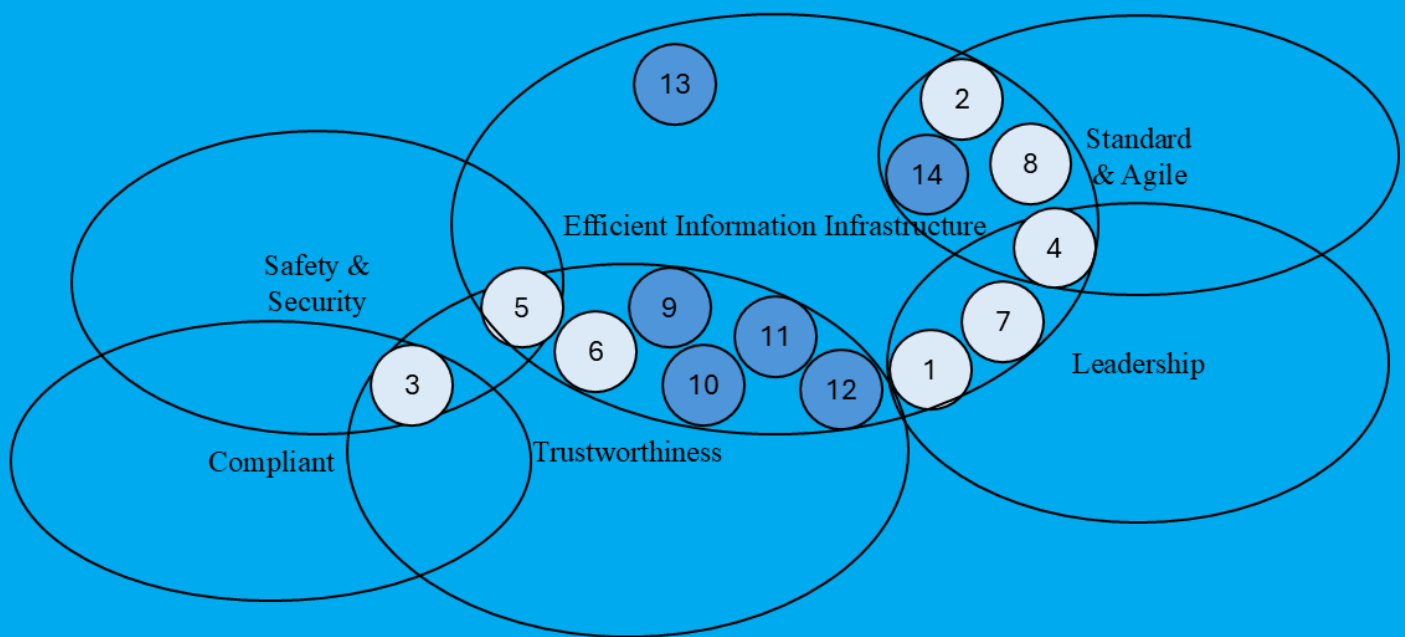


Towards Success for an Information Infrastructure

A Framework for the Design of Actor Success for an Information Infrastructure

H.M.S. Martens



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by

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*H.M.S. Martens
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Executive Summary

Information Infrastructures (II) play a crucial role in modern organisations and governments by facilitating information exchange, improving operational efficiency and enabling strategic decision making (Johnson, 2012). These infrastructures serve as complex, socio-technical networks that evolve over time by integrating software, hardware, institutional frameworks and governance structures (Hanseth and Monteiro (1998); Cordella (2010)). While governments and organisations continuously develop and enhance their II's, the reported success rate of development projects is low (Varajão et al., 2022). In the Netherlands, more than half of the government's II related projects fail to be successful (Rijksoverheid, n.d.-a). The low success rate can be explained by changing goals or negative outcomes during the project, for example due to the varying perceptions on II success by the actors involved in the II (Rijksoverheid (n.d.-a); Iriarte and Bayona (2020)). Moreover, the complexities that characterise an II, make defining success difficult (Hanseth and Monteiro (1998); Cordella (2010)). Despite the critical role of II's, there is no established framework for evaluating II success. This thesis aims to add to the body of knowledge on II success, by developing a framework for measuring II success, with accounting for the perspectives by the actors of an II. To address this knowledge gap, the following research question will be answered: *How do different actors prioritise success measures of an Information Infrastructure?*

This thesis has used a mixed-method approach to answer the research question. A systematic literature review has analysed current literature on the success of an II and an Information System (IS). The inclusion of IS success allows for a more thorough insight in perspectives on success. The results from this analysis will form the basis for the success measures. Next, a single case study was executed, to study the actor's prioritisations of II success measures. For the case study, the Dutch e-invoicing II was chosen. The Dutch e-invoicing II is established and mature but still in development; has a complex network configuration featuring multiple data exchange pathways; is present in both the private and public sector; and multiple standards are present. To understand the perspective on measuring II success of II actors, interviews were held with representatives of each actor category. During these interviews Q-sort methodology was used to establish a ranking in the success measures by the participants (Minkman & Molenveld, 2020). The inclusion of Q-sort methodology during the interviews, allowed for both a quantitative and qualitative data analysis. The goal of the data analysis was to determine the perspectives of actors on measuring II success. The quantitative data analysis formed a statistical basis on the perspectives on II success, while the qualitative data analysis added understanding to the found perspectives.

To answer the research question *How do different actors prioritise success measures of an Information Infrastructure?*, there is a principal shared perspective on success: a successful II is an efficient II. This perspective of the importance of efficiency is reflected in several critical success measures related to the accuracy & reliability of data; interoperability; productivity; reduction of tasks; and effectiveness. In addition, each actor has their own additional perspective on measuring II success. These perspectives are:

- Safety & Security
- Compliant
- Trustworthiness
- Leadership
- Standard & Agile
- Efficiency

These perspectives reflect the role an actor has in the II and their organisational objectives and ideals. In general, public sector actor's perspectives (efficiency, standard & agile, safe & secure, trough leadership) can be related to their organisations ideal of increasing social and economical value. While private sector actor's perspectives (efficiency and trustworthiness) reflect an increase in economic value. Notably, only the actor "regulatory body" did not share the perspective on an efficient II, as their role is focussed on regulating a network in the II. Lastly, all actors found it essential that for a successful II end-users should not need any technical competencies.

This thesis has aimed to add to the body of knowledge on II success, by developing an actor-based framework for measuring the perspectives on II success. This framework is a first step in achieving an established perspective on what II success entails, by accounting for the complexities that characterise an II, to increase the success rate of II development projects. To increase the success rate of the Dutch e-invoicing II, two practical suggestions were given. Firstly, a bimonthly committee can help ensure that market feedback is incorporated and a shared vision between private and public sector actors is developed and known. Secondly, television and radio commercials can be used to increase the adoption rate of the II amongst end-users. Increasing the adoption rate was seen by several actors as a critical success measure of the II. Lastly, future research focussed on testing the validity of the developed framework in different domains is needed to establish a reliable framework for measuring II success.

Keywords: Information Infrastructure, success measures, actor perspectives, e-invoicing.

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List of Abbreviations

Abbreviation	Definition
API	Application Programming Interface
B2B	Business to Business
B2G	Business to Government
CEN	European Committee for Standardisation
DM ISS	DeLone and McLean Information System Success
E-invoicing	Electronic Invoicing
E-procurement	Electronic Procurement
ERP	Enterprise Resource Planning
FTE	Full Time Equivalent
G2B	Government to Business
G2G	Government to Government
HREC	Human Research Ethics Committee
ICBR	Interdepartementale Commissie Bedrijfsvoering Rijk
ICT	Information and Communication Technology
II	Information Infrastructure
IS	Information System
KvK	Kamer van Koophandel
MOT	Management of Technology
NEN	Stichting Koninklijk Nederlands Normalisatie Instituut
OIN	Organisation Identification Number
PCA	Principal Component Analysis
ROAP	Rijksoverheid Access Point
SME	Small Middle Enterprise
TAM	Technology Acceptance Model
TPB	Technology Planned Behaviour
UTAUT	Unified Theory of Acceptance and Use of Technology
VAT	Value Added Taxes
VIDA	VAT in the Digital Age

Table 1: List of Abbreviations

Definitions of Concepts

Concept	Definition
Actor	Entity that is capable of making a difference or changing a state of affairs within their networks (Cresswell et al., 2010, p. 2)
Adoption	The uptake of systems or information infrastructure in (inter)-organisational processes (Watkinson et al., 2021, p. 2)
Critical success measures	Success measures of extreme importance (Vocabulary.com, n.d.)
Efficiency	Efficiency of business operations when using the information infrastructure
Environmental factors	Factors which can influence the information infrastructure, but are not directly linked
Governance	Elements associated with decision making (Feldman et al., 2014, p. 5)
Information Infrastructure	Complex phenomena which have a facilitating and enabling function centred around information exchange (Hanseth and Monteiro (1998); Cordella (2010))
Installed base	The existing version of the information infrastructure, its systems and practices (Hanseth & Monteiro, 1998, p. 11)
Net benefits	Benefits as a result of using the information infrastructure
Organisational	Elements associated with any and all of the stakeholders (Feldman et al., 2014, p. 5)
Safety & security	The safety and security of the information infrastructure and the business operations enabled by using the information infrastructure
Socio-technical	Complex interactions between technological components and social arrangements, which requires the joint optimization of technological and social variables (Bauer & Herder, 2009, p.1)
Standard	Standards regulate, simplify and make possible an extensive division of labour which should be recognized as a necessary basis for far-reaching modernization processes (Hanseth & Monteiro, 1998, p. 55)
Technical	Elements associated with the system or infrastructure (Feldman et al., 2014, p. 5)
Technical quality	Degree to which the information infrastructures systems and data meet the requirements.

Table 2: List of Definitions

Introduction

Information Infrastructures (II) play a crucial role in modern organisations and governments by facilitating information exchange, improving operational efficiency and enabling strategic decision making (Johnson, 2012). These infrastructures serve as complex, socio-technical networks that evolve over time, integrating hardware, software, institutional frameworks and governance structures (Hanseth and Monteiro (1998); Cordella (2010)).

In the Netherlands, the government heavily relies on large-scale ICT (Information and Communication Technology) projects to develop and maintain their II's (Rijksoverheid, n.d.-b). However, a significant portion of those projects struggle with delays and inefficiencies. A report on the ICT projects of the Dutch government indicates that more than half of them failed to be finished within the allocated time (see Figure 1.1) (Rijksoverheid, n.d.-a). These failing ICT projects take almost twice as long to be finished than expected (see green bars Figure 1.1). This big difference comes largely due to extra adjustments, such as changing goals/demands (20% of the time) or negative outcomes within the project (56% of the time) (Rijksoverheid, n.d.-a, page 81). These shifts in goals during the project could be explained by actors not sharing the same goals or perspectives of what II success is. Typically, public actors (such as the government) invest in projects that are focussed around improving the social value for the nation's population. Such as health II's, to improve health outcomes (Feldman et al., 2014). While private actors are more focussed around improving their own economical value and gain a competitive advantage (Cordella, 2010). The difference in prioritised values of these actors often clash, resulting in difficulties when these actors need to cooperate (Hanseth & Monteiro, 1998).

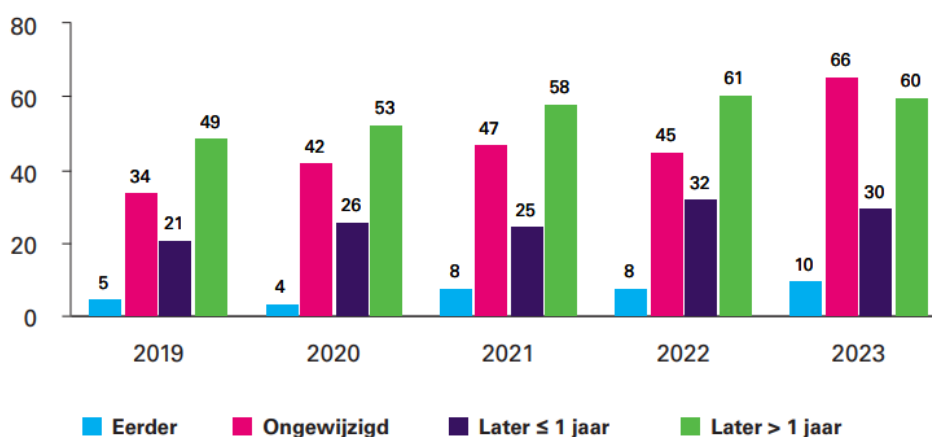


Figure 1.1: Differences between the initial lead time versus the actual lead time of the number of ICT activities. The bars in purple and green indicate a delay of the project (Rijksoverheid, n.d.-a, page 78).

Besides clashing ideals, II's are continuously further developed and are more likely to exceed organisa-

tional boundaries. Using an II in the supply chain, could automate processes and increase the efficiency of business processes. The continuous development of the II, will result in an increase in the size, how many and which actors the II encompasses. In result, II's are also more likely to encompass both the private and public sector. While such an II will probably be beneficial for all parties involved, due to advantages such as networking effects, the clashing values between the multiple parties involved might complicate the cooperation necessary to develop an II beneficial for each party. This complication could arise due to conflicting ideals and objectives of the parties involved, for example between private and public sector actors. But complications can also arise in II's within the private sector, as they also have different or competing ideals. While it is commonly thought that public and private parties have different objectives, how they exactly differ is still known as the publicness puzzle (Bozeman & Bretschneider, 1994). In addition, public organisations and governments have to adhere to stringent rules and are publicly accountable for their (monetary) decisions (Elpez & Fink, 2006). While stringent budgetary rules also influences private organisations, these rules are made less public. These rules also complicate decisions surrounding the development of an II, for public organisations.

A consecutive explanation for the negative outcomes within the ICT projects, could be due to varying perceptions on II success or prioritisations within the projects. As each actor involved has their own ideals and objectives, they, in result, also have a different perspective on what success is. As the actors in an II keep increasing, due to the development of the II. The complexities surrounding what a successful II is, also increases. The perspectives on II success and actor's influences on the II, result in a complex matter of determining what II success is. Iriarte and Bayona (2020) also noted the lacking success of IT projects, and argued that studying critical success measures is essential. The limited understanding of what contains II success and different actor viewpoints, could be a reason of these prolonged projects. These difficulties show how important it is to gain a better knowledge of what constitutes as II success. Establishing an actor-relative definition of what II success is could potentially address these challenges by reducing delays and inefficiencies.

Despite the critical role of II's, there is no established framework for evaluating II success. To determine II success, researchers have been using IS success models, such as Božič and Dimovski (2020). While IS success models can provide insights into IT project evaluation, they fall short in addressing the complexities that characterise an II (Hanseth & Monteiro, 1998). II's are inherently open, emergent, shaped by multiple actors with varying objectives and can be seen as an ecology of networks, which makes success difficult to define (Cordella (2010); Hanseth and Monteiro (1998)). IS success can be measured against organisational goals, while II success is most probably influenced by governance structures, installed base of standardized systems, and tensions between interoperability and continuous technological and institutional advancements (Cordella, 2010).

In addition, the involvement of multiple actors can further complicate the development of an II success framework. Elpez and Fink (2006) noted that actors can have different expectations of an II. As actors are in a governance together to develop the II, tensions between actors expectations can complicate the development of the II. Constantinides and Barrett (2015) also noticed these tensions as II development is shaped by ideological framing of the actors. In addition, van Donge et al. (2024) noted that essential variables can significantly influence both the shape of the II and actor's roles and responsibilities. This dynamic interplay of actors stress the challenge of defining II success. The absence of an II success framework, particularly one that incorporates different actor viewpoints, limits the ability to effectively develop and improve an II.

The continuously reported low success rate of II projects, importance of II's in economic activities and limited understanding of II success calls for an II success framework. Understanding II success while accounting for differences between actors can be crucial to help better navigate governance challenges, improve interoperability and try to anticipate adjustments. The existing IS models are limited in addressing the complexities that characterise an II. A new approach is necessary that considers its socio-technical and emergent nature, involvement of multiple actors and the dynamic forces shaping its development.

This thesis aims to add to the body of knowledge of II success, by developing a framework for II success.

The critical success measures of II's will be explored and identified. In addition, the objectives and prioritisations of actors involved in an II will be studied. This will allow to help determine the prioritisation of success measures of the II per actor. To obtain this objective the following research question is posed: *How do different actors prioritise success measures of an Information Infrastructure?*. Various sub-research questions have been set up to help answer the main research question:

- What are the different actors in an II?
- What are the success measures in an II?
- What are the critical success measures of each actor in the II?
- Are there tensions between the actors?
- Is there a shared perspective on the success of the II by the actors?

The first sub-research question will be answered by performing exploratory literature research to understand the concept of an II and what its actors are. To answer the second sub-research question, a systematic literature study will be performed. The literature study will form the basis of the II success framework. Next, to answer the third sub-research question, qualitative and quantitative data will be collected to test and add to the literature framework in a real-life setting, via interviews. Lastly, the fourth and fifth sub-research question will be answered with the collected data. Besides determining which success measures are critical, the interviews will be used to also determine any tensions between the actors and whether there are any shared perspectives on the success of an II. In the methodology chapter of this thesis the methods will be further explained (see chapter 3).

1.1. Connection to Management of Technology

The focus of Management of Technology (MOT) is on how to use technology as a corporate resource. Technology can be used to increase an organization's productivity, profitability, and competitiveness in addition to designing and developing goods and services to maximise customer satisfaction ("MSc Management of Technology", n.d.). More specifically, the use of innovative technology, which can be radical, frugal or incremental, can help organisations to gain a competitive advantage. This thesis aims to add to the body of scientific research of innovation technologies, by researching success measures of an II. II's fit perfectly in the frame depicted by MOT, as they are a complex socio-technical technology with a multi-stakeholder perspective.

II's are an essential but complex technology, widely used throughout organisations and governments. II's are a product of intra and inter-organisational networks with a variety of stakeholders involved. While II's may have been around since the beginning of the century, they are continuously (re-)developed to account for new stakeholders and technologies. II's are a corporate resource and can be effectively used to optimize their business processes and gain a competitive advantage. Due to the continuous and emergent nature of an II, optimizations or changes frequently take place. By identifying critical success measures of an II, while accounting for the various actors, the II and thus corporate processes can be optimized.

To determine the critical success measures of an II, various techniques learned in the masters program were applied. First of all, the course *Research Methods* was essential and formed the basis of the methodology chapter. The main research method of this thesis is qualitative research, specifically a case study. Techniques related to case studies, how to conduct interviews, coding approaches and statistical analyses were key to collect and analyse the data of this thesis. Second of all, the course *Business Analytics* was key to provide the knowledge for performing statistical analysis with the collected data. Techniques such as correlation analysis learned during this course were applied on the collected data. Third of all, the courses *Technology, Strategy and Entrepreneurship*, *Inter- and Intra-Organizational Decision-Making* and *Digital Business Process Management* were vital to understand stakeholder perspectives and how to analyse those. But also to understand concepts such as standardisation, installed base and socio-technical technologies.

Literature Research

2.1. Understanding Information Infrastructures

The concept of Information Infrastructures (II) emerged in the early 1990s, driven by the technological advancements and policy initiatives, such as the USA's Core/Clinton vision and the European Union's plan for Pan-European II (Hanseth & Monteiro, 1998). These initiatives aimed to structure different information sharing networks, such as teleworking, university and research networks, electronic tendering, and healthcare systems. II's can be seen as a product of information and communication technologies. Which were further developed through innovations but with a large focus on standardisation. As the research field matured, Hanseth and Monteiro (1998) saw that a holistic definition of an II was necessary. Hanseth and Monteiro (1998, ch. 3) identified 6 key aspects of an II. An II is a shared, heterogenous socio-technical network which has an enabling function and develops through extending and improving their installed base. To better understand the different aspects of the II, each of them will be explained more thoroughly.

Firstly, an II is designed to support a wide range of activities. While the II is also used to automate processes, it can enable the use of new technologies to open up to new activities (Hanseth & Monteiro, 1998). Secondly, an II is shared by actors in a community. These actors all use the II, the same object in essence, but may have different interfaces. The II cannot be split into several parts used by different groups independently (Hanseth & Monteiro, 1998). However, the II does exist of several elements. To integrate these elements, interfaces or data files are standardized. Standardization is essential as they constitute to the interoperability of the various elements, making the II a proper infrastructure (Hanseth & Monteiro, 1998). Thirdly, II's are open, there are no limits to the scale of the II (Hanseth & Monteiro, 1998). This openness also implies that there are no strict borders present of the II. Elements of the II, such as actors or use areas, can always be connected to another II or information exchange process (Hanseth & Monteiro, 1998). The limitlessness of the II implies heterogeneity, where changing conditions and requirements, and varying alliances and constellations shape its development over time (Hanseth & Monteiro, 1998). The heterogeneity of the II concerns not only the technology, but also humans, organisations and institutions.

Fourthly, the II is a socio-technical network. The II or its systems will not work without the interaction of humans or the application/usage of the II in organisations and institutions (Hanseth & Monteiro, 1998). Fifthly, an II is an ecology of networks (Hanseth & Monteiro, 1998). The infrastructures have interdependent layers and link logically related networks. The interdependency between layers and elements of the II causes heterogeneity. When one of these interdependent elements is changed, the other elements have to be changed as well. This can result in various formats of a technology, implying heterogeneity (Hanseth & Monteiro, 1998). Lastly, II's are developed through extending and improving the installed base. The installed base are the existing elements in the II (Hanseth & Monteiro, 1998). The installed base heavily influences how the II can be developed. As the existing elements still need to be interoperable with the new developed elements. This aspect also implies that an II is not developed from scratch, but existing elements/systems are integrated or replaced (Hanseth & Monteiro, 1998).

Cordella (2010) added to this perspective on II's, but is more focussed on the relational dimension. While building on the definition provided by Hanseth and Monteiro (1998), Cordella (2010) uses actor-network theory to emphasize the emergent nature of the II. The II is continuously and dynamically defined and refined within their use. The techno- and socio-deterministic dimensions co-define the trajectories of the II via a dynamic interplay which is constantly reshaped by its output. The emergent nature of the II implies that any modification in the II's technology or processes affects the distribution and accessibility of information, leading to potentially unexpected outcomes which require further intervention. Such interventions can cause additional unforeseen consequences, creating a feedback loop that continuously alters the II's trajectory. Therefore, an II is an emergent phenomena instead of a stable static organizational foundation.

This interplay between the different parts of an II, are also what makes the II complex. Moreover, there is no limit to the number of actors involved in the II (Hanseth & Monteiro, 1998). The limitlessness of actors involved can have consequences on the shape of the II. As Cordella (2010) stated, the users co-define the shaping trajectories of the II, by being in a governance. When the number of actors increases, the complexity of reaching a consensus also increases (Huang, 2023). Additionally, the number of systems linked to the II will also increase when the number of actors increases. Each actor has their own systems they currently use. When they become a part of the II, their systems also become a part of the II, further increasing the installed base of the II. With arising competitive needs, changes may need to be made to the II and its standards (Cordella, 2010). However, actors in the II can have different standards for their systems, influencing the flexibility of choosing a new standard, as the standards need to be interoperable with the installed base. The installed base thus also influences how the new standard can be designed (Hanseth & Monteiro, 1998).

However, these changes in the technologies and processes of the II, can have unexpected outcomes on the access and distribution of the II (Cordella, 2010). These outcomes need to be intervened, which in return can cause other unexpected effects, as described in the loop by Cordella (2010). To adjust for these unexpected outcomes, the governance of the II can influence the direction and shape of the II. But, as multiple actors in the governance decide on which direction to take, reaching a consensus can be quite a difficult process and can create tensions. Cordella (2010) described this circular loop, where technologies and processes drift of their intention towards realization. Figure 2.1 gives an overview of the forces influencing the development of an II, highlighting the complex and continuous nature of II's. This thesis views II's as a complex phenomena which have a facilitating and enabling function, centred around information exchange. The II is emergent in its nature, but is shapeable by the governance of the II. This view of II's is based on the definitions given by Hanseth and Monteiro (1998); and Cordella (2010).

2.2. Challenges in Measuring the Success of an Information Infrastructure

To effectively manage, influence and develop an II, it needs to be known what makes an II successful. However, determining what a successful II is, is quite challenging. The interdependencies, continuous reshaping, emergent and open nature and multiple actors involved in the II make determining if an II is successful complex. Even more so, success itself is an ambiguous concept, with a consensus being rarely reached (Varajão et al., 2022).

Take the involvement of multiple actors in the II. Every organisation has one goal, to increase their competitive advantage (Broadbent et al., 1999). Traditionally II's were designed, in an organisational setting, as instruments with a techno-deterministic stance to increase the standardisation of Information Systems (IS) and data throughout the corporation and re-engineering of the corporation (Cordella, 2010). The success of the II can then be measured by the initially set goals and objectives and the implementation of the II can be seen as a strategy (Cordella, 2010). However, Broadbent et al. (1999) lacks an inter-organisational perspective of II application. II's have also evolved to exist outside organisational boundaries. Traditionally, II's have first been developed by governmental parties, to increase the social value in a certain sector (Hanseth & Monteiro, 1998). Governments have played a central role in the development of II's, especially in the health and telecom sectors (Hanseth & Monteiro, 1998).

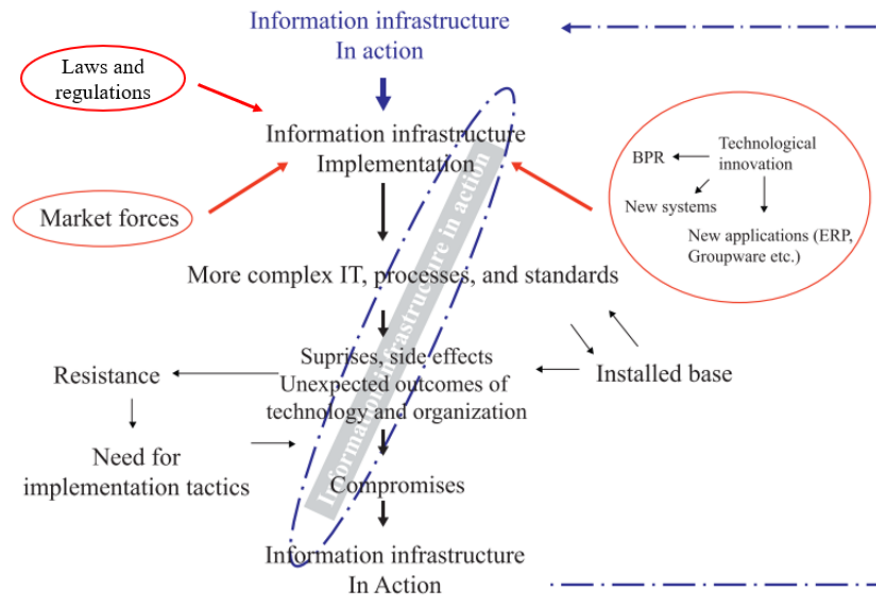


Figure 2.1: Factors highlighting the continuous and complex nature of an Information Infrastructure, adapted from Cordella (2010, page 36).

