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investigating the importance of responsible innovation for standards development

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Towards responsible standardisation: investigating the importance of responsible innovation for standards development

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ABSTRACT

Responsible Innovation has recently been taken up in public policies and discourses. However, it remains challenging to institutionalise its core dimensions – inclusion, anticipation, responsiveness, reflexivity, and transparency – in practice. *De jure* standardisation is increasingly seen as an instrument to embed the core principles of Responsible Innovation in innovation processes, because of its anticipatory and inclusive nature. Yet, Responsible Innovation within the standardisation literature is an under-researched field of study. This paper explores and evaluates the relative importance of Responsible Innovation's core dimensions in the standards development process. We identify eighteen criteria that are deemed essential to the quality of standardisation processes. The Best-Worst Method was used to rank these criteria on their perceived importance. Diversity of participation was found to be the most important contributing factor to the quality of standardisation.

1. Introduction

Standards can help organise societies and markets (Brunsson, Rasche, and Seidl 2012) by including values and worldviews into innovation (Thompson 2020). They can promote interoperability, compatibility, safety, quality, and communication of and between products, processes, and services. Standards can enhance innovative performances (Zhou, Shan, and Li 2018), while reducing technical ambiguities (Rhee, Park, and Yoo 2015). In *de jure* standardisation, stakeholders voluntarily collaborate to create standards in committees through consensus-based decision-making processes (Takanashi and Lee 2013), which are usually coordinated through Standards Developing Organisations (SDOs).

Legitimacy is essential to *de jure* standardisation as these processes lack formal authority (Kusnezowa and Vang 2021; Slager, Gond, and Moon 2012) and rely on the self-selection of knowledge, participants, and governance structure (Timmermans and Epstein 2010). Furthermore, legitimacy is essential to standardisation as it increases credibility and safeguards the continuity of SDOs (Botzem and Dobusch 2012). A standard's legitimacy is tied to its regulatory power (Slager, Gond, and Moon 2012), and can thus be seen as a means to stimulate moral entrapment in order for participants to keep their promises (Haack, Schoeneborn, and Wickert 2012). Because standards aim at adoption and market acceptance (Forsberg 2012), legitimacy contributes to the extent standards are diffused (Haack and Rasche 2021) and affect society (Hayes, Maslen, and Merad 2022). Furthermore, it has been shown that the standards organization's credibility and reputation positively affect the

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chances that participants join the standards committee (Foray 1994). Legitimacy can be considered one of the instrumental rationales of Responsible Innovation (RI).

As a research area, RI has gained much attention in recent years in academic and policy discourses (Owen and Pansera 2019) due to growing concerns regarding undesirable and often uncertain societal implications of emerging technologies. RI aims to govern innovations in light of uncertainty as they become more socially embedded (Fraaije and Flipse 2020; Stilgoe, Owen, and Macnaghten 2013). RI's main focus lies in the *process* of innovation, which presents a departure from the classical consequentialist governance of innovation (Stilgoe, Owen, and Macnaghten 2013).

Due to the anticipatory nature of *de jure* standardisation (Wiegmann, de Vries, and Blind 2017), there is potential to proactively identify technological challenges and opportunities, and to reflect on underlying values that drive standardisation. RI can help implement ethical and technological values in standardisation by engaging societal stakeholders (Inigo et al. 2020; van de Kaa 2013).

However, RI's link with standardisation remains a largely neglected area of research despite its significance for innovation governance (Wiarda et al. 2022; Wickson and Forsberg 2015). It remains unclear what RI means in the context of standardisation. Furthermore, we insufficiently understand whether SDOs perceive RI as a valuable contribution to standardisation and why. This study explores the perceived importance of RI dimensions for the quality of standardisation according to standardisation experts.

This study has several contributions. First, our research contributes to the standardisation literature by proposing a clear definition of standardisation quality. Second, it examines the perceived value of RI according to standardisation experts enables actors to learn more about RI in the context of standards development (Burget, Bardone, and Pedaste 2017; Owen et al. 2021). Third, this study investigates the applicability of RI's conceptual framework and tests this framework in the practical context. Finally, it explores the trade-offs and tensions between RI dimensions and certain political-economic aspects present in standardisation according to standardisation experts.

