratio is presented. The consistency ratio indicates the reliability of rankings given by the respective experts. Consistency was calculated by making pair-wise comparisons between the dimensions and subsequently, pair wise comparisons were calculated for the criteria within each respective dimension. Consistency increases when ξ is near zero (Rezaei, 2015). Generally, the dimensions show good consistency. A few outliers will be discussed in the limitations section.

Table 2; Consistency ratio

Consistency ξ	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8
Dimensions	0.06	0.03	0.02	0.07	0.09	0.06	0.08	0.09
1) Inclusion	0.07	0.18	0.03	0.10	0.15	0.11	0.05	0.12
2) Anticipation	0.13	0.07	0.03	0.11	0.21	0.07	0.10	0.09
3) Responsiveness	0.11	0.04	0.00	0.09	0.00	0.10	0.13	0.15
4) Reflexivity	0.21	0.13	0.09	0.12	0.08	0.11	0.04	0.11
5) Transparency	0.16	0.00	0.06	0.05	0.03	0.09	0.00	0.10

In order to validate the criteria weights, a sensitivity analysis was performed to test the robustness of the data. Since the BWM analysis is not a statistical analysis and the data set is too small, descriptive statistics do not offer any meaningful insights. To test the sensitivity of the analysis, the robustness of the data was tested. Two experts where removed from the results and added back one by one to check the convergence of the average global weights. It was found that this did not affect the average global weights by much, see appendix F. In the case of 6 experts the *Role of information* (Q16) found under transparency becomes slightly more important than *Empowerment of participants* (Q2) under inclusion. The weights of the other criteria remained fairly similar, subsequently the ranking remained the same.

Secondly, a peer debriefing or peer review was used to add credibility to the results and the research method, as suggested by Creswell & Miller (2000). An external expert was interviewed to review, discuss and validate the results based on its plausibility, see appendix G. Moreover the interview was used as a different source of input to help cross validate the other findings, i.e. the literature review, the questionnaire and the semi-structured interviews. The interview was recorded and transcribed. Furthermore a thematic analysis was performed to extract information that could help deepen the discussion of the results, see appendix G. The expert was identified and selected through referral or 'social acclamation' (Shanteau et al., 2002), based on the experience in standardisation. The expert has been active in over 50 committees spanning more than 10 years over service at NEN.

5. Results

The goal of this research was to explore the relative importance of RRI dimensions on the quality of standardisation processes, since it is not clear if the concepts of RRI are important to organisations (Stahl et al., 2017). To answer the main question of the research, a mixed method approach was used to collect and analyse the data, consisting of a series of (semi-)structured interviews, a questionnaire administered face-to-face and a linear BWM analysis.

Interviews

During three interviews, NEN standardisation experts were asked about the definition of quality in standardisation. Furthermore the relationship between RRI and the standardisation context was explored.

All respondents have indicated that the goal of NEN is to facilitate the creation of standards as a neutral platform and provide the tools to create a level playing field for all parties concerned to contribute meaningfully. Since standards are not required by law, neutrality of the standards process needs to be guaranteed in order to gain support for their adoption. The first respondent also suggested that the adoption of standards ensures the continuity of NEN as an SDO and allows it to contribute to a better world.

The interview with the second standardisation experts indicates that the definition of quality in the standardisation process is rather well defined. The respondent referred to a few common qualitative elements defined in the World Trade Organizations Agreements series (World Trade Organization, 2000). It was found that quality of standardisation constitutes: *a consensus-based and transparent process with all parties concerned.*

Firstly, most respondents have linked the a*ll parties concerned* principle to the inclusiveness of standardisation processes. Inclusion refers to diversity and fair representation of participants relevant to the context. All respondents include the creation of tools for people to engage and meaningfully contribute in standardisation processes. The first respondent indicated that inclusion also means a sufficient body of participants to ensure financial viability of committees, single member committees are less desirable for NEN. Inclusion extends to both committee members, but also general stakeholders, who are consulted in public consultation rounds.

Secondly, most respondents mentioned that a *consensus-based process* is essential to meaningfully engage with participants, as it serves as a safeguard for their interests. Feedback is considered very important by all respondents in treating and discussing ideas equally.

A *transparent process* is referred to as openness of information, motivations and interests. Furthermore, most respondents relate it to clear and consistent use of a format. All respondents mentioned that, sometimes personal spaces are required for parties to express underlying interests and motivations. Non-disclosure agreements are in place to enhance the transparency and safeguard the interests of stakeholders.

Anticipation was not directly mentioned by respondents as a core quality of standardisation processes, but is still considered important. Anticipation is referred to as the alignment of NEN towards socially desirable topics and projects. The aim is to identify where interests overlap and common grounds can be found. However, the second respondent indicated that impact assessment of standards are generally not included within the scope of committees. The third respondent indicated that in some

committees anticipation plays a bigger part than others. Some standardisation processes are initiated through governmental mandate, by posing certain questions or indicating the intention of potential regulation. In these cases the social desirability and impacts are predefined by governments, which shifts the attention of the standardisation process away from the outcomes, toward the necessity of the standard.

Most respondents have indicated that keeping an open mind, when it comes to standards, proves difficult in practice, since it is desirable to have one common standard on a specific subject at a time. The first respondent has indicated that there are alternatives for a standard's format. Alternative formats for example are, National Practice guidelines (NPR), National Technical Agreements (NTA) and Technical standards, which present forms of soft law with varying degrees of softness.

The first respondent referred to responsiveness as stimulating certain socially desirable themes. Standards are responsive toward ongoing insights and new requirements. Corrigenda or addenda help to continuously adapt a standard in the short term. In the long term, standards can be reformulated.

Reflexivity suggests a reflection on underlying interests and motivations of participants. According to the first respondent, participants can be considered lay-experts, who present different needs for standards relevant to their context. The respondent has added that inclusion and transparency add to reflexivity through the enrichment of the information exchange, which generates balanced and open discussions. Reflexivity is stated to be based on formalised iterations or rounds of negotiation and decision-making.

BWM analysis

A questionnaire was used to explore the relative importance of RRI dimensions on the quality of standardisation processes. A total of 18 (sub) criteria were identified through a literature review. Subsequently, a linear BWM analysis was used to explore the relative weights of criteria. The results can be seen in table 3 and figure 6.

Table 3; Criteria weights

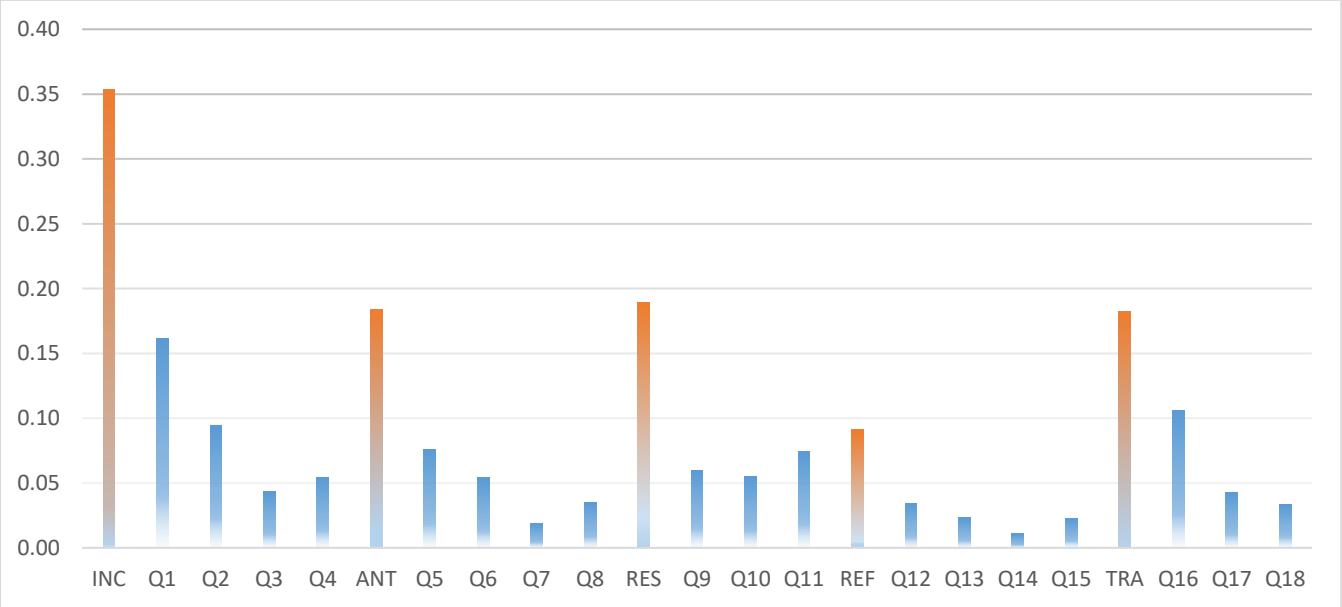
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	**Mean**
INC - Inclusion									**0.35**
Q1 - Diversity of participation	0.14	0.05	0.10	0.23	0.25	0.24	0.20	0.10	0.16
Q2 - Empowerment of stakeholders	0.08	0.22	0.09	0.14	0.08	0.06	0.07	0.02	0.09
Q3 - Timing of involvement	0.01	0.02	0.03	0.05	0.08	0.03	0.07	0.06	0.04
Q4 - Feedback mechanism	0.08	0.06	0.09	0.03	0.04	0.09	0.04	0.01	0.05
ANT - Anticipation									**0.18**
Q5 - Identification of impacts	0.07	0.06	0.05	0.00	0.01	0.09	0.12	0.20	0.08
Q6 - Predefining societal desirability	0.02	0.03	0.05	0.03	0.06	0.09	0.02	0.12	0.05
Q7 - Identification of alternatives	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.02	0.02
Q8 - Timing of anticipation	0.03	0.01	0.05	0.01	0.01	0.01	0.05	0.12	0.03
RES - Responsiveness									**0.19**
Q9 - Adoption of societal perspective	0.04	0.05	0.12	0.16	0.03	0.04	0.02	0.02	0.06
Q10 - Adaptation to contextual change	0.04	0.10	0.12	0.06	0.03	0.02	0.03	0.03	0.05

Q11 - Substantive response mechanism	0.11	0.03	0.06	0.03	0.07	0.06	0.11	0.14	0.07
REF - Reflexivity									**0.09**
Q12 - Recognising role specific drivers	0.02	0.04	0.06	0.05	0.02	0.04	0.02	0.02	0.03
Q13 - Recognising personal drivers	0.01	0.05	0.07	0.01	0.01	0.00	0.03	0.01	0.02
Q14 - Challenging drivers	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Q15 – Understanding impact of drivers	0.00	0.08	0.01	0.02	0.02	0.02	0.03	0.00	0.02
TRA - Transparency									**0.18**
Q16 - Role of information	0.21	0.08	0.04	0.10	0.18	0.10	0.05	0.08	0.11
Q17 - Role of stakeholders	0.09	0.08	0.04	0.02	0.03	0.02	0.05	0.02	0.04
Q18 - Defining process results and limitations	0.02	0.02	0.02	0.05	0.06	0.04	0.05	0.01	0.03

The mean weights indicate the overall importance of both the dimensions and the respective criteria. Table 3 suggests that the inclusive element of standardisation presents the most important aspect for quality of the process. Reflection on underlying interests and motivations of participants presents the least important element. Responsiveness of standards toward social desirable themes was found to be the second most important element of standardisation processes. The third most important dimension is tied between openness of information and the anticipatory nature of standards.

The results further indicate that *Diversity of participation* and *Empowerment of stakeholders* are considered most important for inclusion. *Identification of impacts* and *Predefining societal desirability* score the highest within anticipation. A *Substantive response mechanism* is considered the most important criterion for responsiveness. *Recognising role specific drivers* was found to be the most important criterion pertaining to reflexivity. Lastly, the *Role of information* plays a large part in the scoring of transparency.

Figure 6; Criteria and Dimension Weights



6. Discussion

Inclusion

Standards, which have no inherent authority, rely on their rate of adoption or success (Botzem & Dobusch, 2012). Since standards are aimed at adoption, inclusion is important in providing the necessary support for standards to succeed (Forsberg, 2012). Inclusion can therefore be considered a key quality of standardisation processes. Furthermore, Stilgoe et al. (2013) argue that inclusion can enhance the quality of the dialogue, which is important for framing of issues and creating a sufficient base of support (Fraaije & Flipse, 2020).

From table 1 can be concluded that *Diversity of participation* is considered both the most important criterion within the dimension of inclusion, but also the most important criterion overall. This is reflected in the *All parties concerned* principle, which is part of the definition for quality of standardisation derived in chapter 5. NEN experts have suggested that diversity is necessary for support, "without standards' support, NEN has no raison d'être, because the standards will not be adopted".

These results build on the existing evidence that involving stakeholder relevant to a particular context is an important element of diversity (Correljé et al., 2015). Furthermore, it suggests that input legitimacy plays a significant role quality of standards, as diversity indicates a right balance of interests to enable broad support. Moreover, respondents have indicated the desirability of including participants outside the committees, which supports the aspect of 'openness' by Werle & Iversen (2006). Respondents added that this enables balanced discussions, which is supported by Inigo et al., (2020), who suggest that inclusion adds to a more level playing field for standards by balancing of a more wide variety interests and opinions.

However, respondents have indicated that there are limitations to the desirability and feasibility of *all parties concerned*: "Inclusion is important but must be carefully weighed against the pragmatic side of standardisation."

Firstly, due resource constraints and requirements of expertise diversity cannot always be guaranteed, which seem to suggest there are limitations to stakeholder inclusion (Forsberg, 2012; Wickson & Forsberg, 2015). Secondly, respondents have indicated that diversity does not always result in quality of standards. Including stakeholders *All parties concerned* can lead to undesirable results. Respondents have indicated that including all parties can result in 'one-size fits nobody' solutions that are not desirable to stakeholders.

This result contradicts the notion of collective responsibility offered by (Stilgoe et al., 2013). Literature suggests that despite best efforts of individuals to not act irresponsible, irresponsible outcomes can still occur through a moral divisions of labour, also known as 'the problem of many hands' (van de Poel et al., 2012) resulting in 'organised irresponsibility' (Beck, 1992).

Empowerment of stakeholders is considered another important factor within inclusion. Respondents have indicated that participants of standardisation need to be empowered to make meaningful contributions, which is supported by Stilgoe et al. (2013). Essential to empowerment is consensus, as it serves as a 'safeguard' for interests of participants and is "very important in order to understand

each other". Additionally, it reflects the principle of *consensus-based* standardisation processes, which is part of the definition presented in chapter 5.

This is supported by Lubberink et al. (2017) who indicate the provision of voting power as a way to engage with stakeholders meaningfully. Consequently, *Empowerment of stakeholders* increases input legitimacy of standardisation processes, since it is morally acceptable through its democratic elements (Forsberg, 2012).

Similarly, *Consideration of feedback* is considered desirable by respondents as a means to show how participant input affects documentation and decisions: "A good feedback structure creates transparency and trust in the process". This is supported by de Saille (2015) who makes a case for feedback mechanisms to voice concerns of participants to prevent giving of a false sense of legitimacy.

Lastly, the *Timing of involvement* is scored lowest by respondents within the dimension of inclusion and in general. This result seems to contradict with the motion that stakeholder commitment is created by participating from the outset (Kupper et al., 2015), nor with the notion that intensity increases the quality of the dialogue (Stilgoe et al., 2013). Respondents however, have indicated that intensity of involvement can create a sense of urgency, which could lead to faster decision-making. This result follow the findings of van de Kaa et al. (2019) and van de Kaa & de Bruijn (2015).

Anticipation

Anticipation is a means to increase the chance for successful collaboration and ultimately adoption of standards by challenging the distribution of risks, since impacts can be identified, negotiated and divided among participants (Inigo et al., 2020). Anticipation appears to be an important aspect in standardisation, as respondents have indicated that "standards must have impact to be used and useful". An important element of anticipation is revealing both negative, as well as positive consequences of innovation. Respondents have indicated that, in the case of standards, revealing the potential positive impacts of standards is important in understanding and identifying stakeholders, as well as aligning their interests toward a common solution.

Furthermore, respondents suggested that inclusiveness is considered very important, but should not be seen as the end goal of standardisation processes as "Inclusion is a means to achieve impact". This implies that *Identification of impacts* is a very important criterion, which is reflected in its overall weight.

Identification of impacts is strongly related to discovering the interests of participants and their expectations regarding impacts. This supports the notion of (Lubberink et al., 2017) that *Identification of impacts* revolves around increasing awareness of stakeholders. Respondents have also indicated that the *Identification of impacts* and the resulting awareness strongly depend on the complexity of the standards context. For some standards, the impacts and desirability are predefined and consequently the outcome becomes less important than enabling broad support. This is in line with the notion that anticipation is aimed at uncontrollability and unpredictability of innovation and the governance of outcomes (Jenkins et al., 2020) by reducing complexity (Lubberink et al., 2017).

However, it is interesting to note that formal impact assessments of standards are generally not included within the scope of standardisation processes, as respondents have indicated. Impacts assessment for social innovations have remained an under researched topic, due to difficulties in

defining impacts and appropriate tools for measuring non-quantifiable goals (Maas et al., 2016). These are also called 'soft impacts' referring to outcomes affecting the quality of human life, which are important in understanding the 'societal relevance' of standards (van der Burg, 2009).