II's are widely used in the public sector and have also undergone various developments. For example, van Donge et al. (2024) noted an increase in the collaboration between governmental organisations, the decentralisation of infrastructures and the increased involvement of the private sector providing II components for public sector oriented II's. These developments highlight the interoperability and interdependency of systems of the II even further. When an II exceeds organisational boundaries, the determination of the success of the II is more complex. Then, each actor can have a different expectation of the II, and thus measure its success differently (Elpez & Fink, 2006). If actors intentions of the II differ quite a lot, the determination of a single holistic goal can be difficult. Resulting in the difficulty of measuring the success of an II at the intended goal.

Moreover, the continuous reshaping and interdependencies in the II play a role on the outcome of the II (see Section 2.1). Reshaping due to the availabilities of new technologies, strategies of actors or intervening earlier unexpected outcomes happen continuously. When reshaping the II to adhere to the new technological standard, the standard will be reinforced and therefore shaping the II even further in a certain direction (Cordella, 2010). The reshaped II can reflect the actors preferences, and thus be viewed as becoming more successful. However, the II could also drift away from the intended goals, due to path dependencies and installed base. If these forces are largely negative, it can result in a diminishing interest of the actors involved in the II (Cordella, 2010). Will the success of the II then be measured by the intended goals, or will the view of a successful II also be reshaped? Due to the emergent nature of an II, determining if the II is successful can be quite complicated, as it's characteristics can change over time or actors lose interest.

Lastly, if a new actor wishes to join the II, their involvement might affect the success of the II. Hanseth and Monteiro (1998) stated that II's are open, thus new actors are able join the II. If the actor wanting to join the II has very different goals compared to the rest of the actors, are they then able to join? And if so, what would be the impact of the actor joining on the II, as their systems current standards may vary. The governance of the II can decide on these matters. These decisions will have consequences on the shape and therefore the success of the II. Moreover, those governance decisions will also have an effect on the roles and responsibilities of the actors (van Donge et al., 2024).

These complexities surrounding II success can pose the question if determining II success is even possible or necessary to help influence and manage the II. As mentioned in Chapter 1, projects related

to II or IS development still have quite a low success rate. However, there are many useful and reliable II's and IS's present (Varajão et al., 2022). While Varajão et al. (2022) does not explicitly state examples of reliable and useful II's and IS's, it is argued that the studies reporting the high rate of unsuccessful II/IS projects are widely criticised. The main criticism on those negative studies revolve around the lack of details, impossibility to ascertain the methods or techniques for evaluating the success (Varajão et al., 2022). Even if there are many useful II's present, one could argue that determining the success can help create awareness of the importance of different aspects of the II. Having knowledge about successful characteristics of an II could increase the efficiency of the governance of the II. By knowing actor's perspectives on success, the development of the II can be influenced by influencing those actors in disagreement with you, if one knows which buttons to push. Unexpected outcomes will most probably still be present, as is the nature of the II. With an increased understanding of the direction, these outcomes can be managed more efficiently, hopefully resulting in an increase of successful projects, or at least in knowing if success can be achieved.

2.3. The Absence of a Comprehensive Information Infrastructure Success Framework

Measuring II success is complex, and the body of literature is limited. While certain case studies have studied the success of an II (see Masser and Cromptvoets (2018); Constantinides and Barrett (2015)), a general framework of what II success is, is missing. Even more so, actors different viewpoints on what a successful II is, have been considered to a limited extent (see Abele-Wigert (2006); Watkinson et al. (2021)). Masser and Cromptvoets (2018) used both a qualitative and quantitative approach of measuring II success. They stated that one of the weaknesses of their qualitative approach was the lack of uniform responses, due to the involvement of several organisations. To prevent uneven results, a response template was used. On the one hand, this approach ensures an as complete as possible overview of the qualitative success measures. On the other hand, the prevention of actors answering in their own way reduces understanding of why actors behave in a certain way. This understanding can contribute to better governance and hopefully have a positive effect on the II. Section 2.1 sketched the influences actors have on the shape of the II. Understanding the motivations and tensions between the actors, can possibly influence the governance of the II in a positive way, if that knowledge is applied during the governance. Cordella (2010) stated that the governances of the II can also shape the II, therefore if the governance is more successful, the II can also be more successful. Especially with the limited success II's have had (see Chapter 1) it is crucial to understand how actors view II success. However, no frameworks or models are provided yet in literature.

2.3.1. Evaluating the Success of Information Infrastructures with Information System Success Models

With the lack of an II success model, some researchers have been using IS success models to determine the success of an II (see for example Božič and Dimovski (2020)). An IS is a single stand-alone system, bounded by organisational limits being an integral part of the larger II (Hanseth & Monteiro, 1998). While IS success models can help determine critical success measures of an II, IS success models offer a limited view. An II is much more complex than an IS. The complexity of an II regarding its emergent nature, governance, path dependencies and interoperability, are not present in an IS (Hanseth & Monteiro, 1998)). Therefore only using IS success models most probably leaves out critical success measures that are relevant for II's.

Moreover, one of the most widely used IS success models, the DeLone and McLean model (DM ISS model) (DeLone & McLean, 1992), has received criticism of missing relevant success measures (DeLone and Mclean (2003); Gable et al. (2008)). While DeLone and McLean updated their model to incorporate the criticism (see Delone and Mclean (2003); Petter et al. (2013)), their model still offers a limited view on IS success. DeLone and McLean (1992) developed their model by reviewing the existing body of literature in IS success. While this allows for accounting for what is already understood, it misses the underlying reasoning due to the lack of interviews with experts.

The limited view of the DM ISS model was also noted by other researchers, and multiple models have been used to determine IS success (see Gable et al. (2008); Al-Kofahi et al. (n.d.); Varajão et al. (2022))

for an extensive review). Saarinen (1996) evaluated IS success with a more traditional approach, the cost-benefit analysis. Their research noted that while user information satisfaction is perceived as the main dependent variable of IS success, criticism of it being subjective and a surrogate remains. Saarinen (1996) included the development process and the impact of the IS on the organisation to achieve a more quantitative model. To account for changes across time and stakeholders, Gable et al. (2008) developed their IS success model, showing success to be a multidimensional, dynamic and relative construct.

The existence of multiple IS models highlights the lack of an universal approach to determining IS success. With IS's being an integral part of an II, taking into account the various IS success models will hopefully enhance the understanding of II success measures. In addition, IS success models also fail to incorporate differences of actors perspectives on success (Elpez and Fink (2006); Seddon et al. (1999)). In particular, knowledge of what public actors prioritize in an IS project is limited. As public actors, such as the government, play a central role in developing II's, increasing the understanding of their objectives can hopefully help to increase the success of projects related to both II and IS.

2.4. Towards a Framework for Information Infrastructure Success

As stated before, II's are more complex and have additional layers than an IS. Therefore, developing an II success framework solely based on IS success models is inadequate. Considering measures which reflect the complexities of the II, such as the shape and interoperability, as well as the involvement of actors in the II can add to the understanding of what a successful II is. When developing an II success framework, these measures and the complexities of an II are taken into account. These complexities can become key challenges an II faces (Constantinides & Barrett, 2015). One of those challenges surrounds the development of an infrastructure across an ever expanding base of users, with heterogenous interests and resources. This requires extensive standardization efforts. Another challenge when designing the infrastructure, concerns the tension of seeking to control its scalability versus acknowledging the processes of drift and unintended consequences. These challenges can reflect or accentuate the success points of an II, as mostly an II needs to overcome a challenge to become successful. Therefore, the challenge itself is a measure of success. Moreover, ideological beliefs of actors underpinning their framing strategies can be taken into account (Constantinides & Barrett, 2015). These framing strategies are used by actors to legitimize or oppose certain actions within the II development. The research by Constantinides and Barrett (2015) accentuates the influence actors have on the shape and development of the II. This influence can be observed by when an actor finds the II successful in the development process. To conclude, developing an II success framework requires considering all dimensions of an II and their interdependencies.

2.5. The Actors of an Information Infrastructure

One of the characteristics of an II, as stated by Hanseth and Monteiro (1998), is that an II is open, with no limit in the number of users and actors. Actors are entities that are capable of making a difference or changing a state of affairs within their networks (Cresswell et al., 2010, p. 2). The varying actors involved implies the heterogeneity of the II. The unlimited number of actors, enables changing requirements; changing and unstable conditions for development; varying constellations and alliances; and several activities with varying relations over time (Hanseth & Monteiro, 1998, p. 42). The heterogeneity is on the one hand what characterises the II, but also what makes the development of an II challenging. Understanding the motivations and objectives of the actors involved in the II, might increase the cooperation during development. In addition, when the objectives of actors are known, they can be used strategically to achieve a preferred objective. Mahamadu et al. (2013) mentioned that the following theoretical models: TAM; TPB; and UTAUT (see Table 1 for the abbreviations) share the view that the intention to use has significant influence on the actual use or extent of use based on subjective cognition of participants. These intentions are influenced by motivation, perception of challenges, risks and willingness to overcome them. It is therefore of importance to understand where each actor comes from to understand their views on a successful II. Lastly, Constantinides and Barrett (2015) adds to the necessity of understanding the actors motivations. The actors have various ideologies, which are represented in their framing strategies. The actors make use of those framing strategies to develop the II in the direction they prefer.

While there may be an unlimited number of actors able to join the II, these actors will fall into a category of an actor group. Hanseth and Monteiro (1998, p. 79) defined seven categories of actors in the II. These categories can be further enhanced and simultaneously narrowed down by looking at other literature about actors in an II and an IS (Abele-Wigert (2006); Knol and Tan (2018); Malm-Nicolaisen et al. (2024); Elpez and Fink (2006); and Constantinides and Barrett (2015)). The following list of actor categories was in turn established:

- Advisory body
- End-user
- Regulatory body
- Service provider
- Standardisation body
- Strategic governance
- Software developer

To answer the first sub-research question *What are the different actors in an II*, there were seven actor categories identified, as listed above. For each of the actor categories, a short explanation about their objective in the II will be given in the following sections.

2.5.1. Advisory Body

The actor advisory body has the task to provide expert guidance, decision-making support and give strategic recommendations (*Policy Advisory Systems*, 2017). Advisory bodies can act as knowledge brokers, who are trusted with providing neutral and independent findings and advice. Their main objective is to facilitate and support the effective implementation and governance of II's (*Policy Advisory Systems*, 2017). They value expertise, accuracy, trust and credibility, and wish to contribute to maintaining a trustworthy II (*Policy Advisory Systems*, 2017).

2.5.2. End-User

End-users are the individuals in an organisation who interact directly with the final application (Trymata, n.d.). End-users have the primary objective of effectively using the systems of the II to support their operational tasks to enhance their productivity and performance (Elpez & Fink, 2006). An end-user aims for an II that is both functional, usable and meets their requirements and expectations to facilitate effective task completion (Elpez & Fink, 2006). The main objectives of the end-users can be influenced by several factors, such as the system quality, perceived usefulness, user satisfaction and the organisational goals (F. Davis, 1987). Besides these main objectives, end-users value certain aspects of the II. End-users value the usability, ease of use and system reliability (F. Davis, 1987).

2.5.3. Regulatory Body

A regulatory body is tasked with developing and enforcing the compliance with standards and regulations (Wurzer & Vom Brocke, 2025). It aims to guide the development of regulations of the II, to align with public interests and policy goals. Their primary objective is to manage the effective integration and utilization of data within established regulatory frameworks, ensuring data quality, reliability, and transparency (Knol & Tan, 2018). Adhering to the regulatory standards in a transparent manner, use and sharing is valued greatly (Knol and Tan (2018); Wurzer and Vom Brocke (2025)). Moreover, accountability is valued greatly. Ensuring that the II activities align with public welfare is also valued (Knol & Tan, 2018).

2.5.4. Service Provider

A service provider leases infrastructure resources from a software developer to deliver one or multiple services (Madi et al., 2021). The primary objective is to facilitate and manage the effective exchange and delivery of information and services within an II. By ensuring efficiency, interoperability, and value

creation for all involved parties (Feldman et al., 2014). As any company, their objective is also to increase their economic value, by generating a profit. Service providers get paid per transaction they facilitate for their customers (Exploratory interview with a service provider, see Appendix C). Moreover, service providers value the social good of the II. In the health sector, service providers emphasize the importance of contributing positively to public health, indicating that social value outweighs their economic motivations. This is especially visible in the early phases of the service deployment (Feldman et al., 2014). In addition, trust among their customers and a reliably service delivery are central to the perceived value propositions of the service provider (Feldman et al., 2014). Lastly, service providers aim to be seen as leaders in their specific sector, ensuring high-quality and real-time information delivery at the point of care (Feldman et al., 2014); (Exploratory interview with a service provider, see Appendix C).

2.5.5. Standardisation Body

A standardisation body in an II is a formal, quasi-democratic (international) institution responsible for defining, maintaining and promoting standards (Hanseth & Monteiro, 1998). Standards are the building blocks of II's and play a crucial role to facilitate the II functioning as an integrated whole (Fomin, 2003). These standards are to ensure the interoperability across the systems and actors in the II (Fomin, 2003). The primary objective of a standardisation body is to develop generalizable and widely adoptable standards that facilitate the compatibility and communication between components of an II (Fomin, 2003). The standardisation bodies have to follow predefined procedures and rules regulating the status, organisation and process of developing standards (Hanseth & Monteiro, 1998). The standardisation bodies value coherence, interoperability and universality, which are reflected in their goal to avoid fragmentation and duplication (Hanseth & Monteiro, 1998).

2.5.6. Strategic Governance

A strategic governance actor in the II, gives direction to the development of the II. The main objective is therefore primarily focussed around reaching the organisations goals (Elpez & Fink, 2006). The long-term goal of an organisation is to increase their competitive advantage (Broadbent et al., 1999). To increase their competitive advantage, an optimization of the business process might be essential. The strategic governance actor role can be executed by for example policy makers in the public sector. Or by the senior management of an organisation. The strategic governance actor values the ability to increase the efficiency, responsiveness, innovation and value for money, as this might increase the competitive advantage (Elpez & Fink, 2006).

2.5.7. Software Developer

Software developers develop, design and maintain software solutions that support an organisations II (Imaginnovation, n.d.). A software developers main objective is to deliver software solutions that effectively address user requirements and organisational needs. While simultaneously ensuring the scalability, reliability and interoperability of their solutions within the existing II's (Abele-Wigert, 2006). In the health sector, software developers have long-term strategic ambitions, such as modernizing their current portfolios through transitioning to the cloud, developing platform functionality and modularization (Malm-Nicolaisen et al., 2024). Their aim is to ensure their software is adopted widely and is interoperable with other systems components to enhance the efficiency and effectiveness (Feldman et al. (2014); Abele-Wigert (2006)). They aim for the successful integration and adoption of their products within broader II's. This is achieved by valuing key characteristics such as the interoperability, scalability and flexibility (Abele-Wigert, 2006).

3

Methodology

The goal of this thesis is to design a framework of success measures of an II, which aims to identify the critical success measures of the actors involved in an II. This will be achieved by first developing the basis of the theoretical framework of II success measures by executing a systematic literature research. Next, a holistic single case study design will be utilized to further develop the theoretical framework. The following sections will elaborate on the methods in more detail.

3.1. Exploratory Literature Search

Before the success measures of an II could be researched, it had to be first understood what constitutes as an II. To gain the necessary background knowledge on the II, an exploratory literature search was performed. The focus of this thesis is on determining the actor-based success measures of an II. Therefore, to guide the literature search, two questions were asked: *What characterises an Information Infrastructure?* and *What are the actors of an Information Infrastructure?*. Furthermore, the keywords: information infrastructure; information systems; and (multi)-actor were used during the exploratory literature search. Both the Scholar and SCOPUS data bases were used to search for relevant articles on information infrastructures. When an article that talked about either of the two posed questions was found, the references in said article were examined as well. To conclude, an exploratory literature search was performed to gain the necessary background knowledge about understanding what constitutes as an II. This search formed the basis for chapter 2.

3.2. Systematic Literature Review

As mentioned in section 2.3 there is a lack of knowledge on what a successful II is, while substantial knowledge on a successful IS is present. This thesis aims to reduce this knowledge gap by developing a framework of success measures of actors for an II. To develop this framework, a theoretical framework will first be developed. A systematic literature review will be executed to collect present success measures of an II and success measures of an IS. These findings will be used to develop a theoretical framework of success measures for an II. A systematic literature review increases the reliability of the study by transparently recording why certain studies were included, why they were chosen and what the results are. The goal of the systematic literature review, is to collect all present success measures and challenges of an II and an IS. Using the PRISMA method, ensures that all present and relevant literature is included (Page et al., 2021). The PRISMA method reduces any selection bias a researcher might have, due to incorporating multiple data bases, and establishing a search term. This search term reduces the risk of missing relevant articles, due to the researcher only searching in a certain direction. By using the PRISMA method for a systematic literature review, ensures that all academically recorded success measures and challenges are reviewed. Thus establishing a holistic overview of the current body of knowledge.

First, to guide the systematic literature analysis, a theoretical foundation was used to base the search term on. This theoretical foundation ensures that the literature review is as complete as possible. The

theoretical foundation, based on section 2.4, is represented in the search term as follows: ("Information" OR "Data") AND ("exchange" OR "sharing") AND ("infrastructure" OR "system") AND ("net benefits" OR "performance" OR "success" OR "satisfaction" OR "effectiveness" OR "gain") AND ("model" OR "framework" OR "indicators" OR "metrics" OR "Variables") AND ("actor" OR "stakeholder"). The first three terms are the boundaries of what the IS or II is, an information sharing/exchanging infrastructure. The fourth term represent the synonyms of success. These synonyms focus on success being an objective concept. The fifth search term narrows down how the success of the II or IS is researched in the articles. This term underlines that success is presented in the form of a list or overview. The last search term, ensures that actor's perspectives are mentioned in the articles. This search term underlines that actors are present and mentioned, aligning with this thesis's view on II's.

To reduce the location bias, Scopus and ISI Web of Science were used as data bases. In total, 1654 articles were found (see Figure 3.1: identification). To exclude irrelevant articles, the following filters were applied.

- Year: 1990 - 2025
- Language: English
- Accessibility: All open access; green; gold
- Document type: Article
- Publication stage: Final

The use of the filters resulted in 423 articles (see Figure 3.1: screening). Next, the title and abstract were scanned of these articles. If the concept of information infrastructures or information systems was absent in either the title or abstract, the article was not taken into account. This resulted in 30 articles being eligible (see Figure 3.1: eligibility). Of these 30 articles, the introduction, conclusion and discussion were scanned. If either of these parts mentioned success measures, talked about success in general or mentioned actors of the II or IS, the paper was deemed eligible. Figure 3.1 gives a comprehensive overview of the articles that were deemed eligible for the basis of the framework of success measures. Besides the articles found via the PRISMa method, five additional articles, found during the exploratory literature phase, were found eligible, based on the above criteria. In total, 22 articles were fully read and used for the basis of the II success measures framework (see Figure 3.1: included).

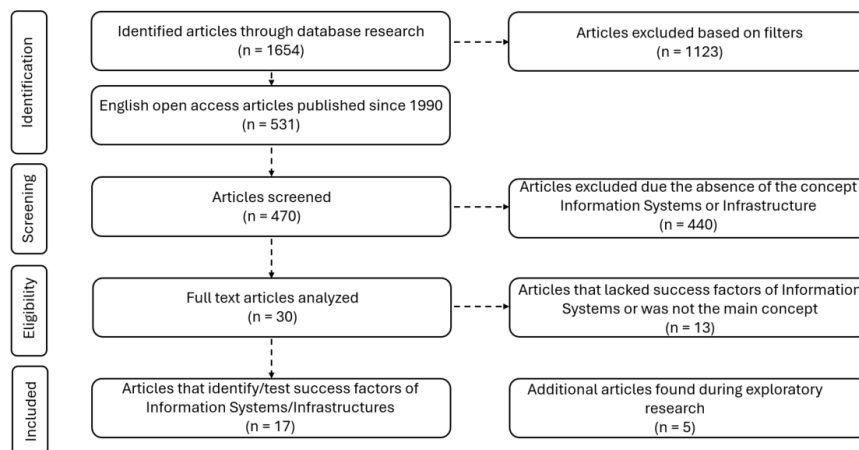


Figure 3.1: Overview of the systematic literature approach and articles analysed.

3.3. Case Study Design

Section 2.2 described that measuring II success is challenging, due to the various actors involved. This thesis aims to add to the body of knowledge and answer the main research question *How do different*

actors prioritise success measures of an Information Infrastructure? From this research question two objectives follow. The first is the ranking of II success measures, for each actor. The second is understanding the motivations of the actor's ranking. Following these objectives, a case study design fits best as it allows for the understanding of actor's motivations. Moreover, as mentioned in section 2.1, an II is a contemporary phenomena, as it is commonly used by organisations and governments. Another reason why a case study design fits best for this thesis objective, is avoiding any influence the study might have on the behaviour of the participants. As the objective is to develop a framework for II success, the influence on the actor's ranking must be as little as possible, to ensure that the collected data represents the actor's real motivations. To summarize, a case study design is the best approach for this thesis, due to the contemporary setting, no control over behavioural events and the type of research question (Yin, 2003, Figure 1.1).

Particularly a holistic single case study design will be used. A holistic single case design is based on studying a single case, where one unit of analysis is present (Yin, 2003). Within an II, there are a multitude of actors present. While these actors fall into previously described categories (see section 2.5), actors in the same category can also differ from each other, specifically in the private versus public sector (see chapter 1). In addition, the data can be exchanged across various ways. Cordella (2010) described that an II can be viewed as a network, where a certain type of data is exchanged across various systems, with various actors involved. Taking the network approach of viewing the II, a single case study allows for understanding the success measures of an II, while accounting for the various perspectives that may also occur per actor category. While a single case study has limited generalizability, the inclusion of varying actor perspectives can add robustness to the framework (Yin, 2003). In addition, the case being studied in this thesis will be a single case. The II being studied will be a typical II, which can also be found in other countries and settings. As this is a typical case, there is some generalizability to the findings (Yin, 2003). Moreover, the inclusion of varying actor perspectives per actor category can add to theory about II's, such as the inclusion of the private and public sector actors. Moreover, the unit that is being analysed is the II, as this thesis's aim is to develop a framework of success measures of actors in an II. Therefore, a holistic single case study design follows naturally. To conclude, a holistic single case design was chosen due to the ability to test theory and use a network approach, while having some generalizability and fitting with the research objective (Yin, 2003). Even if the developed framework will be premature, assuring for some robustness and reliability allows for future research to build on the framework.

Following Yin (2003), a case study should have propositions of theoretical knowledge based on the study's questions, so the data can be linked to the propositions. As described briefly in Chapter 1, public and private sector values clash. In the public sector, the focus is on increasing the social value for the population. While in the private sector, the focus lays on increasing the economical value for the business. Section 2.5 delves further into this theory. To design the cases, this theory is used to develop propositions, based on the research questions. These propositions help give direction to what needs to be examined in the research. Based on this thesis's research questions, the following propositions can be established:

- Private actors measure the success of an II by its economic benefits.
- Public actors measure the success of an II by the benefits it brings for their population.
- Both actors find the efficiency of the II important.

To test these propositions one single case can be used. This case can be used to explore the differences between theoretically different actors, by testing for the theoretical variable. More specifically, private sector and public sector actors will be taken into account. So, for the following actor categories, both public and private sector actors will be analysed; end-user; service provider; software developer; advisory body.

3.3.1. Case Selection - The Dutch E-Procurement

Case Selection Criteria

As there are many II's present today, a domain of wherein II's operate needs to be chosen to limit the II's which can be studied. Section 2.1 describes a definition of what an II is. However, for this thesis the

boundaries of an II need to be made explicit. The II facilitates information exchange between actors. In this thesis, the information exchange will start at the sender (an end-user) and go to the receiver (an end-user). The information will pass by various systems and various actors. The II will thus be viewed within the boundaries of the two end-users, sender and receiver, and all the actors that take a role in the information exchange of this II. This role could be to develop the systems along which the information passes by, or delivers a service. To test the theoretical variable, private versus public sector, a domain where an II with both a public and private end-users, or other actors, is present is essential. In addition, choosing a domain which has an established II, but are still in development is also essential to study the II in a contemporary setting. Also, if the II is still in development, understanding what makes them a success can help the parties involved to give a clearer direction to their development strategies.

The Dutch E-Procurement

Therefore, an II within the domain of the Dutch electronic procurement (e-procurement) will be investigated. The Dutch e-procurement has both private and public end-users, is established in the Netherlands since the 1980s and new developments are emerging (UnifiedPost Nederland, n.d.). Moreover, only II's related to invoicing will be taken into account. The reasoning behind narrowing down the context of which II's will be considered, is to gather deeper insights in the difference of the actors interpretation of success. In addition, during exploratory interviews, it was found out that e-invoicing, both in the public and private sector, is quite established. Other data exchanges related to procurement, such as orders, are less established. Therefore, to ensure all interview participants were on an equal footing with their knowledge about measuring II success, the case was narrowed down to data exchanges surrounding e-invoicing. The main reasoning asking interview participants only about the e-invoicing II, was to increase the reliability of the study, as no participants were ignorant about this data exchange. The existence of multiple data exchanges, with a variety of pathways, in one II also shows the complexities and layers present in an II. The complexity and layers of the II facilitate the deeper analysis of when an II is successful. Executing a single case study within the invoicing e-procurement, allows for a more in-depth exploration of the success measures of actors of the II, motivations and tensions. While only studying an II in the Dutch e-procurement limits the generalizability of the framework, testing for theory allows for a somewhat generalizable framework in this context. Future research could use the framework to study other domains of II's, or the II in a different country and enhance the framework.