2. Theory

RI examines and evaluates the role of science and innovation in society (de Jong et al. 2015), and shares similarities with approaches such as Anticipatory Governance (Guston 2014), Technology Assessment (Schot and Rip 1997) and Value-Sensitive Design (Friedman et al. 2018; Van den Hoven, Lokhorst, and Van de Poel 2012). A commonality in the RI discourse is the uptake of four core dimensions that have come to define Responsible Innovation processes (Burget, Bardone, and Pedaste 2017; Fraaije and Flipse 2020; Lubberink et al. 2017; Stilgoe, Owen, and Macnaghten 2013; Wiarda et al. 2021). Stilgoe, Owen, and Macnaghten (2013) refer to these as *inclusion, anticipation*, *responsiveness,* and *reflexivity. Transparency* is increasingly viewed as a complementary dimension that can support the former dimensions (Fraaije and Flipse 2020). In this section we will review these dimensions and relate them to contributions that have been made by standardisation scholars.

2.1 Inclusion

Since RI aims to address societal aspects of innovation, it needs to capture societal needs and expectations by engaging a variety of stakeholders (Fraaije and Flipse 2020). Including stakeholders helps identify risks and define what social desirability means (Sutcliffe 2011). As such, RI favours stakeholder diversity instead of a purely expert-driven process (Ribeiro, Smith, and Millar 2017). Stahl (2013) argues that research and innovation affect many stakeholders and that they should therefore be included in these processes. Hence, the normative argument for inclusion comes from a particular moral obligation for public engagement (Owen, Macnaghten, and Stilgoe

2012). Sutcliffe (2011) and Jenkins et al. (2020) argue that inclusion adds a layer of transparency and accountability for decision-makers. This means involving stakeholders early and throughout the innovation process.

Lubberink et al. (2017) distinguish between participation and deliberation. They define inclusion as stakeholder participation, i.e. the process of who, how, and when stakeholders participate in RI. Deliberation involves keeping stakeholders engaged throughout the process and committed to responsible outcomes.

Inclusion can – in many cases – be considered a key democratic quality of *de jure* standardisation (Egyedi 2003), which is necessary for standards to succeed (Forsberg 2012). Standards are the product of multi-stakeholder deliberations that tend to cross business boundaries (Inigo et al. 2020) and stimulate mutual learning (Välk and Mougenot 2019).

2.2 Anticipation

Anticipation is a forward-looking practice that explores multiple avenues for innovation. Ribeiro, Smith, and Millar (2017) add that the negative effects of innovation can pose a threat to the environment and society. Anticipatory processes explore future outcomes and impacts resulting from decision-making choices made in the present (Fraaije and Flipse 2020). They deal with questions such as 'what is known, what is likely, what is plausible, and what is possible' (Stilgoe, Owen, and Macnaghten 2013, 1570).

Having an anticipatory mind-set early on is essential to minimise societal risk, since post hoc risk-based governance models are often unable to deal with the pace of socio-technological change (Stilgoe, Owen, and Macnaghten 2013). Ideally, these are dealt with before technologies diffuse into markets and become embedded in society (Pellizzoni 2004). Anticipation increases the robustness of future innovations by dealing with the uncontrollability and unpredictability of technological development (Jenkins et al. 2020). It also helps identify new pathways for innovation to mitigate risks and seize opportunities for society (Fraaije and Flipse 2020). In standardisation, 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).

2.3 Responsiveness

Responsiveness is an essential element of RI (Fraaije and Flipse 2020). It is not always possible or feasible to anticipate or prevent the negative social, ethical, or environmental consequences of innovation (Sutcliffe 2011). A responsive attitude constitutes an inclination for changing the direction of innovation when societal needs and expectations shift (Pellizzoni 2004) while recognising one's insufficient knowledge and lack of control (Stilgoe, Owen, and Macnaghten 2013). Responsiveness encompasses a proactive attitude (Harsanto et al. 2020) as it entails the ex-ante alignment of societal needs and values (Rose 2014) with company interests (Lubberink et al. 2017). Standardisation scholars have emphasised the possibility for standards, despite their irreversible nature, to be flexible and anticipatory in the face of radical changes, especially in the case of information infrastructure standards.(Hanseth, Monteiro, and Hatling 1996).