Respondents have indicated that anticipation includes "the alignment of NEN towards socially desirable topics and projects", therefore *Predefining societal desirability* is found to be important. This result provides an example of 'future scanning' of social, environmental and economic desirability (Wickson & Carew, 2014). It further suggests it helps reflect and lay bare the motivations of projects as well as their implications and it helps define and communicate the need for standards towards the public (Rose, 2014).

However, respondents argued that alignment with new developments proves difficult: "committee members generally do not use standards to encourage new developments, but rather to fit them with their current situation". This appreciation is possibly related to a lack of innovative parties at the table, often the established producers make up a large majority of committee participants. Start-ups and NGOs are often not represented to capture the broader societal themes. These results can partially be attributed to the required resources for effective participation (Forsberg, 2012; Wickson & Forsberg, 2015).

This issue fits in a larger debate on the contribution of standards on innovation. There appears to be no clear consensus whether standards contribute positively or negatively. Standards can negatively affect economic efficiency as a result of lock-in effects (Arthur, 1989); standards can promote older and obsolete technology in favour of superior new technology (Farrell & Saloner, 1985). More recent literature indicates that standards enable the dissemination and diffusion of knowledge and therefore affect innovation positively (Funk & Luo, 2015; Wang et al., 2016).

The remaining criteria *Identification of alternatives* and *Timing of anticipation* are considered less important. NEN experts have indicated that keeping an open mind with regards to standards can sometimes be undesirable. This fits with the assertion that the goal of SDOs is to define one common solution, as they are often initiated to reduce transaction costs (Wiegmann et al., 2017). Therefore defining multiple standards is ultimately self-defeating.

Similarly *Timing of anticipation* was also found to be less relevant, since respondents indicated that standards can be more easily revised, retired or adapted over time as opposed to technical forms of innovation. This perception seems to contradict the importance of anticipating early offered by Stilgoe et al. (2013).

Moreover it suggest a much larger problem with the definition of innovation offered by RRI. Some researchers have argued that the RRI definition of innovation is conceptually naïve (Jenkins et al., 2020). Blok & Lemmens (2015) argue that it stems from an economic paradigm with a utilitarian vision on social responsibility at its core, which seems rather contradictory. RRI was initially conceived as a design strategy in response to irresponsible consequentialist perspectives on innovation. Further investigation is needed into revising or clarify the definition of innovation in RRI literature. Perhaps it would be interesting to further investigate the under researched link between Social Innovation and RRI. Since RRI dimensions seem to share, as this research suggests, common features with social innovations (Edwards-schachter & Wallace, 2017).

Responsiveness

Responsiveness is considered the second most important aspect for quality of standardisation processes. Responding toward new insights, needs and expectations are important for quality of standardisation processes, since it indicates the capacity in which standards meet the expectations of end-users (Botzem & Dobusch, 2012).

Respondents have indicated that responsiveness is necessary for "NEN to be relevant and have an impact on new social issues". Firstly *Adoption of a societal perspective* is considered a requirement to be receptive toward new developments. This fits the notion offered by (Harsanto et al., 2020), that responsiveness entails a proactive process rather reactive meant to align societal benefits and needs (Rose, 2014) with company interests (Lubberink et al., 2017), in this case SDOs interests.

Similar to the findings of Lubberink et al. (2017), a *Substantive response mechanism* was found to be the second important element of responsiveness. Respondents have indicated that a *Substantive Response mechanism* and an *Adoption of a societal perspective* are "important to identify potential opportunities for standards development". This result are in line with research into the importance of feedback and evaluation (Kupper et al., 2015; Wickson & Carew, 2014). They assist helps to creating trust and confidence in voluntary standardisation processes through creation of legitimacy (Sutcliffe, 2011).

Reflexivity

Reflexivity is a necessary quality for standards creation, since the aim of consensus standards is the definition of social and ethical considerations in the innovation process (Inigo et al., 2020). According to respondents, reflexivity is very relevant and essential to SDOs as it "describes the daily role of the [standardisation] consultants". Respondents stress the importance of recognising the interests of parties in order understand activities of participants. This notion of recognising drivers underpinning decision-making is supported by Fraaije & Flipse (2020). Moreover it presents a step in the process of gaining "understanding" (Fraaije & Flipse, 2020).

Reflexivity plays a supporting role in the consensus process to form decisions, but is subordinate to other dimensions. *Recognising role-specific drivers* was deemed important in identifying common problem statements and establishing common grounds. This criterion suggests that recognition of drivers goes beyond understanding their impacts as offered by (Fraaije & Flipse, 2020), but also becomes essential towards the creation of support for standards adoption. Thus, *Recognising role-specific drivers* is important toward input legitimacy of standards.

Respondents have indicated that *Recognising personal drivers* plays a more pivotal role when the complexity, uncertainty and interests are very large in the context of the standardisation process. This suggests that values and motivations become more used and impactful when decision with regards to the future are made or when conflicting/uncertain options are present (Larson, 2000). The difference between role responsibilities and personal considerations is very context dependent. Standardisation processes can be highly dynamic and complex due to requirements of technical expertise and the need for consensus (Featherston et al., 2016; Wickson & Forsberg, 2015).

Insight into impacts of drivers is considered the least important according to respondents. Respondents describe participants as "very goal oriented and self-serving in their attempt to achieve

the goals of their organisation". This notion begs the question whether standardisation can be considered responsible and lead to, as mentioned earlier, 'organised irresponsibility' (Beck, 1992). Additionally respondents indicated that *Challenging drivers* is considered a moral grey area. This directly contradicts the notion of the critical attitude necessary to facilitate responsible innovation (Wickson & Carew, 2014). This result implies a dilemma for SDO involvement in RRI. Can SDOs actually contribute to societal desirability or stimulate collective responsibility while maintaining their neutral facilitative role? Recent research by Inigo et al. (2020) suggest that it might require governmental intervention, as voluntary standards present too many shortcomings as an instrument for RRI.

This could possibly challenges the applicability of moral legitimacy in standardisation. Without moral imperatives, do SDOs really rely on morally acceptable procedures to increase the quality of standards? If the ultimate goal of standards' quality is their adoption, then this implies that pragmatic legitimacy might play a larger role than moral legitimacy. Suchman (1995) defined pragmatic legitimacy as an instrumental form of legitimacy obtained through the exchange of support, in this case between supporters/stakeholders of standards and the SDO. This would mean that inclusion, transparency and reflexivity merely serves as necessities to enable support needed for standards' adoption, and do not serve the need for 'right' processes, as discussed by Botzem & Dobusch (2012). Consequently, the goal of standards adoption seems to suggest that standardisation that 'taken for granted' legitimacy, as discussed by Suchman (1995), might also play a more prominent role than assumed. The term 'taken for grantedness' means attaining a form of authority where 'alternatives are unthinkable, [and] challenges impossible.." (Suchman, 1995, p. 583). Standards literature seems to suggest that this is indeed the case, since standards are aimed at creating one common solution when having multiple is considered undesirable (Wiegmann et al., 2017).

In summary, it might be interesting to investigate the relative importance of pragmatic, moral and cognitive legitimacy on the process of standards development.

Transparency

The seminal work of Stilgoe et al (2013) was used as a starting point for identifying the most important process dimensions of RRI. The original RRI dimensions include anticipation, inclusion, reflexivity and responsiveness (Owen et al., 2012; Stilgoe et al., 2013). However transparency was added as a fifth core concept for responsible innovation, since transparency can indirectly support the other dimensions (Fraaije & Flipse, 2020). Transparency adds to inclusion by enabling more meaningful dialogue and creating a base of trust (Kupper et al, 2015). Furthermore it can support reflexive processes by revealing and framing underlying motivations and interests (Fraaije & Flipse, 2020). In standards creation, transparency plays an additional role as it can reveal whether standards were developed as the result of 'right process' (Botzem & Dobusch, 2012). Transparency is essential toward standardisation, since it directly affects the trust parties have in a process characterised by a lack of formal authority and self-organisation (Botzem & Dobusch, 2012). Its importance is also reflected in the definition of quality of standardisation processes.

Within transparency the *Role of information* presents the most important criterion and the second most important criterion overall. Respondents stress that "transparency is important to make clear to parties what the steps are to arrive at a standard in order to create trust". Thus, transparency can be seen as a form of moral legitimacy, and a means of facilitating socially desirable and acceptable

procedures (Suchman, 1995). These findings also coincide with the necessity for readability and comprehensibility of documentation, argued by Fraaije & Flipse (2020).

Furthermore, respondents have indicated that the *Role of information* and *Role of stakeholders* relates to openness of information, motivations and interests. Respondents have suggested that "every participants has access to unique, sometimes specific, and relevant information related to their context". This suggests that facilitating the exchange of knowledge is an essential added value of transparency in standardisation. In essence, transparency plays a supportive role in facilitating meaningful dialogue (Fraaije & Flipse, 2020), which stimulates mutual learning (Wickson & Carew, 2014).

However respondents have also indicated that complete transparency of underlying motivations and interests is impossible. Interests of participants can be conflicting or personal issues can arise in committees. In that case, respondents stress the importance of conflict resolution through an individual approach. These findings seem to suggest that safe discussion arenas or 'closed' spaces, characterised by confidentiality, can paradoxically lead to more transparency as participants are more likely to share (de Bakker et al., 2014). It might be fruitful to investigate the importance of closed spaces and their effect on transparency in the context of standardisation.

Lastly, *Defining process results and limitations* was found to be important by respondents, in case of large uncertainty or when the aim of the committee is knowledge creation. Respondents have indicated that "In more established committees uncertainties are less prevalent: the market is known, the interests are known". Defining limitations of knowledge and uncertainties is therefore very context dependent and not always a necessity. This is reaffirmed by Kupper et al. (2015), who indicate that limitations, uncertainties and a lack of knowledge should be communicated, since complete transparency is not always possible.

Limitations and recommendations for further research

Limitation of this research are strongly related to the abstract nature of RRI and its interpretation of responsibility. First and foremost, (longitudinal) limitations of the researcher must be acknowledged. The research is constrained in scope, since both the researcher has limited experience with standardisation and RRI literature. This may have led to bias in the integration of RRI concepts, which subsequently, could have affected the transcriptions of interviews with NEN experts. Since RRI concepts are somewhat ambiguous and strongly interrelated its possible elements are misinterpreted or perhaps wrongly attributed to other dimensions.

The consistency ratio, despite being acceptable overall, might indicate there is some conceptual ambiguity underlying some of the criteria identified in this research, see table 4. Furthermore it might also suggest that the BWM method might not be a suitable research method for ranking abstract concepts. The BWM method may have added to the complexity and difficulty of the cognitive process for respondents. Respondents had limited time to familiarise themselves with the abstract elements of RRI, after which they were required to rank them on their perceived importance on standardisation quality accordingly. Most respondents indicated that this was not an easy task.

For example, respondents indicated a strong interdependence between diversity and empowerment and found them difficult to score separately. Therefore their scoring depends on the existence of the other. Furthermore, respondents were initially confused by the difference between anticipation and responsiveness, as they conceptually overlap. Both constitute an active alignment with societal needs

and expectations. The lack of external validation of transcriptions might explain some of the conceptual fuzziness and therefore the understanding of the concept by respondents.

Table 4; Consistency ratio

Consistency ξ	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8
Dimensions	0.06	0.03	0.02	0.07	0.09	0.06	0.08	0.09
1) Inclusion	0.07	0.18	0.03	0.10	0.15	0.11	0.05	0.12
2) Anticipation	0.13	0.07	0.03	0.11	0.21	0.07	0.10	0.09
3) Responsiveness	0.11	0.04	0.00	0.09	0.00	0.10	0.13	0.15
4) Reflexivity	0.21	0.13	0.09	0.12	0.08	0.11	0.04	0.11
5) Transparency	0.16	0.00	0.06	0.05	0.03	0.09	0.00	0.10

Differences in interpretation of dimension weights might also be the result of using a wide range of standardisation experts. Some experts were more active in innovation of standardisation processes, rather than the facilitation of standards committees. Since the sample size of this research is too limited to address this discrepancy, further investigation is needed in the role of the expert on the perceived importance of RRI criteria. The criteria identified in this research, could serve as a starting point to perform a survey among standardisation experts. NEN was chosen as a representative for SDOs, since they present the national standards body in the Netherlands and thus possess a select expertise. However, comparing standardisation guidelines there appears to be differences in the manner standards are established (ISO, 2020). Further research could include other national standards bodies or even other standards bodies, like professional organisation (IEEE) or trade associations (IATA).

The respondents also revealed that the relative importance of criteria differ greatly between committees, see table 3. Respondents have indicated this might be the result of contextual elements relevant to the respective standardisation committee. Since these contextual elements are outside the scope of this research, extending this line of research to study the relative importance of RRI dimensions in individual committees might be interesting. Stahl et al. (2017) has developed a maturity mode, which could be used to investigate the relevance and importance of RRI dimensions from a bottom-up approach. The RRI maturity model can provide an evaluation of potential weaknesses of RRI in committees, rather than assigning an overall score to SDOs as a whole (Stahl et al., 2017). This could present practical contributions as well as a starting point to further develop and implement elements of RRI to ensure social responsibility of standardisation.

It likewise serves as a starting point to investigate the contextual element that influence the applicability of RRI in committees. This could extend to for example the motivations of parties to collaborate (Blind & Mangelsdorf, 2016) or incumbent power dynamics between committee members (Brand & Blok, 2019). Forsberg (2012) has found that standardisation requires a significant time investments and resources. Wickson & Forsberg (2015) add that the technical expertise required for effective participation also results in a barrier to entry. It is therefore interesting to extend the investigation of the relative importance between RRI criteria and economic criteria.

7. Conclusions

The goal of this research was to explore the relative importance of RRI criteria in standardisation processes. A mixed methods approach was used to collect and analyse the data. Three semi-structured interviews with NEN standardisation experts were conducted, which revealed a definition for the quality of standardisation processes. The quality of standardisation processes can be defined as:

A consensus-based and transparent process with all parties concerned.

A questionnaire was administered to 8 standardisation experts by means of face-to-face interviews in order to explore the relative importance of 18 criteria, which comprise the 5 key RRI dimensions, identified through a literature review. Subsequently, the data from the questionnaire was analysed by using the linear Best-Worst-Method, developed by (Rezaei, 2015). This section will present the key takeaways from this research.

Firstly, the *Diversity of participation* was found as the most important criterion on the quality of standardisation process, which is reflected in the definition quality of standardisation. Standards lack inherent authority and thus, rely on their rate of adoption for success (Botzem & Dobusch, 2012). Since standards are aimed at adoption, inclusion is important in providing the necessary support for standards to succeed (Forsberg, 2012).

Secondly, this research suggests that participants of standardisation need to be empowered to make meaningful contributions. This refers to the principle of *consensus-based* standardisation processes. Consensus presents a democratic element that serves to 'safeguard' the interests of participants and increases legitimacy of the standardisation process.

Thirdly, transparency was found to be essential toward standardisation, since it directly affects trust in a process characterised by a lack of formal authority and self-organisation (Botzem & Dobusch, 2012). Its importance is also reflected in the definition of quality of standardisation processes.

Lastly, the research has revealed the importance of Anticipation. Respondents have indicated that "standards must have impact to be used and useful" and should be considered as the end goal of standardisation processes. *Identification of impacts* was found to be a very important criterion, but is surprisingly not represented in the core definition of quality of standardisation. Additionally, institutionalisation of Anticipation appear to be absent in standardisation processes.

Theoretical contributions

Firstly, this research presents one of the first attempts to explore the RRI dimensions and their respective criteria in the empiric context of voluntary standardisation. Standards can be considered an instrument to realise responsible innovation despite the fact that RRI research has received little consideration in the academic field of standardisation (Wickson & Forsberg, 2015). Hence, this research shows how process dimensions might actually be institutionalised in a practical context (Burget et al., 2017). The research also contributes to the field of RRI by synthesising the efforts over the last decades to conceptualise the criteria that make up the core RRI dimensions (Owen et al., 2012; Stilgoe et al., 2013) and testing them in the standards development context. This research also contributes to RRI literature by providing an argument for including transparency as one of its core dimensions, since it was found to a key dimension on the quality of standardisation context.

Secondly, the research contributes to the standardisation literature by linking standard's legitimacy and Responsible Innovation. The research suggests that dimensions like inclusion, transparency and responsiveness directly relate to input and throughput legitimacy necessary for standards adoption and quality. Moreover, this research has presented a definition for quality of standardisation processes.

Practical contributions

A practical contribution of this research is the definition of well-defined performance criteria, which SDOs and other standards developing bodies can use to assess the quality of their standardisation processes. They could prove helpful in the identification of possible avenues for institutionalising aspects of RRI process in practice, which is currently lacking (Burget et al., 2017; Owen et al., 2021). Furthermore, this research presents a policy recommendation, see chapter 8, addressed at institutionalising the *Identification of impacts* in standardisation processes through a social impact assessment framework for creating impactful standards.