Choosing the Dutch e-procurement is due to the complexity and variety in the II present in the domain. In the Dutch e-procurement, various data exchanges between end-users can occur. Such as the Business-to-Business (B2B), Business-to-Government (B2G), Government-to-Business (G2B) and Government-to-Government (G2G) context are present. In each context, the design varies, but also has some overlap, which enables to explore deeper insights into the prioritisations of the actors. During the exploration of the Dutch e-procurement domain, it was noted that only the end-users at the back end differ, such as a public or private end-user, but not the end-user at the front end. Also, while there are many different private service providers and software developer companies, there is little variation in other actors. Therefore, the Dutch e-procurement domain can be approached as one II, with a network view. As there are multiple ways to exchange data, making use of various actors. These variations in the II, show the complexity of what an II is and thus also how to determine the success of the II.

Moreover, since the 1980s, the Dutch government has invested in their e-procurement and the II supporting it (Unifiedpost Nederland, n.d.). The longevity of the II adds value to the study, as the development of the II, and in which direction it has moved, can be of importance when determining success measures. Furthermore, multiple standards are used for different, or the same, intermediaries of the information exchange (Logius, n.d.-b). The variations of standards in the II can give additional insights into what actors view as a successful II. In addition, the public and private sector may be working towards the use of one standard in the II for invoicing, namely Peppol eInvoicing (Tickstar, n.d.). Moreover, new developments surrounding laws and regulations might have an impact on the e-procurement II, but it is unsure to what extent, if at all (see for example VIDA (European Commission, n.d.)). It might be interesting to see whether this development influences the actors preferences, but also makes this domain contemporary. This understanding can add to the understanding of success measures of the II. Overall, the e-invoicing II of the Dutch e-procurement domain is complex, with multiple variations of configurations, context measures, actors and standards. These measures allow for a holistic single case study design, where the success measures of actors of an II can be studied

in-depth.

Actor Selection Criteria

As mentioned before, one case will be studied to research the success measures of actors of an II, but also explore the theoretical variable: private versus public sector. To choose the actors to research the success of an II, and to test the theoretical variable, various aspects were considered. First of all, the actor has to be established. An established actor has been a part of the II for quite some time, at least a year. The establishment allows for the maturity of the use of the II by the actor. Which in turn gives the actor the necessary knowledge to know on when and why they find the II successful. Second of all, the actor, particularly the end-user, has to make use of the e-invoice II. Invoices can also be send via a pdf format with an email. Ensuring that the actor indeed makes use of the II, is essential otherwise the actor cannot determine the success of the II. Third of all, the configuration of the II has to be similar in the actors. In particular, the actors have to make use of, at least for a part, of Peppol. If the data exchange configuration is not partly similar, the theory testing between actors in the II is limited. With these criteria, organisations representing the actor categories were selected.

3.3.2. Data collection

This research will be qualitative of nature, by carrying out a literature review and a case study. To collect the primary data, interviews will be held. Semi-structured interviews will be held with one expert per actor group, to determine the prioritisation of the success measures of an II. The systematic literature review might not reveal all the II success measures. Therefore, the interviews will also determine whether important success measures are missing. These experts will be sampled via judgment sampling. However, as judgment sampling is a form of non-probability sampling, no real generalization can be obtained, which is therefore also a limitation of this research (Sekaran & Bougie, 2016). Furthermore, a snow-ball sampling approach was used, by which participants could further extend the interview invitation to their colleagues. The reasoning for interviewing experts is that in-depth knowledge about the II is necessary, as they need to formulate their motivations in prioritizing certain success measures over others. One expert of each actor group per case will be interviewed, resulting in 14 interviews (see Table 3.1). Choosing an expert can be difficult, especially when external criteria are lacking (Shanteau et al., 2002). Therefore, Shanteau et al. (2002) have developed the CWS method, which tests the consistency and discrimination of experts. These characteristics can be helpful when choosing an expert. Shanteau et al. (2002) argue that the ability to differentiate between cases on consistent bases is necessary in an expert. Therefore, the discrimination and consistency ability of expert prospects will be taken into account when choosing experts. For example, specialists or managers who are highly involved in the II will be considered. A senior data engineer who is involved in the development of the II but also in the governance will probably have expert knowledge about the II and discriminates consistently during the progression of the II. However, choosing an expert remains a subjective matter, as the individuals themselves validate their expertise, and will therefore also be a limitation of this thesis.

In these interviews, the Q-sort methodology will be applied. The Q-sort method can give systematic insight into the reasoning of the participants. Q-sort methodology is right for studies where the researcher aims to analyse the underlying perspectives of the subjects (Minkman & Molenveld, 2020). Using this approach will allow for the listing and weighting of the success variables, while simultaneously exploring the reasoning (Minkman & Molenveld, 2020). In addition, a relatively small set of subjects are already sufficient, with each of these subjects representing all different viewpoints (Minkman & Molenveld, 2020). The goal of the interview is to determine which success measures are essential, out of a list of 49 measures (see Table 4.2). The Q-sort method allows for the forced ranking and limited number of spots for the measures (Minkman & Molenveld, 2020). Other methods, such as best and worst scaling or ranking the measures individually, also establish an ordered list of the measures. However, in those measures there are an unlimited number of spots available for each category. The Q-sort method really allows for determining which measures are critical, as there are only a limited number of spots available per category. Also, there is no maximum to the number of measures being ranked with Q-sort. Of course, one can imagine that ranking more than 70 measures would become difficult. The forced ranking of the measures with a limited number of spots available, understanding the reasoning behind choices, the small set of interview participants and limitlessness of measures are the reasoning behind choosing the Q-sort method to identify the critical success measures of an II.

Table 3.1: Overview table of the participants, their role description, their organisation's description, the corresponding actor category and the date of the interview

Participant code	Actor	Organisational description	Role description	Date of interview
1	Strategic governance	Writing policies related to e-invoicing and procurement	Digitalisation advisor	22 April 2025
2	Public service provider	Maintaining and facilitating data exchanges surrounding the Dutch central government	E-procurement architect	28 April 2025
3	Public regulatory body	Regulating the Peppol network	Account relationship manager	10 April 2025
4	Standardisation body	Establishing data standards surrounding e-invoicing and procurement	Specialistic advisor standards	28 April 2025
5	Public end-user	Department within the Dutch central government receiving e-invoices	Senior advisor strategic procurement	8 May 2025
6	Public software developer	Providing and maintaining the facilities surrounding the Leveranciers Portaal	Product Owner Leveranciers Portaal	14 April 2025
7	Public advisory body	Increasing the adoption rate of e-invoicing for decentral governments by providing knowledge sessions	Stakeholder manager decentral governments	9 April 2025
8	Public end-user	Municipality receiving e-invoices	Project lead transaction processing	22 April 2025
9	Private end-user	Supplier sending e-invoices	EDI/MFT product owner	17 April 2025
10	Private service provider	Organisation who provides software as a service and maintains a Peppol access point	UX designer	29 April 2025
11	Private software developer	Organisation which sells pre-accounting software to accountancy offices	Senior robotic specialist	1 May 2025
12	Private software developer	Organisation which sells ERP software for real estate	CEO	6 May 2025
13	Private end-user	Hospital which receives e-invoices	Application management	15 May 2025
14	Private advisory body	Organisation which advises the market about e-invoicing and procurement solutions	Owner	7 April 2025

The Q-sort does not naturally support adding new measures. Therefore, the participants will identify if any success measures are missing. The participants will be asked if any measure for success is missing from the literary established list. If so, the participant can identify which ranking they would give the measure and why. The interviews will take about a hour, see Appendix A for the interview protocol. The first fifteen minutes will be centred around starting up and asking open questions about the success of an II and the role of the participant in it's organisation. The following half hour will be used for the Q-sort. In the last fifteen minutes, the experts will be asked how their critical success measures could be influenced. During the interviews, two types of data will be collected. Firstly, the order and weights of the success variables, which will be measured in an ordinal scale. Secondly, the reasoning behind the ordering of the variables will be collected, which will be in the form of text.

3.3.3. Data Analysis

Both qualitative and quantitative data were collected during the interviews. Therefore, the data analysis was done according to the type of data collected.

Interviews - Qualitative Data

First of all, the qualitative data analysis will be described. All interviews were recorded and transcribed. The transcriptions were send to the respondents to verify, conforming to the HREC application. From the 14 interviews, none of the participants gave additional feedback. Next, the transcripts were analysed and coded with Atlas.TI. For the coding analysis, a deductive coding approach was used. Deductive coding applies an existing theoretical framework to new data (ATLAS.ti, n.d.). In this thesis, the success measures which are tested in the interviews, are established based on a literature review. The

theoretical framework is thus present and tested on new cases, the interview participants, allowing for a deductive coding approach. Deductive coding makes use of a predefined codebook, and links the data to the codes. Therefore, the codebook exists of the established measures. Additionally, six codes were added to the codebook. The first is "quote", this code was used to highlight pieces of text which could be used as a quote to add to an argument. The second is "value", this code was used to highlight the underlying value which an actor used as an argument in their reasoning for ranking a certain measure. The third is "conflict", this code was used to highlight underlying conflicts, either between actors or within the actors organisation. The fourth is "automatization", during the interviews, it was noted that many of the participants reasoning was related to automatization, therefore this code was added to the code book. The fifth is "adoption rate", this code was also mentioned quite often during the interviews. The sixth quote is "missing measure", to indicate the participant mentioning a missing measure. This deductive approach allows for the understanding of the perspectives of each actor on II success. Appendix section B.1 shows an exemplary piece of transcript with the applied codes.

Q-sort - Quantitative Data

The Q-sort analysis aims to describe shared viewpoints of participants in the study and creating an understanding of what a shared perspective entails. The shared perspectives of the participants are extracted by analysing the quantitative data collected and determine if there are any correlations between the Q-sorts of the participants. Also, if any factors of participants are formed (Minkman & Molenveld, 2020). The Q-sort represents all the ranked measures for one participant. The qualitative data can then add to the understanding of the found patterns in the data. The analysis of the Q-sort follows two steps and was executed in R (Zabala, 2014) (Q Method Software, n.d.). Appendix F shows the used R code for the Q-sort analysis. The data file necessary for the Q-sort, was constructed in the following manner: the rows represent the 49 measures, the columns each participant and the corresponding cells the rankings. The rankings are on a scale of -4 to +4, with a normal distribution, as is typical for a Q-sort (Q Method Software, n.d.). Note that the data of participant 14 could not be used for the Q-sort analysis, as several rankings of measures were missing and Q-sort cannot handle missing values (Zabala (2014); Q Method Software (n.d.)).

The first step of the analysis is the calculation of the correlations between the Q-sorts of participants. The correlation between the Q-sorts forms the basis for the analysis, as the factor analysis builds on the correlations (Zabala, 2014). The correlations are calculated with "Pearson's R", between the whole Q-sorts of each participant. The correlation method "Pearson's R" is based on a linear relationship, both variables are quantitative, are normally distributed and have no outliers (Scribbr, n.d.). The Q-sort data follows all these requirements, thus "Pearson's R" is used to calculate the correlations. "Pearson's R" calculates the correlation between the Q-sorts of the participants, indicating how well the two participant's overall ranking correlate with one another. The correlation matrix can thus add understanding to which extent some participants share a similar viewpoint. For example, if participant 1's Q-sort is [-4, 0, +2, +2] and participant 2's Q-sort is [-3, 0, +1, +2], the correlation between the Q-sorts of the participants is 0.982, so these two participants have an almost similar perspective.

The second step of the analysis is a factor analysis. The Q-sorts forms clusters (factors) of subjectivity, a certain point of view. A factor then represents one such a viewpoint. The factor analysis determines the significance between the viewpoints in the dataset and which measures have the highest ranking in a viewpoint. Thus, the factor analysis gives insight into what the most prominent viewpoints on II success are, and which participants share that viewpoint. The factor analysis is based on a multivariate technique to reduce the correlation matrix into components. In this thesis, the technique "Principal Component Analysis (PCA)" is used. PCA wishes to explain the most of the variability, with the least amount of factors. In the PCA, the factors are ordered by the total variability, with the first few factors summarising most of the variability of the initial correlation (Zabala, 2014). Thus, the PCA extracts the most important shared viewpoints of the participants Q-sorts. To help determine the optimal number of factors, the elbow point in a scree plot (based on the eigenvalues of the factors) was plotted (see appendix Figure D.1). Next to an initial exploration of the dataset and the factors, the optimal number of factors can be chosen. For this dataset, the optimal number of components is three. While the scree plot shows an elbow point at two components, the initial exploration of the dataset suggest that there are three distinct viewpoints. As the scree plot gives an indication, but not a hard requirement, it was

chosen to use three components (Zabala, 2014). The next step is to select these three components and rotate them in order to obtain a clearer and simpler structure of the data (Zabala, 2014). For the rotation, the method "varimax" was used, which is standardly used in combination with PCA, as it maximizes the variance of the factor loadings, to make each factor more distinct (Zabala, 2014).

After the factors were determined, the significant Q-sorts (participants) that define each factor are flagged and will be used for the following calculations. The flagging is done automatically, see Zabala (2014, p. 166) for further explanation. Next, the z-scores of the measures are calculated. The z-score indicates how much, on average, the participants in that particular factor agree with a measure. The z-score is based on the Q-sort rankings of the individual participants. With the z-scores, the distinguishing and consensus measures can be found, to gain deeper insight into conflicting or shared viewpoints of the actors. For each pair of factors, if the difference between the z-scores is statistically significant, than what both factors think about that measure is distinct. If none of the differences between the pairs of factors is significant, the measure is considered to be of consensus. Thus all factors (perspectives) think similarly about a measure (Zabala, 2014).

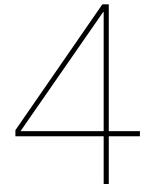
To evaluate the Q-sort, key elements to look at are the relative position of measures within the z-score grid, distinguishing all, consensus statements, and flagged measures with a z-score greater than 1.5, or lower than -1.5, for a factor (Zabala (2014); Watts and Stenner (2014)). It was chosen to explore only measures with a z-score in the range of $z\text{-score} < -1.5$ & $z\text{-score} > 1.5$, as this was a cut-off point for outlying groups of measures (see Figure 6.2). Limiting the interpretation of the factors to focus on the measures with a z-score greater than 1.5, or lower than -1.5; the distinguishing all; and consensus measures might result in a non-holistic approach to the data (Watts & Stenner, 2014). Therefore, when analysing the top and bottom outlying measures, the perspectives of participants not significantly associated with that factor were also included. The main objective of this study is to understand why participants choose certain critical measures, and explore whether there is common ground between multiple participants (actors). For this objective, the understanding of the outliers is essential, and understanding about measures ranked in the middle can add to the general understanding. Therefore, the approach to analyse the outliers, distinguishing all and consensus measures was deemed effective. However, there remains a limitation in a holistic approach. As the exploration of perspectives on the middle measures during the interviews will be limited and subsidiary to understanding the perspectives on the outliers. To delve into the results of the Q-sort and analyse them, a histogram of participants significantly associated of each factor were made. In addition, a factor z-score plot was made to gain further insight into the overall ranking of the measures per factor. Moreover, the top and bottom outlying measures were listed. Lastly, a dendrogram was plotted, to visualise the participant clusters in their shared viewpoint.

3.3.4. Validity and Reliability

Lastly, to enhance the reliability of this thesis, a case study protocol will be set up. The case study protocol is a set of comprehensive guidelines and systematic procedures, which enhances the studies transparency and repeatability. The case study has a couple of criticisms, which can be remedied by using a case study protocol (Yin, 2003). The methodology chapter of this thesis (chapter 3) will function as the case study protocol, with supplementary materials in the appendix. Developing a case study data base and maintaining a chain of evidence, will also increase the studies reliability. The construct validity tests the correct identification of the measures of the concepts being studied (Sekaran & Bougie, 2016). To increase the construct validity, triangulation between the findings and theory will be applied. In addition, the internal validity of the case study will also be increased by using a case study protocol and triangulation between sources of evidence (Patino & Ferreira, 2018). As the design of this research is a single case study, the external validity of the study is limited to the domain of the case study. The Dutch e-invoicing will be researched on a national level, therefore the findings might be applicable to other nations. However, those nations would need to have the same actor groups and involvement of their government. The findings of this study have little analytical generalizability. Analytic generalization means that previously developed theory is used as a template with which to compare the empirical results of the case study (Yin, 2003). As there is only one case testing a theoretical variable, no replication can be claimed. Replication may only be claimed when two or more cases are shown to support the same theory (Yin, 2003).

3.4. Ethical Approval

This thesis was approved by the Human Research Ethics Committee (HREC) of Delft University of Technology, according to the TU Delft Regulations on Human Trials (2016) (reference number 5292). The interview respondents were informed of this thesis's purpose, confidentiality and data handling. The interview respondents gave their written informed consent prior to the interview.



Success Measures of an Information Infrastructure

Success is a multi-dimensional, dynamic and relative construct (Saarinen, 1996). The complexity of what success itself is, complicates the search towards knowing what a successful II is. A systematic literature review was applied on the current body of knowledge on II success to incorporate the complexities of II success. The goal of this systematic literature review is to develop a framework for success measures of an II. As mentioned before, the body on II success is limited, therefore IS success has also been taken into account when developing the framework. The systematic literature research resulted in 22 relevant articles, 15 of which discussed success measures. These 15 articles will be analysed critically to develop a framework for success measures for an II. Before assessing whether proposed success measures of articles could be used to assess the success of an II, the definition of success in the article will be analysed. Table 4.1 gives an overview of the respective researchers interpretation of how success in that system is defined. Some of the articles lacked a set definition of what success was, therefore, the success of the II or IS was interpreted and deducted by the context of priorities in the IS or II.

4.1. What is success

Traditionally, II's were designed in an organisational setting, as instruments with a techno-deterministic stance to increase the standardisation of information systems and data throughout the corporation and re-engineering of the corporation to achieve a competitive advantage (Cordella, 2010). Therefore, the success of an II can be measured by the goal to improve competitive capabilities and foster business strategies (Broadbent et al., 1999). However, if an II exceeds organisational boundaries, the determination of the success of an II is more complex. Actors of the II can have different intentions when participating in the II. Varying intentions complicate the determination of a single holistic goal, therefore complicating the determination of what a successful II is. Even if there is a unified view on the end goal of the II, beliefs on how to approach that can differ. While literature on II's in the health industry agree on that an II should improve the social value, namely improved health outcomes, specific aspects on how to achieve that differ per source (see Table 4.1).

Feldman et al. (2014) states that the success of an II is reflected in an improved social and economic value. Their view on the benefits of an II is based on Emerson (2003, p. 37), which stated that "the core nature of an investment and return is not a trade off between social and financial interest but rather the pursuit of an embedded value proposition composed of both". To see both the improved social as economical value, Feldman et al. (2014) used a sociotechnical systems approach. By using a sociotechnical approach, the technical, organisational and governance aspects of the II can be addressed, which have an effect on both the social and economical value of the II. Increasing the social value of the II is seen as the improvement of health outcomes. However, the manner on how to reach better health outcomes differs per II. For example, Watkinson et al. (2021) focusses on the acceptability of the systems into the network, while Li et al. (2023) highlights the importance of interoperability of the

Table 4.1: Definitions of what is seen as a successful II or IS, across different literature sources.

II or IS?	What is success?	Type of Industry	Source
II	Adoption of systems into the network to increase clinical and health decision-making.	Health	Mora et al., 2024
II	Improved health outcomes by increasing interoperability and data exchange.	Health	Li et al., 2023
II	Maximizing population health improvement with a people-centered approach and financial protection.	Health	World Health Organization and European Observatory on Health Systems and Policies, 2022
II	Success is measured by user acceptance and the acceptability of systems in the II.	Health	Watkinson et al., 2021
II	Development and scalability.	No industry in particular	Constantinides and Barrett, 2015
II	Increasing both social and economic value.	Health	Feldman et al., 2014
IS	Adoption of system implementation in an organization.	Construction	Schery et al., 2023
IS	Improved evidence-informed decision making.	Health	Delnord et al., 2021
IS	High-quality data for targeting, monitoring, and better clinical decision support.	Health	Scharf et al., 2021
IS	Operational efficiency, productivity, and better services, value, and holistic education.	Education	Ibrahim et al., 2020
IS	Efficiency of the system.	No industry in particular	Savchenko et al., 2017
IS	Interoperability, system quality, and effectiveness of data exchange.	Construction	Mahamadu et al., 2013
IS	Long-term success is measured by quality and impact.	No industry in particular	Gable et al., 2008
IS	Systems and information quality with individual and organizational impact.	No industry in particular	Sedera and Gable, 2004
IS	System quality, Information quality, Service quality, Use, User satisfaction, and Net benefits.	No industry in particular	Delone and Mclean, 2003
IS	User acceptance.	No industry in particular	Venkatesh et al., 2003
IS	User acceptance.	No industry in particular	F. Davis, 1987

systems in the network. These two approaches can be seen as aspects of the adoption of systems into the network, which Mora et al. (2024) highlights. Constantinides and Barrett (2015) highlights the importance of the development and scalability of the II. The varying highlighted aspects of an II underline the multi-dimensionality and relativity of II success.

As mentioned in Subsection 2.3.1, the DM ISS model is widely accepted (Delone & Mclean, 2003). The authors highlight the six different dimensions that characterise an IS. While their model is based

on extensive literature reviews, real-world evidence is lacking. A lack of interviews or other studies validating the findings of the DeLone & McLean model has been the subject of criticism of Gable et al. (2008) amongst others. The identified dimensionality of success, by DeLone and McLean (2003), is also recognised by Gable et al. (2008) & Sedera and Gable (2004). Gable et al. (2008) build on the work of Sedera and Gable (2004) to take into account the long-term impact of the IS to determine its success. They measure the success of an IS by its quality, both information and systems, as by its organisational and individual impact. The importance of information quality is also noted by Petter et al. (2013), as "generating quality information is the primary purpose of any IS" Petter et al. (2013, p. 41).

Another widely accepted model is by F. Davis (1987), who developed the Technology Acceptance Model, which focusses on the user acceptance of a technology. User acceptance is often a pivotal factor when determining the success or failure of an IS project (F. D. Davis, 1993). Moreover, user acceptance is an important factor of the adoption of a system (Watkinson et al., 2021). TAM evaluates an IS based on four measures of behavioural variables to determine the usage and acceptability of the system. However, the initial model does not account for individual acceptance. Overtime, TAM was extended to incorporate measures more closely related to individual acceptance (Watkinson et al., 2021). While TAM is the most commonly known model for IS user acceptance, other models exist (Venkatesh et al., 2003). Venkatesh et al. (2003) unified the various literature models into a single model: the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT attempts to explain real-world intentions to using an IT system.

Besides these IS success models, various IS success case studies have been carried out. In these case studies, improved decision making and system efficiency were measures of success (Delnord et al. (2021) & Ibrahim et al. (2020) & Savchenko et al. (2017) & Mahamadu et al. (2013)). The success of an IS being related to improved decision making and increased efficiency can be interpreted as improving the social and economic value of an II. As better informed decision-making leads to better health outcomes (Delnord et al. (2021) & Scharf et al. (2021)). And the improved health outcomes are seen as increased social value. Increased efficiency can lead to better economic outcomes, as operational costs are reduced.

The success of an II is multi-dimensional and relative. In different settings, actors prioritise other aspects of an II, but eventually the goal of the II is to improve social and economical value for the organisations involved. Table 4.1 gives a comprehensive overview of the various aspects of II success. In the next section, those aspects and corresponding measures for II success will be sorted out.

4.2. Success measures of an Information Infrastructure

To develop a framework for success measures of an II, 15 papers were reviewed. During this review, the success measures, barriers and facilitators were listed. This resulted in a list of around 350 measures (see Appendix Appendix G). To reduce this list to a comprehensible and manageable list, questions were posed about these measures. First of all, the measures were compared and if they involved the same core concept, the measures were combined. Second of all, the question was asked if the measure was case specific, or could be generalized to a measure of II success. For example, the measure "availability of pharmaceuticals & consumables (World Health Organization & European Observatory on Health Systems and Policies, 2022)" was deemed specific to the case, and was therefore not taken into the final list. Lastly, the question was posed if the measure could measure the success of an II, and was not IS specific. So for example, the measure "The IS has resulted in better positioning for e-Government/business (Gable et al., 2008)" was taken into account, as the IS could be replaced by the II, and thus the measure would be about measuring the success of the II. The final list of II success measures is shown in Table 4.2, and is 49 measures long.

Efficiency

Various themes were discovered in the different success measures. These themes were used to sort the success measures into. First of all, is the efficiency of the II (see Table 4.2). While the authors mentioned that determining the efficiency of the II can be difficult, one of the most obvious measures is

the reduction of duplicate tasks or procedures for an organisation. In addition, Savchenko et al. (2017) mentioned the importance of the productivity of the II to determine the efficiency of the II.

Net Benefits

The second theme is net benefits. These net benefits could be seen as the overall success of the II, as the II brings certain benefits to organisations making use of the II (see Table 4.2). These net benefits reflect in a sense the focus of improving the social and economical value of the II, mentioned by the papers (see Table 4.1). For example, the measurement of better informed decision-making processes increases the social value, as in a health II, better informed decision-making increases patient outcomes. It is therefore not strange, that this specific measure was mentioned in most of the analysed papers, also in papers outside the health sector. Also, the essence of increasing the economic value, was visible in the measures proposed by the papers. The measurement time and cost savings / cost-effectiveness of the II was mentioned in five of the papers.

Technical Quality

Besides measures related to the net benefits of the system, the technical quality of the II was very prominent in the papers. The technical quality, related to the elements of the systems and infrastructures (Feldman et al., 2014), could be divided into two sub-categories. Namely, system and data quality. System quality encompasses measures that test the success of the systems in the II. Data quality encompasses measures related to requirements of successful data. Throughout the papers, the real-time information accessibility was most prominent: "HIE system was useful in their work as it allows real-time information accessibility" (Watkinson et al., 2021, p. 7). Another important literary measure is the interoperability of the systems, without data loss or delays. As mentioned in Section 2.1, an II consists of multiple systems that exchange data with one another. If the systems are not interoperable, data losses or delays can occur more often. These delays and losses result in financial costs, due to inefficiency and ineffectiveness of the II (Mahamadu et al., 2013). Measures for data quality highlight the importance of the accuracy and reliability of the data. But also, the transparency and a visible data provenance was mentioned. Transparent data provenance increases the feeling of trust users and actors have in an II (Mora et al., 2024). Increased trust can play a role in the adoption of the II.