Responsiveness strongly relates to a responsible attitude towards technological futures (Jenkins et al. 2020) and not an instrument towards attaining outcomes (Owen, Macnaghten, and Stilgoe 2012; Pellé 2016). Lubberink et al. (2017) suggest that a responsive attitude comprises two distinct elements. Firstly, it requires awareness of insights that indicate the need for innovation adjustments. Secondly, it relates to a substantial response to these new insights.

Responsiveness indicates the capability of standardisation to meet the expectations of end-users (Botzem and Dobusch 2012).

2.4 Reflexivity

Burget, Bardone, and Pedaste (2017) describe reflexivity as a dimension related to one's reflection and understanding of the (implicit) values, beliefs, and assumptions that drive innovation. Larson (2000) states that these play a crucial role in decision-making when uncertain options are present. Harsanto et al. (2020) add that reflexivity includes an awareness of uncertainties and unknowns.

Drawing from van de Poel and Zwart (2010), Schuurbiers (2011) distinguishes between first-order and second-order reflexivity. First-order reflexivity encompasses the reflection on activities, judgments, motivations, assumptions, and limits of knowledge within one's value system. These are often tied to the responsibilities of stakeholders in their respective organisations. Second-order reflexivity moreover challenges one's value and belief system that influence decision-making (Schuurbiers, 2011).

Distinguishing between the different roles participants play in standardisation helps manage its efficiency, openness and inclusiveness (Umapathy et al. 2007). Spring et al. (1995) hint that understanding and defining clear roles could furthermore speed up the pace of *de jure* standardisation.

2.5 Transparency

Stilgoe, Owen, and Macnaghten (2013) do not consider transparency as a core dimension of RI. However, von Schomberg's (2011) original definition of RI explicitly includes transparency as a core concept. Fraaije and Flipse (2020) argue that transparency can help clarify and justify both assessment criteria and the distribution of responsibilities for decision-making. Transparency creates a basis of trust between stakeholders which can enable more meaningful dialogues (Kupper et al. 2015). Moreover, transparency supports reflexivity as it requires stakeholders to openly communicate arguments for their decisions (Fraaije and Flipse 2020). Hence, transparency can be considered a core dimension in RI.

Transparency is also important for standardisation because it signals a form of procedural legitimacy as suggested by Botzem and Dobusch (2012). It affects the trust parties have in a process which can be characterised by self-regulation and a lack of formal authority (Slager, Gond, and Moon 2012; Timmermans and Epstein 2010).

3. Methodology

This research examines the relative importance of the five RI dimensions for the quality of standardisation as perceived by standardisation experts. A four-step mixed-methods approach was used to collect and analyse data. This concerned the identification of RI descriptors (1), exploratory interviews (2), a questionnaire administered through structured interviews (3), and a Best-Worst Method (BWM) to analyse and interpret the questionnaire data (4). In this last step, the structured interviews and BWM results were also subject to peer review by a standardisation expert to interpret the results and review their validity.

3.1 Inventory of descriptors

First, an inventory was conducted to identify criteria pertaining to the five RI dimensions as is commonly done prior to a BWM analysis. Existing RI frameworks and reviews formed the starting point of our inventory (i.e. Burget, Bardone, and Pedaste 2017; Fraaije and Flipse 2020; Lubberink et al. 2017; Stilgoe, Owen, and Macnaghten 2013; Wiarda et al. 2021). A backward search was done to collect articles that explicitly discussed the five RI dimensions (i.e. inclusion, anticipation, responsiveness, reflexivity, and transparency). These articles were subject to deductive thematic analysis (i.e. open and axial coding; Braun et al. 2019) to derive criteria that describe the dimensions. Identified criteria

Table 1. An overview of RI dimensions and descriptors.