Final thoughts

RRI was conceived as means to meeting 'the grand challenges of our time' (von Schomberg, 2013) and has seen a recent surge in policy interest (Jenkins et al., 2020; Owen & Pansera, 2019). The research hopefully raises awareness on the importance of standardisation for policy makers as a meaningful tool for the realisation of socially responsible innovation. Future innovations will challenge society and environment in making responsible choices. Whether its security implications relating to Internet of Things. Or the impact AI will have on future job security and social stratification. Lastly, climate change poses an existential risk for society and environment, characterised by a limited time window for innovations to mitigate its risks before they become irreversible.

Furthermore the research hopes to illustrate the important role SDOs can play in assuming 'stewardship' through the creation of impactful standards.

8. Design: Impact Assessment for standards

This chapter presents an institutional design approach to facilitating Anticipation in standardisation processes. The process design focuses on a Social Impact Assessment (SIA) Framework, which is depicted in figure 7.

8.1 Social Impact Assessment and standards

One of the core findings of this research was the relative importance of anticipation in standardisation processes. Anticipation is a means to increase the chance for successful collaboration and ultimately adoption of standards by challenging the distribution of risks, since impacts can be identified, negotiated and divided among participants (Inigo et al., 2020).

However, it is interesting to note that formal impact assessments of standards are generally not included within the scope of standardisation processes, as respondents have indicated. Impacts assessment for social innovations have remained an under researched topic, due to difficulties in defining impacts and appropriate tools for measuring non-quantifiable goals (Maas et al., 2016). These are also called 'soft impacts' referring to outcomes affecting the quality of human life, which are important criteria in understanding 'societal relevance' (van der Burg, 2009). Standards have tremendous potential at meeting societal challenges and societal needs due to their anticipatory nature.

In the left column of the poster, see figure 7, the social impacts are determined by measuring the outcomes of standardisation activities and subtracting the part of the outcomes that would happen regardless.

8.2 Social impact assessment framework

In order to present a SIA framework for standards, there needs to be a base for understanding of the need and emergence of standards. Standards are often considered with respect to the innovation lifecycle (Blind & Gauch, 2009; Egyedi & Sherif, 2010) from market entry to market saturation, wherein they play a pivotal part in addressing interoperability and performance of new technologies.

For this purpose, a market transformation model, developed by Simons & Nijhof (2021), will be used. The central framework depicted in the poster, see figure 7, details the four stages of sustainable market transformation defined by Simons & Nijhof (2021). It essentially describes stakeholder behaviour as the result of systemic threat, which could be a new technological development, new legislation or a (environmental) issue. Every phase presents the process of institutionalisation of a problem by stakeholders relevant to the problem context. They indicate different levels of stakeholder awareness and the alignment of their interests towards dealing with the issues at hand. The market transformation framework can assist standards development organisations (SDOs) with a structured approach to assess the value and opportunity for standards creation. These phases are accompanied by SIA steps in order to assist stakeholders in assessing the impact of potential standards.

Phase 1: Inception

The first phase can be characterized by the introduction of a problem (societal issue) and a growing receptiveness among actors towards new opportunities to address this problem (Simons & Nijhof, 2021). Stakeholders in this phase become responsive towards alternatives and the requirements they should meet. Phase one of the SIA framework is characterised by early (pre-standardisation) exploration of underlying motives and interests of organisations relevant to a societal theme.

Phase 2: Competitive advantage

The second phase can be characterized by a recognition of societal needs and competitive aspects of alternatives (Simons & Nijhof, 2021). The primary objective of stakeholders in this phase revolve around enhancing the efficiency and competitiveness of alternatives. Understanding the causality between stakeholder action (input) and their results on their objective, is essential in recognizing the impacts of the standards. During this phase gaining deeper insight into stakeholder's understanding of a system is important by revealing underlying assumptions.

Phase 3: Pre-competitive collaboration

This phase describes the early stages of standards development through the process of co-creation of future visions. Furthermore, agreements can be made on measurable targets, which allows for the choice of an appropriate method for assessing impacts. This can, for example, be purely quantitative through a NPV analysis or qualitative, by means of a radar diagram as depicted in figure 7.

Phase 4: institutionalisation

In phase 4, the alternative becomes the new normal as a result of standardisation. Adoption of standards receives support of a critical mass, creating level playing field for market opportunities. At the same time, new societal developments arise including new needs and expectations (Simons & Nijhof, 2021). In this phase impact assessment covers the process of attributing outcomes (Catley et al., 2014) to standards' adoption. Lastly, phase four, is important in evaluating the impacts of standards by comparing and contrasting results with secondary sources. This is necessary to distinguish between intentional impacts and the impacts that would have occurred regardless of standards adoption.

Figure 7; Social Impact Assessment Design Poster

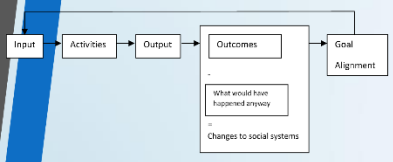
Impact Assessment for standards:
Framework for assessing social impacts

Bsc Almar Meijer
TUdelft

Introduction

Anticipation was found to be an important dimension on the quality of standardisation processes, especially the identification of impacts. NEN has indicated that standards must have impact to be used and useful. Surprisingly however, the process of standards creation has no formalised procedure to assess the impacts of standards. This section is aimed at making a recommendation toward a model for (social) impact assessment for standards.

Figure 1. Defining social impacts.



Note. Defining social impacts. Reprinted from "Social Impact Measurement: Classification of Methods" by L.Maas & K.Liket, in R.Buritt, S.Schaltegger, M.Bennet, T.Pohjola, M.Csutora (Eds.) *Environmental management accounting and supply chain management*, 2011, p. 6. Spinger Netherlands. Copyright 2011 by Springer Science+Business Media B.V. 2011.

Social Impact Assessment

Measuring the impacts of social innovations, like standards, has proven a difficult task. Firstly, there is a distinct lack on what constitutes social impact (Maas & Liket, 2011). In this design we adopt the definition offered Clark et al. (2004), see figure 1. Clark et al. (2004) define the social return or impact as that the net result of the total outcomes minus what would have happened anyway. This part represents the part of the outcome that can be attributed to the activities of the organisation through measuring the organisation's output. Impacts relate to both unintended and intended consequences (Maas & Liket, 2011)

Secondly measuring impacts of social innovations has proven difficult due to limitations of the predominant financial perspective of impact assessment methods for assessing societal goals and 'soft impacts' (Grieco et al., 2015; Maas & Liket, 2011; Van der Burg, 2009). Due to growing need for impact assessment tools that look beyond traditional quantifiable and monetary indicators for impact, social impact assessment (SIA) has been gaining traction in literature (Maas & Liket, 2011). Recent efforts by (Grieco et al., 2015; Maas & Liket, 2011) to categorise an otherwise scattered array of social impact assessment methods, have resulted in a classification of SIA methods for different purposes.

SI Framework

The framework for social impact (SI) assessment designed for standards, see figure 2, is based on the Participatory impact assessment method (Catley et al., 2014) and the Ex- ante impact assessment model for SI by Dhondt et al., (2016). The steps for the impact assessment can be found in the right column.

The first two columns represent the process of systemic change, which presents an adaptation of the work of Simons & Nijhof (2020). The four phases represent the way societal issues are introduced and instutionalised through stakeholder interaction and learning. The model presents a structured model for the alignment of standardisation processes with societal issues. To measure impacts standards can have on addressing societal issues, several steps are presented for each of the corresponding phases.

Figure 2. SI Framework

Market transformation phase	Stakeholdersinteraction	Impact assessment steps
Phase 1: Inception: Awareness about a problem in the sector, stakeholder orientation into possibilities. Receptive toward new innovation		**Step 1: Mapping** -Stakeholder analysis - Determining Socio-economic goals (goal tree), criteria and KPIs -Determine scope
Phase 2: Competitive advantage Recognition of competitive advantage and societal need for innovation		**Step 2: Causal relations** -Relating inputs to output: CLD (systems diagram) -Determining the role of the stakeholders (what, how and when do they have to do anything)
Phase 3: Pre-competitive collaboration Co-creation of future visions, agreement on measurable goals and targets, agreement on stakeholder roles		**Step 3: Analysis** -Choice of method (qualitative/quantitative), for example radar map of KPIs -Calculating impacts
Phase 4: Institutionalisation Adoption of innovation through support of critical mass, creating level playing field for market opportunities.		**Step 4: Evaluation** -Triangulation (comparing results with secondary information) -Feedback/validation

Note. Market transformation column 1 and 2. Adapted from *Changing the Game: sustainable market transformation strategies to understand and tackle the big and complex sustainability challenges of our generation* (p. 73-76) by L. Simons & A.Nijhof. 2021. London: Routledge. Copyright 2021 by Lucas Simons & André Nijhof. Adapted with permission.

Phase 1: Mapping

The first phase can be characterized by the introduction of a problem (societal issue) and a growing awareness that an alternative is required (Simons & Nijhof, 2021). Stakeholders in this phase become responsive towards alternatives and the requirements they should meet. The corresponding SI step is mapping the scope and interests of stakeholders involved. A possible tool to determine socio-economics goals and performance indicators (PI) is the goal tree, see figure 3

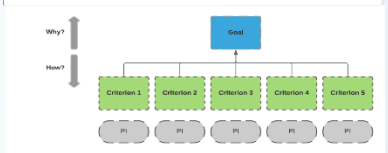


Figure 3. Goal tree

Figure 4. Systems Diagram

Phase 2: Causality

The second phase is characterized by a recognition of societal needs and competitive aspects of alternatives (Simons & Nijhof, 2021). Enhancing the efficiency and competitiveness of alternatives are the primary objectives at this stage. This is where mapping causal relations is most important, to understand the (expected) impact of stakeholder input on performance indicators.

Figure 5. Radar Diagram

Phase 3: Analysis

The third phase entails collaboration to remove barriers and scale up production of alternatives, through a process of co-creation (Simons & Nijhof, 2021) . Agreements are made on measurable targets, which allows for the choice of an appropriate method for assessing impacts. Assessment methods can be quantitative or qualitative, see for example the radar diagram in figure 5

Phase 4: Evaluation

In phase 4, the alternative becomes the new normal as a result of standardisation. At the same time, new societal developments arise including new needs and expectations (Simons & Nijhof, 2021). In this phase impact assessment covers the process of attributing outcomes (Catley et al., 2014) to standards' adoption.
Furthermore, phase 4 covers evaluation of the results. Catley et al. (2014), suggest triangulation as a way to compare results of the impact assessment to secondary resources.

Contact

Almar Meijer
TUDelft
j.a.meijer@tudelft.nl

References

1. Catley, A., Burns, J., Omeno, S., & Davitt, A. (2014). Participatory Impact Assessment: A Design Guide. *Feinstein International Centre, Tufts University, Somerville*, 1–51. https://fic.tufts.edu/assets/PIA-guide_revised-2014-3.pdf
2. Clark, C., Rosenzweig, W., Long, D., & Olsen, S. (2004). Double Bottom Line Project Report: Assessing Social Impact in Double Bottom Line Ventures. *Working Paper Series*, 13, 1–30. http://repositories.cdlib.org/cri/wps/13
3. Dhondt, S., van de Ven, H., Zlaebeyte, R., van de Torre, W., Cressey, P., Kaderabkova, A., Luna, A., Saman, S. M., Castro Spila, J., & Tenbrinck, J. (2016). Ex-Ante Impact Assessment & Value Network Analysis for SI. *SIMPACT Working Paper*, 2(January), 1–16. https://www.researchgate.net/publication/314184067_Ex-Ante_Impact_Assessment_Value_Network_Analysis_for_SI
4. Edwards-schachter, M., & Wallace, M. L. (2017). Technological Forecasting & Social Change ' Shaken , but not stirred ' : Sixty years of defining social innovation. *Technological Forecasting & Social Change*, 119, 64–79. https://doi.org/10.1016/j.techfore.2017.03.012
5. Grieco, C., Michelini, L., & Iasevoli, G. (2015). Measuring Value Creation in Social Enterprises: A Cluster Analysis of Social Impact Assessment Models. *Nonprofit and Voluntary Sector Quarterly*, 44(6), 1173–1193. https://doi.org/10.1177/0899764014555986
6. Lubberink, R., Blok, V., Ophem, J. van, & Omta, O. (2017). Lessons for responsible innovation in the business context: A systematic literature review of responsible, social and sustainable innovation practices. *Sustainability (Switzerland)*, *9*(5). https://doi.org/10.3390/su9050721
7. Maas, K., & Liket, K. (2011). Social Impact Measurement: Classification of Methods. In R. Burritt, S. Schaltegger, M. Bennett, T. Pohjola, & M. Csutora (Eds.), *Environmental management accounting and supply chain management* (pp. 171–202). Springer Netherlands. https://doi.org/10.1007/978-94-007-1390-1_8
8. Simons, L., & Nijhof, A. (2021). *Changing the Game: sustainable market transformation strategies to understand and tackle the big and complex sustainability challenges of our generation* (1st ed.). Routledge.
9. van der Burg, S. (2009). Taking the "soft impacts" of technology into account: Broadening the discourse in research practice. *Social Epistemology*, *23*(3–4), 301–316. https://doi.org/10.1080/02691720903364131

9. Reflection on research and CoSEM

In this section I will reflect on some of the lessons I have learned during my research into standardisation and RRI. Furthermore, I will reflect on these topics and their relation to the CoSEM masters programme, while I believe some standardisation and RRI aspects deserve more attention. Lastly, I will shortly reflect on the research and what I can improve in future endeavours.

The CoSEM masters programma places a large emphasis on designing in socio-technical systems and understanding of actor behaviour. Throughout the most of the masters programme, New institutional Economics (NIE) and Williamson's (1998) four-layer model are presented as a way to understand to actor behaviour as a result of institutional arrangements. However, it was quite surprising to me that no attention was ever given to standards as a form of soft law. Standards are ubiquitous and embedded in almost any aspect of life, yet they were never explicitly mentioned or related to within the CoSEM programme. For example, in my specialisation (Energy & Industry), transition towards a sustainable energy sector is a core topic. Oftentimes, technical, legislative and economic considerations are offered as to how this transition might be given shape. But standards are never considered as a means to achieve this. As a working student at NEN however, I found that standards can play a considerable role the problem of energy transition. For example, performance standards play a pivotal role in the financing of on- and offshore windmills, since they cover the aspect of risk. Risk and insurance is an important driver for the cost of windmills. Standards address risk and risk distribution through certification schemes for windmill safety, performance and maintenance.

Another aspect that was surprising to me was the lack of value driven design. There was but one course in CoSEM about ethics and engineering, which remained very theoretical and descriptive. It involved certain ethical theories (utilitarianism version Kantianism), ethical aspects of risk and moral problems engineers encounter in practice. However, it remains unclear to me how to deal with these aspects in a socially responsible way and how to incorporate these elements into policy recommendations. Responsible Research and Innovation was the first theory that offered me a clearer perspective on responsible design.

Delving into the topic of RRI, it also revealed the unuanced look on innovation within the CoSEM master's program. CoSEM emphasises the innate ability of (technological) artefacts to shape society and vice versa, but never really discusses the essence of these artefacts or innovations. Policy recommendations are seen as an instrument to design in socio-technic systems, but are never referred to as institutional innovations. I think CoSEM could do a better job of discussing the nature of innovation and its ability to shape society, by including both technical/commercial and institutional innovations like standards.

The core method of analysis in this research was the use of the linear Best-Worst Method, created by Rezaei (2015). During the CoSEM master, linear programming is added to the (CoSEM) engineer's toolbox. Linear programming is used as a MCDM method and is generally used to optimise certain objectives of decision makers. However, linear programming assumes that values and preferences are quantitative and known beforehand. Usually this is not the case. In my opinion BWM could be nice addition to the CoSEM linear programming course to consider more qualitative criteria for decision-making through the process of ranking.

If I look back on the research process, there is not a whole lot I could have changed when it came to research planning due to current pandemic. However it would've been nice to plan in a workshop beforehand with the NEN experts at the end. In the research, I noticed differing opinions between the experts. A workshop could have facilitated a discussion with all the experts to reflect back on their motivations. This could have made for a stronger discussion section, especially when it comes to investigating the origins of these differences.

In my opinion, the inclusion of a phd candidate or another external (student) supervisor related to the research area has added a lot of value to the overall quality of my research. Firstly, because there is a more involved look on the content of the research topic. External supervisors can go more in depth on theoretical concepts. Secondly, it provides a way to stay more in touch and keeping students more motivated. In my case this was noticeable as motivation dropped after a period of time due to becoming increasingly unsure about the quality of the work.