Table 4.2: Success measures of an II, with corresponding literary sources.

Domain	Measure	Source
Efficiency		
Efficiency	Reduction of duplicate procedures or tasks	Watkinson et al. (2021); Ibrahim et al. (2020); Sedera and Gable (2004); Gable et al. (2008)
Efficiency	Productivity of the II	Savchenko et al. (2017)
Net Benefits		
Net Benefits	Better informed decision-making processes and improved outcomes	Scharf et al. (2021); Delnord et al. (2021); World Health Organization and European Observatory on Health Systems and Policies (2022); Sedera and Gable (2004); Gable et al. (2008); Watkinson et al. (2021)
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Domain	Measure	Source
Net Benefits	Time and costs savings, cost-effectiveness of the II	Watkinson et al. (2021); Sedera and Gable (2004); Gable et al. (2008); Venkatesh et al. (2003); Scharf et al. (2021)
Net Benefits	Payment of additional costs to exchange data with organisations outside the II	Li et al. (2023); Sedera and Gable (2004); Gable et al. (2008)
Net Benefits	Optimized/changed business processes	Sedera and Gable (2004); Gable et al. (2008)
Net Benefits	Increased capacity to manage a growing volume of activity	Sedera and Gable (2004); Gable et al. (2008)
Net Benefits	The II has resulted in a better market positioning	Sedera and Gable (2004); Gable et al. (2008)
Net Benefits	Quality of the governance collaboration to give strategic directions	World Health Organization and European Observatory on Health Systems and Policies (2022)
Net Benefits	Effectiveness of the II	World Health Organization and European Observatory on Health Systems and Policies (2022)
Technical Quality		
System Quality	Real-time information accessibility	Mahamadu et al. (2013); Scharf et al. (2021); Sedera and Gable (2004); Gable et al. (2008); Watkinson et al. (2021)
System Quality	The systems are interoperable without data losses or delays	Mahamadu et al. (2013); Li et al. (2023); World Health Organization and European Observatory on Health Systems and Policies (2022); Watkinson et al. (2021)
System Quality	Scalability of the II	Mahamadu et al. (2013); Schery et al. (2023); Scharf et al. (2021)
System Quality	Ability of the II to handle multiple standards	Li et al. (2023); Sedera and Gable (2004); Gable et al. (2008)
System Quality	Customizability of standards	Feldman et al. (2014); Sedera and Gable (2004); Gable et al. (2008)

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Domain	Measure	Source
System Quality	Customizability of the systems	Sedera and Gable (2004); Gable et al. (2008)
System Quality	The II is continuously tested for its functionality, adaptation to new technologies or limitations	Gable et al. (2008); Feldman et al. (2014)
System Quality	Ease of inter-system sharing in the II	Mora et al. (2024); Li et al. (2023)
System Quality	Existence of data quality control processes	Mora et al. (2024); Li et al. (2023)
System Quality	Stable and fast internet network system	Schery et al. (2023); Ibrahim et al. (2020)
System Quality	The II can be adapted to implement a new technology without disrupting existing connections	Scharf et al. (2021)
Data Quality	Accuracy and reliability of documents and data	Schery et al. (2023); Li et al. (2023); Delnord et al. (2021); Scharf et al. (2021); Sedera and Gable (2004); Gable et al. (2008)
Data Quality	Usability of the data	Li et al. (2023); Scharf et al. (2021)
Data Quality	Transparency and visible data provenance	Mora et al. (2024); Delnord et al. (2021)
Governance		
Regulations	Establishment of clear, accurate and interactive communication processes between actors	Schery et al. (2023); Feldman et al. (2014); Delnord et al. (2021); Watkinson et al. (2021)
Regulations	Establishment of the governance of the II in written form	Feldman et al. (2014); Scharf et al. (2021); World Health Organization and European Observatory on Health Systems and Policies (2022); Watkinson et al. (2021)
Regulations	Establishment and management of II standards	Schery et al. (2023); Sedera and Gable (2004); Gable et al. (2008)
Regulations	Incorporation of data available from the II to enhance/develop policies and rules	Delnord et al. (2021); World Health Organization and European Observatory on Health Systems and Policies (2022)
Regulations	Testing and implementation guidelines are in place	Feldman et al. (2014); Scharf et al. (2021)
Oversight	Establishment of a shared vision and organisational goals by all actors	Feldman et al. (2014); Ibrahim et al. (2020)
Oversight	Identification and addressment of conflicting or competing priorities of actors	Feldman et al. (2014)
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Domain	Measure	Source
Resources	Establishment of the accountability and responsibility for roles, tasks and costs	Feldman et al. (2014); Scharf et al. (2021); Watkinson et al. (2021); Schery et al. (2023)
Resources	Presence of a project champion, with decision-making power, who can disseminate knowledge	Feldman et al. (2014); World Health Organization and European Observatory on Health Systems and Policies (2022); Watkinson et al. (2021)
Resources	Identification of project resources, with flexibility for adjustments	Feldman et al. (2014); Delnord et al. (2021); Schery et al. (2023)
Cooperation	Regular reminders about on-boarding guides and trainings	Feldman et al. (2014); Watkinson et al. (2021); Sedera and Gable (2004); Gable et al. (2008)
Cooperation	Incorporation of feedback from end-users during development and implementation	Watkinson et al. (2021); Sedera and Gable (2004)
Cooperation	Support of top-organizational management of each actor	Schery et al. (2023); Scharf et al. (2021)
Cooperation	Is there a level of expertise for the II in the governance	Schery et al. (2023)
Cooperation	Existence of II-based project management workflow	Schery et al. (2023)
Safety & Security		
Safety & Security	Regulations for safe and secure storage of data	Mahamadu et al. (2013); Scharf et al. (2021); Delnord et al. (2021); Watkinson et al. (2021)
Environmental Factors		
Environmental Factors	Conforming to laws and regulations on data exchange	Mahamadu et al. (2013); Scharf et al. (2021); Delnord et al. (2021); World Health Organization and European Observatory on Health Systems and Policies (2022); Li et al. (2023); Schery et al. (2023)
Environmental Factors	Industry's role in the development of adaptable standards/technologies	Mahamadu et al. (2013)
Environmental Factors	Differences in actors' technology levels, competency, capacity and financial capability	Mahamadu et al. (2013)
Adoption		
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Domain	Measure	Source
Adoption	User friendliness of the II/ systems in the II	Li et al. (2023); Ibrahim et al. (2020); Sedera and Gable (2004); Gable et al. (2008); Venkatesh et al. (2003); F. Davis (1987)
Adoption	Awareness of the II's value and benefits, by all the actors	Ibrahim et al. (2020); Venkatesh et al. (2003); F. Davis (1987); Watkinson et al. (2021)
Adoption	Existence of training and reference materials	Feldman et al. (2014); Ibrahim et al. (2020); Watkinson et al. (2021); Schery et al. (2023)
Adoption	Technical competency of end-users	Schery et al. (2023); Ibrahim et al. (2020)
Adoption	Social influence to use the II	Venkatesh et al. (2003)
Adoption	Presence of a support II team and help desk	Ibrahim et al. (2020)

Governance

Measures related to governance were strongly present. Governance are elements associated with decision-making (Feldman et al., 2014). In the governance category, four sub-categories could be identified, namely: regulations, oversight, resources and cooperation. The essence of regulations measures was the establishment of various processes in written form. Establishing regulations surrounding communications, standardizations, testing, policies, etc., was featured in all of the papers which analysed an II. When working with multiple stakeholders, having some form of proof or document to refer to is of importance. Conflicts can arise, but by establishing clear regulations any misinterpretations are avoided (Scharf et al., 2021).

For successful decision-making having an oversight of actors interests, values and conflicts can be helpful. Feldman et al. (2014) and Ibrahim et al. (2020) noted the importance of establishing a shared vision and creating an oversight of organisational goals, priorities across the actors in the II, at the start of a project. This oversight can help to minimize conflicts and be aware of competing interests.

Determining the right and necessary resources, and having the ability to adjust them when necessary, is also of importance in successful governance. In addition, Feldman et al. (2014) and others found that having a project champion, who is the main point of contact for the actors and has decision-making power, can be very valuable to the projects success: "the real success in this project, from a governance perspective, was having a project champion with decision-making power" (Feldman et al., 2014, p.13). The project champion is able to ask the right questions and make decisions. A project champion is able to provide guidance and authority to move forward in a project to further develop the II. Lastly, governance can also be measured by the cooperation of the actors in the II. One important measure seems to be having regular reminders about the onboarding guides and having regular technical presentations. Users needed the reminder to be kept engaged in the developments of the II, as these documents can often be quite long (Feldman et al., 2014). Having technical presentations regularly increases the cooperation of the actors, as they are more involved in the II (Feldman et al., 2014).

Environmental Factors

Adhering to the regulations and laws is also a measure of success of an II. If the II, or the systems or data standard does not adhere to the laws, the II cannot be used. Another environmental factor influencing the success of an II, are competing technologies (Mahamadu et al., 2013). The industries development of competing or aligning standards, systems or technologies can play a role in the further development of the II.

Safety and Security

The safety and security of the data is also a prominent success factor. Having a safe and secure data storage in place increases the trust of the actors in the II. Knowing who has access to the data and for how long the data is stored can reduce concerns of actors (Mahamadu et al., 2013).

Adoption

The last category of II success measures, is the adoption of the II. The adoption of the II is the uptake of the II or its systems in (inter-)organisational processes (Watkinson et al., 2021, p.2). Adoption can be measured in multiple ways. One of them is a users acceptance. The Technology Acceptance Model (TAM) of F. Davis (1987) identified multiple factors influencing a user's acceptance of a technology. One of these measures is the ease of use of the II/systems,(user friendliness). If the systems in the II have an easy to use interface or are easily adjustable, the user is more likely to use that system (F. Davis, 1987). Another way to measure the success of an II by, is the awareness of the II's value and benefits by all the actors. When the actors understand the significance of the II a greater possibility exists that full value is harnessed (Ibrahim et al., 2020). Moreover, again the importance of training and reference materials is highlighted. The presence of the training material ensures that end-users know how to use the II and what the benefits are (Feldman et al., 2014).

4.2.1. Conclusion

To answer the second sub-research question, *What are the success measures in an II?*, a systematic literature review was executed. This literature review resulted in a list of success measures of an II. Overall, there are a couple of prominent success measures which are mentioned in most of the analysed papers. One of these measures is the accuracy and reliability of the documents and data. Another measure is the conformation of the II according to (privacy) laws and regulations surrounding data exchange in the II. A third measure are the time and cost savings. A fourth measure are the better informed decision-making processes. A last measure that is frequently named is the real-time information accessibility. These measures all highlight different themes of II success. Namely, the net benefits, technical quality and environmental factors. So, to answer the first sub-question posed, success measures of an II can be divided into seven categories, with a few prominent measures mentioned across multiple articles.

As most of the analysed papers were case studies in the health sector, some of the success measures might be sector related and not generalizable. During the selection of the measures, measures really specific to a certain sector were not taken into account. However, if that measure was also mentioned in various other health papers, the measure was taken up into the final list, due to the implied importance. To generalize these measures, the core concept of the measure was used. However, while the measure might not imply a specific sector any more, the core concept might only relate to that sector. Therefore, while the success measures of the II were reduced their core concepts, these core concepts might still only be sector specific.

5

The Dutch e-invoicing Case

This chapter aims to describe the case the Dutch e-invoicing and its actors present in the Dutch e-invoicing. The Dutch e-procurement domain was chosen to because of its establishment since the 1980s, the presence of both public and private sector actors and the ongoing developments (see subsection 3.3.1). Moreover, it was chosen to narrow the case study down to the e-invoicing data exchanges of the II. The main reason for this choice, was the variety in the establishment of other data exchanges, such as e-orders, by the actors. To increase the reliability of this study, by ensuring both private and public sector actors played a role in the II, the e-invoicing II was chosen.

E-procurement is the electronic procurement of goods and services. The procurement starts from the moment an organisation wishes to buy a certain good or service, and ends when the invoice of that good/service is paid. In the Netherlands, the e-invoicing II can be approached as a network. In this network, e-invoices are exchanged between end-users across various pathways, and with various data standards. In the Dutch e-invoice II, there are six different pathways along which an e-invoice can be exchanged. The pathway depends mainly on the end-users and their capabilities. These pathways in turn also affect the data format which is being exchanged. In addition, these pathways differ in the actors that are involved, and the systems along which the data is exchanged. The following sections will explain the network the e-invoicing II is in more detail, by describing different pathways, data standards and actors.

5.1. Pathways

In the Dutch e-invoicing II, there are several pathways across which the e-invoice can travel (see Figure 5.1). In this II, there are two main paths, namely B2G and B2B. At the front end of the data exchange, currently there are only private suppliers. For the back-end of the data exchange, the central government, private sector receivers and decentral governments are present. The pathway along which the e-invoice is sent, is therefore dependent on the end-user, but also the supplier's capabilities.

Since 2017 it is obligatory to send e-invoices to the central government (Digitale Overheid (n.d.); Rijksoverheid (n.d.)). Therefore, the central government has organised their systems to be able to receive e-invoices. This resulted in three pathways for suppliers to send e-invoices to the central government. All these pathways end at the Digipoort. The Digipoort is gate where each of the governments administrations are linked to (Interview Participants 1 and 2). The incoming e-invoices are sent to the respective department administration, by making use of an OIN (organisation Identification Number). This OIN is specified in the basisfactuur Rijk. The Digipoort was set up, to increase the efficiency of e-invoicing while remaining interoperable with the administrations. Most of the administrations of the central government have their own ERP (Enterprise Resource Planning) systems. To have some form of standardisation for suppliers when doing business with the central government, the Digipoort was set up. This standardisation ensures that less data is lost, and if one supplier is doing business with various departments, they will not have to deliver their e-invoices in different data standards.

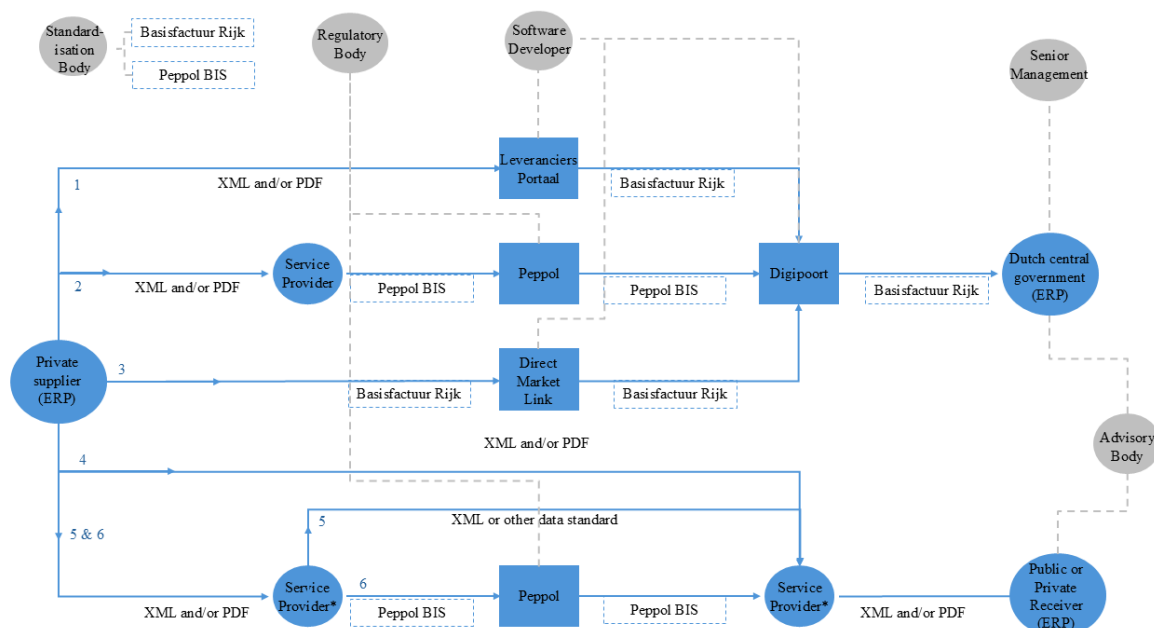


Figure 5.1: Overview of the Dutch e-invoicing Information Infrastructure. The circles represent the different actors, with in gray the actors who have an influential role. In blue are actors who take an active role in exchanging the invoices. The squares represent the various systems/networks over which the e-invoice can be exchanged. The uninterrupted lines represent the pathways along which the data exchange can take place. The dashed gray lines represent the influence of some actors. These actors do not take place with the actual data exchange, but play a regulatory, advisory, steering role in the II. The standardisation body is tasked with establishing and developing the standards with the dotted blue line (Basisfactuur Rijk and Peppol BIS). Note that for the data exchange with the end-user being a receiver, the service providers are annotated with a *. This annotation indicates that also a software developer could also execute this role.

The first pathway is via the Suppliers Portal (see Figure 5.1: pathway 1). This portal is specifically for suppliers who send a limited number of invoices per year. For these suppliers, it is illogical to set up their own systems, as these suppliers are largely small and local businesses (Interview participant 6). Therefore, this portal was established to ensure these small suppliers were able to send e-invoices to the Dutch government. The second pathway is via Peppol (see Figure 5.1: pathway 2). Peppol is an internationally recognised network which enables the sending and receiving of procurement documents (Peppol, 2021). Peppol enables the exchanging of documents for both the B2B and B2G. The central government has created an application programming interface (API) connection, between the Digipoort and Peppol, to increase the interoperability with the market. But also, for the central government to stimulate suppliers to invest in their own connection to Peppol, as to increase the adoption rate of B2B e-invoicing. The third pathway is via a direct connection of suppliers to Digipoort (see Figure 5.1: pathway 3). These suppliers send numerous of e-invoices to the central government. These suppliers had already invested in their API connection to the Digipoort, before Peppol was established.

The fourth, fifth and sixth pathways are for data exchanges to decentral governments and private sector receivers. The fourth pathway, is directly from the supplier to the service provider of the receiver (see Figure 5.1: pathway 4). The data standard which is exchanged depends on the supplier. The service provider (or software developer) of the receiver then changes the e-invoice standard to a standard compatible with the clients ERP system. The fifth and sixth pathways are also called the four corner model (see appendix Figure A.1 for the four corner model). This model has four corners, where the end-users are corner 1 and 4. And the service providers (or software developers) are corner 2 and 3. The fifth pathway shows a direct link between the service providers, while the sixth pathway goes via the Peppol network (see Figure 5.1: pathways 5 and 6). To be able to send via the Peppol network, a service provider (or software developer) has to have an API connection to Peppol (Peppol, 2021). Some of the service providers and software developers have such a connection and are thus able to send via the Peppol network. This is only possible if the service provider (software developer) of the

receiver also has an API connection.

To conclude, there are several pathways along which an e-invoice can be sent in the Dutch e-invoicing II. These pathways show that while there is only one type of data being exchanged, invoices, it is still a complex network.

5.2. Data Standards

In the Dutch e-invoicing II, there are a variety of data standards. A data standard is a technical set of rules which describe how the data is structured, described and represented (Resources.data.gov, 2025). Exchanging data in a standardised way is a form of standard business reporting (Bharosa et al., 2015). All of the e-invoicing data standards, in Europe and the Netherlands, are based on an XML format. An XML format is a structured document where information is stored in pre-specified fields. The XML format supports information exchange between computer systems (Amazon, n.d.). The XML format allows for sharing data in a standardised manner, increasing the interoperability and efficiency of data exchange.

In Europe, an European data standard for invoices is present, namely the EN19631 norm (European Commission, n.d.). The EN19631 norm was set up to increase the standardisation of invoicing and doing business across European countries. Based on the EN19631 norm, each country can have their own additional requirements to the data standard. In the Netherlands, extra requirements on the data standard were added, which resulted in the NLCIUS (Forum Standaardisatie Rijksoverheid, n.d.-a). The NLCIUS has additional rules related to Dutch laws surrounding invoicing, such as the KvK number. The NLCIUS can be used when exchanging invoices with Dutch decentral governmental organisations or with private sector organisations.

For the Dutch central government, a specific data standard is present, the basisfactuur Rijk. The basisfactuur Rijk is a data standard compliant with the NLCIUS and with the Peppol BIS (Logius, n.d.-a). This data standard has additional requirements specifically altered for the Dutch central government. Suppliers who do business with the Dutch central government have to send their invoices in this specific data standard.

The last data standard present in the Dutch e-invoicing II, is the Peppol BIS. The Peppol BIS standard is specifically for invoices, but also orders, for data exchange over the Peppol network (Forum Standaardisatie Rijksoverheid, n.d.-b). The Peppol BIS is an international standard, as the Peppol network is also international. The data standard ensures that the data exchange between organisations happens in a standardised manner, ensuring the interoperability between the systems. For the private sector, there are several sector-specific data standards present, such as the DICO SALES005 (econnect, n.d.). These sector specific data standards are based on a standard XML format, where for each sector additional rules can be added. These sector-specific standards will not be discussed individually, as they scope of the case is the whole e-invoicing II, not a specific sector. However, it is important to know that there are sector specific data standards, and they are based on the standard XML format.

To conclude, the variety of data standards emphasises on the complexities of an II. While data standards try to enhance the interoperability, it is also essential to support the present data standards to ensure the installed base is still able to take part in the II. The presence of multiple data standards also emphasise the influence of actor's installed base on the use of standards, which was also noted by van de Kaa et al. (2018).

5.3. Actors in the Dutch e-invoicing II

Within the Dutch e-invoicing, several actor roles are present. Each of these roles will be discussed in more detail in the following section. To gain insight into these actor's roles, the interviews with the participants were used to understand the operations and values of the organisation that represented a certain actor role.

5.3.1. Advisory Body

In the Dutch e-invoicing II, the actor advisory body can be taken on by both a private or public sector organisation. The public sector advisory body is tasked with increasing the adoption rate of e-invoicing for the decentral governments. To achieve this, the advisory body gives knowledge sessions about e-invoicing and e-procurement. In addition, the advisory body also provides projects and guidelines of decentral governments. Moreover, the advisory body also takes on the task of providing support for the Suppliers Portal. Overall, the task of the advisory body is to inform and advise all actors about e-invoicing (Interview Participant 7).

The private advisory body hopes to inform other organisations about e-invoicing. The goal of the advisory body is to increase the adoption rate of the e-invoicing II. To achieve this, they research ERP systems, and other administrative software's, to be able to provide expert knowledge about the options for e-invoicing. In addition, the advisory body has helped software developers to test their software, before it was introduced to end-users. Moreover, the advisory body organises a yearly seminar to further inform the market about developments surrounding e-invoicing. But also supports end-users to choose the right software developer and service provider for their needs (Interview Participant 14).

5.3.2. End-user

For the actor end-user, both a public and private end-user is present in the Dutch e-invoicing II. Both of these types of end-users will be discussed. In the public sector, an end-user can be a department in the central government, who has business relationships with a supplier. But also, a decentral governmental organisation can be an end-user. For the central government, the focus of setting up a somewhat central e-invoicing II, was mainly because of the reason of increasing the efficiency and monetary savings. As most of the departments already had their own systems and business operations, the Digipoort was established which is interoperable with each of the administrations. For the central government, being a trustworthy business partner is essential. To be such a partner, they need an effective business process. To achieve this, efficiency and the incorporation of data available is of essence to optimize their business processes and be trustworthy business partner. However, for the II to be really beneficial, they wish for the procurement process to be a single information process, where the orders, contracts and invoices are connected and matched, to increase the efficiency and reduce costs (Interview Participant 5).

Also decentral governments can represent the actor end-user. For the decentral governments, it is not obligatory to do their businesses via e-invoicing. However, there are advantages to the e-invoicing II for decentral governmental end-users. The main benefit is an increase in efficiency of their business operations. As it is not obligatory for suppliers to send e-invoices to this end-user, end-user also has to facilitate invoices in other formats such as PDFs. For this end-user, having suppliers sending them invoices in a standardized format increases the efficiency of their business operations, as they can automate their processes more. Therefore, increasing the adoption rate of e-invoices is essential to the end-user (Interview Participant 8).

Lastly, an end-user can also be a private organisation. For this end-user, making use of the e-invoice II increases their operational efficiency, as more tasks can be automated. For the end-user, being able to spend less time on these administrative tasks is beneficial. But also, if e-invoices can be connected to e-orders, it would result in a more substantial increase in efficiency and benefits. To achieve an increase in efficiency, it is essential to have data standardisation and interoperability with other systems (Interview Participant 9 and 13).

5.3.3. Regulatory Body

In the Dutch e-invoicing II, there is one regulatory body present. This regulatory body is tasked with monitoring the Peppol network. In their supervisory role, they check if both service providers, who send the e-invoices via the Peppol network, adhere to the requirements to be on the network. This is done to guarantee the safe data exchange. When a service provider wishes to enter the Peppol network, the regulatory body checks whether they have a valid KvK number; what the VAT number is; and how the process of data exchange in the service provider is organised. This process is more focused on the data exchange between the service provider and their client. In addition, the regulatory body checks

whether the service provider has their ISO certificates and how the end-identification in their process is equipped. If everything is in place, a contract between the regulatory body and the service provider is established. After a service provider has entered the network, the regulatory body performs two types of checks. First of all, the regulatory body checks whether the network is up in the air for 99.5% and what the performance is. Second of all, the regulatory body performs regular compliance checks, similar to when a service provider wishes to enter. These checks are executed to ensure that the Peppol is a safe and secure network. The regulatory body is not able to check the data within an e-invoice, but they have to ensure that the e-invoice travels unopened along the Peppol network. They are focussed on a fast, efficient and safe II. To achieve this, the adoption rate and interoperability is of importance. As Peppol is an international network, there are already interoperability benefits to joining the network.