Inclusion	Descriptors
Diversity of participation	Diversity relates to involving actors relevant to the innovation context (Correljé et al. 2017).
	Diversity of participation means including actors from various disciplines (Fraaije and Flipse 2020; Wickson and Carew 2014).
	Diversity is also related to a sufficient number of participants (Fraaije and 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	When and how often stakeholders are involved in the development and decision-making of innovation (Stilgoe, Owen, and Macnaghten 2013).
Consideration of feedback	Mechanism showing how stakeholder contributions impact results and decisions (de Saille 2015).
Anticipation	
Identification of impacts	Creating awareness of 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	Identifying impacts and uncertainties early to deal with (negative) societal impacts (Burget, Bardone, and Pedaste 2017; Owen, Macnaghten, and Stilgoe 2012). Continuous and repeated identification of potential consequences (Jenkins et al. 2020; Wickson and 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	Adapting to changing societal needs and expectations (Fraaije and Flipse 2020).
Substantive response mechanism	Evaluating strategies and incorporating feedback (Kupper et al. 2015; Wickson and Carew 2014).
Reflexivity	
Recognising role-specific values, beliefs, and assumptions	Cognition of activities, judgments, motivations, assumptions (Schuurbiers, 2011); Canvassing the limitations of knowledge (Harsanto et al.,2020) Cognition of scientific standards and methodologies (Fraaije and Flipse 2020); Cognition of organisational culture and contextual limitations (Wickson and Carew 2014).
Recognising personal values, beliefs, and assumptions	Cognition of beliefs, assumptions and underlying values that fuel assumptions and understanding them (Fraaije and Flipse 2020);
Challenging values, beliefs, and assumptions	Critical reflection on ethical and other societal considerations (Burget, Bardone, and Pedaste 2017).
Understanding the impact of values, beliefs, and assumptions	Understanding the impact of products, services, and processes on our society; Ensuring 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 and the procedures/methodology of the innovation process (Fraaije and Flipse 2020)
Role of stakeholders	Defining clear expectations for stakeholders, their roles, and responsibilities (Wickson and Carew 2014); Clear indication to what extent they can influence the innovation process (Fraaije and Flipse 2020)
Defining process results and limitations	Openness toward limitations, uncertainties, and a lack of knowledge (Kupper et al. 2015)

from our axial coding (themes) were collectively discussed to resolve any inter-coder disagreement. Themes were described with so-called descriptors (Table 1).

3.2 Exploratory interviews

Second, exploratory interviews were conducted with three standardisation experts to explore how RI dimensions return in the practical context of standardisation. Interviews were moreover used to derive a definition of the quality of standardisation.

The Royal Netherlands Standardisation Institute (NEN) was chosen as our case study. NEN is the official national standards body of the Netherlands, and represents the interests of the Netherlands Electrotechnical Committee and the Dutch Committee as an official member of International Organization for Standardization (ISO). Because standardisation practices are highly formalised within the organisation, it is assumed that research findings can be generalised to the organisation as a whole.

NEN experts were identified through referral or social acclamation (Shanteau et al. 2002) – a form of purposive sampling – by an internal innovation specialist. Experts have at least ten years of experience in the international standardisation context. Interviews were recorded and transcribed, and thematically analysed to understand what defines the quality of standardisation according to practitioners. Transcripts were also thematically analysed to reveal how the RI dimensions are reflected in standardisation. For instance, practitioners explained that standardisation aims to be an inclusive process by inviting stakeholders to participate in committees. However, resource constraints and required expertise are known challenges for stakeholder inclusion (Forsberg 2012; Kusnezowa and Vang 2021; Wickson and Forsberg 2015).

3.3 Structured interviews

Third, structured interviews were conducted with eight experts. These experts were active in a facilitative capacity by bringing together interested parties and guiding them through the process of reaching joint agreements. Their selection and identification was identical to the process for the exploratory interviews. We used structured interviews to let respondents rank the importance of RI dimensions and criteria (Table 1) on the quality of standardisation. We first asked respondents to identify the most important (best) and the least important criterion (worst) within each of the five dimensions respectively. Respondents were subsequently asked to rank the relative importance of the best criterion over the others on a Likert scale from 1 to 9 (1 = equally important; 9 = much more important). Next, the relative importance of the other criteria to the worst criterion were ranked by respondents, again on a Likert scale from 1 to 9. These steps were repeated for every dimension until an internal ranking for each criterion per dimension was obtained.