References

Allen, R. H., & Sriram, R. D. (2000). The Role of Standards in Innovation. *Technological Forecasting and Social Change*, *64*(2–3), 171–181. https://doi.org/10.1016/s0040-1625(99)00104-3

Arthur, B. W. (1989). Competing Technologies , Increasing Returns , and Lock-In by Historical Events. *The Economic Journal*, *99*(394), 116–131. https://www.jstor.org/stable/2391646?seq=1#metadata_info_tab_contents

Beck, U. (1992). Risk Society: Towards a New Modernity. In M. Ritter (Ed.), *Economic Geography* (Vol. 69, Issue 4). Sage Publications Ltd. https://doi.org/10.2307/143601

Belleflamme, P. (2002). Coordination on formal vs . de facto standards : a dynamic approach. *European Journal of Political Economy*, *18*(1), 153–176. https://doi.org/10.1016/S0176-2680(01)00073-8

Blind, K. (2013). The impact of standardization and standards on innovation - Compendium of evidence on the effectiveness of innovation policy intervention. *Manchester Institute of Innovation Research, Manchester Business School, University of Manchester*, *13*. https://pdf4pro.com/view/the-impact-of-standardization-and-standards-on-innovation-3af1cc.html

Blind, K., & Gauch, S. (2009). Research and standardisation in nanotechnology: Evidence from Germany. *Journal of Technology Transfer*, *34*(3), 320–342. https://doi.org/10.1007/s10961-008-9089-8

Blind, K., & Mangelsdorf, A. (2016). Motives to standardize: Empirical evidence from Germany. *Technovation*, *48–49*, 13–24. https://doi.org/10.1016/j.technovation.2016.01.001

Blok, V., & Lemmens, P. (2015). The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. *In: Koops BJ., Oosterlaken I., Romijn H., Swierstra T., van Den Hoven J. (Eds) Responsible Innovation 2. Springer, Cham.*, 1–303. https://doi.org/10.1007/978-3-319-17308-5

Botzem, S., & Dobusch, L. (2012). Standardization Cycles: A Process Perspective on the Formation and Diffusion of Transnational Standards. *Organization Studies*, *33*(5–6), 737–762. https://doi.org/10.1177/0170840612443626

Boynton, P., & Greenhalgh, T. (2004). Selecting , designing , and developing your questionnaire. *BMJ*, *328*(7451), 1312–1315. https://doi.org/10.1136/bmj.328.7451.1312

Brand, T., & Blok, V. (2019). Responsible innovation in business: a critical reflection on deliberative engagement as a central governance mechanism. *Journal of Responsible Innovation*, *6*(1), 4–24. https://doi.org/10.1080/23299460.2019.1575681

Burget, M., Bardone, E., & Pedaste, M. (2017). Definitions and Conceptual Dimensions of Responsible Research and Innovation: A Literature Review. *Science and Engineering Ethics*, *23*(1), 1–19. https://doi.org/10.1007/s11948-016-9782-1

Coenen, C. (2016). Broadening Discourse on Responsible Research and Innovation (RRI). *NanoEthics*, *1*(10), 1–4. https://doi.org/10.1007/s11569-016-0255-4

Colman, A. M., Norris, C. E., & Preston, C. C. (1997). Colman, A. M., Norris, C. E., & Preston, C. C. (1997). Comparing rating scales of different lengths: Equivalence of scores from 5-point and 7-point scales. *Psychological Reports*, *80*(2), 335–362. https://doi.org/10.2466/pr0.1997.80.2.355

Correljé, A., Cuppen, E., Dignum, M., Pesch, U., & Taebi, B. (2015). Responsible Innovation in Energy Projects: Values in the Design of Technologies, Institutions and Stakeholder Interactions. In *In: Koops BJ., Oosterlaken I., Romijn H., Swierstra T., van den Hoven J. (eds)Responsible Innovation. Springer, Cham.* https://doi.org/10.4324/9781351283960

Creswell, J. W., & Miller, D. L. (2000). Determining Validity in Qualitative Inquiry. *Theory Into Practice*, *39*(3), 124–130. https://doi.org/10.1207/s15430421tip3903

David, P. A. (1985). Clio and the economics of qwerty. *American Economic Review*, *75*(2), 332–337. https://doi.org/10.2307/1805621

David, P. A., & Greenstein, S. (1990). The Economics Of Compatibility Standards : An Introduction To Recent Research. *Economics of Innovation and New Technology*, *1*(1–2), 3–41. https://doi.org/10.1080/10438599000000002

de Bakker, E., de Lauwere, C., Hoes, A. C., & Beekman, V. (2014). Responsible research and innovation in miniature: Information asymmetries hindering a more inclusive "nanofood" development. *Science and Public Policy*, *41*(3), 294–305. https://doi.org/10.1093/scipol/scu033

de Jong, M., Kupper, F., Roelofsen, A., & Broerse, J. (2015). "Exploring Responsible Innovation as a Guiding Concept - the Case of Neuroimaging in Justice and Security." *Responsible Innovation 2: Concepts, Approaches, and Applications*, *Cham: Spri*, 57–84. https://doi.org/10.1007/978-3-319-17308-5

de Saille, S. (2015). Innovating innovation policy: the emergence of 'Responsible Research and Innovation.' *Journal of Responsible Innovation*, *2*(2), 152–168. https://doi.org/10.1080/23299460.2015.1045280

De Vries, H. J., & Verhagen, W. P. (2016). Impact of changes in regulatory performance standards on innovation: A case of energy performance standards for newly-built houses. *Technovation*, *48–49*, 56–68. https://doi.org/10.1016/j.technovation.2016.01.008

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, *40*(4), 314–321. https://doi.org/10.1111/j.1365-2929.2006.02418.x

Dunphy, S. M., Herbig, P. R., & Howes, M. E. (1996). The Innovation Funnel. *Technological Forecasting and Social Change*, *53*(3), 279–292. https://doi.org/10.1016/S0040-1625(96)00098-4

Edwards-schachter, M., & Wallace, M. L. (2017). Technological Forecasting & Social Change ' Shaken , but not stirred ' : Sixty years of de fi ning social innovation. *Technological Forecasting & Social Change*, *119*, 64–79. https://doi.org/10.1016/j.techfore.2017.03.012

Egyedi, T. M., & Sherif, M. H. (2010). STANDARDS ' DYNAMICS THROUGH AN INNOVATION LENS: NEXT GENERATION ETHERNET NETWORKS. *IEEE Communications Magazine*, *10*(48), 166–171. https://doi.org/10.1109/MCOM.2010.5594692

European Commission. (2012). *Europe's ability to respond to societal challenges*. *92*(March), 1–11. https://ec.europa.eu/research/swafs/pdf/pub_rri/KI0214595ENC.pdf

Evans, C. (2018). Analysing Semi-Structured Interviews Using Thematic Analysis: Exploring Voluntary Civic Participation Among Adults. In *SAGE Research Methods Datasets Part 1*. SAGE Publications. https://doi.org/10.4135/9781526439284

Farrell, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation. In *Rand Journal of Economics* (Vol. 16, Issue 1, pp. 70–83). https://doi.org/10.2307/2555589

Farrell, J., & Saloner, G. (1986). Installed Base and Compatibility: Innovation, Product

Preannouncements, and Predation. *The American Economic Review*, *76*(5), 940–955. https://www.researchgate.net/publication/243776630_Installed_Base_and_Compatibility_Innovation_Product_Preannouncements_and_Predation

Featherston, C. R., Ho, J. Y., Brévignon-Dodin, L., & O'Sullivan, E. (2016). Mediating and catalysing innovation: A framework for anticipating the standardisation needs of emerging technologies. *Technovation*, *48–49*, 25–40. https://doi.org/10.1016/j.technovation.2015.11.003

Forsberg, E. M. (2012). Standardisation in the Field of Nanotechnology: Some Issues of Legitimacy. *Science and Engineering Ethics*, *18*(4), 719–739. https://doi.org/10.1007/s11948-011-9268-0

Fraaije, A., & Flipse, S. M. (2020). Synthesizing an implementation framework for responsible research and innovation. *Journal of Responsible Innovation*, *7*(1), 113–137. https://doi.org/10.1080/23299460.2019.1676685

Franck, T. M. (1999). Democracy, legitimacy and the rule of law: linkages. *NYU Law School, Public Law and Legal Theory Working Paper*, *2*. http://dx.doi.org/10.2139/ssrn.201054

Friedman, B., Smith, I., Kahn, P. H., Consolvo, S., & Selawski, J. (2006). Development of a Privacy Addendum for Open Source Licenses: Value Sensitive Design in Industry Backdoors: Definition, deniability and detection. In P. Dourish & A. Friday (Eds.), *UbiComp'06: Proceedings of the 8th international conference on Ubiquitous Computing: Vol. 11050 LNCS* (September). https://doi.org/10.1007/978-3-030-00470-5_5

Funk, J. L., & Luo, J. (2015). Open standards, vertical disintegration and entrepreneurial opportunities: How vertically-specialized firms entered the U.S. semiconductor industry. *Technovation*, *45–46*, 52–62. https://doi.org/10.1016/j.technovation.2015.07.001

Giovannucci, D., & Ponte, S. (2005). *Standards as a New Form of Social Contract ? Sustainability Initiatives in the Coffee Industry*. *30*(3). https://doi.org/10.1016/j.foodpol.2005.05.007

Green, B. N., Johnson, C. D., & Adams, A. (2006). *Writing narrative literature reviews for peer-reviewed journals : secrets of the trade*. *5*(3), 101–117. https://doi.org/10.1016/S0899-3467(07)60142-6

Grundström, C., & Wilkinson, I. F. (2004). The role of personal networks in the development of industry standards : a case study of 3G mobile telephony. *Journal of Business & Industrial Marketing*, *19*(4), 283–293. https://doi.org/10.1108/08858620410516763

Guston, D. H. (2013). Understanding "anticipatory governance." *Social Studies of Science*, *44*(2), 218–242. https://doi.org/10.1177/0306312713508669

Harsanto, B., Kumar, N., Zhan, Y., & Michaelides, R. (2020). Responsible Research and Innovation (RRI) in Emerging Economies: A Preliminary Review. *Proceedings - 2020 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2020*. https://doi.org/10.1109/ICE/ITMC49519.2020.9198465

Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation : The Reconfiguration of Existing Product Technologies and the Failure of Established Firms Author (s): Rebecca M . Henderson and Kim B . Clark Source : Administrative Science Quarterly , Vol . 35 , No . 1 , Special Issue : Tech. *Administrative Science Quarterly*, *35*(1), 9–30. http://www.jstor.org/stable/2393549

Hoel, T., & Hollins, P. (2008). Learning technology standards adoption - how to improve process and product legitimacy. *Proceedings - The 8th IEEE International Conference on Advanced Learning Technologies, ICALT 2008*, 587–589. https://doi.org/10.1109/ICALT.2008.14

Inigo, E. A., Garst, J., Blok, V., & Pentaraki, K. M. (2020). Do voluntary standards support responsible

innovation implementation and reporting in industry? The case of the European food sector. *In E.Yaghmaei & van de Poel. I, Assessment of Responsible Innovation. Methods and Practices (Pp.145-168). Publisher: Routledge*, *November*. https://doi.org/10.4324/9780429298998

ISO/IEC. (2017). *ISO / IEC Directives, Part 1 + IEC Supplement* (13th ed.). http://isotc.iso.org/livelink/livelink/fetch/2000/2122/4230450/4230452/ISO_IEC_Directives_Part_1_and_Consolidated_ISO_Supplement_-_2014_(5th_edition)_-_PDF.pdf?nodeid=16578881&vernum=-2

ISO. (2020). *Code of Conduct for the technical work*. ISO.org. https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf

Jain, S. (2012). Pragmatic agency in technology standards setting : The case of Ethernet. *Research Policy*, *41*(9), 1643–1654. https://doi.org/10.1016/j.respol.2012.03.025

Jamshed, S. (2014). Qualitative research method-interviewing and observation. *Journal of Basic and Clinical Pharmacy*, *5*(4), 87. https://doi.org/10.4103/0976-0105.141942

Jenkins, K. E. H., Spruit, S., Milchram, C., Höffken, J., & Taebi, B. (2020). Synthesizing value sensitive design, responsible research and innovation, and energy justice: A conceptual review. *Energy Research and Social Science*, *69*(January), 101727. https://doi.org/10.1016/j.erss.2020.101727

Kaplan, B., & Duchon, D. (1988). Combining qualitative and quantitative methods in information systems research: A case study. *MIS Quarterly: Management Information Systems*, *12*(4), 571–586. https://doi.org/10.2307/249133

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review*, *75*(3), 424–440. https://doi.org/10.2307/1814809

Krosnick, J. A. (1999). SURVEY RESEARCH. *Annual Review of Psychology*, *50*(1), 537–567. https://doi.org/10.1146/annurev.psych.50.1.537

Kumar, A., A, A., & Gupta, H. (2020). Evaluating green performance of the airports using hybrid BWM and VIKOR methodology. *Tourism Management*, *76*(June 2019), 103941. https://doi.org/10.1016/j.tourman.2019.06.016

Kupper, F., Klaassen, P., Rijnen, M., Vermeulen, S., & Broerse, J. (2015). Report on the quality criteria of Good Practice Standards in RRI. Deliverable D1.3 . RRI Tools Project. *RRI Tools*, 1–50. http://www.rri-tools.eu/documents/10182/18424/D1.3_QualityCriteriaGoodPracticeStandards.pdf/f7a1d707-5e54-48cb-949b-053dc7c6f36f

Kuziemsky, C., & Lau, F. (2017). Engaging in eHealth Evaluation Studies. In L. Francis & K. Craig (Eds.), *Handbook of eHealth Evaluation: An Evidence-based Approach* (pp. 157–179). University of Victoria. https://www.ncbi.nlm.nih.gov/books/NBK481608/

Larson, A. L. (2000). Sustainable innovation through an entrepreneurship lens. *Business Strategy and the Environment*, *9*(5), 304–317. https://doi.org/10.1002/1099-0836(200009/10)9:5<304::AID-BSE255>3.0.CO;2-O

Le Ber, M. J., & Branzei, O. (2010). (Re)Forming Strategic Cross-Sector Partnerships. *Business and Society*, *49*(1), 140–172. https://doi.org/10.1177/0007650309345457

Leung, W. (2001). How to design a questionnaire. *Student BMJ*, *9*(322), 187–189. https://doi.org/10.1136/sbmj.0106187

Liang, F., Brunelli, M., & Rezaei, J. (2020). Consistency issues in the best worst method : Measurements and. *Omega*, *96*, 102175. https://doi.org/10.1016/j.omega.2019.102175

Lubberink, R., Blok, V., Ophem, J. van, & Omta, O. (2017). Lessons for responsible innovation in the business context: A systematic literature review of responsible, social and sustainable innovation practices. *Sustainability (Switzerland)*, *9*(5). https://doi.org/10.3390/su9050721

Maas, K., Schaltegger, S., & Crutzen, N. (2016). Integrating corporate sustainability assessment, management accounting, control, and reporting. *Journal of Cleaner Production*, *136*, 237–248. https://doi.org/10.1016/j.jclepro.2016.05.008

Manders, B., De Vries, H. J., & Blind, K. (2016). ISO 9001 and product innovation: A literature review and research framework. *Technovation*, *48–49*, 41–55. https://doi.org/10.1016/j.technovation.2015.11.004

Manu, F. A., & Sriram, V. (1996). Innovation, marketing strategy, environment, and performance. *Journal of Business Research*, *35*(1), 79–91. https://doi.org/10.1016/0148-2963(95)00056-9

Martin, B. R. (2013). Innovation Studies: an emerging agenda. In J. Fagerberg, B. R. Martin, & E. S. Andersen (Eds.), *Innovation Studies: Evolution and Future Challenges* (1st ed., pp. 168–186). Oxford University Press. https://doi.org/10.4018/978-1-59904-795-9.ch002

Mason, J. (1994). Linking qualitative and quantitative data analysis. In A. Bryman & G. R. Burgess (Eds.), *Analyzing Qualitative Data* (Vol. 1). Routledge. https://d1wqtxts1xzle7.cloudfront.net/30612100/data_20analysis.pdf?1361183764=&response-content-disposition=inline%3B+filename%3DAnalyzing_discourse.pdf&Expires=1618831226&Signature=WbmE8iC3Kiwm6ZFU9CYM7XfJZMVjfPmovdSFQq~4JLmz~pz7F-NtZ2iJLMOkXIA2~rOel3QTcNY39lcKKLg8MCJIlmLAjxVgmK5d22UwoQ63AdoCNIV9UDGygsNnDSxvDUw7eYbVr3i9n~WJEMA8CO2qBo62c1xT55SjeC-4Af~JVznqCN~ZW7njSodXdEkvzfgxFnjXGX4tThNQCIkMiUl4mrxW6GyU7~rStYeoPG9R5aRk93LyjcP~h9rrnP8l-zVfpDrd7ojhGzENzT5zAirlz~za8lyxOCgnDblompMvi1-ZC16reQQrcWabjRV3YNEtsmnszcXx2Rcs8BNuYg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA#page=104

Mclafferty, S. L. (2010). Conducting Questionnaire Surveys. In N. Clifford, S. French, & G. Valentine (Eds.), *Key Methods in Geography* (2nd ed., pp. 77–88). SAGE Publications. https://is.muni.cz/el/sci/jaro2015/Z0132/um/54979481/_Nicholas_Clifford__Gill_Valentine__Key_Methods_in_BookFi.org_.pdf#page=26

Nazarko, L. (2019). Responsible research and innovation – A conceptual contribution to theory and practice of technology management. *Business: Theory and Practice*, *20*, 342–351. https://doi.org/10.3846/btp.2019.32