5.3.4. Service Provider

The Dutch e-invoicing II has two main types of service providers, namely public and private sector service providers. Both of the roles of the service providers will be discussed, based on the information given in the interviews. For the private sector, participant 2 represented the role of a service provider. The actor public service provider is represented by a department within the Dutch central government. This department also assumes the role of a standardisation body. Therefore, there might be some overlap in the tasks of the two actors. The service provider is tasked with maintaining Digipoort and facilitating the data exchanges surrounding Digipoort. To facilitate the data exchange, a ROAP (Rijks Overheid Access Point) was established. This ROAP is the connection between Digipoort and the other systems, such as Peppol or the administrations. While an external supplier executes the ROAP, the service provider executes the functional management. In addition, they are involved in the Rijk-procurement council, which focusses on the total scope of the II architecture. The council establishes what the requirements for the Rijks-procurement are and what the Rijks-procurement entails. The public service provider provides their expert knowledge in this council to help establish the best direction. The public service provider values the adoption of the II, not only by government suppliers, but also in the B2B. They value the interoperability, which is enabled by Peppol, as Peppol also enables B2B e-invoicing (Interview Participant 2).

The private sector service provider was represented by participant 10. While participant 10's organisation develop their own software, they provide their software as a service, and have an access point to Peppol. The task of the service provider is to transform the e-invoice data they receive from their clients, to the Peppol BIS standard, and then send the e-invoice to the service provider of the receiver, via Peppol (corner 2). Besides sending e-invoices via Peppol, the service provider also sends e-invoices in an XML format directly to the service provider of the receiver. The service provider can also be corner 3, where he receives the e-invoice, either via Peppol or in an XML format. The service provider then has to transform the e-invoice into the format supported by the clients ERP system. The vision of the service provider is to make accountancy as easy as possible for their clients. The service provider is dependent on their clients to exist, therefore they aim to keep their clients content. To achieve this, the service provider aims to increase their efficiency by automating, standardising and increasing the adoption rate as much as possible (Interview Participant 10).

5.3.5. Standardisation Body

The standardisation body is tasked with establishing and managing the standards surrounding e-invoicing. They develop, check and test the requirements for the standards surrounding e-invoices. To increase the interoperability with the market, the standardisation bodies aims to incorporate the current market standards. In addition, the standardisation body is a part of European standardisation commissions (CEN), to ensure that the Dutch standards adhere to the EN16931 norm. But also the be involved with the updates on the requirements and influence those requirements. Moreover, the standardisation body is asked for their expertise by organisations implementing or using the data standards. While the standardisation body determines the rules surrounding the structure and description of the data formats, they are not able to check the contents of the data. While the standardisation body establishes the standards, there is little feedback from the users. The standardisation body values the safety and security of exchanging data, to increase the trust in the data and II. To achieve this, standardisation of the data is essential. The standardisation of data increases the efficiency, as the II is less prone to errors, which negatively influences the trust end-users have in the II.

5.3.6. Strategic Governance

The strategic governance actor, in the public sector, establishes the policies surrounding e-invoicing of the Dutch procurement for the central government. The strategic governance actor is represented by a department of a ministry in the Dutch central government. They are tasked with looking into the current way ministries procure their supplies and developing policies and a shared direction for the central government surrounding procurement. This can be challenging, as each administration has their own procurement policies and systems. Therefore, the strategic governance tries to manage the diversity of the systems and administrations. To ensure that each administrations needs are heard, each ministry has their own coordinating director procurement, which reports to the ICBR. The ICBR is a commission of each of the ministries, which focusses on the business operations of the central government. Via the ICBR, feedback is given to the strategic governance to incorporate in their policies. To develop a shared direction, across all departments for the e-invoicing II, the strategic governance develops policies which represent the five core values of the Dutch central government: efficiency; future oriented; inclusive; trust and social responsibility. Based on these values, the strategic governance focusses the development of the II on three pillars. The first pillar is increasing the internal efficiency by optimizing business processes of the administrations. The second pillar is focussed on the suppliers, by optimizing their experience and decreasing the complexity of invoicing with the central government. The third pillar is optimizing internal decision-making, by using data available to enhance their policies and strategic directions (Interview Participant 1).

5.3.7. Software Developer

For the actor software developer, both private and public sector organisations take on this role in the Dutch e-procurement. The public sector software developer, provides the software for one of the systems of the Dutch central government, in particular the Suppliers Portal. The Suppliers Portal exists since 2023 and was developed to provide facilities to suppliers who do not have the abilities to conform to the obligated e-invoicing of the Dutch central government. This facility represents the duty of care, a central value by the government. In addition to sending e-invoices, the portal also enables the sending of e-orders. The public software developer is thus tasked with providing and maintaining the software for this portal. They value being able to take care for those suppliers without the capabilities of sending e-invoices themselves. The public software developer has the goal to increase the adoption rate of e-invoicing, and also e-ordering, in the B2G as well as the B2B. To achieve this, the software developer tries to reposition themselves to hopefully incentivize the market to develop their own portals. The software developer is repositioning the portal as it has become too successful, as suppliers who do have the capabilities to invest in e-invoicing systems largely make use of the portal. As the government does not wish to compete with the market, the portal has to reposition themselves to incentivise the market to adopt to e-invoicing by themselves (Interview Participant 6).

In addition, there are also private organisations who take on the role of software developer. These software developers can either have a pre-accounting solution, which can be connected to ERP systems (Interview Participant 11). But also be an ERP system which has a subsystem specifically for invoicing (Interview Participant 12). The software developer is tasked with processing the incoming invoice data into a data format that can be read by the ERP systems of their clients. The software developer guarantees the quality of the data they send to their clients. The software developer is dependent on their customers, so even if the incoming data is of a poor quality, the software developer has to transform the data into the high quality necessary for their clients. Therefore, it is essential to standardise the e-invoices, and for the incoming data to be accurate and reliable. If the data is standardised, reliable and accurate, the software developer can automate their operations and increase their efficiency, by reducing errors (Interview Participant 11 and 12).

6

Results

This chapter aims to present the results of the case study and give insight into the various perspectives the actors have on success measures of an II. To structurally delve into the different viewpoints each actor¹ has on the success of an II, the results from the Q-sort will be used as a basis. Q-sort methodology can give a systematic insight into the reasoning of participants by finding underlying patterns in shared perspectives of the participants (see also subsection 3.3.3). The goal of the Q-sort is thus to find shared perspectives of participants on II success.

During the Q-sort, the success measures were ranked on a scale of irrelevant (-4) to essential (+4). The total ranking of the measures by a participant is referred to as the Q-sort. The first step in the Q-sort analysis is to determine the correlations between the Q-sorts of the participants. This is done to measure which participants ranking of success measures (Q-sort) closely aligns with other participants. In this thesis, the correlations are calculated based on Pearson's R (see subsection 3.3.3 for the reasoning behind the method choice). For example, participant 3 and participant 5 have a correlation of 0.56 (see Table D.1). This correlation indicates that there is a moderate agreement on the participants ranking of the II success measures, indicating that these participants might have a similar perspective on II success. The calculated correlation matrix forms the basis for the further analysis. The next step, is the factor analysis. The goal of the factor analysis is to extract the shared perspectives of the participants. For the factor analysis, the number of factors must be determined, for this study the number of factors is 3 (see subsection 3.3.3). The number of factors was determined with the elbow method (see appendix Figure D.1).

Based on these three factors, the factor analysis finds the participants who significantly ($p\text{-value} < 0.05$) share the perspective of the factor. When the shared perspectives of the participants are determined, these perspectives can be analysed. To analyse the shared perspectives, the z-scores of the measures in a factor are calculated. The z-score represents the average ranking of a measure, in that particular factor. For example, measure 38 has a z-score of -0.5 in factor 1, a z-score of +2 in factor 2, and a z-score of -1 in factor 3 (see Figure 6.2). This means that for the participants of factor 2, measure 38 is essential for measuring II success, but not essential for the participants in factor 1 and 2. In addition, the consensus and disagreement measures can be determined with the help of the z-scores. The goal of determining these measures, is to gain a comprehensive understanding on the shared and different perspectives of the factors, at a first glance. The consensus measures, are the success measures which show no significant difference between the ranking by the participants, per factor. While the disagreement all measures, are the success measures for which each factor has a significantly different score. So, the consensus measures are the measures on which the participants all have the same view. While the disagreement all measures show a significantly different perspective of the participants in each factor.

The goal of this chapter is to understand how actors prioritise II success. To achieve this, the shared perspectives of participants on II success, actor's critical success measures and missing measures

¹Participant 14's Q-sort was not complete, therefore only when participant 14 shared an opinion about one of the measures, it was taken into account. For this chapter "all participants" automatically excludes participant 14, unless stated explicitly.

will be analysed. During the interviews, the participants were asked if any measure for II success was missing from the Q-sort list. Some participants indicated that a certain II success measure was indeed missing, or that a particular measure did not fully reflect their perspective on II success. To gain insight in the three shared perspectives, the top and bottom measures, distinguishing all measures and consensus measures are taken into account. The interview data will be used to deepen the insights of the shared perspectives of the participants. In addition, the interview data is used to understand the underlying core values and why certain measures are critical in measuring II success. Lastly, any missing measures of II will be listed.

Before the results can be discussed, it is important to note that participant 14's data was not taken into account for the Q-sort analysis. Participant 14's Q-sort was not complete, as not all of the success measures were sorted during the interview. Thus, participant 14 is not a part of a shared perspective. However, participant 14 did sort his critical success measures (+4, +3 & +2). Therefore, participant 14's interview data will be used to add to the insights of the analysed success measures in the following sections, to capture the perspective of participant 14.

6.1. Consensus and Disagreement Measures

To understand the shared perspectives, but also the key differences between the three perspectives, the consensus and disagreement all measures will be analysed. The consensus measures can give insights if there are certain essential measures of II success that each participant values. While the disagreement measures give an understanding to key differences between the viewpoints on II success.

6.1.1. Consensus Measures

During the Q-sort analysis, 10 consensus measures were found (see list 6.1.1). So there are 10 success measures which each participant shared the same perspective on. Most of the consensus measures are ranked around a score between -1 and +1. Indicating that a measure was, in general, not essential for measuring success. While no particular insights were given by the participants for ranking these measures around the centre. In general, these consensus measures can represent a shared perspective on the possible maturity of the II. A mature II is established and focusses on additional benefits, such as the customizability of the systems. For example the existence of II-based project management and workflow, is more likely to be of importance in a mature II, then an II in early development. These consensus measures show that there is a shared perspective on the neutral importance of benefits that can be associated with a mature II. However, some of the participants scored a measure as essential (+4), or irrelevant (-4). To add to the understanding of the participants perspectives, only those outliers, and consensus measures outside the -1 and +1 range will be analysed in this section. In addition, the measure *Technical competency of end-users* will be discussed in more detail in Table 6.4.1.

- Increased capacity to manage a growing volume of activity.
- Customizability to the systems.
- Ease of inter-system sharing in the II.
- Stable and fast internet network system.
- Establishment of clear, accurate and interactive communication processes between actors.
- Identification of project resources, with flexibility for adjustments.
- Existence of II-based project management and workflow.
- Awareness of the II's value and benefits, by all the actors.
- Existence of training and reference materials.
- Technical competency of end-users.

The first measure with an outlier is the measure: *Increased capacity to manage a growing volume of activity*. On average, this measure was ranked as neutrally essential for measuring success. But for participant 12, this measure is essential for measuring II success, as their business relies on being able to handle more e-invoices: *"the use of the infrastructure increases and we need to be able to handle the volumes"* - Participant 12. The second measure with an outlier is measure: *Awareness of the II's value and benefits, by all the actors*. Participant 10 is unique in their ranking of this measure. The value of this measure lies in the increase in efficiency of their business processes, if all actors are aware of the benefits: *"it makes it easier for us to stimulate them to use Peppol. ... Than the information is more reliable in the administration and we can automate more."* - Participant 10. Lastly, the measure *Existence of II-based project management and workflow*, was ranked on average as a -2. The general perspective on this measure is that it is not essential for success. One participant noted that this happens automatically, and is therefore irrelevant: *"that is something that develops themselves"* - Participant 7.

Overall, the participants agree that measures listed above are somewhat essential, but not *the* measure for II success. For the measures about the capacity and awareness of the benefits, one of the participants did not agree with the general viewpoint. For the participant in question, that measure was essential for measuring success, as it related to the actors objectives.

6.1.2. Disagreement Measures

From the Q-sort, there were several measures on which the factors significantly disagreed. Each factor has a significant different perspective on that measure. These measures are as follows:

- Scalability of the II.
- The systems are interoperable without data losses or delays.
- Accuracy and reliability of documents and data.
- Incorporation of data available from the II to enhance/develop policies and rules.
- Establishment of a shared vision and organisational goals by all actors.
- Regulations for safe and secure storage of data.
- Conforming to laws and regulations on data exchange.

Most of these measures will be analysed in the following sections. For the measures related to the interoperability; accuracy and reliability; safe and secure storage of data; and conforming to laws, see Table 6.4.1. For the scalability measure, see Table 6.4.2. For the shared vision measure, see factor Table 6.4.3. Only the measure *"Incorporation of data available from the II to enhance/develop policies and rules"* will not be analysed separately in the following sections. The rankings of this measure differ per participant. But there is a similar underlying perspective: *"it results in creating a better overview of your data. Extracting better insights."* - Participant 5. But, dependent on the actor category of the participant, the ranking is placed from a -3 to a +2. For example, participant 1 placed this measure as partly essential (+2) as this measure reflected the organisations objectives *"It has two sides, one more internally focussed, ... But also more to the outside, the transparency ..."* - Participant 1. This statement emphasises the central governments objective to be internally and externally efficient, but also transparent. This difference in placement, is mainly due to the participants organisations objectives.

6.2. Missing Measures

The participants were also asked whether there are any missing measures for II success. Also, some of the existing measures did not fully represent the perspective of a participant. First of all, it was noted, by participant 5, that none of the measures represented the ethics of the II. Second of all, participant 3 noted that, for them the existence of contractual agreements/ requirements with actors are essential for the success. Participant 6 also noted the importance of contractual agreements/requirements. Another missing measure was the adoption rate. While adoption is a category in the success measures, no measure specifically mentions the adoption rate. The adoption rate represents the number

of e-invoices, which was noted by participants 8, 9 and 10. Lastly, participant 3 noted that the current measure about safety and security was not complete enough. Privacy and the safe and secure data processes are essential for measuring II success. This led to the following few measures which need to be added to the list of II success measures:

- Ethical decision-making processes
- Contractual agreements/requirements with the actors
- Adoption rate of the number of e-invoices
- Regulations for safe, secure and private data processes and storage

6.3. Critical Success Measures of the Actors

To further deepen the understanding of the shared perspectives, but also differences between the participants, their critical success measures will be analysed. During the interviews, the participants were asked to rank the 49 measures of II success. The participants ranked the measures on a scale of irrelevant (-4) to essential (+4), with limited spots available for a certain ranking (see section A.1). This ranking was done to force the participants to choose two critical success measures. The following Table 6.1 gives a comprehensive overview of the critical success measures of the participants, with an exemplary quote to try to understand the participants reasons behind why a certain measure was essential for II success.

It was noted that some of the critical success measures are shared by the participants. For example, the measure *Accuracy and reliability of documents and data* is shared by participants 5, 9, 11 and 13. The shared perspective on why the accuracy and reliability is essential for II success was nicely explained by participant 9: *"If you for example receive an invoice where the VAT calculations is wrong... then you cannot automatically process the invoice, ..., which costs time, and time is money"* - Participant 9. This quote shows the underlying value on why the accuracy and reliability is essential, is due to the automatization benefits. Most of the critical success measures have the underlying perspective on a successful II is an automated II, so the efficiency of the business operations can be increased: *"if an invoice is automatically processed. Well, you need less employees"* - Participant 14. Another shared perspective reflected by the critical success measures, is the presence of an ideal, or future goal, of an organisation. For the public service provider, the measure related to interoperability is essential for II success as: *"a goal on itself would be that we can be interoperable with other open networks"* - Participant 2. This exemplary quote substantiates the importance of reaching certain goals or ideals. To conclude, on an initial glance, there are two main perspectives on the success of an II. The first perspective reflects the benefits related to automatization and efficiency. The second perspective reflects reaching an ideal or future goal an organisation has.

Table 6.1: Overview of the critical success measures for each of the participants, with interview quotes to substantiate their ranking of a measure.

Actor	Participant	Measure	Substantiation
Strategic governance	1	Productivity of the II	"But we can make the world a bit more efficient"
		Effectiveness of the II	"Behind this is the reasoning that we want to be, to the outside, effective."
Public service provider	2	The systems are interoperable without data losses or delays	"a goal on itself would be that we can be interoperable with other open networks"
		Establishment of II standards	"If you only look at our organisation, for us the most important is that people conform to the standards, and the more the do this, the more it becomes a success"

Actor	Participant	Measure	Substantiation
Regulatory body	3	Regulations for safe and secure storage of data	"The regulatory body values the safety and security the most"
		Conforming to laws and regulations on data exchange	"it (the II being a future thing) is not more important than law and regulations"
Standardisation body	4	Reduction of duplicate procedures or tasks	"So in efficiency it is simply better and also simpler and therefore safer"
		Is there a level of expertise for the II in the governance	"There are people who know very clearly how it needs to work and what the necessity is. In the end it is handled effectively"
Public end-user	5	Accuracy and reliability of documents and data	"Yes, so that part safety and reliability of the data is essential"
		Regulations for safe and secure storage of data	Interviewer: "Follows that from the goal you have?... Participant 5: Yes, I think so."
Public software developer	6	Effectiveness of the II	"Yes, than it is immediately correct"
		User friendliness of the II/systems in the II	"In this way, it is immediately correct"
Public advisory body	7	Establishment of a shared vision and organisational goals by all actors	"It is absolutely essential that we all move in a certain direction. ... With noise and delays as a result"
		Presence of a project champion, with decision-making power	"want to place this on essential, as we really need one"
Public end-user	8	Productivity of the II	"because it is processed automatically"
		Time and costs savings, cost-effectiveness of the II	"it might be less important than for a profit-organisations, ..., but it is really important"
Private end-user	9	The systems are interoperable without data losses or delays	"If the systems are not interoperable, I can send what I wish, but the client is not able to process it. That is crucial"
		Accuracy and reliability of documents and data	"If you for example receive an invoice where the VAT calculation is wrong,... then you cannot automatically process the invoice, ..., which costs time, and time is money"
Private service provider	10	Time and costs savings, cost-effectiveness of the II	"The mission of our company nicely aligns"
		Awareness of the II's value and benefits, by all the actors	"it makes it easier for us to stimulate them to use Peppol. ... Than the information is more reliable in the administration and we can automate more."
Private software developer	11	Existence of data quality control processes	"We guarantee our clients, that the invoice, whether it be PDF or Peppol, will always be 100% digitalised"
		Accuracy and reliability of documents and data	"That is for us the most important, we guarantee that data quality"
Private software developer	12	Productivity of the II	"it is very simple if the infrastructure does not function, the employee might not function, and in the end we don't have any clients"

Actor	Participant	Measure	Substantiation
		Increased capacity to manage a growing volume of activity	"the use of the infrastructure increases and we need to be able to handle the volumes"
Private end-user	13	The systems are interoperable without data losses or delays	"If the systems between the supplier and us do not communicate correctly, then it goes wrong"
		Accuracy and reliability of documents and data	"If the information is not accurate, there is no benefit to the system"
Private advisory body	14	Productivity of the II	"if an invoice is automatically processed. Well, you need less employees"
		Effectiveness of the II	"namely effectiveness. That delivers money"

6.4. Shared Perspectives on Information Infrastructure Success

To further deepen the understanding of the shared perspectives on measuring II success, the results of the Q-sort analysis will be analysed. The goal of the Q-sort analysis is to describe shared perspectives by participants on the success of an II. The Q-sort analysis resulted in three distinct perspectives among the participants. Figure 6.1 visualises the clustering of the participants and how close certain participants are in their ranking of their Q-sorts. So, for example, participants 9 and 11 are at the lowest point in the dendrogram, indicating that they share quite a similar viewpoint. When looking at the correlation matrix (see appendix Table D.1), the participants have a correlation of 0.445, indicating that they are moderately correlated, and thus share the same point of view about half of the measures.

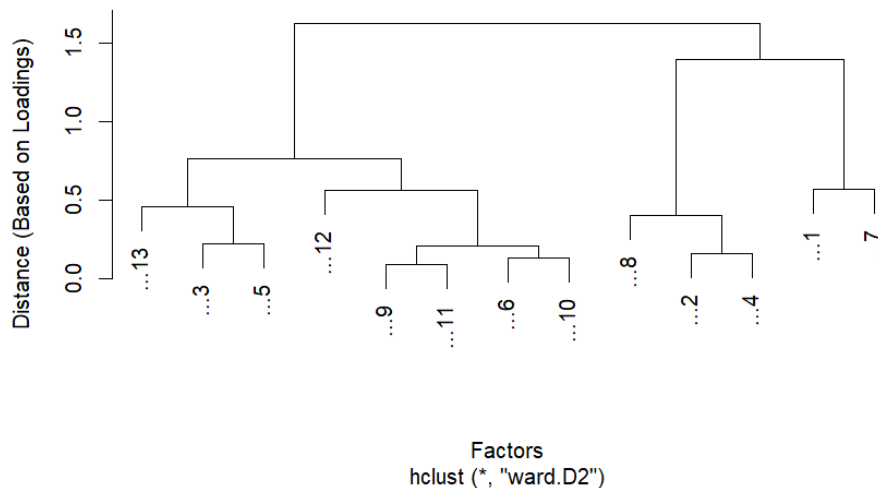


Figure 6.1: Dendrogram of the factors and the participants corresponding to those factors. So the most left cluster is factor 1. And on the right, there is a cluster which divides both factor 2 (participant 2, 4 and 8) and factor 3 (participant 1 and 7).

A dendrogram can visualise the three clusters of shared viewpoints by the participants. In the dendrogram (Figure 6.1) a clear divide at the beginning can be seen. This divide is between factor 1 (on the left hand side) and factors 2 and 3 (on the right hand side). Then, another divide in factor 1; and between factor 2 (participants 2, 4 and 8) and 3 (participants 1 and 7) can be seen. While the quantitative factor analysis showed that the optimal number of factors is 3 (see subsection 3.3.3) the dendrogram indicates that there are two sub-perspectives present in factor 1. These two sub-perspectives are between participants 3, 5 and 13; and participants 6, 9, 10, 11 and 12. On an initial glance at the two sub-perspectives, it can be seen that participants 3, 5 and 13 share the perspective on the importance

of a safe and secure II. Participants 6, 9, 10, 11 and 12 in turn share the perspective on an efficient II. These two sub-perspectives will be analysed more deeply in the analysis of factor 1. Moreover, from the factor analysis it was noted that participant 13 did not significantly shared one of the factors. However, as can be seen in the dendrogram 6.1 participant 13 seems to be in a sub-perspective with participants 3 and 5. This sub-perspective surrounds the importance of a safe secure and reliable II. An explanation for why participant 13 is not a part of factor 1, is because while the critical success measures are shared by the other participants in factor 1, the remaining success measures are not ranked similarly enough. Therefore, participant 13's perspective on the success of an II will be analysed together with the three factors.

To understand the most important measures that build up the factors, the outlying measures of each factor were visualised. These outlying measures have a z-score of larger than 1.5 or smaller than -1.5. The reason for choosing this cut-off of the outlying measures can be seen in Figure 6.2. For the outlying top measures, each factor has a small group of outlying measures, with a cut-off point of about 1.5. For the bottom outlying measures there also seems to be some group forming of measures, where a cut-off point could also be -1.5. These measures with a cut-off point of 1.5 or -1.5 will be used to give a deepening insight into the shared perspectives of each factor.

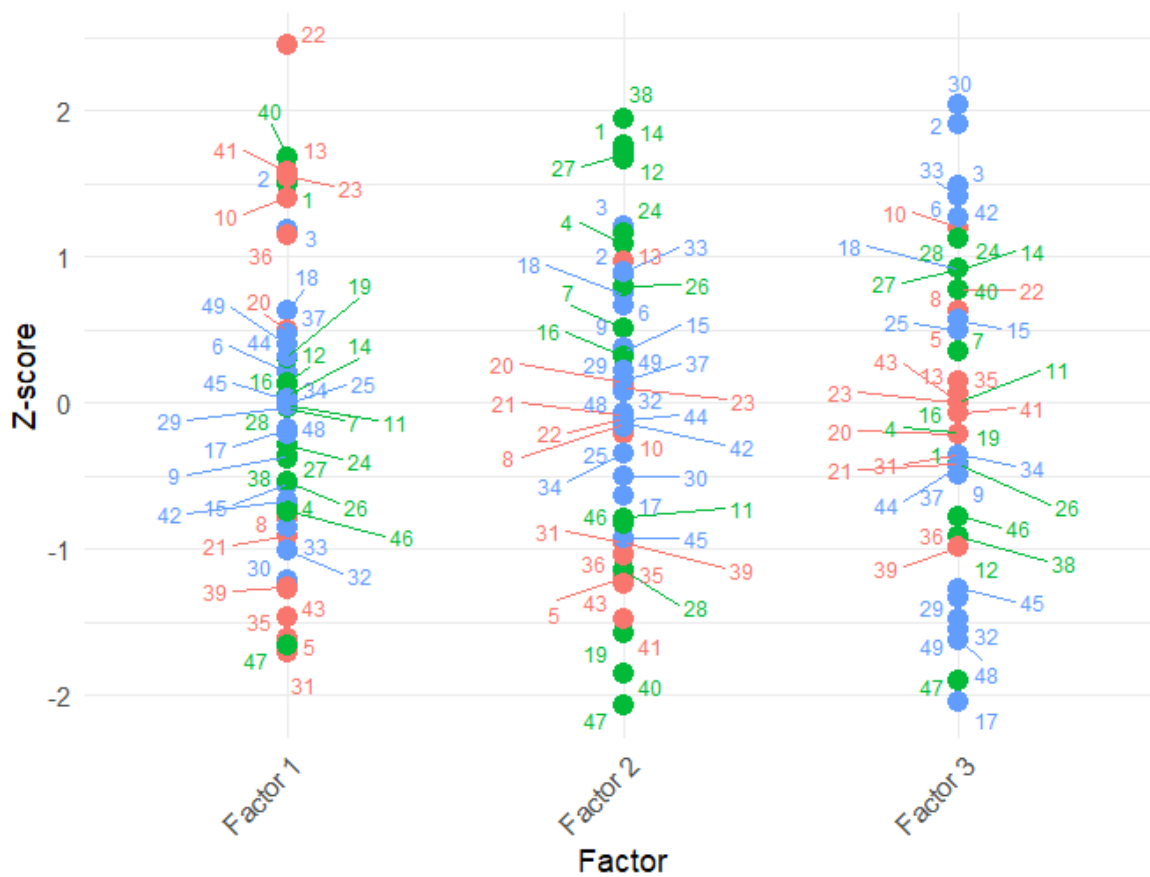


Figure 6.2: Z-scores of the measures for each of the factors

6.4.1. Factor 1: a Trustworthy and Compliant II

The most dominant shared viewpoint is factor 1. The first factor explains 23.20% of the variance in the Q-sort. So, the first factor explains more than 20% of differences between the Q-sorts of the participants. For social studies, there is no ideal variance explained per factor, as long as the factors explain about 50% of the variance (Watts & Stenner, 2014). To understand what characterises the first shared

viewpoint by most of the participants, the outlying top and bottom measures will be analysed. The participants that significantly associate with this factor are both private and public sector actors, and are also a mix of categories (end-user, software developer, service provider). The outlying measures in a factor can give valuable insight to understand which measures the participants in that factor, commonly, find the most valuable (see Table 6.2). While the bottom outlying measures are not essential to the participants (see Table 6.2).