In the last step we asked respondents to rank the dimensions as a whole, and to rank their relative importance to each other, similar to the criteria within each dimension. These rankings served as input for BWM analysis.

3.4 Best-worst method analysis

Fourth, we applied the BWM to analyse the structured interview data. The BWM is a multi-criteria decision-making tool that ranks relevant criteria by making pairwise comparisons of their respective weights (Rezaei 2015; 2016). The BWM is generally known for its simplicity and reliability, while requiring less information than comparable methods (Rezaei 2020). We used the BWM to compare the relative importance of criteria with respect to the best and worst criterion in order to calculate criterion weights with respect to their dimension. To calculate the (global) weights of the criteria, we multiplied the dimension weights by the criterion weights, providing insight in the overall importance of the criteria. We conducted a peer review with another expert to review, discuss and validate the results. Moreover, we checked the result' internal consistency by removing the sixth, seventh and eight respondent. This did not significantly change the order of importance, which indicates that a sufficient number of interviews has been conducted.

4. Results

This section presents the results of the interviews, and the BWM analysis. Interviews with respondents suggest that the quality of standardisation is well defined. A common definition

for high-quality standardisation offered by respondents goes as follows: The quality of standardisation relies on a consensus-based and transparent process with all parties concerned. Additionally, neutrality or impartiality of the SDO was found to be essential to ensure support for standards' adoption, since they are not required by law. Table 2 shows the results of the structured interviews and the BWM analysis. It presents the calculated weights for the RI criteria. The weights indicate the relative importance of the criteria – higher weights show greater importance.

4.1 Inclusion

Inclusion has the highest overall weight (0.35) of all five dimensions (Table 2). Inclusion refers to diversity and fair representation of participants relevant to the standard's context, and refers to the creation of tools for stakeholders to engage and contribute meaningfully to standardisation. *Diversity of participation* (Q1) and *empowerment of stakeholders* (Q2) are considered the most important elements of inclusion. *Diversity of participation* extends to committee members, but also general stakeholders who can take part in public consultation rounds. However, one respondent indicated, 'Inclusion is important but must be carefully weighed against the pragmatic side of standardisation'. This shows that there may be limits to including all relevant stakeholders. *Empowerment of stakeholders* through a consensus-based process is essential to engage with stakeholders meaningfully, safeguarding their interests (Q2). Additionally, many respondents consider *feedback* (Q4) very important by treating and discussing ideas on an equal footing. *Timing of inclusion* (Q3) was considered to be relatively unimportant, since most respondents suggested that it was very dependent on the standard's context.

Table 2. Criteria weights.

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Mean
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 Consideration of Feedback	0.08	0.06	0.09	0.03	0.04	0.09	0.04	0.01	0.05
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 pathways for innovation	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
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
Reflexivity									**0.09**
Q12 Recognising role specific values, beliefs, and assumptions	0.02	0.04	0.06	0.05	0.02	0.04	0.02	0.02	0.03
Q13 Recognising personal values, beliefs, and assumptions	0.01	0.05	0.07	0.01	0.01	0.00	0.03	0.01	0.02
Q14 Challenging values, beliefs, and assumptions	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Q15 Understanding impact of values, beliefs, and assumptions	0.00	0.08	0.01	0.02	0.02	0.02	0.03	0.00	0.02
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

4.2 Anticipation

Anticipation was found to be an important dimension (0.18) for the quality of standardisation (Table 2). Anticipation refers to the active alignment of the SDO towards the societal desirability of topics and projects. *The identification of impacts* (Q5) and *predefining societal desirability* (Q6) ranked the highest within anticipation. However, impact assessments of standards are not common practice within the scope of standardisation committees. Some respondents indicated that anticipation plays a more significant role than others in some committees. Standardisation can be initiated through government mandate by posing certain questions or indicating the intention of potential regulation. In these cases, the social desirability and impacts are predefined, and standards development focuses on the standard's necessity and support. *The identification of alternative pathways for innovation* (Q7) was found to be very unimportant by most respondents. The aim of the standardisation is to reduce the amount of alternatives, hence this criterion was found to be counterproductive. The *timing of anticipation* (Q8) criterion was found to be less important than others, for similar reasons as the timing of inclusion.