Owen, Richard, Macnaghten, P., & Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society. *Science and Public Policy*, *39*(6), 751–760. https://doi.org/10.1093/scipol/scs093

Owen, Richard, & Pansera, M. (2019). Responsible Innovation and Responsible Research and Innovation. In S. Dagmar, K. Stefan, S. Julia, & C. Weert (Eds.), *Handbook on Science and Public Policy*. https://doi.org/10.4337/9781784715946

Owen, Richard, Pansera, M., Macnaghten, P., & Randles, S. (2021). Organisational institutionalisation of responsible innovation. *Research Policy*, *50*(1), 104132. https://doi.org/10.1016/j.respol.2020.104132

Pellé, S. (2016). Process, outcomes, virtues: the normative strategies of responsible research and innovation and the challenge of moral pluralism. *Journal of Responsible Innovation*, *3*(3), 233–254. https://doi.org/10.1080/23299460.2016.1258945

Pellizzoni, L. (2004). Responsibility and environmental governance. *Environmental Politics*, *13*(3), 541–565. https://doi.org/10.1080/0964401042000229034

Ponte, S., & Chenys, E. (2013). Voluntary Standards, Expert Knowledge and the Governance of Sustainability networks. *Global Networks*, *October*. https://doi.org/10.1111/glob.12011

Preston, C. C., & Colman, A. M. (2000). Optimal number of response categories in rating scales: Reliability, validity, discriminating power, and respondent preferences. *Acta Psychologica*, *104*(1), 1–15. https://doi.org/10.1016/S0001-6918(99)00050-5

Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega*, *53*, 49–57. https://doi.org/10.1016/j.omega.2014.11.009

Rezaei, J. (2016). Best-worst multi-criteria decision-making method: Some properties and a linear model. *Omega (United Kingdom)*, *64*, 126–130. https://doi.org/10.1016/j.omega.2015.12.001

Rezaei, J., Kothadiya, O., Tavasszy, L., & Kroesen, M. (2018). Quality assessment of airline baggage handling systems using SERVQUAL and BWM. *Tourism Management*, *66*, 85–93. https://doi.org/10.1016/j.tourman.2017.11.009

Ribeiro, B. E., Smith, R. D. J., & Millar, K. (2017). A Mobilising Concept? Unpacking Academic Representations of Responsible Research and Innovation. *Science and Engineering Ethics*, *23*(1), 81–103. https://doi.org/10.1007/s11948-016-9761-6

Rose, N. (2014). The human brain project: Social and ethical challenges. *Neuron*, *82*(6), 1212–1215. https://doi.org/10.1016/j.neuron.2014.06.001

Rothwell, R., & Wissema, H. (1986). Technology, culture and public policy. *Technovation*, *4*(2), 91–115. https://doi.org/10.1016/0166-4972(86)90002-7

Saltzman, J., Chatterjee, S., & Raman, M. (2008). A framework for ICT standards creation: The case of ITU-T standard H.350. *Information Systems*, *33*(3), 285–299. https://doi.org/10.1016/j.is.2007.10.001

Saunders, M. N. K. (2012). Choosing Research Participants. In G. Symon & C. Cassell (Eds.), *Qualitative Organizational Research: Core Methods and Current Challenges* (pp. 35–52). SAGE Publications. https://doi.org/10.4135/9781526435620.n3

Schot, J., & Rip, A. (1997). The Past and Future of Constructive Technology Assessment. *Technological Forecasting and Social Change*, *54*(2–3), 251–268. https://doi.org/10.1016/s0040-1625(96)00180-1

Schuurbiers, D. (2011). What happens in the Lab: Applying Midstream Modulation to Enhance Critical Reflection in the Laboratory. *Science and Engineering Ethics*, *17*(4), 769–788. https://doi.org/10.1007/s11948-011-9317-8

Shanteau, J., Weiss, D. J., Thomas, R. P., & Pounds, J. C. (2002). Performance-based assessment of expertise: How to decide if someone is an expert or not. *European Journal of Operational Research*, *136*(2), 253–263. https://doi.org/10.1016/S0377-2217(01)00113-8

Simons, L., & Nijhof, A. (2021). *Changing the Game: sustainable market transformation strategies to understand and tackle the big and complex sustainability challenges of our generation* (1st ed.). Routledge. https://doi.org/10.4324/9780429052613

Smyth, J. D., Dillman, D. O. N. A., Christian, L. M., & Stern, M. J. (2006). COMPARING CHECK-ALL AND FORCED-CHOICE QUESTION FORMATS IN WEB SURVEYS. *Public Opinion Quarterly*, *70*(1), 66–77. https://doi.org/10.1093 / poq / nfj007

Stahl, B. C. (2013). Responsible research and innovation: The role of privacy in an emerging framework. *Science and Public Policy*, *40*(6), 708–716. https://doi.org/10.1093/scipol/sct067

Stahl, B. C., Obach, M., Yaghmaei, E., Ikonen, V., Chatfield, K., & Brem, A. (2017). The Responsible Research and Innovation (RRI) Maturity Model : Linking Theory and Practice. *Sustainability*, *9*(6), 1–19. https://doi.org/10.3390/su9061036

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/10.1016/j.respol.2013.05.008

Suchman, M. C. (1995). Managing Legitimacy: Strategic and Institutional Approaches. *The Academy of Management Review*, *20*(3), 571. https://doi.org/10.2307/258788

Sutcliffe, H. (2011). A report on responsible research & innovation. In *MATTER and the European Commission*. https://www.researchgate.net/publication/267791930_A_Report_on_Responsible_Research_Innovation

Sylvester, A., Tate, M., Johnstone, D., Sylvester, A., Tate, M., & Johnstone, D. (2013). *Beyond synthesis : re-presenting heterogeneous research literature Beyond synthesis : re-presenting heterogeneous research literature*. *32*(12), 1199–1215. https://doi.org/10.1080/0144929X.2011.624633

Tamura, S. (2016). A new intellectual property metric for standardization activities. *Technovation*, *48–49*, 87–98. https://doi.org/10.1016/j.technovation.2016.01.007

Tassey, G. (2000). Standardization in technology-based markets. *Research Policy*, *29*(4–5), 587–602. https://doi.org/10.1016/S0048-7333(99)00091-8

Thapa, R. K., Iakovleva, T., & Foss, L. (2019). Responsible research and innovation: a systematic review of the literature and its applications to regional studies. *European Planning Studies*, *27*(12), 2470–2490. https://doi.org/10.1080/09654313.2019.1625871

Thompson, V. A. (1965). Bureaucracy and Innovation. *Administrative Science Quarterly*, *10*(1), 1–20. https://www.jstor.org/stable/2391646?seq=1#metadata_info_tab_contents

Timmermans, S., & Epstein, S. (2010). A world of standards but not a standard world: Toward a sociology of standards and standardization. *Annual Review of Sociology*, *36*, 69–89. https://doi.org/10.1146/annurev.soc.012809.102629

van de Kaa, G. (2013). Responsible innovation and standardization: A new research approach? *International Journal of IT Standards and Standardization Research (IJITSR)*, *11*(2), 61–65. https://doi.org/10.4018/jitsr.2013070105

van de Kaa, G., & de Bruijn, H. (2015). Platforms and incentives for consensus building on complex ICT systems : The development of WiFi. *Telecommunications Policy*, *39*(7), 580–589. https://doi.org/10.1016/j.telpol.2014.12.012

van de Kaa, G., Kamp, L., & Rezaei, J. (2017). Selection of biomass thermochemical conversion technology in the Netherlands: A best worst method approach. *Journal of Cleaner Production*, *166*, 32–39. https://doi.org/10.1016/j.jclepro.2017.07.052

van de Kaa, G., Papachristos, G., & de Bruijn, H. (2019). The governance of platform development processes: A metaphor and a simulation model. *Technological Forecasting and Social Change*, *138*(February 2017), 190–203. https://doi.org/10.1016/j.techfore.2018.08.021

van de Poel, I., Fahlquist, J. N., Doorn, N., Zwart, S., & Royakkers, L. (2012). The Problem of Many Hands: Climate Change as an Example. *Science and Engineering Ethics*, *18*(1), 49–67.

https://doi.org/10.1007/s11948-011-9276-0

Van den Hoven, J., Lokhorst, G. J., & Van de Poel, I. (2012). Engineering and the Problem of Moral Overload. *Science and Engineering Ethics*, *18*(1), 143–155. https://doi.org/10.1007/s11948-011-9277-z

van der Burg, S. (2009). Taking the "soft impacts" of technology into account: Broadening the discourse in research practice. *Social Epistemology*, *23*(3–4), 301–316. https://doi.org/10.1080/02691720903364191

von Schomberg, R. (2011). Towards Responsible Research and Innovation in the Information and Communication Technologies and Security Technologies Fields. In *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2436399

Von Schomberg, René. (2013). A Vision of Responsible Research and Innovation. In R Owen, M. Heintz, & J. Bessant (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society* (Issue November 2013, pp. 51–74). London: John Wiley, forthcoming. https://doi.org/10.1002/9781118551424.ch3

Wang, Z., Zhang, M., Sun, H., & Zhu, G. (2016). Effects of standardization and innovation on mass customization: An empirical investigation. *Technovation*, *48–49*, 79–86. https://doi.org/10.1016/j.technovation.2016.01.003

Werle, R., & Iversen, E. (2006). Promoting legitimacy in technical standardization. *Science, Technology & Innovation Studies*, *2*(March), 19–39. http://dx.doi.org/10.17877/DE290R-12756

Wickson, F., & Carew, A. L. (2014). Quality criteria and indicators for responsible research and innovation: learning from transdisciplinarity. *Journal of Responsible Innovation*, *1*(3), 254–273. https://doi.org/10.1080/23299460.2014.963004

Wickson, F., & Forsberg, E. M. (2015). Standardising Responsibility? The Significance of Interstitial Spaces. *Science and Engineering Ethics*, *21*(5), 1159–1180. https://doi.org/10.1007/s11948-014-9602-4

Wiegmann, P. M., de Vries, H. J., & Blind, K. (2017). Multi-mode standardisation: A critical review and a research agenda. *Research Policy*, *46*(8), 1370–1386. https://doi.org/10.1016/j.respol.2017.06.002

Williamson, O. E. (1998). Transaction cost economics: How it works; where it is headed. *Economist*, *146*(1), 23–58. https://doi.org/10.1023/A:1003263908567

World Trade Organization. (2000). The WTO Agreements Series Technical Barriers to Trade. *World Trade Organization*, *34*, 21–144. https://www.wto.org/english/res_e/booksp_e/tbt3rd_e.pdf

Yadav, G., Mangla, S. K., Luthra, S., & Jakhar, S. (2018). Hybrid BWM-ELECTRE-based decision framework for effective offshore outsourcing adoption: a case study. *International Journal of Production Research*, *56*(18), 6259–6278. https://doi.org/10.1080/00207543.2018.1472406

Zi, A., & Blind, K. (2015). Researchers' participation in standardisation: a case study from a public research institute in Germany. *Journal of Technology Transfer*, *40*(2), 346–360. https://doi.org/10.1007/s10961-014-9370-y

Zwart, H., Landeweerd, L., & Rooij, A. Van. (2014). Adapt or perish ? Assessing the recent shift in the European research funding arena from ' ELSA ' to ' RRI .' *Life Sciences, Society and Policy*, *10*(11), 1–19. https://doi.org/10.1002/9781118551424.ch3

Appendix A - Identification and selection of literature

This section will outline the goals, scope, identification and selection of literature for the literature review presented in chapter 2.

The goal of this literature review is to explore the concept of RRI and its meaning according to different researchers, as well as compare and contrast different definitions in recent history. In essence the aim is to derive concise definitions of its core elements. Ultimately the result of this research would amount to a clear set of criteria that can be used for further discourse in this research. Therefore this literature review takes on frameworks and narrative reviews as a starting point, since recent efforts to expand and synthesize RRI as a concept have been numerous (Burget et al., 2017; Fraaije & Flipse, 2020; Lubberink et al., 2017; Stilgoe et al., 2013) and, thus, form a logical starting point to explore extant literature.

The 'narrative review' is chosen as the approach of reviewing extant literature in this section as it is considered a mainstream way to interpret prior knowledge in a qualitative manner (Sylvester et al., 2013). The goal of the narrative review is to summarise, contrast and synthesize existing knowledge on topics to engage in a predefined discussion of interest to the researcher (Green et al., 2006). Due to a lack of explicit criteria however, the process of selection and identification becomes ultimately subjective (Kuziemsky & Lau, 2017), and risks bias towards interpretations and conclusions (Green et al., 2006; Sylvester et al., 2013).

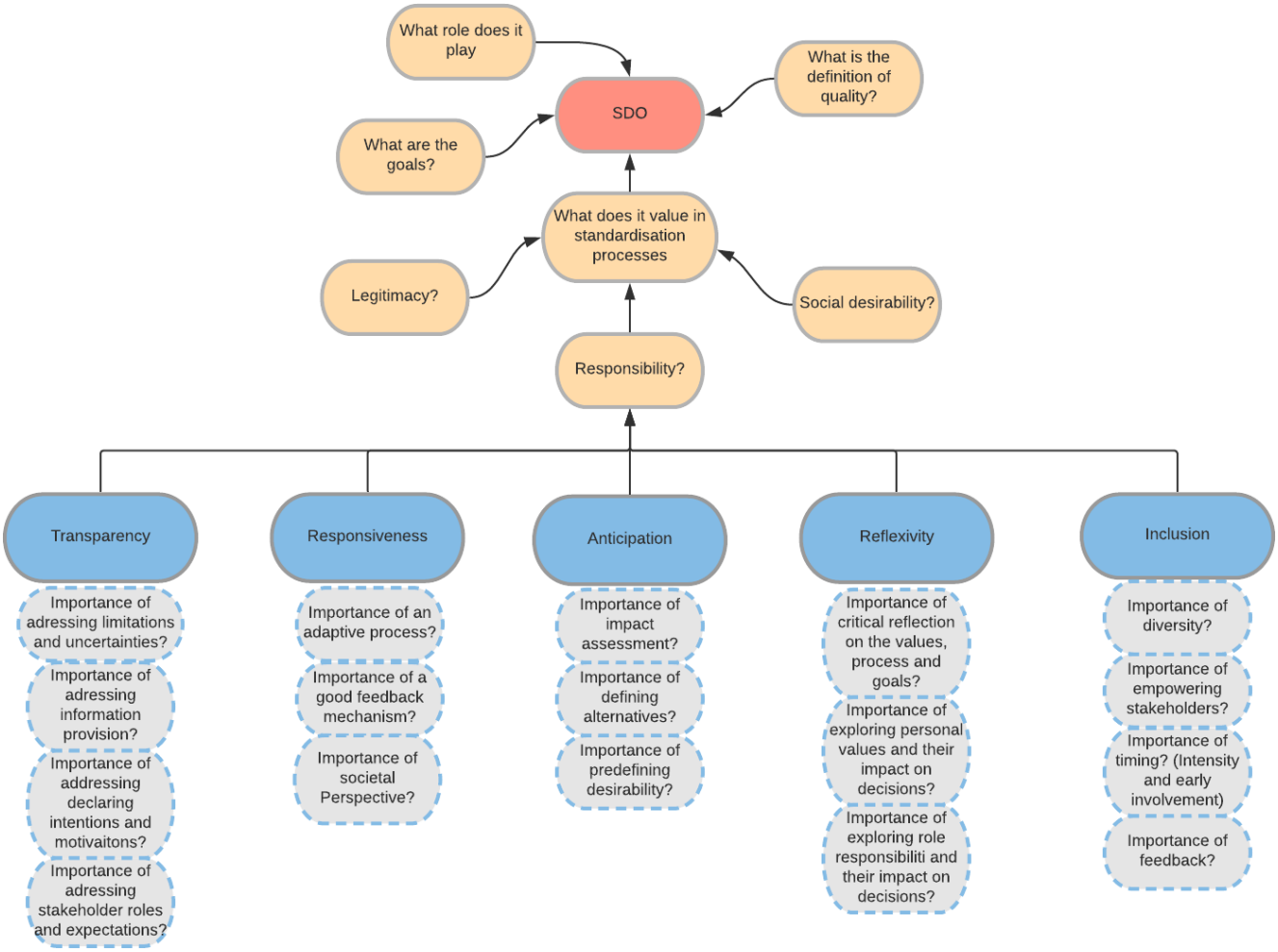
However, the narrative review, remains a powerful way of accumulating and exploring large volumes of literature to make discussion more accessible and readable (Kuziemsky & Lau, 2017). Its usefulness extends to providing a comprehensive overview highlighting past and present understanding of knowledge, and present a 'broad perspective' on a topic (Sylvester et al., 2013). Furthermore it can stress and further help identify avenues of new research.

In order to conduct this literature review, it's important to meet clear search criteria as to not fall prey to a subjective literature review. To safeguard its objectiveness, clear and predefined search terms were used to search for literature. Search engines such as Scopus, World of Science and Google Scholar have been used to find relevant results. Keywords of notice include combinations of 'RRI', 'RI', 'review', 'framework' and 'responsible research and innovation'. Whilst reviewing literature, a snowballing method and a backwards search were applied to find further literature in order to gain a deeper understanding of core concepts.