Table 6.2: Overview of the outlying success measures of factor 1 "Trustworthy and compliant II", and the participants who significantly share this viewpoint as described in the factor.

Participants	Top or Bottom	Measures	Z-score
3, 5, 6, 9, 10, 11, 12	Top	Accuracy and reliability of the data	2.44
		Regulations for safe and secure storage of data	1.68
		The systems are interoperable without data losses or delays	1.67
		Conforming to laws and regulations on data exchange	1.58
		Productivity of the II	1.55
	Bottom	Usability of the data	1.54
		Identification and addressment of conflicting or competing priorities of actors	-1.70
		Technical competency of end-users	-1.65
		The payment of additional costs to exchange data with organisations outside the II	-1.61

Most Important Measures

The measures corresponding to factor 1, are surrounded around the trustworthiness of the II and conforming to the law and regulations. The importance of trustworthiness in the II can be deduced from the measures about the accuracy and reliability of the data (which is the most prominent measure); regulations for safe and secure storage of data and the interoperability of the systems, without data losses or delays. The importance of conforming to laws and regulations can be deduced from both the regulations for safe and secure data storage; and conforming to laws and regulations. This leaves the productivity as a measure, highlighting also the importance of a productive II.

To further explore this shared viewpoint amongst the participants, each measure will be explored more in depth. First, *The accuracy and reliability of the data*. The shared consensus about this is that for the success of an II, you need accurate and reliable data. The reason behind why the data has to be accurate and reliable, is that it is essential for the automatization processes, which the II is all about: *"If you for example receive an invoice where the VAT calculation is wrong,..., then you cannot automatically process the invoice, ..., which costs time, and time is money."* - Participant 9. Most of the participants (3, 5, 6, 9, 11, 12 and 13) shared this viewpoint that accurate data is essential for the efficiency, which is essential for the objectives of the participants organisation: *"In the end, we deliver information."* - Participant 3. The goal of the public software supplier is to deliver a duty of care for the smaller suppliers, but also to increase their own organisations efficiency, and having accurate and reliable data is essential to the success of the II: *"e-invoicing, for me it is successful when, errorless without interaction can be automatically processed."* - Participant 6. But also the reliability of the data is essential for II success: *"even if there are two wrong data fields, the employee has to go through the whole document, as he doesn't trust it."* - Participant 12. If the data is not reliable, it will still result in a decrease of efficiency and will result in increased costs. Two of the participants, 14 and 10, in this factor mentioned that they viewed the accurate and reliable data as a boundary condition: *"In principal, with e-invoicing a 100% of the data should be correct."* - Participant 14. Indicating that accurate and reliable data are indeed a key measure for II success. An interesting viewpoint on why the accuracy and reliability of the data is not so essential for II success, can be found in factor 2, particularly for participants 2 and 4. Where they note it is not their responsibility: *"But if you are talking about the content of the data,*

that is not our responsibility." - Participant 2. This statement indicates that for measuring II success, the responsibilities and objectives of the organisation matter the most, and how a measure relates to those objectives. This builds on the argument made in chapter 1, which stated that the objectives of an organisation also result in a particular perspective on II success.

The second measure is: *The regulations for safe and secure data storage.* Interestingly, the consensus within the factor about this measure is divided. On the one hand, participants 3, 5, 6 and 9 find this measure essential for the success of the II: *"We often provide private information, ... Data privacy and security are of crucial importance."* - Participant 9. For these participants, security is also one of the objectives their organisation values highly: *"security, that is for use very important."* - Participant 5. While the participants ranked this measure high, it was also noted that the measure did not reflect the objective completely of what the participant meant: *"that is something else then what I mean with security."* - Participant 3. While on the other hand, participants 10, 11 and 12 ranked this measure as somewhat neutral: *"Neutral. We need to conform to the standards and that is that."* - Participant 11.

The third measure is: *The systems are interoperable without data losses or delays.* Again, the relevance of this measure for II success is also shared by participants not in this factor. There are different reasoning's behind why the interoperability is an essential measure for II success. The first explanation, for participants 1, 2 and 3, is that the organisation strives to be interoperable: *"We strive to be. That we really are interoperable as a central government."* - Participant 2. And in particular Peppol, is build on the interoperability: *"It is one of the building blocks of the network."* - Participant 3. The regulatory body regulates the Peppol network, and one of the selling points of Peppol, is its interoperability: *"it is an international network"*. But for the network to be effective, it needs to be interoperable. While for participants 5, 9, 14, 10, 11, 13 the communication to the clients is viewed as essential: *"If the systems are not interoperable, I can send what I want, but the client cannot process it."* - Participant 9. Notably, the participants 4, 6, 7, 8 and 12 were neutral about this measure: *"It is important, but we do not measure success with it."* - Participant 8.

The fourth measure is: *Conforming to laws and regulations on data exchange.* While the ranking of this measure differed for all of the participants. Almost each participant had the same reasoning behind their ranking, namely this measure is a boundary condition: *"you have to conform to the laws. But we do not measure our success by it"* - Participant 8. Only participant 4 had a different viewpoint: *"do we need to obligate it (e-invoicing)? It doesn't fit in the liberal economic policy"* - Participant 4. It is not the place of the government to obligate organisations to make use of the II, it should be a result of the market. As this measure and viewpoint is almost completely shared by all participants, it will not be taken into account for describing the difference between the viewpoints.

The fifth of the top outlying measures in factor 1, but is also essential in factor 3 is: *Productivity of the II.* Also, this measure correlates highly with the measure *Reduction of duplicate tasks or procedures*, which is one of the top 5 measures in factor 2. In general, the productivity of the II is seen as the efficiency, which can be seen as an essential measure for II success, for two different reasons. One, for the reduction of costs: *"It is about money, about the efficiency."* - Participant 6. If the II is productive, by automating the invoice processes, it increases the efficiency of an organisations, thus reducing the number of FTE's spend on tasks, it reduces the costs: *"if an invoice is automatically processed. Well, you need less employees."* - Participant 14. This reduction of costs is beneficial for the organisation as money is one of the most important objectives: *"In the end, it is about money."* - Participant 12. Two, efficiency itself is a ideal objective of the organisation: *"On the one hand, internal government, that it leads to an efficient process. On the other hand, to the outside if it leads to a simple and efficient way of doing business for suppliers."* - Participant 1. For this viewpoint, the costs are less essential, but it revolves more around an ideal way of doing business. The first perspective is shared by most of the participants, particularly participants 5, 6, 7, 9, 14, 10, 11, 12 and 13. While the second reasoning resonates more with participants, 2, 3, 4 and 8. To add, participant 4 also noted that an efficient II results in a more simpler and safer way of data exchanging: *"in efficiency is it just simply better and also more simple en therefore also safer."* - Participant 4. As safety is an important objective of the organisation - standardisation, the safety angle on why efficiency is essential corresponds with their values.

The last of the top outlying measures is the *usability of the data*. This measure closely relates to the measure *accuracy and reliability of the data*, but is more focussed on having useful information, which can be used in for example optimizing business processes: *"The usability means that I can automatically connect that information to my accountancy"* - Participant 9. The general consensus on this measure was that it is somewhat essential (+2) for measuring II success, but not the most essential. No particular reasons were given for the placement of this measure.

Least Important Measures

Besides the top 5 measures which characterise this factor, it is also valuable to understand which measures in the factor the participants do not find essential for II success (see Table 6.2). The measure which scores the lowest on average in factor 1 is *Identification and addressment of conflicting or competing priorities of actors*. The shared sentiment about the identification of conflicting priorities is not explicitly stated, but participant 6 mentioned *"it is not our place to compete with the market, therefore it is irrelevant."* - Participant 6. The public software developer established the Suppliers Portaal out of a duty of care for the smaller suppliers, who do not have the capabilities for their own e-invoicing systems. As the Suppliers Portal is not in the position to compete with the market, understanding any conflicting priorities of competitors is irrelevant, at least for measuring success. This train of thought could also apply for the other participants, at least for participants 3 and 6, who are also a public organisation. *"that is irrelevant, as we never wish to compete with companies."* - Participant 6. While for the participants 9, 10, 11, 12, who are private organisations, the identification of conflicting priorities rather revolves around *"the management of damage control."* - Participant 9, instead of measuring II success.

The second least important measure is: *Technical competency of end-users*. For this measure, the shared viewpoint of the participants is that the end-user should not need to have any technical competency to use the II, or systems in the II: *"an end-user should have the least amount of technical competency, that shouldn't be the case."* - Participant 1. This sentiment is shared across all the participants, more specifically in factor 2 this measure scores the lowest, and in factor 3 the second to lowest, and also by participant 13. Across these actors, the shared sentiment is that the end-user should easily be able to use the system, and any technicalities should be handled by the software developers. It is not the task of the end-user to be able to be technically competent to use the II, the II itself should be easy enough to be used. It is the task of the software developer to handle the technicalities. While it might be desired for the end-users to have little to no technical competency, the current e-invoicing II still requires some level of technical competency of the end-user, which resulted in the low adoption rate amongst end-users of the II: *"Technical competency of the end-users,, needs a lot of attention. It is one of the reasons why the adoption is not as we hope."* - Participant 4

The third least important measure is *The payment of additional costs to exchange data with organisations outside the II*. The consensus around this measure is somewhat divided. While participant 9 places this measure as somewhat essential: *"how smaller your invoicing volume, how higher the relative costs per invoice will be."* - Participant 9. Participant 11 states this measure as somewhat irrelevant: *"for us, the difference in costs between an e-invoice and PDF is negligible."* - Participant 11. Even though there is no total consensus about the payment of additional costs, the majority place this measure as irrelevant. Participants 5, 6, 10, 11, 12 place the measure to the irrelevant side, while participants 3, 9 place the measure to the relevant side. This could be because at least for participant 9, they payment of additional costs could be a barrier for (smaller) organisations to participate in the II. Therefore, it could be a measure of success, if there are additional costs. But for participant 5, additional costs during development are a part of the deal *"but that is then the price you have to pay to make that development."* - Participant 5.

Conclusion

Overall, the top outlying measures of factor 1, revolve around a trustworthy and law obliging II. The participants in this factor share this viewpoint, but for different reasons which can be explained with their organisations objectives. Besides the participants flagged in factor 1, other participants shared a similar point of view on some of the measures. In particular, the measure about conforming to the law was

viewed by almost everyone as a boundary condition for a successful II. The bottom outlying measures of factor 1 also gave additional insights into the common viewpoint. In particular the measure about the technical competency of the end-user. This scored quite low on average across all the participants. The general consensus about this measure related also to a boundary condition, namely that the end-user should not need any technical competency to use the II. In addition, while there is a shared viewpoint about the irrelevance of the bottom measures, the thought behind it differs and can be related back to their organisations objectives.

6.4.2. Factor 2: a Standard and Agile II

The "standard and agile II", is the second viewpoint, which explains 14.29% of the variance in the study. The participants 2, 4 and 8 significantly associate with this factor. Participants 2 and 4 are part of the same organisation, but different actor categories. participant 8 is a public end-user. This factor is more closely in distance with factor "an efficient II through leadership" than with the factor "a trustworthy and compliant II" (see Figure 6.1). In this section, the shared viewpoint will be explored by analysing the top and bottom outlying measures (see Table 6.3).

Table 6.3: Overview of the outlying success measures of factor 2 "A Standard and Agile II", and the participants who significantly share this viewpoint as described in the factor.

Participants	Top or Bottom	Measures	Z-score
2, 4, 8	Top	Is there a level of II expertise in the governance	1.94
		Reduction of duplicate procedures or tasks	1.76
		Ability of the II to handle multiple standards	1.72
		Establishment and management of II standards	1.70
		Scalability of the II	1.67
	Bottom	Technical competency of end-users	-2.07
		Regulations for safe and secure storage of data	-1.85
		Existence of data quality control processes	-1.58

Most Important Measures

The top 5 most important measures were considered to deduce the shared viewpoint of the participants on. The measures about the reduction of duplicate procedures, ability to handle multiple standards, establishment of the standards highlighted the importance of the standardization of the II, therefore a standard II. While the measures about the scalability and ability to handle multiple standards, also highlighted the need for the II to be agile. And the level of II expertise could positively contribute to developing a standard and agile II.

The most important measure is *Is there a level of II expertise in the governance*. The participants share the viewpoint that it is important to have expertise in the governance. The level of expertise is essential for the success of an II, as it results in taking essential and the right choices: *"There are people who know very clearly how it needs to work and what the necessity is. In the end it is handled effectively."* - Participant 4. But also as it is a part of an organisations portfolio: *"Because on the basis of the expertise we bring to the expert groups in the government, or in the NEN, or the CEN. Yes, it is a large part of our work."* - Participant 2. This measure is a part of an organisations objective and fits in their role as an actor in the organisation, therefore it is also essential to measure the success of an II.

The second most important measure is *Reduction of duplicate procedures or tasks*. This measure correlates strongly with the measure *Productivity of the II*, and has already been discussed in Table 6.4.1.

The third most important measure is *Ability of the II to handle multiple standards*. This measure is viewed as essential, as *"there just are a variety of standards. This also relates to the interoperability. If you only focus on one standard, how interoperable are you. So yes, important."* - Participant 2. Participant outside this factor also find this measure to be somewhat essential, notable participants 7, 11, 12

and 13. The underlying reasoning why the interoperability and the ability to handle multiple standard, stems from the ideal that the whole market makes use of the II: *"The end goal is to support as many processes as possible. To accommodate the complete market."* - Participant 4. But also, if the whole market can use the II, it will simplify the invoicing processes for organisations in the II: *"the standard is important to register suppliers."* - Participant 8. However, even if it is essential to be able to handle multiple standards for the interoperability, participants also prefer to have a single data standard, to even further increase their operational efficiency: *"preferably, we only want one standard to process."* - Participant 8. The one standard only, is also preferred by participants 1, 3 and 9, but that would be an ideal scenario, so therefore it is still essential to be able to handle the multiple standards for a successful II.

The fourth most important measure is *Establishment and management of II standards*. For a successful II, which is interoperable with other systems, standards are necessary to communicate. If those standards are not established or managed, it is still not a success as: *"Even if you have the networks ready, having no standards will result in the II being slow."* - Participant 2. And a slow II does not increase the efficiency. Also, having no standards can result in an error prone II, which is not desired: *"Which can result in errors, or extra work, or failure, ... And then the success automatically decreases."* - Participant 8. Therefore, having an established II standards is essential to the success of the II, for participants 2, 4 and 8. While most of the other participants, except participant 7, the establishment of II standards is somewhat irrelevant or neutral for measuring II success. One of the explanations why the establishment is irrelevant, but having standards is somewhat essential, is that it is not the task of their organisation to establish and manage the standards: *"The management of the standards is not interesting for me, that is the task of external organisations."* - Participant 9. Thus, if it is not an organisations objective, it is not essential for measuring II success.

The fifth most important measure is *Scalability of the II*. Besides the participants in this factor, other participants also viewed this measure to be essential in measuring II success. The scalability is essential to ensure you can connect multiple suppliers: *"With a lot of suppliers, you can really save time and money."* - Participant 13. Having a scalable II is essential to ensure you can handle all the new connections, and in turn increase the efficiency by saving time and money. This perspective is shared by participants 1, 2, 4, 8, 10, 12 and 13. Only participant 6 viewed scalability as really irrelevant, as their organisational objective is to have a solution for the small suppliers of the government. Fittingly, they wish to be really small scale: *"It is way more important to reduce our user number than to scale up."* - Participant 6.

Least Important Measures

The least important measure in the shared viewpoint of "a standard and agile II" is *Technical competency of end-users*. As analysed in subsection 6.4.1, there is general consensus about the technical competency of end-users being irrelevant to measure II success, as they should not need to have any technical competency.

The second least important measure is *Regulations for safe and secure storage of data*. This measure is one of the most important measures of the factor "a trustworthy and compliant II". For this measure, there are two different viewpoints present. The first is that the safe and secure storage of data is important, but it is explained as a boundary condition when looking at a suitable service provider: *"Yes, that is important. We have looked at that in the beginning, is it safe enough?"* - Participant 8. The second viewpoint, is that it is not part of the scope of the organisation: *"the real storage is at the receiver or sender."* - Participant 4. Therefore, the organisation is not able to have any influence on this measure, and is therefore not essential for measuring II success, as it is outside their scope. While participant 2 did not state their reasoning behind scoring this measure, as their organisations task is not about the content of the data, the reasoning behind ranking this measure are assumed to be the same as that of participant 4.

The third least important measure is *Existence of data quality control processes*. This measure relates to the viewpoint of the previous measure, namely that, for participants 2 and 4, they cannot view the contents of the data: *"We can control the data quality to a certain extent."* - Participant 2. This relates

back to their organisational objectives and scope. If a measure does not fall under their scope, it cannot be used to measure II success with. While for participants 11 and 12, this measure is essential for II success. For a software developer, their organisation revolves around guaranteeing data quality: *"We guarantee our clients, that the invoice, whether it be PDF or Peppol, will always be 100% digitalised."* - Participant 11. Therefore, having data quality control processes are essential to conduct their business. If they are not able to do so, their clients will leave and they can go bankrupt. For participant 8, the real success is about the number of e-invoices, related to their main objective to reach a certain percentage of e-invoices. Having a certain level of data quality relates more to a measure that needs to be in order before the real success can be celebrated: *"it is not something where you immediately think about when celebrating success."* - Participant 8. Participants 8 view of data quality control processes being a boundary condition, is also shared by other participants (3, 5, 6, 7, 9, 10 and 13).

Conclusion

Overall, the participants in this factor "a standard and agile II" all highlight the necessity of having standards to increase the efficiency of the II, but also necessity of the II to be able to handle multiple standards to ensure interoperability. The underlying values that could be found, related to benefits of having an II which everyone could use, by being interoperable and having no specific technical requirements. Also the measures in this viewpoint reflected the scope an actor has in the II, and how this scope also influences how an actor measures the success of the II. When looking at the least important measures, there was a shared viewpoint that end-users and actors should not need any (technical) capabilities to be able to use the II. In addition, conforming to laws and (safety) regulations are seen as a boundary condition, and therefore not important. However, participants 2 and 4 shared a viewpoint that, due to their role in the II, the safety regulations and data quality control processes were irrelevant to measure II success. As it is not their place to have any influence on the content of the data, therefore the data content is not important for them, and in turn does not affect their view on II success.

6.4.3. Factor 3: an Efficient II Through Leadership

Factor 3 explains 13.17% of the variance of the study. The participants 1 and 7 are significantly associated with this factor. These participants are both a part of a public organisation. While participant 1 can be characterised as the strategic governance actor category, participant 7 is a public advisory body. As shortly introduced in subsection 2.5.1, an advisory body is tasked with giving decision-making support to the policy makers (strategic governance). The ideals of both actors may therefore logically align, as they are closely connected in their organisational goals. The top and bottom outlying measures of factor 3 "an efficient II through leadership" will be analysed to explore the shared viewpoint (see Table 6.4). This factor is more closely related to the factor "a standard and agile II", as mentioned in subsection 6.4.2.

Table 6.4: Overview of the outlying success measures of factor 3 "Efficient II through leadership", and the participants who significantly share this viewpoint as described in the factor.

Participants	Top or Bottom	Measures	Z-score
1, 7	Top	Establishment of a shared vision and organisational goals by all actors	2.04
		Productivity of the II	1.90
	Bottom	The II is continuously tested for its functionality, adaptation to new technologies or limitations	-2.04
		Technical competency of the end-users	-1.90
		Social influence to use the II	-1.62
		Presence of a support II team and help desk	-1.55

Most Important Measures

The top 5 most essential measures of this shared viewpoint were analysed to understand the shared viewpoint of the participants 1 and 7 (see Table 6.4). The measures about the shared vision and project champion highlighted the importance of leadership in the success of the II. While the measures about the productivity, cost effectiveness and optimized business processes highlighted the importance of efficiency and effectiveness for a successful II.

The most important measure is *Establishment of a shared vision and organisational goals by all actors*. The shared viewpoint about this measure, is that it is essential to have a direction for II success: *"It is absolutely essential that we all move in a certain direction. ... With noise and delays as a result"* - Participant 7. The shared viewpoint is necessary to determine in which direction the II needs to go to, to make it efficient and accessible for the entrepreneur, so the II becomes a success. Especially for participant 1, who is part of the strategic governance of the central government and writes policies about the II, having a direction is essential for their organisational objectives, namely writing effective policies to further develop the II: *"What do we still want? When is it a success?"* - Participant 1. A contradictory viewpoint by participant 5, is that establishing a shared vision can decrease the success of the II, as it distracts from the content which is essential for II success: *"There is a real risk you are only focussing on describing instead of the content."* - Participant 5.

The second most important measure is *Productivity of the II*. This measure was also analysed in Table 6.4.1.

Least Important Measures

For the shared viewpoint "An efficient and effective II through leadership", the least important measure for measuring II success is *The II is continuously tested for its functionality, adaptation to new technologies or limitations*. Both participants ranked this measure as really irrelevant, but for participant 7 this ranking was mainly due to there not being any other place left on the scale: *"that it is irrelevant has to do with there being no places left."* - Participant 7. While for participant 1, the continuous testing of the II is more a tool than a measure for success: *"that is again a tool."* - Participant 1. These two participants were somewhat unique in their viewpoint on this measure, almost all of the other participants ranked this measure somewhat neutral. Only participant 9 shared the same point of view, but for a different reason: *"If the e-invoicing works and adheres to the standard, than there is little to improve."* - Participant 9.

The second least important measure is also the *Technical competency of end-users*. See Table 6.4.1 for an analysis about this measure.

The third least important measure is *Social influence to use the II*. The ranking of this measure differs a bit for all of the participants, but there is a common viewpoint about this measure. The participants are in agreement that social influence should not be necessary for organisations to use the II, but it is a factor. When social influence is used in a positive way, it can increase the adoption rate: *"Because it is market forces we want."* - Participant 3. When there is a high adoption rate, the advantages of using the II also increase: *"it (the II) mostly has value when other people also use it."* - Participant 10. Most of the participants see the benefits of a social influence on increasing the adoption rate of using the II, and in turn the success of the II. Additionally, for participant 1, the measure of social influence also reflects one of the ideals of the central government: *"But you try that (social influence) in a positive way. So you are a pioneer as the central government, which is also reflects one of our core values."* - Participant 1. So while for participant 1, a positive social influence can increase the adoption rate, it also reflects a core value of their organisation.

Conclusion

Overall, the shared viewpoint of an efficient and effective II through leadership was shared by participants 1 and 7. Some of the characterising measures were also shared by the other shared viewpoints, and emphasise that even though there are differences between how participants view II success, there are also in agreement about certain aspects. The underlying reason why efficiency and effectiveness

is essential for measuring II success, is largely due to the organisations objectives, but also ideals, in particular for participant 1. What is unique about this shared viewpoint, is the essence of leadership and a shared direction. Both participants 1 and 7, underlined the benefits leadership can have for a successful II. The least important measures also added to the understanding of this viewpoint. These measures substantiated the argument of an organisations objective reflects their perspective on II success further. In particular, the measure related to the help desk showed that if a measure is not adding to one of the objectives of the organisation, it is not essential.

Discussion

This chapter reflects on the findings of the case study and aims to answer the main research question: *How do different actors prioritise success measures of an Information Infrastructure?*. Based on the results (see chapter 6) and the following discussion, a new framework for measuring the success of an II can be established (see Figure 7.1). This framework incorporates the actor's perspectives on the success of an II. This framework shows that while there are various perspectives on a successful II, in the end almost all of the actors measure the success of the II by its efficiency. The actors associate different measures with the efficiency. This is because, each actor has a different role in the II. Therefore, also a different objective and ideal about the II. Critical success measures which participants associate with the efficiency are about the productivity; effectiveness; reduction of tasks; interoperability; user friendliness; data quality control; and accuracy and reliability of data. While there is a shared perspective on success, the success measures of the actors reflect their ideals and objectives. To answer the main research question, first the results from the factor analysis (see section 6.4) will be discussed. Then the theoretical propositions of the case study will be discussed. In addition, conflicts and tensions between the actors will be discussed. Lastly, the future of the Dutch e-invoicing II will be discussed.