4.3 Responsiveness

Responsiveness was considered the second most important dimension (0.19) in standardisation (Table 2). Responsiveness relates to *promoting certain socially desirable themes* (Q9), which is essential for SDOs to be relevant and have an impact on new social issues. Standards are generally *responsive toward ongoing insights and new requirements* (Q10) through corrigenda and addenda for technical aspects. This enables standards to adapt to new expectations and requirements. In the long term, standards can be reformulated. A *substantive response mechanism* (Q11), is therefore considered the most important criterion for responsiveness.

4.4 Reflexivity

Reflexivity was found to be the least important dimension (0.09) in standards development processes (Table 2). According to most respondents, the most important criterion pertaining to reflexivity was *recognising role specific values, beliefs, and assumptions* (Q12). According to some respondents, participants can be considered lay experts, who present different needs for standards relevant to their context. These respondents indicated that inclusion and transparency add to reflexivity through the enrichment of the information exchange. The exploratory interviews also revealed that the relative importance of criteria differ greatly among standardisation committees due to contextual elements. These contextual differences included the complexity of the standardisation context, the divergence of stakeholder interests, and the degree of uncertainty. *Personal values, beliefs, and assumptions* (Q13) are considered less important overall by most respondents, but can play a role when uncertainty and complexity are present in the standardisation context. *Challenging values, beliefs, and assumptions* (Q14) by NEN was often considered undesirable by respondents, since it undermines the (value) neutral role NEN plays in the standardisation process as a convenor and facilitator. *Understanding the impact of values, beliefs, and assumptions* (Q15) can help standardisation experts understand underlying interests of participants in case of structural uncertainty. However, respondents suggested that in most cases the standard's context is clear and the present interests are well known.

4.5 Transparency

Transparency is another important dimension (0.18) for the quality of standardisation (Table 2). Most respondents indicated that a transparent process relates to the *openness of information, motivation, and stakeholders' interests* (Q16). According to some respondents, addressing the role of information

in standardisation plays a large part in the ranking of transparency. Additionally, it refers to the clear and consistent use of a standardisation format or methodology. Regarding the openness of information, two respondents suggested that, sometimes, parties need to express underlying interests and motivations in confidence. Non-disclosure agreements are often in place to enhance internal transparency and to safeguard the interests of stakeholders and the openness of the process. *Addressing the role of the stakeholders* (Q17) was considered less important by most respondents, since stakeholders will adopt their role based on the relevant procedures and processes rather than through predefined agreements. Lastly, *defining process results and limitations* (Q18) was considered a core part of Q16 by all respondents, and was therefore not found to be important standalone.

4.6 Consistency ratio

The BWM analysis calculated relative weights of criteria by pairwise comparisons. These comparisons allow for a formal ranking and yield a consistency ratio for every dimension. Table 3 presents the consistency ratios per dimension with respect to the respondent. The consistency ratio indicates the reliability of rankings given by the respective experts. Consistency increases when ξ is near zero (Rezaei 2015). Generally, dimensions show good consistencies. We discuss two outliers, since the consistency ratios offered by expert 1 and expert 5, for anticipation and reflexivity respectively, appear to significantly deviate from zero.

First, expert 5 found it difficult to rank the criteria pertaining to anticipation, which might explain the higher consistency ratio found in Table 3. This respondent suggested that there was significant overlap between anticipation and responsiveness, since they both constitute active alignment with societal needs and expectations. This conceptual fuzziness could have affected the understanding of the concept and therefore the consistency in ranking. Second, expert 1 showed a relatively high consistency ratio for reflexivity and indicated that it was difficult to rank the individual criteria of reflexivity since they differ greatly between committees.