In recent years RRI has become embedded in public policy discourse originating from the European Commission (Owen & Pansera, 2019). RRI encompasses certain, more recent, instrumental values such as science education, openness and gender roles. The main focus of this literature review is to look at the process dimensions more akin to core concepts of Responsible Innovation as presented by Stilgoe et al. (2013), since these dimensions share great resemblance (Zwart et al., 2014). The aforementioned instrumental nature of RRI, including concepts such as open science, gender roles, diversity and science education are beyond the scope of this literature review.

Appendix B - Interview guide

Figure 8; Interview Guide



Appendix C - Exploratory interview Transcripts

The goal of the transcriptions and thematic coding is to explore the RRI dimensions in the context of standardisation. Purposefully, the interviews are color-coded with respect to five key RRI dimensions of this research, which were adopted as the main perspective. The themes are therefore predefined. The transcripts were read and re-read to categorise the interview section toward their respective theme/dimension. This color-coding includes elements like examples and connecting phrases. The transcripts will be used for the discussion section, where the most important takeaways will interpreted and compared to with questionnaire findings and literature. The important takeaways of the thematic analysis can be found in appendix D.

Thematic codes

Objectives/goals (quality)

Inclusion

Anticipation

Responsivity

Transparency

Reflexivity

Interview 1

What is the role of NEN in the standardisation process?

NEN serves a neutral role and actually functions as a platform for the development of standards. It concerns subjects where there are conflicting interests, in which NEN wants to create a level playing field so that everyone can contribute meaningfully. In addition, they guarantee the steps in which everyone is actually heard. NEN has this authority because of its long-held reputation. The goal of NEN in this respect, is for stakeholders to find NEN; NEN does not create standards out of some idealistic viewpoint. Although there is a discussion within NEN about the desirability of NEN stimulating certain societal themes. This happens in the context of circular economy, in which NEN actively takes up certain projects.

What are NEN's interests?

How to get as many people involved as possible under conditions that are appropriate for them. The current standardization processes are slow and not very useful in the fast way, in which information is shared these days. NEN is looking for methods, e.g. events, forums and lectures, to better communicate the importance of standardisation as well as finding ways to involve parties in standardisation. Consensus is baseline and non-negotiable. This means that projects can sometimes take years, but consensus is necessary to safeguard interests.

Standards are not required by law, so it is important that broad support is necessary for their application. The application of standards is part of NEN and a good example of this. Originally it was only a publishing house, but nowadays it is also involved in providing training and developing web applications: other products for the application of standards.

Nowadays, NEN does find it important that there are enough people at the table to arrive at a qualitative standard. One-man committees are less present these days. NEN has taken a critical look

at the business case as a service provider, despite its role as a platform for standards creation. Continuity plays a role, projects are only taken up if there is sufficient funding in return.

How important is responsibility for NEN?

NEN will only leave its mark on a document if all the steps have actually been undertaken. Sometimes it turns out that the end product is not quite what it was hoped for. In that case it's important to be honest and look for other more suitable forms (e.g. NTA) to publish something meaningful when the outcome of a standardisation process is perhaps not so coherent.

What is qualitative standardisation process?

The quality of standards is guaranteed by a system of rounds in which proposals are presented, revised and negotiated. To a certain extent, quality is a formalised process. There is an obligation to inform and involve stakeholders in advance. NEN is obligated to report this to the Ministry of Economic Affairs. Quality lies in the transparency and consistency of the formalised format (word use, text formatting, editing) through stakeholder engagement. Ultimately, there is also a public consultation round, in which anyone who has not participated can view the document and comment on it for publication. Consensus is a precondition for this; if documentation is not sufficient, it is returned to the drawing board/negotiation table.

What is the argument for participation, why is it so important for NEN?

On the one hand, participation is important to create support for standards; without support NEN actually has no raison d'être for their development, because without support the standards will not be adopted. NEN is convinced that standards can only contribute to a better world if they are actually applied. The success of a standard is therefore important. It is not always possible or necessary to have all parties at the table. If not all parties are at the table, there can still be qualitative standards.

How important is diversity in the participation of standardisation processes?

It is important to have parties at the table in certain proportions, because it is seen that some parties (often producers) will dominate/overshadow less represented parties. Balanced discussions are important in order not to end up in a push and pull situation in which, at the end of a round, objections are raised by smaller parties. NEN is committed to individual initiatives to involve yet other stakeholder categories. In addition, the aforementioned reporting obligation to EZK also applies when participation threatens to result in the over-inclusion of a certain type of stakeholder (oftentimes producers).

How important is it to give participants the feeling that they can make a meaningful contribution to standardisation?

All feedback is treated equally by NEN and the chairman of the relevant committee. Power asymmetries are not so bad in practice, because of the consensus precondition for taking decisions. However, it appears that certain persons/parties overshadow other stakeholders. NEN monitors this during the process by actively offering the floor to less talkative parties. In addition, when there is a conflict of interests between parties that cannot be resolved in the committee, individual contact for solutions can be offered as well as providing more parties for the committee in order to find a better balance. Giving personal space is important to express certain underlying interests and motivations and to give space when these cannot easily be expressed in a consensual setting. Feedback mechanisms are present in the form of comment tables in which all interests and objections are expressed. The whole committee will treat and discuss any criticism on an equal footing. Party members are actively encouraged to participate, as they are part of the committee for a reason.

How important is it to involve stakeholders in the standardisation process from the start?

It is definitely preferable. In the case of long drawn out standardisation processes, it is less important when people join or leave. However, some smaller and short-term standardisation activities call for participation from the outset. Because some standards committees set deadlines for drawing up standards and it is simply not desirable from a pragmatic point of view to have new insights and objections from late participants.

Is the intensity (how often one meets) of the discussion important?

Meeting quality is not directly influenced by intensity. Intensity depends very much on the (technical) complexity of an issue and sometimes also on the urgency. Examples are the NEN spec, this is a trajectory about non-medical masks. The intensity of this standards committee is very high because of the relevance/urgency of the subject in the current situation. Intensity can, however, contribute to the progress of standards creation, since committees don't have to wait for documents and comments. But for some processes speed is not essential, but rather ensuring a thorough process.

To what extent is it important to look at the impact of standards on society/economy/etc?

NEN finds it very difficult to define the impact of standards. Social desirability is expressed in the alignment of NEN towards these goal and their uptake of certain projects. But NEN remains neutral: no normative preference for solutions/standards. The aim is to find out where the interests overlap and where common ground can be found. Social desirability can be the starting point, but it's not defined by NEN.

Does NEN consider more than one standard during the standardisation process?

In standardization, this proves difficult, because there can't be two standards on the same subject at the same time. Standards have room for changes and new developments, but several standards are not developed at the same time. This is also not necessary, as standards can be reformulated, adapted and retired as opposed to innovation. Standards are adaptive/flexible. Ongoing insight results in ever new requirements. Example of this are a set of standards for playground equipment: 10 standards that are continuously reviewed. Corrigenda or addenda help to always adapt a standard in the short term, in the long term standards can reformulated.

What is the role of transparency?

By taking a neutral role, they hope that parties share openly and honestly about their goals and motivations/interests. However, parties often have a hidden agenda or other goals than those indicated. But over time, over various feedback rounds and revisions, you learn more about certain parties and the transparency increases. The prolonged exposure to discussions clarifies a lot of things. In the end, most issues come to light. In addition, NEN provides an open platform for documents for comments and technical documents and all old versions of the standards and comment tables even after the standard has been published. In this way, feedback becomes an important component and participants can see how comments have been incorporated into new documents.

How important is the sharing of motivations, interests and information

Many competitors sit at the table and are usually reluctant. However, legal NDAs are used to protect parties when they run off with information. Thus, NEN tries to encourage transparency and avoid undesirable strategic behaviour in order to generate an open field in which everyone feels they can share in the discussion.

How is the role of information organised in a standardisation process?

The exchange of knowledge is an essential added value of a standards committee. Every participant has access to unique (sometimes specific) and relevant information. People who have a lot of information are usually asked to submit a first version of a document for discussion in order to raise

the level of knowledge. Stakeholders generally have different needs from their context and therefore different input. This enriches the exchange of knowledge. Subjectivity and high-tech information asymmetry are kept in check by the consensus decision-making process. If something is incomprehensible or not true, everyone has the right to refer the proposal back to the drawing board/negotiation table. Fewer candidates can often also add value by playing devil's advocate and questioning the assumptions and knowledge of experts. Ultimately, the standards will have to be applied, so they will have to be readable and understandable by all.

Interview 2

What does quality mean in the standardisation process? What is a quality process?

Standardisation has a number of basic principles defined by the WTO. This definition describes standardisation as a transparent process, with 'all parties concerned' where decisions are taken on the basis of consensus. Impartiality in the process is also an important qualitative element of NEN. NEN strives to offer a neutral platform for those who want to develop standards.

What are NEN's interests in the standardisation process?

NEN itself has no preferences with regard to standards, but it can point to the use of certain sustainability goals, defined by bodies such as ISO or other standards developers (interest groups). Sometimes they suggest including such goals in the foreword. By way of illustration, there is an ISO guide on how sustainability can be embedded in the information provision process in standardisation. This can serve as a source of inspiration for experts, but is not made compulsory by the NEN or insisted upon. Committees usually consist of an older group of men. Promoting gender equality now plays a role in ISO, but to require certain gender roles is not possible. NEN itself does not have a social objective such as fair trade alliances, WWF and Solidaridad.

What is the role of diversity in the standardization process?

It follows from the principle of 'all parties concerned' that diversity plays an important role, in which the relevance of parties to societal issues is most important. In addition, it is also important to look at this ageing group of men who are usually participants in processes and how to deal with the loss of their knowledge and expertise when they retire. Involving younger people gives the opportunity to preserve that knowledge better. But representatives for committees are ultimately determined by the parties themselves. The only room for decision that NEN can play in this respect is in the distribution of roles, for example the appointment for the position of chairman.

What is the role of the consensus? How important is this for creating a level playing field?

It is a definitely a challenge, but it depends on the situation. In some sectors, party members are very dependent on each other and in other sectors, party members are very independent and therefore more quickly at odds with each other. The people who work the hardest, hand in documents and comment on them, will still have more influence on the process. Power relations and personal competencies determine the influence on the process. Consensus does play an important role in creating support, but this is not always necessary. Sometimes this is naturally present in certain subjects. The process of consensus, on the other hand, is very important in order to understand each other.

In some cases, standards are so widely accepted that parties are almost forced to participate (e.g. ISO quality management). This results in a kind of forced consensus, because the document in question is so important. Consensus protects the process of the less fortunate in the field of technical knowledge.

What role does transparency play and how important is it for the standardisation process?

Transparency is a requirement. NEN achieves transparency through a formalised structure for sharing information/documents and voting on proposals. Everyone is essentially equal. But at the same time parties can get bogged down in procedures that make it difficult for parties to understand what they have to do and what is expected of them. Information meetings to help people with this formal structure are usually used to remedy this. There is a great deal of effort put into communicating the basic outline of standardisation in order stimulate people to participate in standardisation.

What role do the interests and roles play in the standardisation process?

Things are usually not intentionally withheld. Part of this consensus process is that people get to know each other better and understand each other's interests and motives. It does happen that parties are not understandable, but talking things through helps to clarify matters. Interests do eventually come to the table. Individual discussions also play a role in clarifying certain problems and values.

How important is impact assessment in the standardisation process and how is it organised?

The impact is more defined from the organisation itself and what is important for their perspective. For this reason, NEN uses a business method called OGSM that centres on objectives, goals, strategy, and measurements. It is a method for defining organisational strategy. This is defined in the context of the organisation of NEN and signals the extent to which NEN is in line with social goals through its projects.

However, some interest groups that partake in standardisation (e.g. rainforest alliance) look beyond the organisation. They also look at the impact assessment of standards. What does the diffusion of standards lead to in the final figures on the goals of the standard? Strangely enough, this question does not play a role in NEN's standards.

The idea does exist, however, to have a discussion with committees in order to better understand what the parties actually want with them, what future prospects they have ahead of them.

What is the role and importance of feedback mechanisms in standardisation?

A good feedback structure creates transparency and trust in the process / outcome. NEN puts a great deal of effort into ensuring feedback goes through the proper channels and is treated with care. However sometimes it is not possible for people to attend certain meetings and give feedback. NEN facilitates this through organising online commenting. In addition, a great deal of attention is paid to taking the time to deal with each piece of comment separately and carefully, so that people feel that they are being heard. There must always be clear arguments when comments are not recorded.

Interview 3

What is the importance of NEN in topics such as earthquake guidelines and constructive safety?

The demand for standards often comes from the government, e.g. the earthquake directive is an issue created by the Ministry of Economic Affairs. As an independent institute NEN facilitates the process of knowledge development. Their role is facilitating and there are no self-interests involved. NEN takes on an assignment to facilitate a certain process within a certain period of time with the intent to create an actual a usable product/standard. They only make decisions when processes seem to get bogged down in endless revisions. NEN's core values are transparency, quality and consensus.

What is the role of consensus in the standardisation process?

Progress can only be made if everyone agrees on the direction of resolution, otherwise the process falls back to its starting point. Consensus and having parties at the table, is the key to this process. Parties with a great deal of technical expertise are often more influential, often because of the structure of some standard development processes, in which experts are sometimes necessity. Parties

that do not have a great deal of knowledge, often public parties (housing corporations, etc.) can be represented in a steering group, in order to maintain an overview. As a non-technical party, you cannot really participate in task forces, for example, because the question is often very concrete and technical in nature. However, these less technically-savvy parties can express an opinion on the carefulness of the process, e.g. are all parties represented and heard. In normal committees, parties can exercise more influence.

Is it important to include parties from the outset, especially in such technically sophisticated projects?

In a standards committee parties have to put their knowledge on the table and pay membership fees in order to fund the structure to facilitate the process and to gain access to international standardisation documentation. That is why there are paid people at the table to represent certain interests from their respective organisation. During the standardisation process, which can be characterised by tight deadlines, there are hardly ever any newcomer. It is not the case, however, that new parties are excluded unless there is a large over-representation of a specific category of parties at the table. In that case parties are asked whether they would perhaps like to participate from a different role, for example as an industry association. This proves difficult in practice, because NEN has no insight into whether this role is actually being fulfilled and the industry is actually being consulted.

What is the role of transparency in the process?

It is important to make clear and transparent to parties what the steps are to arrive at a standard, but they cannot be forced to put all their knowledge on the table. NEN can, however, enforce that what is decided or discussed is properly recorded, in order to avoid the impression that things are being discussed in back rooms. It oftentimes happens that technicians outside the process call in with a number of new ideas, but this must always be fed back to the committee in a meeting. Otherwise you run the risk of losing parties in the process. It is possible that parties may change their minds through new insight, but this new insight must always be referred back to the table. If it is not possible to work on the basis of trust, then no decisions can be made. Parties often withhold opinions and sometimes knowledge; it is the consultant's task to fathom these dynamics. Sometimes the parties are at odds with each other, in which case they can explore in private or in one-on-one talks what exactly is going on. It is an art to clarify these interests and, if desirable, to share them.

How important is feedback in this process?

In the standardisation world there are standards, clear agreements on how something should be carried out, measured, etc. In addition, there are guidelines that have a more suggestive role on how something could be carried out, measured, etc. There are also NTA (Dutch Technical Agreements), in which agreements are made in small groups. NTAs are often forerunners of standards, and parties often adhere to these agreements. In addition, there are also less formal forms for documenting standards (web tools, position papers, etc.). According to NPR (guidelines for standards), the standardisation process follows a number of formal steps, starting with the submission of a draft. This is followed by public commenting rounds in which parties who are not members of the committee may also vote, provided they also submit suggestions. These rounds of comments are subject to the rules of the game and last about 3 months, after which they return to the committee. It is the committee's task to consider any criticism or suggestion carefully. These rounds of comments are invaluable for an ultimately workable and practically applicable document, as a committee often discusses technical matters and sometimes loses its practical orientation. The comments are fed back to those who have made suggestions or criticisms. In the end, the agreements are used under private law.

Does it matter how often a committee meets for the quality of a standard?

Usually it does not matter how often parties meet, this depends on the theme and does not say anything about the quality of the substantive dialogue. The fact is, however, that a great deal of progress can be achieved if intensive meetings are held. Certainly when the subject of a committee is knowledge development, it is not desirable for a subject to be spread out over a long period of time. In that case, inertia does have an effect on the quality of the process. In addition, it is the case for commercial parties that standards do not always yield returns and are therefore not high on their agenda. So it sometimes happens that these parties do not hand in their documents or hand them in too late. This presents a difficulty for the consultant because ultimately their contribution is voluntary. Deadlines can help maintain the tempo/momentum and prevent parties from losing their interest. Some committees with an innovative character do benefit from speed, because parties do not want to be late with the introduction of such a standard.

Is there any concern for the impact of standards?