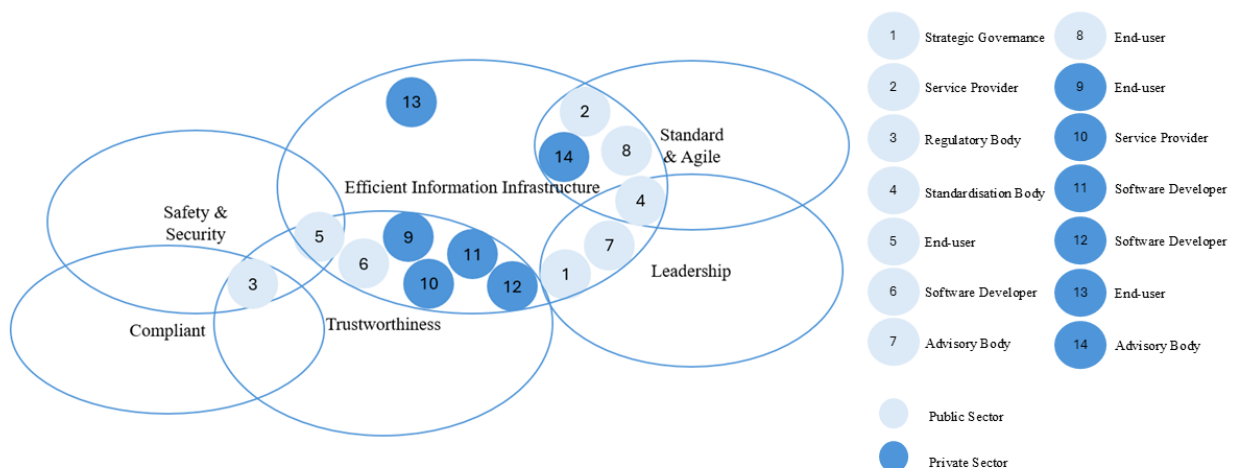


Figure 7.1: Framework of the actor's perspectives on the success of an Information Infrastructure. These perspectives on success are the result of the factor analysis. Where within the three factors, different sub-perspectives were present, resulting in six perspectives on Information Infrastructure success.

7.1. Factor differences between stakeholder perspectives

To determine how the actors of an II prioritised the success measures of an II, a single case study was executed. In this case study, interviews were held with a representative of each actor category. In ad-

dition, when applicable, both a private sector and public sector actor were interviewed. The inclusion of both a private and public actor deepens the understanding about actors' prioritisations. But also, an II is not limited to certain organisational or sector boundaries, but can encompass multiple sectors. This showcases the complexity of an II.

The analysis of the interview data, in particular the Q-sort analysis, demonstrated that actors have a different perspective on II success. Three distinct perspectives were present. However, when analysing the results, sub-perspectives and an overall shared perspective was found. Almost all of the participants shared the same perspective, namely that a successful II is an efficient II (see Figure 7.1: efficient). Figure 7.1 shows there are six different perspectives on the success of an II. While the Q-sort analysis resulted in 3 distinct perspectives, six sub-perspectives were present in the 3 factors. In factor 1, two sub-factors could be found (see Figure 6.1). While these sub-factors were not distinct enough to be their own factor, the analysis of the factor showed that the following perspectives on II success can be found: safety & security; compliant; and trustworthiness. Factor 2 represents two perspectives on II success: efficiency; and through leadership. Factor 3 represents a standard & agile perspective on II success. The efficiency perspective was essential for all actors, apart from participant 3. The regulatory body measures the success by a safe & secure, compliant and trustworthy II (see Figure 7.1). Participant 13 was not a part of one of the factors, but their measures showed that efficiency is essential (see Figure 7.1 and Table 6.1). Participant 14 was not included in the Q-sort analysis, due to missing data. But, when looking at their ranked success measures, the perspective on a standard & agile II was also present. The other actors all greatly valued the efficiency, but also other perspectives on II success, which were found by the Q-sort analysis. In the following sections, the three perspectives and the underlying shared perspectives will be discussed. The goal of this discussion is to determine how each actor prioritises the success measures and if an underlying shared perspective on II success is present.

7.1.1. Trustworthy and Compliant II

The first shared perspective on the success of an II, is a trustworthy and compliant II. The critical measures within this perspective are related to the accuracy and reliability of the data; safety & security; interoperability; conforming to laws; and productivity. Within this perspective, two sub-perspectives could be found, reflecting the trustworthiness and conforming to the law. First, the trustworthiness perspective will be discussed. The participants in this factor, share the perspective that they should be able to trust the data and the systems in the II. If the participant is not able to trust the accuracy and reliability of the data and standards, they do not view the II as successful. A poor trust in the quality will result in more manual work, therefore reducing any economical benefits the II has. The trustworthiness, in this example, reflects the importance of economic benefits for the actors' organisation. Feldman et al. (2014) described that the eventual goal of an actor's organisation will most likely be to increase the economic and/or social value. The above example sketches the importance of the economic benefits and thus the economic value for certain actors, which is mainly reflected by their prioritisation of success measures related to increasing the organisation's efficiency.

As discussed in section 6.4.1, the trustworthiness is essential for the software developers, private service provider and end-users. In addition, section 6.4.1 noted that the trustworthiness of the data is not an essential measure for the public service provider and the standardisation body. This divide between the actors is mainly based on the objectives of the actors' organisation. However, for the private and public service provider, an additional explanation can be devised. For this actor, the organisation's sector (public or private) is of importance. While in principle, the actor has the same role, namely providing a service for the end-users in the II, the interpretation of this role differs. For the public service provider, they establish the standards, access points and provide expertise and support. On the other hand, the private service provider uses software to process the e-invoice data of their clients. In addition, the private service provider establishes access points with other organisations and networks. The private service provider is different compared to the public service provider, as they differ in their operations. Moreover, it can be argued that the private service provider is dependent on their clients to be able to survive, while the public service provider is dependent on the central government for their survival. These differences in objectives reflect a difference in their perspectives on the success of the II.

The second sub-perspective in the factor highlights the importance of conforming to laws and the safety

of the II. In particular, the regulatory body (participant 3) and the public end-user (participant 5) largely share this perspective. The importance of safety and conforming to the law, can be related back to the actor's objectives. For the regulatory body, it is essential that the network is safe and secure, as it is one of their objectives. For the public end-user, the safety is essential, as this represents one of the ideals for the actor, being a safe and reliable business partner. Both of the actors that have a preference for a safe and secure II, by conforming to the laws, are a public sector actor. The actors with a preference for the trustworthiness of the II, are largely private sector actors. Only the public software developer shares the value of a trustworthy II with the private sector actors.

7.1.2. Standard and Agile II

The second factor is a standardized and agile II. The critical measures in this perspective are related to the governance expertise; reduction of tasks; ability to handle multiple standards; establishment of standards; and scalability. This perspective was shared by participants 2 (public service provider), participant 4 (standardisation body) and participant 8 (public end-user). The participants share the perspective that a successful II should encourage standardization, but be agile in the developments and interoperability with other networks. As discussed in a previous section (see section 5.2), there are multiple standards present in the II. For the II to be successful, the II should be able to support these various standards related to data exchanging. However, there is a shared ideal that the II will only truly be successful when the II is standardised. This standardisation is important in increasing the efficiency and reliability of the II. The importance of standardisation can be related back to the objectives of the actors. Both the public service provider and standardisation body are a part of one single organisation. This organisation is a sub-department of the Dutch central government. Section 7.3 will discuss a conflict that arose in the Dutch central government for the public software provider. This conflict mainly arose because of the core values of the Dutch central government (strategic governance) and the objectives of the public software developer. These two actors are represented by different departments, but are a part of a single organisation. The closeness of the actors can explain why they have a similar perspective on the success of an II. As they most probably also adjust their objectives on one another, being in a closer governance structure. One thing to note, is that the standardisation body also values the expertise in the governance. This can be related back to their objectives, as the standardisation body also provides expertise knowledge for other organisations and actors in the II.

In addition, a difference in the perspectives on II success of the public end-users was noted. While both of the participants value the accuracy and reliability of the documents, there is a difference in the perspective on the success of the II. A department in the Dutch central government views the success of the II, by being able to be a safe and reliable business partner. The municipality views the success by having a standard and agile II. Which enables cost savings and increased efficiency. This difference in perspectives can be explained by the size of the actor's organisation. While both of them receive a substantial amount of e-invoices, the size of the Dutch central government is several times that of the municipality. For the Dutch central government, a central policy on procurement is present, which each of the ministries has to follow. As the size of the organisation is so enormous¹, strategic governance establishes policies based on the ideals of the Dutch central government. While these ideals also represent an efficient way of doing business internally, other values are also present, which focus more on how the Dutch central government wishes to be perceived. As the municipality is in comparison smaller, there is no need to establish policies solely based on ideals to incorporate the different sub-organisations. Therefore, there is a greater possibility of closely aligning the objectives of using the II with their business operations.

7.1.3. Efficient and Effective II Through Leadership

The third factor is an efficient and effective II through leadership. The critical success measures in this factor are related to a shared vision and productivity. This perspective was shared by participants 1 (strategic governance) and 7 (public advisory body). The leadership was essential for the strategic governance and public advisory body. Both of these actors have similar roles, providing guidance and direction to the development of the II. While strategic governance writes policies about the development

¹ The Dutch central government has 16 ministries and 157,019 FTE's ("Jaarrapportage Bedrijfsvoering Rijk 2024 gepubliceerd | Nieuwsbericht | Rijksoverheid.nl", n.d.)

direction, the public advisory body supports them by providing market feedback. The actor's roles and objectives explains why leadership is essential for achieving an efficient and effective II. The importance of leadership for the strategic governance and public advisory bodies perspective on II success is distinct from other actors. But there is great overlap in the perspective on II success with other actors. In particular, the principal perspective of a successful II being an efficient II, is shared by all the other actors, with the exception of the regulatory body.

To conclude, the actors share the perspective that efficiency is essential for measuring II success (see Figure 7.1). The efficiency is represented by the critical success measures surrounding the accuracy and reliability of the data; productivity; reduction of tasks; and interoperability. In addition, there are various sub-perspectives on the success of an II. These sub-perspectives are actor specific. In general, the end-users also value the trustworthiness, and standardization and agility. Software developers also value trustworthiness. Service providers value standardization and agility, but also trustworthiness. The advisory bodies value the standardization and leadership. The strategic governance also values the leadership. While the standardisation body values a standard and agile II through leadership. Lastly, the regulatory body values a compliant, safe & secure and trustworthy II, but does not share the general perspective on the importance of an efficient II (see Figure 7.1).

7.2. Organisational context influences the perspectives on success

The perspective on what success is for an actor can be related to the participants organisations objectives and values. There was one interesting difference between actor's perspectives which was related to their organisational context. The difference which was found in this thesis, was related to the difference in the sector. As stated in section 3.3, this case study made use of theoretical propositions. These theoretical propositions stated that public and private organisations measure the success differently, as they have differing values. Public organisations measure the success by social benefits, while private organisations measure success by the economical benefits. When looking at the prioritisations of public and private actors, it can indeed be seen that success is measured differently.

For a private sector actor, the survival of the organisation is of great importance and success is thus measured by its increase in efficiency of economical benefits. While for a public sector actor, success is measured by its adoption rate with the ideal II being shared by everyone. The difference between public and private sector is especially clear for the actor advisory body. For the private sector advisory body, a successful II decreases costs and time spent on invoicing for the SME's and entrepreneurs. The public sector advisory body measures the success of the II by its adoption, because they also see non-economical benefits to using the II. Such as the ability to incorporate other information exchanges. Also, the public sector advisory body greatly valued the efficiency of the II. They view that the adoption rate would increase if the II is efficient, as it creates benefits for the end-users. It can therefore be concluded that the actor's sector influences how success is measured. These results can add to the body of knowledge of the publicness puzzle (Bozeman & Bretschneider, 1994). While this thesis researched a very niche topic, success measures of an e-invoicing II, the results collected give an insight and nuance to how public and private sector actors can differ. These nuances can help further define the ideas surrounding the publicness puzzle.

Notably, for the software developers no remarkable differences could be found in their perspectives. This can indicate that for the software developers, the influence of being a private or public sector organisation is limited, and the objectives and role of an actor are of greater influence on measuring II success. This indicates that while for most of the actors, the sector does influence the perspective on success, it is not the standard. Adding to the nuances of the publicness puzzle.

7.3. Conflicting Values

During the analysis of the results of the Q-sort analysis, conflicting values of an actor and viewpoints between actors were noticed. These conflicts show that while there is a generally shared value of actors on the success of an II, the involvement of multiple actors also complicates the development of an II and complicates measuring II success (see section 2.2). While an actor has a specific role and objectives in the II, achieving those objectives can be done in multiple ways. These ways can reflect

the values of that actor, and/or that of the organisation that carries out the actors role. These values and objectives can clash with each other and result in tensions or conflicts within the actor itself. In addition, there can also be conflicts between actors, due to conflicting viewpoints on the role of the actor. The following two sections describe an example of a conflict given during the interviews, which highlight the complexities the presence of various actors in the II can bring. These examples can add to the understanding of how actors measure II success and which factors can be at play.

7.3.1. Conflicting Values of an Actor

For one of the actors, conflicting values within their organisation were noticed. The conflicting values were noticed for the public software developer (participant 6). The public software developer wishes to both achieve the goal of increasing the adoption rate of e-invoicing, but also does not wish to compete with the market. The public software developer set up the Suppliers Portal of a duty of care for the smaller suppliers, to be able to invoice to the Dutch central government. However, currently, the public software developer is too successful and is competing with market portals. Which is exactly not what they wish. The public software developer only wishes to help the small suppliers with e-invoicing. However, the Dutch central government (strategic governance) does have the ideal to increase the adoption rate of the II. Therefore, having a successful public software developer, is achieving that goal, as quite a group of suppliers uses the portal. This example emphasises that while the Dutch central government is one organisation, it has a variety of departments, and exactly those departments represent an actor role in the II. Each actor has their own objectives, but being a part of a single organisation can result in conflicting values. This example sketches that these conflicting values complicate the development of the II, especially when there are multiple actor roles in one organisation. When these actors are aware of the shared value, in this example increasing the social value, they can establish governance structures to communicate about a common direction. Then, there are benefits of having multiple actor roles in a single organisation. The communication between the actors might be more easily established. Also, actors can make use of existing governance structures in their organisation, without the need of establishing new ones. These governance structures can be used to make the actors aware of the shared value and develop a common direction. Overall, this example shows the complexities having multiple actor roles in one organisation might bring. But also that having a shared value might help in establishing a common direction.

7.3.2. Conflicting Viewpoint Between Actors

Besides conflicting viewpoints for a single actor, there are also conflicting viewpoints between actors. The ranking of the measure *Conforming to the law and regulations on data exchange* generated quite a discussion amongst participants. While all of the participants viewed this measure as a boundary condition of the II (see Table 6.4.1), there were conflicting perspectives on what the role of the some of the actors were supposed to be. In particular the role of the policy makers of the Dutch government (strategic governance) was placed in question. In the Netherlands, the government follows a liberal economic policy, where technologies and innovations are left to market forces. Based on this policy, the strategic governance does not wish to interfere with the market and obligate the use of the II for organisations (in the B2B). However, some of the participants (of the private sector) are in agreement that it is necessary for the strategic governance to make the II obligatory. Their reasoning behind the obligation to use the II, stems from being able to adjust their business strategies and being proactive in the adoption of the II. Currently, primarily businesses who are in business with the government (B2G) are aware of the current possibilities of the II. With Peppol, the Dutch government wishes to increase the adoption rate of the II, as Peppol also enables B2B e-invoice traffic.

Participants gave two explanations for why B2B organisations have not widely adopted the II (Peppol in particular). The first is due to the low awareness of the benefits of the II, but also the II itself. The Dutch business market is full with smaller organisations (SME's). These smaller organisations are not aware of what an e-invoice entails, for example it is commonly thought that a PDF is a form of an e-invoice. This low awareness rate is a challenge for increasing the adoption. The second is due to the existence of sector specific standards. In the B2B, businesses make use of the e-invoice II, but there are multiple invoice standards. These standards are sector specific, resulting in a limited cross-sector

use of e-invoicing. The Peppol BIS V3 standard² is a non-specific sector standard, allowing for cross-sector B2B e-invoicing. As mainly government suppliers use Peppol, there is limited market feedback on the data standard. Resulting in a limited ability of standardisation bodies (OpenPeppol³) being able to adapt the standard to the needs of the market. Due to the low awareness and existence of sector specific standards, B2B organisations are hesitant in adoption the II, as the current network effects are limited. But also, the resistance of these organisations due to their installed base of standardized systems, based on these sector specific standards.

This also showcases the complexities in developing the II due to the installed base of standardized systems Cordella (2010). These organisations (participants) wish for the strategic governance to raise awareness, by for example making the II obligatory. In addition, the EU is debating about the upcoming law: VIDA. VIDA is kind of based on organisation's e-invoicing. If this law is established in a couple of years, a large part of the Dutch market will be caught unaware, and will need to swiftly adopt to e-invoicing. This example emphasizes a conflicting viewpoint between actors on the role each actor has. On the one hand, private organisations (eg software developers and service providers) wish for the public strategic governance to give direction to the market, by making e-invoicing obligatory. On the other hand, the public strategic governance follows the policy of a liberal economic policy, letting market forces take place. Factoring in future obligations (eg VIDA), the complexities of II development are emphasized. The complex network between actors, data exchange standards and external influences by laws and regulations are what characterises the II.

The above two examples describe the complexities present in the II due to the involvement of multiple actors. In the II, one organisation can take on the role of various actors. While this could simplify the governance communication around the development of the II. On the other hand, these actors could have very different objectives, such as the ones described by the public software developer. Therefore complicating the determination of a shared direction. As described by Cordella (2010), the actors co-define the shaping trajectories of the II. Conflicting values of actors can thus result in an II which is not shaped into a single direction, but continuously alternates between various directions. Constantinides and Barrett (2015) researched the use of framing strategies to achieve a certain development. When understanding the underlying values and perspectives on II success, the governance of the II can use corresponding framing strategies to ensure that the II is continuously developed, and not dependent on continuous reshaped directions. In addition, participants criticised the role of the strategic governance in the e-procurement II. This criticism shows the perspective on what an actor's role entails can differ. Due to the varying perspectives on the role of the strategic governance, participants noted a lack of a clear and effective strategy and direction of the II. It can be argued that, for an effective governance and development of the II, it is necessary that an actor's role is clearly defined. Lastly, the influence of external factors, such as the upcoming VIDA law, emphasises the probable influence this new law might have on the development of the II. To conclude, the interdependencies between external factors, actor's objectives and perspectives on roles emphasise the complex nature of an II. It is therefore essential to understand the shared underlying values to successfully develop the II.

7.4. The Future of the Dutch e-invoicing Information Infrastructure

The continuously low success rate of II development projects, limited body of knowledge on II success and the complexities characterising an II, called for further research on how success is measured. This thesis found that for the Dutch e-invoicing II, there are various perspectives on measuring II success, which differed per actor role. When looking at these actor role, a divide can be seen. On the right hand side of Figure 7.1 the perspectives "standard & agile" and "leadership" can be seen. The actors who share these perspectives are the advisory bodies, strategic governance, standardisation body, public end-user and also the public service provider. More on the bottom of Figure 7.1, the "trustworthiness" perspective can be seen. The software developers, public and private end-user and private service providers share this perspective. The measures characterising the trustworthiness surround the data and system quality. While the measures characterising the standard & agile and leadership highlight the importance of knowledgeable governance, agility of the II and a shared vision.

²Data standard which is obligatory to use across the Peppol network

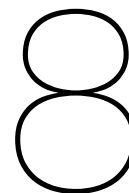
³OpenPeppol is a standardisation body who is tasked with establishing the standard for Peppol

When taking a closer look at these two groups, the group which values the technical quality greatly are also a part of the II and actively use the II themselves. While the group on the right hand side, which is more focussed on the leadership and agility, take on a role of influencing the development of the II. And are therefore more focussed on success measures which emphasize the development of the II. These influencing actors, especially the strategic governance, are in control of developing the II. In the Dutch e-invoicing II, the public sector strategic governance develops the policies surrounding the pathways of the II where the Dutch central government is the end-user. But also, they are able to develop laws surrounding the pathways in the II with a private sector end-user. It can be deduced that the strategic governance has a great influence on the development of the II. In addition, the standardisation body is a part of standardisation committees, both national⁴ and international⁵ and influences the development of the II by supporting certain standards. Lastly, both advisory bodies also influence the development of the II through providing market feedback and give expertise to the strategic governance.

The actors in the trustworthiness perspective, have an active role in the II. These actors can also exert influence on the development of the II by taking part of several committees, such as the NEN. Or for example, by forming a consortium with other same actor organisations and seeking contact with the strategic governance (Interview Participant 7). These active actors also have ideas about the future developments necessary in the II. But, they are more focussed around participating and measuring the II's current success.

⁴NEN is the Dutch national standardisation committee ("Home - NEN", n.d.)

⁵CEN is the European standardisation committee (CEN - CENELEC, n.d.)



Conclusions & Recommendations

This chapter will answer the research questions of this thesis, posed in chapter 1. Next, the limitations of this thesis will be discussed. In addition, the theoretical and practical contributions will be discussed. Lastly recommendations for future research will be stated.

8.1. Answering the Research Questions

The main research question of this thesis is *How do different actors prioritise success measures of an Information Infrastructure?*. To answer this research question, several sub-research questions have been set up. Each of these sub-research questions will be answered, in order to answer the main research question.

The first sub-research question is *What are the different actors in an II?*. To answer this question, an exploratory literature search was executed, which showed there are, in general, seven actor categories in an II. These are: advisory body; end-user; regulatory body; service provider; strategic governance; standardisation body; and software developer. Section 2.5 discusses these actors and the typical roles they presume in the II in more detail.

The second sub-research question is *What are the success measures in an II?*. To answer this question, a systematic literature review was executed. In the literature, a substantial number of success measures, of an II, can be found. These success measures reflect the different objectives and viewpoints actors have on success. The literary success measures were analysed and generalized where possible. In the success measures, several categories can be found. These categories are: efficiency; net benefits; technical quality; governance; safety & security; environmental factors; and adoption. Table 4.2 gives an overview of the success measures of an II.

The third sub-research question is *What are the critical success measures of each actor in the II?*. To answer this question, a holistic single case study was executed. In this case study, interviews were held with representatives of each actor category. During these interviews, the participants were asked to rank the success measures of Table 4.2 based on the importance of a measure for measuring II success. From these interviews, two critical success measures per participant were determined, see Table 6.1. These critical success measures reflected the view of an actor on measuring II success.

The fourth sub-research question is *Are there tensions between the actors?*. To answer this question, the interview participants were asked if, to their knowledge, any tensions between actors were present. In addition, based on the ranking of the success measures of the participants, differences between actors their rankings were analysed. It was found that there are tensions present between actors (see section 7.3). These tensions can arise due to a different perspective on the role of an actor in the II. But also, there are tensions present between actors when they are a part of a single organisation.

The last sub-research question is *Is there a shared perspective on the success of an II by the actors?*.

To answer this question, the ranked success measures of actors were quantitatively analysed with a Q-sort analysis. This analysis resulted that there are three distinct perspectives on II success. When analysing these perspectives, one shared viewpoint between almost all of the actors, except the regulatory body, was present. Namely, an efficient II is a success measure for an II. While the efficiency was essential for almost all of the actors, there are other perspectives present on II success, see Figure 7.1. These perspectives are a compliant; safe and secure; trustworthy; leadership; and standard and agile II.

Lastly, the main research question *How do different actors prioritise success measures of an Information Infrastructure?* can be answered. As mentioned, there are several perspectives on measuring II success, but almost all of them have efficiency in common. While different actors share certain perspectives, there are differences between the actors. One notable difference is between private sector and public sector actors. For the private sector actors, efficiency and trustworthiness is essential for a successful II, as this relates closely to their organisations economical objectives. Besides the efficiency, public actors mentioned the importance of standard & agile, safety & security, and leadership. These perspectives reflect the actors roles and objectives, but also reflect the importance of also increasing the social value. For the private sector actors, the focus lies solely on increasing their economic value. So to answer the main research question, actors prioritise success measures based on their perspective of a successful II. This perspective reflects both the actors organisational objectives, but also reflects the values an organisation may have.

8.2. Contributions

As discussed in chapter 1, most of the projects related to II development are subjected to delays. One of the reasons for these delays can be due to the limited understanding of what exactly contains II success and what the different actor viewpoints are. This thesis aimed to increase the understanding of measuring the success of an II, by researching the perspectives actors in an II have. This thesis has therefore developed a framework for measuring II success, which accounts for the actor's prioritisations. In addition, critical success measures and underlying shared values of the actors were determined. This thesis's theoretical and practical implications will be discussed separately in the following sections.

8.2.1. Theoretical Implications

As discussed in section 2.3, there is limited theoretical knowledge available on measuring the success of an II, with a framework for measuring II success missing. Due to the limited knowledge on II success, previous researchers mainly used IS success models. Also, the actors different viewpoints on a successful II have been considered to a limited extent. Moreover, most of the studies have been executed in the health sector field. This thesis aimed to reduce the knowledge gap on II success and developed an actor-based II success framework. This framework increases the understanding of what II success entails, how it can be measured and what the actors perspectives are. The theoretical implications of this thesis will be discussed in the following sections.

Dimensionality of Information Infrastructure Success

Due to the limited research on II success, researchers have used IS success models (see for example Božič and Dimovski (2020)). As mentioned in subsection 2.3.1, using IS success models for evaluating II success ensures a restricted view on what II success is. Moreover, IS success models themselves have received criticism for offering a narrow focus on IS success itself. But also the opaqueness of models for determining IS success (Varajão et al., 2022). This thesis has tried to incorporate the different aspects of both II and IS success known in literature, to account for the heterogeneous and emergent nature of the II. By using a train of evidence for the success measures, the opaqueness of the framework is limited. The IS success models themselves only emphasise one aspect of what success is. For example, the widely known TAM model tests success by its adoption (F. Davis, 1987). DeLone and McLean (1992) tried to incorporate the multi-dimensionality of IS success, but still received criticism for their limited perspective (DeLone and Mclean (2003); Gable et al. (2008)). Even so, an II is more complex than an IS and II success is multi-dimensional. This multi-dimensionality can be seen through the categories of the collected success measures of an II (see Table 4.2). However, when reflecting on these categories and this thesis's case study, dimensions of success are missing.

The dimensions present in the literature (efficiency; net benefits; technical quality; governance; safety & security; environmental factors; and adoption) reflect some of the characteristics of the II, but to a limited extent. Thus still offering a restricted view on II success. First of all, the design of the case study incorporated the openness of the II, by including the actors of an II. However, the interdependencies of an II were only incorporated to a limited extent. The case study focussed on e-invoicing, which is one type of data exchange in the procurement II. While the e-invoicing has multiple layers and interdependencies, the interdependencies between types of data exchanges could not be incorporated. In addition, the II is socio-technical in its nature. Cordella (2010) researched the interdependencies between the social and technical aspects of the II, by using actor-network theory. In the current body of knowledge, no success measures were present which related to the social and technical relationships. The lack of success measures highlight the lack of an integral design theory which can account for these interdependencies. Using design theory in the social sciences, the exploration of unknown variables, such as unknown success measures, can be accounted for (Hatchuel et al., n.d.). Moreover, although developments of the II were addressed, a whole emergent loop (as described by Cordella (2010)) could not be studied, due to limited time resources.