5. Discussion & conclusions

The results hint that *diversity of participation* is considered the most important criterion for the quality of standardisation. Diversity relates to the inclusiveness of standardisation. Most respondents suggested that diversity is essential for support. One mentioned that without standards' support, SDOs would have no *raison d'être* because standards would not be used. This is in line with Slager, Gond, and Moon (2012) who showed that engaging organisations provides normative legitimacy, which contributes to standards' regulatory power. Standardisation scholars also point to the importance of the formation of alliances surrounding standards for the standardisation process. They mentioned the relevance and importance of alliance formation during the (market-based) standardisation process(Shapiro and Varian 1999). Furthermore, they, e.g. emphasise the importance of stakeholder diversity for achieving de-facto standards. However, they have not linked diversity in terms of inclusiveness to the standardisation process' quality (van den Ende et al. 2012).

Some respondents mentioned limitations to the desirability and feasibility of including all relevant parties and gave two reasons. Firstly, resource constraints and a required expertise are

Table 3. Consistency ratios.

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

known challenges for stakeholder inclusion (Forsberg 2012; Kusnezowa and Vang 2021; Wickson and Forsberg 2015). Secondly, diversity does not necessarily always result in higher quality standards. Two respondents suggested that over-participation could result in 'one-size fits nobody' solutions that are undesirable for any stakeholder. This challenges the notion of collective responsibility mentioned by Stilgoe, Owen, and Macnaghten (2013). The literature shows that despite the best efforts of individuals not to act irresponsibly, irresponsible outcomes can still occur through a moral division of labour. This is also known as 'the problem of many hands' (van de Poel et al. 2012), resulting in 'organised irresponsibility' (Beck 1993). Most importantly, while inclusion is deemed the most important dimension, it is also perceived to be the most inadequately institutionalised dimension in standardisation (Wiarda et al. 2022).

Furthermore, the study hints at the importance of the criterion *identification of impacts*. Indeed, respondents related this criterion to discovering the interests of participants and their expectations regarding impacts (Lubberink et al. 2017). However, respondents mentioned that identifying impacts strongly depends on the contextual elements of the specific standardisation effort, for example, the complexity of the content. This supports the notion that anticipation deals with the uncontrollability and unpredictability of innovation (Jenkins et al. 2020) to deal with uncertainty (Lubberink et al. 2017). Respondents perceived the identification of impacts important as standards must have an impact to be useful in the first place. Revealing negative and positive consequences of standards is essential to understanding, identifying, and aligning stakeholder interests toward a common solution.

However, identifying societal impacts of standards has received little attention and lacks proper formalisation in standardisation (Wiarda et al. 2022). This could be due to the difficulty of defining and assessing non-quantifiable impacts (Maas, Schaltegger, and Crutzen 2016). These 'soft impacts' may, for instance, refer to how standards affect affecting the quality of human life (van der Burg 2009).

The study suggests that responsiveness towards values and changing circumstances is an important quality of standardisation for meeting the expectations of end-users (Botzem and Dobusch 2012). *Adopting a societal perspective* is considered a prerequisite to being receptive to new developments. This fits the notion offered by Harsanto et al. (2020) that responsiveness entails a proactive process aimed at aligning societal benefits and needs (Rose 2014) with company interests (Lubberink et al. 2017). Responsiveness is therefore important for creating shared value (Porter and Kramer 2018). Standardisation scholars have also argued that standards that are adapted to changing user requirements are more successful compared to standards that are not (van de Kaa and de Vries 2015). Some respondents consider a *substantive response mechanism* an important tool to identify potential opportunities for standards development. These results are in line with research on the importance of feedback and evaluation (Kupper et al. 2015; Wickson and Carew 2014), which support standardisation processes (Sutcliffe 2011).

What is more, some respondents mentioned that transparency, particularly the role of information, is important to clarify what steps should be taken to arrive at a standard to create trust. Transparency may therefore contribute to moral legitimacy and to socially desirable and acceptable procedures (Suchman 1995). Respondents suggested that standardisation aims to facilitate knowledge exchange. Transparency supports this through fostering meaningful dialogue (Fraaije and Flipse 2020) and stimulating mutual learning (Wickson and Carew 2014).