Standards are often considered important by certain parties with certain interests. But NEN will not suggest to start a certain trajectory themselves. The moment a standardisation process is started, it is actually already evident that parties suspect that there is a positive impact for the standard. In some committees, for example earthquake guidelines from Groningen, the positive impact of the standard has been considered beforehand. There is no need to elaborate further on this, as the product is of social desirability. The fact a standard is needed, is often a goal in itself. The expectation is then not so much about what comes out of such a standard development process, but that a standard will be developed.

In some cases, the government indicates that something is going to change or that there are intentions for regulation, in which case the parties are out to make a contribution to a new standard. Certainly when this standard will also be codified. Here it is important to influence the process from an early stage.

Appendix D - Thematic analysis

Objectives:

The objective of NEN is to facilitate the creation of standards as a neutral party and provide the tools to create a level playing field for all parties concerned to contribute meaningfully. Neutrality and a formalised system for process allow standards to gain support for their adoption, since standards are not required by law. Standards can only contribute to a better world, if they are ultimately adopted, similarly adoption of standards ensure the continuity of NEN as a business. The process of standards creation is based on the principle of trust, if there is no trust no decisions can be made.

From the thematic analysis with NEN standardisation experts can be concluded that the definition of quality in the standardisation process is quite standardised. Many standardisation experts have referred to a few common qualitative elements defined in the World Trade Organizations Agreements series (World Trade Organization, 2000).

The three most important indicators of (process) quality are transparency, openness, consensus/ impartiality. Transparency can be defined as consistency and clear use of the formalised structure for standard creation from inception to publishing. Transparency also refers to accessibility of documentation to both committee members as well as general stakeholders outside the committee (World Trade Organization, 2000).

Secondly, openness refers to the principle of 'all parties concerned', where stakeholder engagement is facilitated on a non-discriminatory basis. Openness includes the creation of tools and means in order to create equal opportunity for interested parties to meaningfully interact and participate.

Thirdly, consensus is a precondition for meaningful interaction by means voting power and a way to ensure impartiality of the process. World Trade Organization (2000) describes consensus as a facilitator of shaping common ground and views through reconciliation of conflicts, while giving no privilege to particular interests. NEN strives to offer a neutral platform for those who want to develop standards.

Inclusion:

Inclusion means the diversity and fair representation of participants relevant to the context, i.e. all parties concerned. It also relates to creation of tools for people to engage and meaningfully contribute in standardisation processes. Essential to engagement is consensus, as it serves as a safeguard for interests of participants. Inclusion also means a sufficient body of participants, single member committees are not financially viable. Participants not only include committee members but also general stakeholders, who are consulted in public consultation rounds. Feedback is therefore very important in treating and discussing ideas on an equal footing. Quality of standards creation generally isn't affected by intensity or early engagement, but I can serve to create urgency and therefore keep maintain momentum in the process.

Transparency:

Transparency relates to openness of information, motivations and interests as well as readability and comprehensibility of documentation. Furthermore, it is also related to clear and consistent use of a formalised format. Sometimes personal spaces are required for parties to express underlying interests and motivations. Legal Non-disclosure agreements are in place to safeguard transparency and the interests of stakeholders.

Anticipation:

Anticipation includes the alignment of NEN towards socially desirable topics and projects, the aim is identify where interests overlap and common ground can be found. However impact assessment of standards are generally not included within the scope of anticipation in standardisation. In some cases anticipation plays a bigger part than other committees. Some standardisation processes are initiated through governmental intervention, by posing certain questions or indicating the intention of potential regulation. In these cases the social desirability and impacts are predefined and excluded from the standardisation process. Defining alternative standards proves difficult, since it's desirable to have one common standard on a specific subject at a time. But there are options of the format of the standard.

Responsivity:

Responsivity means adopting a perspective in favour of stimulating certain socially desirable themes. Standards are relatively flexible, since they can be adapted or retired. Standardisation is receptive toward ongoing insights and new requirements. Corrigenda or addenda help to always adapt a standard in the short term, in the long term standards can reformulated.

Reflexivity:

Reflexivity means a reflection on underlying interests and motivations of participants. Participants generally have different needs from their context and therefore present different inputs. This enriches the exchange of information and learning. Reflexivity is facilitated through formalised iterations or rounds of negotiation and decision-making. Reflexivity is strongly supported by transparency and participation, in order to generate balanced and open discussions as to not end not to end up in a push and pull situation in which, at the end of a round, objections are raised by smaller parties.

Appendix E - Questionnaire form

Block 2

Consent

U bent uitgenodigd om deel te nemen aan een enquête naar Maatschappelijk Verantwoordelijke Innovatie (Responsible Innovation) in de ontwikkeling van normen. Het onderzoek waar u aan mee zal doen wordt uitgevoerd door Almar Meijer van de TUDelft.

Het doel van deze enquête is het bepalen van de invloed/belang van concepten van maatschappelijk verantwoordelijke innovatie op de kwaliteit van normalisatieprocessen, en duurt ongeveer 10-25 minuten. De resultaten van het onderzoek kan NEN helpen om haar diensten verder te ontwikkelen. Uw deelname aan deze enquête is geheel vrijwillig en u kunt zich op elk moment terugtrekken. Het staat u vrij om vragen weg te laten.

Er wordt zorgvuldig omgegaan met de onderzoeksgegevens van deze enquête. De verzamelde gegevens en de analyses zullen worden opgeslagen in een speciale TUdelft opslagruimte voor gevoelige informatie voor een periode van 1 jaar. De enquête is in eerste instantie anoniem, er wordt geen persoonlijke informatie opgeslagen.

Als u door klikt naar de volgende pagina, ga ik ervan uit dat u akkoord gaat met de voorwaarden.

Contact
Almar Meijer
Bsc Systems Engineering, Policy Analysis and Management
4113314

Block 3

Algemene Vragen

In welke sector bent u actief? (Aggro/food, EP/EV, Bouw, etc...)

Hoe lang bent u al werkzaam bij NEN?

- ○ 0-3 Jaar
- ○ 4-6 Jaar
- ○ 7-9 Jaar
- ○ >9 jaar

Bij hoeveel commissies bent u betrokken of betrokken geweest? (ordegrootte)

Block 4

DEEL 1: INCLUSIE

In de onderstaande tabel worden de concepten beschreven die tot Inclusie behoren:

Diversiteit van participatie	Diversiteit heeft betrekking op de aanwezigheid van participanten die relevant zijn voor de normalisatiecontext. Diversiteit van deelname betekent dat participanten uit verschillende disciplines moeten worden betrokken. Diversiteit hangt ook samen met een voldoende aantal participanten.
'Empowerment' van belanghebbenden	Het bieden van stemrecht en andere mogelijkheden om invloed uit te oefenen op het proces en de resultaten van normalisatie.
Tijdstip van betrokkenheid	Hoe vroeg en hoe vaak participanten worden betrokken bij de ontwikkeling van en besluitvorming over normen.
Aandacht voor feedback	Mechanismen/tools die aantonen hoe bijdragen van participanten van invloed zijn op resultaten en besluiten.

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items	Meest Belangrijk	Minst Belangrijk
Diversiteit van participatie		
Empowerment van participanten		
Tijdstip van betrokkenheid		
Aandacht voor feedback		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Diversiteit van participatie	○	○	○	○	○	○	○	○	○
» Empowerment van participanten	○	○	○	○	○	○	○	○	○
» Tijdstip van betrokkenheid	○	○	○	○	○	○	○	○	○
» Aandacht voor feedback	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Diversiteit van participatie	○	○	○	○	○	○	○	○	○
» Empowerment van participanten	○	○	○	○	○	○	○	○	○
» Tijdstip van betrokkenheid	○	○	○	○	○	○	○	○	○
» Aandacht voor feedback	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Diversiteit van participatie	○	○	○	○	○	○	○	○	○
» Empowerment van participanten	○	○	○	○	○	○	○	○	○
» Tijdstip van betrokkenheid	○	○	○	○	○	○	○	○	○
» Aandacht voor feedback	○	○	○	○	○	○	○	○	○

Block 5

DEEL 2: ANTICIPATIE

In de onderstaande tabel worden concepten beschreven die tot Anticipatie behoren:

Identificatie van impacts	Bewustwording van mogelijke onvoorziene of juist wenselijke gevolgen van normen.
Het vooraf bepalen van maatschappelijke wenselijkheid	Scheppen van wenselijke visies op de toekomst door sociaal wenselijke (vormen van) normen te definiëren.
Identificatie van alternatieve trajecten voor innovatie	Open staan voor alternatieve normen om niet te vroeg een norm te ontwikkelen, wanneer deze achteraf toch niet wenselijk blijkt.
Timing van anticipatie	Vroegtijdige (vanaf het begin) identificatie van effecten en onzekerheden om (negatieve) maatschappelijke gevolgen aan te pakken; herhaalde aandacht voor mogelijke impact van normen gedurende het normontwikkelingsproces

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items	Meest belangrijk	Minst belangrijk
Identificatie van impacts		
Vooraf bepalen van maatschappelijke wenselijkheid		
Identificatie van alternatieve norm trajecten		
Timing van anticipatie		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Identificatie van impacts	○	○	○	○	○	○	○	○	○
» Vooraf bepalen van maatschappelijke wenselijkheid	○	○	○	○	○	○	○	○	○
» Identificatie van alternatieve norm trajecten	○	○	○	○	○	○	○	○	○
» Timing van anticipatie	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Identificatie van impacts	○	○	○	○	○	○	○	○	○
» Vooraf bepalen van maatschappelijke wenselijkheid	○	○	○	○	○	○	○	○	○
» Identificatie van alternatieve norm trajecten	○	○	○	○	○	○	○	○	○

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Timing van anticipatie	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Identificatie van impacts	○	○	○	○	○	○	○	○	○
» Vooraf bepalen van maatschappelijke wenselijkheid	○	○	○	○	○	○	○	○	○
» Identificatie van alternatieve norm trajecten	○	○	○	○	○	○	○	○	○
» Timing van anticipatie	○	○	○	○	○	○	○	○	○

Block 6

DEEL 3: RESPONSIVITEIT

In de onderstaande tabel worden de concepten beschreven die tot Responsiviteit behoren:

Hanteren van een maatschappelijk perspectief	Inspelen op maatschappelijke vraagstukken door het scheppen van een gemeenschappelijke (maatschappelijke) probleemstelling met participanten.
Aanpassing aan maatschappelijke veranderingen	Ontvankelijkheid voor veranderende maatschappelijke behoeften en verwachtingen
Evaluatiemechanisme	Evalueren van strategieën en verwerken van feedback of normen nog wel fit-for-purpose zijn

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items	Meest belangrijk	Minst belangrijk
Hanteren van een maatschappelijk perspectief		
Aanpassing aan contextuele verandering		
Evaluatiemechanisme		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Hanteren van een maatschappelijk perspectief	○	○	○	○	○	○	○	○	○
» Aanpassing aan contextuele verandering	○	○	○	○	○	○	○	○	○
» Evaluatiemechanisme	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Hanteren van een maatschappelijk perspectief	○	○	○	○	○	○	○	○	○
» Aanpassing aan contextuele verandering	○	○	○	○	○	○	○	○	○
» Evaluatiemechanisme	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Hanteren van een maatschappelijk perspectief	○	○	○	○	○	○	○	○	○
» Aanpassing aan contextuele verandering	○	○	○	○	○	○	○	○	○
» Evaluatiemechanisme	○	○	○	○	○	○	○	○	○

Block 7

DEEL 4: REFLEXIVITEIT

In de onderstaande tabel worden concepten beschreven die tot Reflexiviteit behoren:

Herkennen van rol specifieke drijfveren	Herkennen en leren begrijpen van drijfveren die participanten, als vertegenwoordiger van hun organisatie, sturen in hun aannames. Herkennen van wetenschappelijke normen en methodieken. Herkennen van organisatiecultuur en contextuele beperkingen.
Herkennen van persoonlijke drijfveren	Herkennen en leren begrijpen van de sociale en maatschappelijke overwegingen van participanten als deelnemer van de samenleving.
Uitdagen van drijfveren	Kritische reflectie over ethische en andere meer maatschappelijke overwegingen.
Inzicht in de impacts van drijfveren	Inzicht vergroten van de impact van producten, diensten en processen op onze samenleving; ervoor zorgen dat de juiste indicatoren worden afgewogen om de impact te evalueren

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items

Meest belangrijk	Minst belangrijk

Herkennen van rol specifieke drijfveren		
Herkennen van persoonlijke drijfveren		
Uitdagen van drijfveren		
Inzicht in de impacts van drijfveren		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Herkennen van rol specifieke drijfveren	○	○	○	○	○	○	○	○	○
» Herkennen van persoonlijke drijfveren	○	○	○	○	○	○	○	○	○
» Uitdagen van drijfveren	○	○	○	○	○	○	○	○	○
» Inzicht in de impacts van drijfveren	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Herkennen van rol specifieke drijfveren	○	○	○	○	○	○	○	○	○
» Herkennen van persoonlijke drijfveren	○	○	○	○	○	○	○	○	○
» Uitdagen van drijfveren	○	○	○	○	○	○	○	○	○

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Inzicht in de impacts van drijfveren	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Herkennen van rol specifieke drijfveren	○	○	○	○	○	○	○	○	○
» Herkennen van persoonlijke drijfveren	○	○	○	○	○	○	○	○	○
» Uitdagen van drijfveren	○	○	○	○	○	○	○	○	○
» Inzicht in de impacts van drijfveren	○	○	○	○	○	○	○	○	○

Block 8

DEEL 5: TRANSPARANTIE

In de onderstaande tabel worden concepten beschreven die tot Transparantie behoren:

Rol van informatievoorziening	Openheid ten aanzien van doelstellingen, belangen en criteria die ten grondslag liggen aan het besluitvormingsproces, alsmede de procedures/methodologie van het normontwikkelingsproces.
Rol van participanten	Duidelijke verwachtingen formuleren voor participanten, hun rollen en verantwoordelijkheden; Duidelijk aangeven in hoeverre zij invloed kunnen uitoefenen op het normalisatieproces.
Definitie van	Openheid ten aanzien van beperkingen, onzekerheden en een

procesbeperkingen	gebrek aan kennis

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items	Meest belangrijk	Minst belangrijk
Rol van informatievoorziening		
Rol van participanten		
Definitie van processbeperkingen		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Rol van informatievoorziening	○	○	○	○	○	○	○	○	○
» Rol van participanten	○	○	○	○	○	○	○	○	○
» Definitie van processbeperkingen	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Rol van informatievoorziening	○	○	○	○	○	○	○	○	○
» Rol van participanten	○	○	○	○	○	○	○	○	○
» Definitie van processbeperkingen	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijk
» Rol van informatievoorziening	○	○	○	○	○	○	○	○	○
» Rol van participanten	○	○	○	○	○	○	○	○	○
» Definitie van processbeperkingen	○	○	○	○	○	○	○	○	○

Block 1

DEEL 6: BELANGRIJKE CONCEPTEN VAN MAATSCHAPPELIJK VERANTWOORDE INNOVATIE

In de onderstaande tabel worden de belangrijkste concepten van Maatschappelijk Verantwoorde Innovatie beschreven:

Concepten	Beschrijving
Inclusie	Het betrekken van partijen en met hen in gesprek gaan met als doel een publieke dialoog tussen private en publieke partijen mogelijk te maken. Het doel van inclusie is om de kwaliteit van de dialoog te verbeteren en daarnaast voldoende draagvlak te creëren.
Anticipatie	Een toekomstgericht perspectief met als doel het verkennen van maatschappelijke wenselijkheid voor normen en het minimaliseren van maatschappelijke risico's op lange termijn door te kijken naar impacts die normen hebben.
Responsiviteit	Reactie op nieuwe kennis, waarden of maatschappelijke behoeften en aanpassen van normen wanneer ontoereikende kennis onderkend wordt of wanneer de bruikbaarheid van een norm in het geding komt.
Reflexiviteit	

	Reflecteren op onderliggende gedragingen (keuzes, handelingen, input) van participanten als gevolg van aannames, waarden en verwachtingen ten aanzien van normen. Reflexiviteit gaat verder dan zelfevaluatie vanuit de rol die participanten hebben als vertegenwoordiger van hun organisatie, maar gaat ook over het uitdagen van de persoonlijke waardesystemen en denkwijzen van participanten.
Transparantie	Communicatie van de besluitvormingsprocedures, beoordelingscriteria voor besluiten en het scheppen van verwachtingen voor participanten (taken en verantwoordelijkheden)

Welk van de bovenstaande concepten is het MEEST belangrijk en welke het MINST belangrijk voor de kwaliteit van de standaardisatieprocessen? Sleep de concepten naar het bijbehorende vak

Items	Meest belangrijk	Minst belangrijk
Inclusie		
Anticipatie		
Responsiviteit		
Reflexiviteit		
Transparantie		

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met het 'Minst belangrijke' concept hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Inclusie	○	○	○	○	○	○	○	○	○
» Anticipatie	○	○	○	○	○	○	○	○	○
» Responsiviteit	○	○	○	○	○	○	○	○	○
» Reflexiviteit	○	○	○	○	○	○	○	○	○
» Transparantie	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker is het 'Meest belangrijke 'concept in vergelijking met de overige concepten hieronder, op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Inclusie	○	○	○	○	○	○	○	○	○
» Anticipatie	○	○	○	○	○	○	○	○	○
» Responsiviteit	○	○	○	○	○	○	○	○	○
» Reflexiviteit	○	○	○	○	○	○	○	○	○
» Transparantie	○	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn de overige concepten hieronder in vergelijking met het 'Minst belangrijke', op een schaal van 1 tot 9?

	1) Even belangrijk	2)	3) Iets belangrijker	4)	5) Belangrijker	6)	7) Veel belangrijker	8)	9) Heel veel belangrijker
» Inclusie	○	○	○	○	○	○	○	○	○
» Anticipatie	○	○	○	○	○	○	○	○	○
» Responsiviteit	○	○	○	○	○	○	○	○	○
» Reflexiviteit	○	○	○	○	○	○	○	○	○
» Transparantie	○	○	○	○	○	○	○	○	○

Appendix F - Validation

Robustness

In table 3 the sensitivity analysis is presented. Because the sample size of the data set is simply too small for descriptive statistics, a robustness test was chosen to test the convergence of the global average weights. The robustness is tested by taking out two experts from the table below and determine whether this impacts to overall scores, see table 4 and figure 9-11. Afterwards the same test was performed for 7 experts, where one expert was excluded. From the table below can be surmised that only in the case when two experts are excluded the overall ranking changes slightly. In the case of 6 experts the *Role of information* (Q16) found under transparency becomes slightly more important than *Empowerment of participants'* (Q2). Rankings of the other criteria remain fairly similar, there appear to be no other changes in ranking from both the 6-experts and the 7-experts results.

Table 5; Robustness of results

										6 experts	7 experts
	Expert 1	**Expert 2**	**Expert 3**	**Expert 4**	**Expert 5**	**Expert 6**	**Expert 7**	**Expert 8**	**Mean**	**Mean**	**Mean**
									0.35		
Q1	0.14	0.05	0.10	0.23	0.25	0.24	0.20	0.10	0.16	**0.18**	**0.16**
Q2	0.08	0.22	0.09	0.14	0.08	0.06	0.07	0.02	0.09	**0.08**	**0.10**
Q3	0.01	0.02	0.03	0.05	0.08	0.03	0.07	0.06	0.04	**0.05**	**0.05**
Q4	0.08	0.06	0.09	0.03	0.04	0.09	0.04	0.01	0.05	**0.05**	**0.05**
									0.18		
Q5	0.07	0.06	0.05	0.00	0.01	0.09	0.12	0.20	0.08	**0.08**	**0.08**
Q6	0.02	0.03	0.05	0.03	0.06	0.09	0.02	0.12	0.05	**0.06**	**0.06**
Q7	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.02	0.02	**0.02**	**0.02**
Q8	0.03	0.01	0.05	0.01	0.01	0.01	0.05	0.12	0.03	**0.04**	**0.04**
									0.19		
Q9	0.04	0.05	0.12	0.16	0.03	0.04	0.02	0.02	0.06	**0.06**	**0.06**
Q10	0.04	0.10	0.12	0.06	0.03	0.02	0.03	0.03	0.05	**0.05**	**0.06**
Q11	0.11	0.03	0.06	0.03	0.07	0.06	0.11	0.14	0.07	**0.08**	**0.07**
									0.09		
Q12	0.02	0.04	0.06	0.05	0.02	0.04	0.02	0.02	0.03	**0.04**	**0.04**
Q13	0.01	0.05	0.07	0.01	0.01	0.00	0.03	0.01	0.02	**0.02**	**0.03**
Q14	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	**0.01**	**0.01**
Q15	0.00	0.08	0.01	0.02	0.02	0.02	0.03	0.00	0.02	**0.02**	**0.03**
									0.18		
Q16	0.21	0.08	0.04	0.10	0.18	0.10	0.05	0.08	0.11	**0.09**	**0.09**
Q17	0.09	0.08	0.04	0.02	0.03	0.02	0.05	0.02	0.04	**0.03**	**0.04**
Q18	0.02	0.02	0.02	0.05	0.06	0.04	0.05	0.01	0.03	**0.04**	**0.04**

Figure 9; Criteria Weights (8 experts)

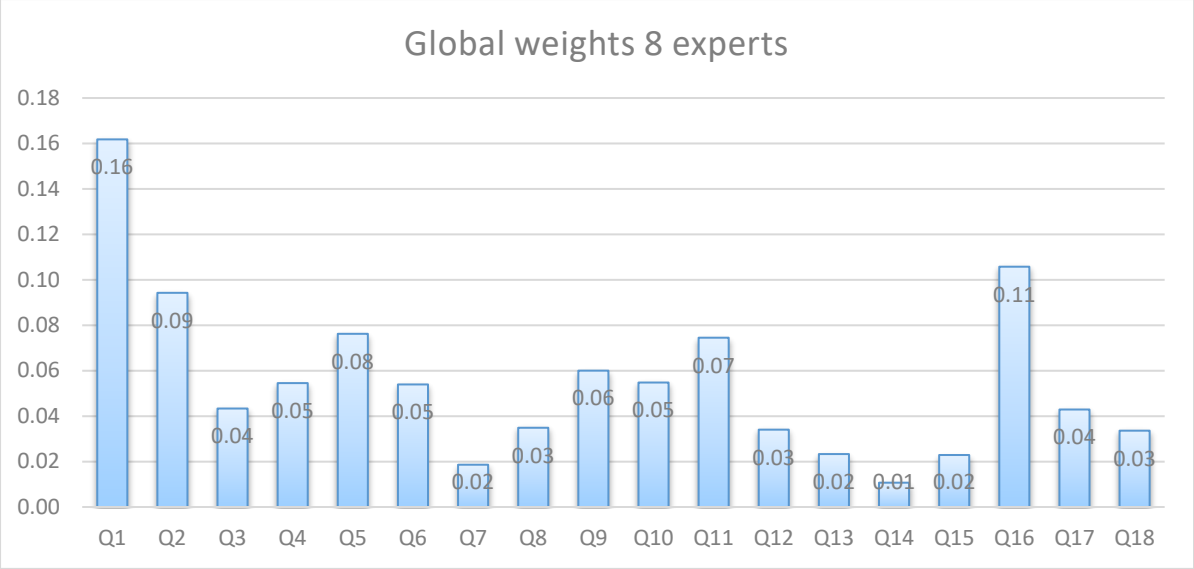


Figure 10; Criteria Weights (6 Experts)

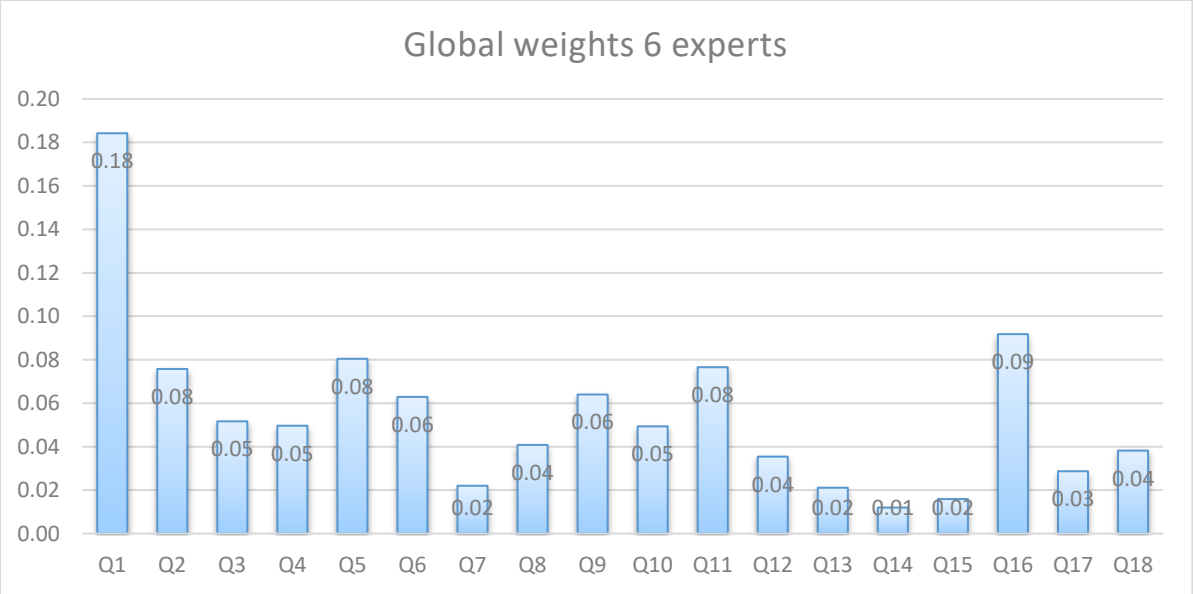
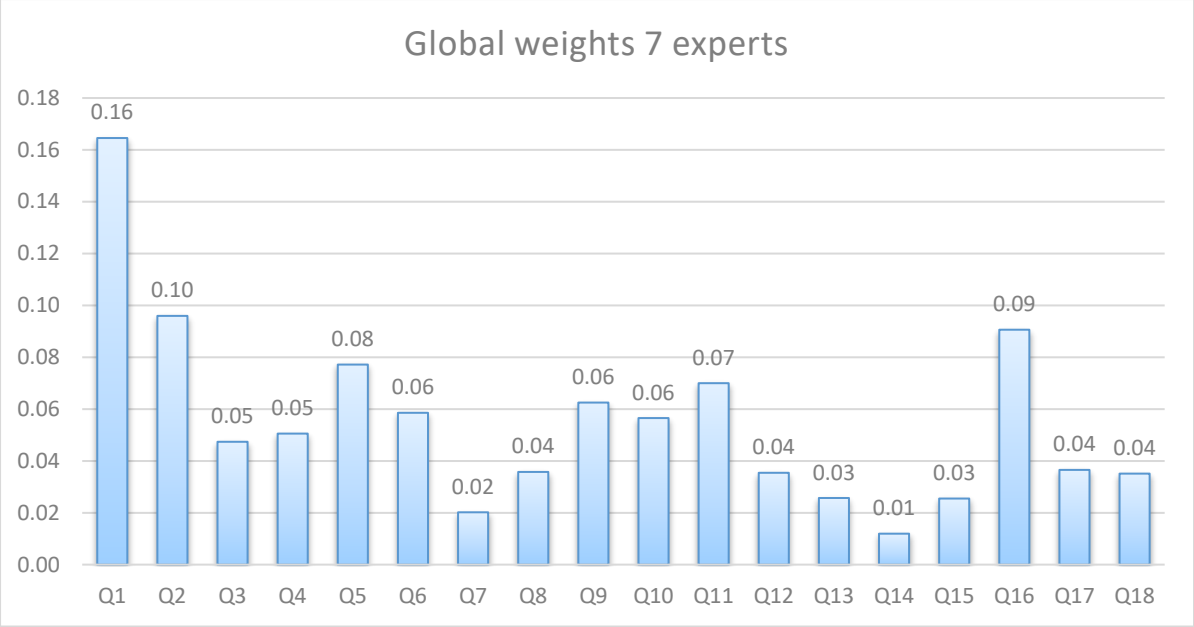


Figure 11; Criteria Weights (7 experts)


Global weights 7 experts
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.16
0.10
0.05
0.05
0.08
0.06
0.02
0.04
0.06
0.06
0.07
0.04
0.03
0.01
0.03
0.09
0.04
0.04
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18

Appendix G - Expert review transcript

Inclusiveness is considered very important, but should not be seen as the end goal of standardisation processes. Inclusion is a means to achieve impact. It's important to have the right balance of interests. Empowerment is strongly related to this. Parties must be able to exert influence in order to serve their interests and promote them in the process. It was indicated that it is very difficult to distinguish between the dimensions. The concepts are strongly related. It is difficult to experience the benefits of diversity if one is not told what was done with the input.

The timing of a standard development is considered the least important, urgency is often not an issue. Some processes can take years. There are actually few Dutch initiatives in the electro-technical field, the development is mainly at an international level in the form of 'standards'. Variety of stakeholders is always an issue for committees, since it takes a lot of resources for stakeholders to participate. Only the most interested parties participate.

For example, there was heavy criticism toward an initiative at NEN to offer external experts (not part of the committee experts) the right to vote. Voting rights are linked to membership (costs). Sometimes, external experts are introduced to clarify certain subjects. Stakeholders can see this as a threat. Empowerment is therefore, less important, because you don't want to include all participants out of respect for the (paying) parties in the committee.

Inclusion is important but must be carefully weighed against the pragmatic side of standardisation. As the number of participants increases, so does the inefficiency of committees, which may be at the expense of decision-making. It can even be detrimental to the ultimate desirability of the final results.

This is strongly linked to a transparent definition roles and expectations of stakeholders. However, these are considered less important, because the role of information provision indirectly shapes the expectations of the process and, thus, already allows parties understand their role and how they can influence the process. In addition, it is also difficult because some roles are difficult to perform. Chairs of committees are chosen from the committees themselves and are expected to guide the process objectively. But these parties are, of course, primarily representatives of their organizations. The chairperson may weigh in on their interests, but may not push them. It must be clear to everyone what the roles are to ensure trust in the process.

Reflexivity describes the role of the consultant. It is important to understand the interests of parties in order to understand activities of participants. Reflexivity plays a supporting role in the consensus process to form decisions, but is subordinate to other dimensions. Reflexivity supports the process of inclusion and achieving impacts, but is not the ultimate goal of standardization. In addition, reflexivity is in a grey area regarding the neutral role of NEN in standardization. NEN does not benefit from challenging motivations, if this is does not contribute to consensus. Recognising drivers is an important first step, challenging the values or interests is optional.

Generally, stakeholders represent their own organisation and do not adopt a social perspective. These are often people with a technical background, and therefore very down-to-earth, but not socially inclined.

It was found to be important to recognize underlying motivations and interests from stakeholder roles. Once participants can be understood, alliances can be made. Sometimes this is difficult to figure out, complexity of interests and uncertainties can be large at times. In that case, a higher level perspective

is needed to find compromises. The difference between role responsibilities and personal considerations is context dependent. Insight into impacts is not something that is considered very important by stakeholders, who are pre-occupied with serving their own interests.

Anticipation is considered an important aspect, as standards must have impact to be useful. It is therefore important to identify in advance the interests and goals of participants. The identification of impacts is therefore strongly related to discovering the interests of parties and the expectations regarding impacts. The focus on innovation in standardisation committees is not very high. Parties at the table generally do not use standards to encourage new developments, but rather to fit in with their current situation. This is exacerbated by a lack of innovative parties at the table; often only established producers/suppliers are present. Start-ups are often not at the table anyway to capture the broader societal themes/aspects.

Responsiveness is considered very important for NENin order to be relevant and have an impact on new social themes. Within NEN, general efforts are being made to determine the extent to which NEN is relevant, but there is insufficient attention for new developments (innovations). Responsiveness in circular building, for example, is considered very important. Responsiveness is often considered an end goal and inclusion a means. Responsiveness is becoming more important, especially the speed of response to social issues is increasingly important.

It is considered important to adopt a social perspective in order to keep an eye on new developments and therefore also on potential standards committees. On the other hand, it is also considered important to evaluate where there are still opportunities for standards. So an evaluation mechanism and a social perspective are important to identify potential opportunities for standards development. Furthermore evaluation is the only thing a consultant has a grip on, there is less input on the side of NEN regarding societal changes.

Differences between committees.

With regards to newer societal topics, inclusion, anticipation and responsiveness are generally considered more important. They present indicators on how to become relevant in innovative developments and how to recognize them. In more established committees uncertainties are less prevalent: the market is known, the interests are known. Changes therein are usually less significant.

Key findings:

Inclusion	Inclusion is an important means to find the right balance of interests in standardisation, but should not be the end-goal. Inclusion is not always possible due to resource barriers for participation. Furthermore standardisation processes can result in undesirable results if too many participants share differing inputs. Empowerment is necessary for participants to exert influence. Timing of standard development is considered less important, as urgency oftentimes does not play a role.
Transparencorty	The role of information is important to shape expectations of the process. Defining roles and responsibilities is difficult, due to conflicts of interest with facilitative functions in committees. Transparency is considered important, as it ensures trust in the process.
Reflexivity	Reflexivity plays a supporting role to inclusion and anticipation, but is not considered as important. Moreover, it presents a grey area, since plays a neutral facilitative role. Insights into impacts is not very important, as parties are very self-serving in attaining their interests. They do not adopt a societal perspective. The relevance of recognising personal or role specific drivers is down to context. Sometimes complexity and uncertainty is so large, personal drivers take a more prominent role.
Anticipation	Standards must have impact to be used and useful. Identifying interests, goals and motivations of stakeholders is necessary to explore the social desirability and assess potential impacts. The uptake of new developments in standards committees is limited, since parties do want standards to fit their current situation. This is exacerbated by a lack of innovative parties, e.g. star-ups, in committees.
Responsiveness	Responsiveness is an indicator of NEN's relevance in addressing societal issues. The speed of response to new societal needs and expectations has become increasingly important. Feedback mechanisms and the adoption of a societal perspective are a tools that enable NEN to actively evaluate opportunities for standards development.
Differences between committees	Differences between committees appear to be the result of complexity of the standards context, i.e. the degree in which the market and stakeholder interests are known.