However, a few respondents indicated that complete transparency of underlying interests is unlikely. The participants' interests can conflict, and personal issues may arise in committees. In these cases, respondents stressed the importance of conflict resolution through an individual approach. This suggests that safe discussion arenas, or closed spaces, characterised by confidentiality can paradoxically lead to more transparency as participants are more likely to share information (de Bakker et al. 2014).

Understanding the impact of values, beliefs, and assumptions was considered the least important dimension. Respondents indicated that participants tend to have (implicit) instrumental rationales

for partaking in standardisation. In addition, a few respondents indicated that *challenging values, beliefs, and assumptions* is a moral grey area, which contrasts the critical attitude needed for RI processes (Wickson and Carew 2014), since SDOs merely play a facilitative role. These results prompt the question of whether SDOs are able to encourage and contribute to socially desirable standards while maintaining their neutral facilitative role. Recent research suggests that government intervention might be required to promote legitimacy of standardisation (Hayes, Maslen, and Merad 2022; Inigo et al. 2020).

This could question the relevance of moral legitimacy in standardisation. Without moral imperatives, it is questionable whether SDOs rely on morally acceptable procedures to increase the quality of standards. This hints that a more pragmatic form of legitimacy is at play since the goal of standardisation is the adoption of standards (Forsberg 2012). Suchman (1995) defined pragmatic legitimacy as an instrumental form of legitimacy obtained through the exchange of support, in this case between supporters of standards and the SDO. This could mean that inclusion, transparency, and reflexivity merely serve as instrumental necessities to leverage support needed for standards adoption, which could be seen as a form of moral entrapment (Haack, Schoeneborn, and Wickert 2012). Additionally, the goal of standards adoption seems to suggest that 'taken for granted' legitimacy, as discussed by Suchman (1995), plays an important role in standardisation, where standards derive their authority from a tacit but ubiquitous support. *De Jure* standardisation literature suggests that this is indeed the case since standards aim to create one common solution when having multiple is considered undesirable (Wiegmann, de Vries, and Blind 2017).

5.1 Limitations and further research

This study comes with a few limitations. First, our empirical context is limited to the Netherlands and may therefore come with a limited generalisability to other countries, regions, and the international context, despite the robustness of our findings. Although NEN has extensive and exclusive expertise, there are differences between national and international standardisation bodies due to organisational and cultural differences (ISO 2020). Future research could explore the external validity of our findings. Second, our research suggests that the relative importance of criteria may differ substantially among national standardisation committees due to contextual elements (e.g. sector type or classification of stakeholders). We therefore advocate research that investigates committee-level differences in their ability to institutionalise RI dimensions.

5.2 Theoretical contributions

This research contributes to the RI literature as it examines RI's dimensions and criteria in the context of *de jure* standardisation. Even though standards are often seen as a means to insert ethics (Busch 2011; Thompson 2020), research has showed little consideration for the institutionalisation of RI in standardisation (Wickson and Forsberg 2015). Our findings hint at what RI dimensions are deemed most important to institutionalise. Our research also validates the importance of transparency as an additional dimension of RI due to its importance for maintaining trust in standardisation. Most importantly, this research bridging the gap between the RI and standardisation literature by suggesting a link between RI and standards' legitimacy. The research indicates a close relationship between inclusion, transparency, responsiveness and the input and throughput legitimacy necessary for the adoption and quality of standards.

5.3 Practical contributions

A practical contribution of this research is the definition of quality standardisation, which SDOs can use to assess their own standardisation processes. This could help identify directions for further institutionalisation of RI in practice. For example, formal impact assessments might be useful for SDOs to

identify the impacts of standards and align stakeholder goals. A social impact assessment could provide SDOs with a tool to institutionalise the dimension of anticipation, which is currently lacking.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The research presented in this article was conducted by Almar Meijer as part of his Master Thesis, see http://resolver.-tudelft.nl/uuid:99a9c7b4-f3db-4c9a-b851-09dae88283fb.

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

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