So, this thesis tried to assemble the different known dimensions of II and IS success in an integral framework, to account for the complexities characterising an II and thus also its success. But, these complexities were considered to a limited extent due to the design of the case study and the lack of known success measures for certain dimensions of the II. However, this thesis does add to the current body of knowledge by providing and creating a comprehensive overview of several dimensions of II success, with accounting for some of the characteristics of an II, in particular the presence of multiple actors.

A non-Health Domain Perspective

Moreover, the selected case: the Dutch e-invoicing II, is also a first to be studied. II's are typically studied in a health domain (see section 4.2). Studying a non-health domain related II can test whether the found values and perspectives on II success are also applicable to other sectors. Feldman et al. (2014) found that actors either measure the success based on an increase in social or economic value. This thesis found that there are several perspectives on II success. But actors their underlying values were related back to an increase in economical value, or social value. In addition, it was found that actors who have an active role in participating in the II prioritise the efficiency to increase their economical benefits. While actors who have an influential role and are in the governance to develop the II, also prioritise a standard & agile II and its leadership. These actors see both the economical and social benefits an II can bring.

In the studied e-invoicing case, the focus of the actors lies mainly on the efficiency of the II. In the health sector, the focus was also largely on providing better patient care (see for example Li et al. (2023)). This difference in the focus of the actors on how success is measured, can be explained by the type of business operations the II supports and why the II was originally developed. The e-invoicing II was set up to increase the efficiency of business operations by automating parts of the procurement process. While II's in the health domain were developed to provide better patient care by exchanging more information. While other factors also played a role in measuring II success, the importance of efficiency was noted by almost all actors. With the findings of success in the health domain II's (see section 4.1) it can be noted that the initial goal of why a certain II is developed over time, plays a role in how success is determined. These findings add to the body of knowledge, as the underlying values might be non-sector specific but it also seems that the initial goal of the II can influence which values are most prominent.

Publicness Puzzle

The publicness puzzle describes the challenges to understand why and how public and private sector differ in their behaviour and outcomes (Bozeman & Bretschneider, 1994). This thesis incorporated both public and private sector actors to understand whether they measure II success differently. It was found that for most of the actors, being a private or public sector organisation influenced their perspective on II success (see section 7.2). But, respective critical success measures seemed to be non-sector specific, such as the accuracy and reliability of the data (see Table 6.1). These findings can

add to the body of knowledge on the publicness puzzle. While this thesis focussed on an II, creating an increased understanding on the differences and similarities between the public and private sector is valuable. Also, these findings add to the knowledge that the publicness puzzle is an all-encompassing concept visible in different literary movements.

To conclude, this thesis adds to the current body of knowledge by providing an actor-based framework for measuring II success. In addition, this thesis has increased the understanding on the perspectives actors have on II success. Lastly, the procurement domain adds to the general understanding of II success, as it is a domain studied to a limited extent.

8.2.2. Practical Implications

This thesis also adds value for policymakers and organisations in the procurement domain. As mentioned in chapter 1, one of the main reasons why II projects fail, are due to shifting goals during the projects or negative outcomes within the projects. The results of this thesis can help to increase the success rate of II projects. In section 7.4 it was discussed that certain actor roles have a greater influence on the development of the II, while certain actors take on a participating role in the II. When looking at this divide in actor roles and their influence on the development of the II, it can be deduced that the focus of the future Dutch e-invoicing II will most probably be efficiency, standardisation and agility. To achieve the efficiency, standardisation and agility, it needs to be ensured that each actor cooperates, by having expert leadership. While the participating actors also greatly value the efficiency of the II, the corresponding critical success measures of the actors differ. This difference in the success measures can reflect the shifting goals or negative outcomes during the projects, as the actors are unaware they share the same end-goal, but have different focus points.

By knowing that efficiency is greatly valued by most actors in the II, increasing the efficiency of the II will result in increasing the general success of the II. But, because there are also differences between actors their perspectives on II success, it might be difficult to achieve a single strategy for increasing the success of the II. The more participating actors wish for an increase in the trustworthiness. The standardisation bodies wish for an increase in standardisation. While the strategic governance aims for an increase in knowledge, adoption and better leadership development. With the knowledge gained with this thesis, the development of the II can be steered towards success by the actors who have an influencing role in the II. Knowing which actors to involve in which aspects of the II, for example software developers and end-users for their technical quality preferences, can help increase the overall success of the II. Moreover, transparently communicating with the actors in the II, might help to increase the understanding of the actors on why certain decisions are made. Based on this thesis's observations, two practical manners of increasing the success rate of II projects were developed.

Bimonthly Committee with Influencing and Participating Actors

One of the main success goals of the strategic governance actor and other influencing actors, is to increase the adoption rate in both the B2G and the B2B pathways. However, when looking at the pathways including the Peppol network (both B2B and B2G), the current governance of the e-invoicing II mainly exists of the public strategic governance actor, the standardisation body and the regulatory body. Private sector actors do not actively participate in the governance. Private service providers and software developers can exert influence and provide feedback via standardisation committees (NEN and CEN), or via an online feedback platform for Peppol (Exploratory interview with a service provider, see Appendix C). But, this influence and feedback does not have to be implemented by the II's governance. Which can result in a lower success rate of the II projects, as these actors their preferences are not taken into account. The low adoption rate of the e-invoicing II in the B2B might be a result of not taking their preferences into account.

Therefore, to increase the success rate, a new committee can be set up to increase the participation of the private sector actors. This committee should exist of the regulatory body for the Peppol network, the standardisation body, the public strategic governance, the private service provider and private software developer. When the private service provider and software developer increasingly see the benefits of e-invoicing, they can promote e-invoicing to their clients, the end-users. However, including all the service providers and software developers is a tad difficult. Therefore, yearly representatives for a service

provider and software developer can be chosen. These representatives can collect the feedback of their colleagues, via a website, and convey the feedback in the committee. To reduce the workload, the committee meets bimonthly and has a predefined agenda and speaking time per actor. In this meeting the feedback from the B2B sector can be conveyed and action plans can be set up to incorporate said feedback, or develop a shared direction. Actively including the private sector actors with a participating role in the II, can ensure that the amount of negative outcomes of the projects is reduced, as feedback is incorporated regularly.

Also, by meeting every two months, the strategic governance can explain their vision for the II. As the participating actors are more focussed on the efficiency benefits and the strategic governance also on the standardisation and agility, the strategic governance can explain the benefits these projects will have on the efficiency of the II. Even if certain projects might not directly influence the efficiency, but are more focussed on the standardisation and agility. Explaining the strategic governance's motivations, with an emphasis on the shared end-goal, in the committee will add to the understanding of those participating actors and hopefully increase their acceptance and cooperation and thus its success.

E-Invoicing Commercials

The above example described how the success rate can be increased by focussing on the private software developer and service provider. However, the awareness of the existence and benefits of the e-invoicing II is low for end-users. As stated before, a long term success goal is to increase the adoption rate of the e-invoicing II. However, with limited awareness of the existence of the II by end-users, the adoption rate will remain low. Other countries have also realised this and are currently increasing the awareness of the e-invoicing II with information commercials. For example, Germany and Belgium have television and radio commercials about e-invoicing and the benefits for SME's and entrepreneurs (Interview with participant 7 and 11). These commercials seem to achieve their goal as SME's and entrepreneurs are increasingly using e-invoices. Currently, in the Dutch e-invoicing II it can be seen that both the public and private advisory body are trying to increase the awareness of e-invoicing of the end-users, by providing information sessions and sending out documents. While these methods do result in an increase of the awareness and adoption amongst end-users, it might not be the most effective way. As it might be difficult to reach new end-users who, in their network, are unaware of e-invoicing II. Therefore, television and radio commercials might be a more suitable approach to increase the adoption rate, as new audience can be reached more easily.

To conclude, the understanding gained by this thesis of actors perspectives on II success, gave two practical implications. To increase the success rate of the e-invoicing II, a bimonthly committee can be set up. This committee consists of both the more influencing actors, but also the participating actors. This committee can be a tool to incorporate market feedback and relay the reasoning of development projects to increase a shared vision. When the actors in the committee understand that all of them measure the success by its efficiency, but there are different sub-perspectives present. Then the intention of development projects and its outcomes can be understood and are hopefully seen as less negative and increase the success rate. Moreover, to increase the adoption rate amongst end-users, commercials can be used to reach a new audience. Germany and Belgium are already using such commercials and service providers report the success of those commercials (Interview with participant 11). As the adoption rate is one of the success goals by the influencing actors, increasing the adoption rate will also increase the reported success rate of the II.

8.3. Limitations

In the following section, this thesis's limitations will be discussed and can be used as an input for future research. Several limitations based on the methodology were determined. The approach of a holistic single case study limits the generalizability of this research (Yin, 2003). II's are a complex and emergent phenomena, therefore they can also vary widely (Cordella, 2010). While the II encompasses all sectors in the Dutch market, narrowing down the scope to only e-invoicing influences the generalizability of the case. So, while the studied II is a cross-sector national II, the narrowing down of the scope limits the generalizability of this thesis. Therefore, the theoretical framework established might need adjustments when applied in different countries or different domains, e.g. the health sector.

A second limitation is due to the selection of the interview participants. When selecting the interview participants, criteria were established to reduce the selection bias and increase the reliability of this thesis. To reduce the selection bias and increase the reliability of the study, it is preferred to interview multiple experts/representatives per actor. Therefore, a main limitation of this research is having only one participant per actor group. Even though this participant can be seen as an expert, having only one participant per actor negatively influences the reliability of this thesis.

Thirdly, the subjectivity of choosing an expert is in itself also a limitation of this thesis. While selection criteria were established, choosing experts remains a subjective matter, especially in fields which has no hard criteria established by other researchers (Shanteau et al., 2002).

A fourth limitation of this study is related to the Q-sort. It was noted by the participants, that ranking the success measures on the scale (see appendix section A.1) was quite difficult. While the intention of the Q-sort is to force participants to rank their critical success measures, the participants were sometimes forced to rank measures lower than they initially wanted. While the participants were content with the eventual ranking, as it reflected their priorities, the design of the scale might have not been the most optimal. The forced ranking may have influenced the prioritisation of the measures by the participants and did not fully reflect their ideal distribution. Therefore, this fourth limitation surrounds the scale of the Q-sort and the negative influence on the reliability of the study.

The last two limitations are also related to the interviews. This thesis aimed to minimize the bias of participants by setting up an interview protocol. However, during the interviews, the participants asked for some examples for certain measures. Some of the measures were unclear by themselves and needed extra information for the participants to understand what a measure entailed. From this, the last two limitations of this thesis arises. The fifth limitation is that the measures itself introduced some form of subjectivity. Resulting in an interpretation being made by the participants. This interpretation can differ between the participants, therefore a level of subjectivity was present during the interviews, which reduces the reproducibility of this thesis. If other representatives of the actor's organisation are asked to rank the success measure, they might interpret the success measure differently.

The sixth and last limitation is the subjectivity introduced by the interviewer. When participants asked for an example for a certain measure, the interviewer gave an example to which the participant could relate. While this increased the understanding of the participant about the measure, a participant specific examples reduces the reproducibility of this thesis. Because, if the interviewer gave a different example to the same participant, the participant might interpret the success measure differently, resulting in a different ranking of the success measure.

A seventh limitation can be found with the time context of the case study. Parts of the e-invoicing II are closely connected with the Dutch central government. Therefore, the views of the Dutch central government and their policies are likely to influence how public sector, but probably also private sector actors view the success of an II. Currently, there is an insecurity in the long-term safety and stability in Europe. Policies of the Dutch central government are increasingly more focussed on increasing the defensive capacity of the Netherlands ("Kabinet omarmt hogere NAVO-norm: komende jaren fors meer geld naar defensie | Politiek | NU.nl", n.d.). This setting can play a role in how actors measure II success, as they currently are more focussed on for example the safety. However, if this thesis is executed in 5 years time, the context may differ as the threat of war had reduced. Thus, actors may prioritise different success measures.

Lastly, the researchers positionality can be seen as a limitation. The researcher has a background in Management of Technology. II's are a complex technology and increasing the success can be seen as an important aspect of managing a technology. The study background the researcher has also reflects their positionality. For example, a researcher with a Complex Systems Engineering background will probably interpret an II differently than with a Management of Technology background. This thesis's research has approached an II as a complex technology, which can be used by organisations as a tool. Another researcher with a different positionality can approach an II differently, in turn resulting in a different study. Therefore, the researchers positionality is a limitation of this thesis.

8.4. Future Recommendations

This thesis also provides several directions for future research to strengthen the reliability and applicability of the developed framework. The first recommendation is to reduce the subjectivity in how success measures are interpreted during interviews. As some participants requested examples for clarification, future studies could include an explanatory document, offering definitions and real-world examples for each measure. This would ensure a shared understanding among participants and reduce interpretation bias. In addition, increasing the number of interview participants per actor group, ideally three participants, would enhance the reliability of the overall Q-sort outcomes by capturing a broader range of intra-group perspectives. Moreover, the Q-sort methodology could be refined to better visualise the participants ranking. For example, the distribution could allow more space on the essential and irrelevant ends (+4 and -4), giving participants greater flexibility to rank their critical success measures. Moreover, a second Q-sort round with the same participants and measures, but on a different scale can further test the stability of the results. This follow-up round would indicate whether actor priorities remain consistent over time or vary depending on the framing of the sorting task. Lastly, to validate the reliability of the framework, it is recommended to test it again in the Dutch e-procurement domain, but with different representatives of the same actor groups. By repeating the study with other individuals in similar roles, the consistency of prioritisations and reasoning can be evaluated. If similar patterns emerge, this will confirm the robustness of the framework. If not, new insights may surface that could further improve the framework. To conclude, by expanding the sample, refining the tools, and validating results across similar actors, future research can enhance the robustness and practical utility of the II success framework.

In a more practical setting, the effect of knowing about the critical success measures of each actor can be studied. For example, during a new development project by the Dutch central government, related to e-ordering as a next step in developing the II further, the effects of knowing what each actor in the II measures its success by can be studied. For such a development project, if the strategic governance is aware of the actors success measures, they can steer the development project in a direction preferred by all actors. If there are negative outcomes, the strategic governance can develop a solution which reflects the relevant success measures. This hopefully increases the success rate of the project. Studying such a project from start to end and how the actors incorporate the knowledge of what the critical success measures are, can give the necessary substantiation, that indeed knowing how actors view success increases the success rate.

8.5. Researchers reflection

In retrospect to the content and process of this thesis, I learned a couple of lessons. First of all, the main research method of this study is qualitative of nature, as the data was primarily collected via a literature search and interviews. Both of these research methods were new to me. While a course of the study program ("Research Methods") gave me the necessary knowledge to understand the method, executing the method was wholly new. With a trial and error attitude, the first few interviews went less than perfect, but overall went gradually better. However, one of the lessons learned was that finding, planning and executing interviews takes up quite some time. In retrospect, I could have started the interview process while simultaneously executing the systematic literature research, to plan more time for analysing the interviews. While I managed to thoroughly analyse all the planned interviews, I had less time than expected, which resulted in a bit of stress.

Second of all, during the study program I have used several quantitative methods, but had limited experience with qualitative methods. Therefore, setting up a qualitative research study was also a new learning experience and called for several adjustments over time. Yin (2003) stated that a case study can be adjusted over time, to ensure that the right objective is being studied. This was also the case for my thesis's case study. When starting with the thesis, I designed a multiple case study with four different cases. However, when researching the e-procurement domain, it was noted that a single case study design would fit better (see section 3.3 for the reasons). I found that using a qualitative method requires some level of flexibility, and a really thorough understanding of what the study's objective is.

Third of all, when choosing the domain for the case study, several of them were available in the Nether-

lands. As the e-procurement II adhered to all the requirements, this domain was chosen. However, when interviewing participants in this II, I got the feeling that some of the participants did not really see the II as an infrastructure, but were more focussed on the system they encountered. This can be explained because some of the participants their actor role was indeed focussed more on one of the e-invoicing systems and were not involved in the whole infrastructure. This made me wonder whether the same actors in another II also evaluated the II based on the system they encountered. In retrospect, I think that during the interviews I could have placed the system they were evaluating in perspective of the infrastructure. Maybe placing the focus more on the infrastructure during the interviews and asking the participants to take a step back and try to see the whole II, could have resulted in different success measures. But during the interviews, I was also still increasing my understanding of the II. The lesson learned from this is for a future study I need to more fully understand the case being studied, before executing the interviews, to be able to ask the right questions and ensure the participant is aware on the objective being asked.

Lastly, the MOT study program gave me the necessary skills for a thesis. However, I believe that in the program, more time can be spend on qualitative research. Also, there is a lack of an universal structure for a MOT thesis. Without study colleagues, I did not know certain parts of the thesis needed to be included, for example this reflection. But overall, during this thesis's process, I have learned new research methods, specifically executing a case study, preparing and analysing interviews and a systematic literature review. In retrospect, while I believe that for this thesis's research objective the literature review and case study fit best, the nuances of qualitative research methods unknown to me at the beginning of the thesis sometimes made the process challenging. However, with the help of my supervisors and their great knowledge on qualitative research and the studied concepts, I feel that I have managed to execute this thesis to the best of my abilities.

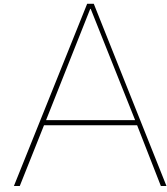
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Interview Related Documents

A.1. Interview Protocol

An interview protocol was set up to ensure each interview was, in the basis, similar to enhance the reproducibility of the case study.

Interview protocol

Vooraf het interview:

- Email met het informed consent document + een lijst met de metingen opsturen, zodat de deelnemer de metingen al kent.

Fase 1: Openen van het interview. ~ 10 minuten

- Wat is de rol van de stakeholder in de e-facturatie infrastructuur. *Kunt u iets vertellen over uw rol binnen de e-facturatie uitwisseling?*
- Algemene vraag: *Wanneer zou u deze infrastructuur als succesvol zien?*
- Uitleg over de Q-sort: 50 verschillende metingen die u moet ordenen van helemaal irrelevant (-4) tot essentieel (+4). Tijdens het neerleggen van de kaartjes zal ik vragen stellen waarom deze meting zo belangrijk is.

Fase 2: Sorteren van de 50 metingen ~ 30 tot 40 minuten

- Beginnen met sorteren van de meest extreme metingen
- Vragen:
 - *Waarom is deze meting essentieel?*
 - *Waarom vind je dit belangrijk?*
 - *Mist er nog een essentiële meting van succes?*
 - *Waarom is deze meting zo onbelangrijk/niet essentieel?*
 - *Is er een situatie waaruit blijkt dat deze meting (niet) essentieel is?*

Fase 3: Resterende open vragen en afsluiten ~ 10 minuten

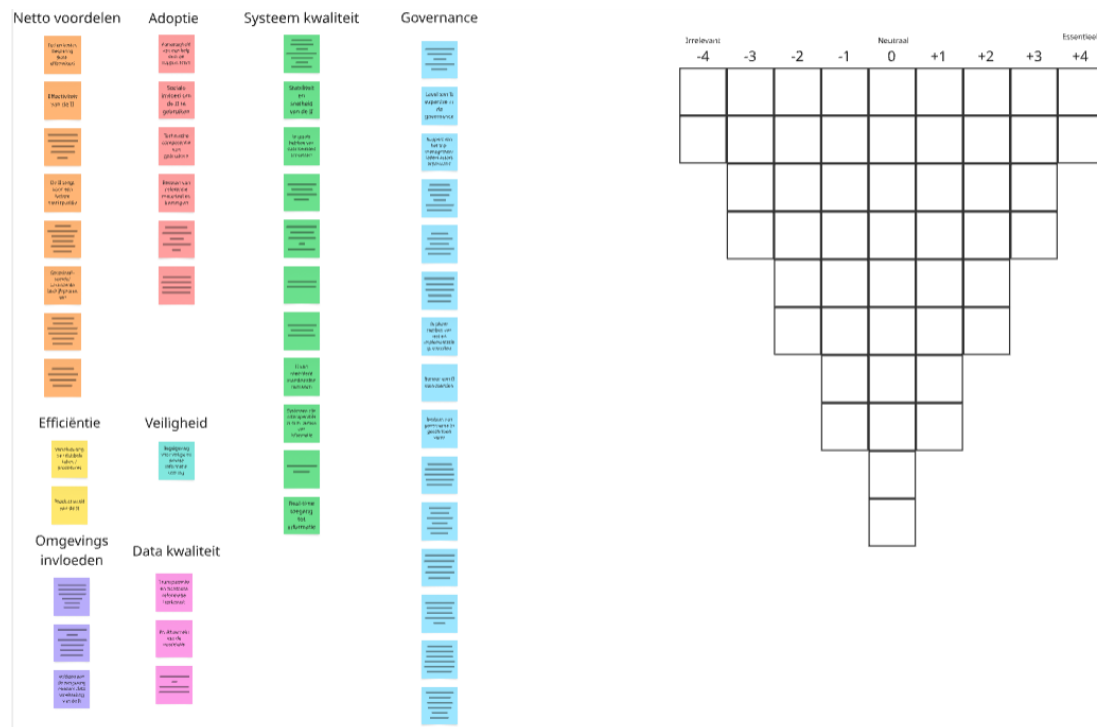
- Vragen:
 - *Zijn er spanningen tussen bepaalde metingen?*
 - *Zijn er, dat u weet, nog andere kijken op succes tussen stakeholders betrokken bij de II?*
 - *De verschillende kijken op succes, hangt dat van het type project af? Of van de stakeholders?*
 - *Zijn er spanningen tussen stakeholder?*
 - *Missen er nog metingen uit deze lijst?*
 - *Voor de essentiële metingen, hoe kan je deze beïnvloeden?*
- Afsluiten en bedanken voor het meedoen aan het interview. + Vermelden dat ze een transcript van het interview krijgen.

Uitleg:

Het doel van het interview is om te achterhalen wanneer een II als succesvol gekenmerkt wordt. Dit probeer ik te achterhalen door naar verschillende stakeholder perspectieven te kijken. In dit interview vraag ik eerst een open vraag, vervolgens gaat u de succes metingen sorteren, op relevantie en met een gelimiteerd aantal plekken van hoe belangrijk iets kan zijn.

De sortering is van de -4 (Irrelevant) tot + 4 (Essentieel). In het midden ligt 0 (neutraal), hiervoor zijn de meeste plaatsen beschikbaar. Tijdens het sorteren, zal ik vragen stellen waarom u kiest voor een bepaalde plek van een meting. Na de sortering zijn er nog een aantal open vragen waar we dieper op bepaalde metingen en stakeholder verschillen in kunnen gaan.

Voorbeeld Q-sort online interview. Dit krijgt elke online deelnemer te zien.



A.2. List of the Success Measures of an II, in Dutch

This list was shared with the participants before the interview, to give the participant time to read through the measures before the interview started.

II = Informatie Infrastructuur = data uitwisselingsketen

Efficiëntie:

- Vermindering van dubbele taken of procedures.
- Productiviteit van de II.

Netto Voordelen:

- Tijd en kost besparing / kost-effectiviteit van de II.
- Verbeterde besluitvorming processen en resultaten.
- Betaling van additionele kosten voor data-uitwisseling met organisaties buiten de II.
- Geoptimaliseerde /veranderde bedrijfsprocessen.
- Vergrote capaciteit van het toenemende volume van activiteiten te beheersen.
- De II zorgt voor een betere marktpositie.
- De governance geeft een goed toepasbare strategische koers.
- Effectiviteit van de II.

Systeem Kwaliteit:

- Real-time toegang tot informatie.
- Schaalbaarheid van de II.
- Systemen zijn interoperable met elkaar zonder informatie verlies of vertragingen.
- II kan meerdere standaarden hanteren.
- Aanpasbaarheid van de standaarden gebruikt in de II.
- Aanpasbaarheid van de systemen in de II.
- Continue testen van de II op de functionaliteit en verbeteringen.
- Gemak van data uitwisseling tussen systemen in de II.
- In plaats hebben van data kwaliteit processen.
- Stabiliteit en snelheid van de II.
- Mogelijkheid implementatie nieuwe technologie, zonder verstoren van huidige verbindingen.

Data Kwaliteit:

- Nauwkeurigheid en betrouwbaarheid van de informatie.
- Bruikbaarheid van de informatie.
- Transparante en zichtbare informatie herkomst.

Governance (Elementen rondom besluitvorming):

- Bestaan van duidelijke, interactieve en accurate communicatie processen.
- Bestaan van de governance in een geschreven vorm.
- Beheer van II standaarden.
- Meenemen van de beschikbare informatie om processen en beleid te verbeteren.
- In plaats hebben van test en implementatie protocollen.
- Bestaan van een gemeenschappelijke visie en organisatorische doelen van de actoren.
- Identificatie en adressering van conflicten of concurrerende objectieven van actoren.
- Verdeling van verantwoordelijkheden van rollen, taken en kosten tussen actoren.
- Aanwezigheid van een project champion, met besluitvormende kracht, om kennis te verspreiden.
- Identificatie van benodigde middelen, met ruimte voor verandering.

- Reguliere herinneringen over de on-boarding gidsen en trainingen.
- Meenemen van feedback van gebruikers tijdens de ontwikkeling en implementatie.
- Support van het top-management ieders actors zijn organisatie.
- Level van II expertise in de governance.
- Bestaan van II-gebaseerde project management en workflow.

Veiligheid:

- Regelgeving voor veilige en private informatie opslag.

Omgevings-invloeden:

- Voldoen aan de wetgeving rondom data uitwisseling van de II.
- Industrie zijn rol in het ontwikkelen van competitieve standaarden/technologieën.
- Verschillen tussen de actoren in hun technologie level, capaciteit en financieel vermogen.

Adoptie:

- Zijn alle gebruikers/actoren op de hoogte van de voordelen en waarde van de II.
- Gebruiksvriendelijkheid van de II/systemen in de II.
- Bestaan van referentie materiaal en trainingen om kennis te verspreiden.
- Technische competentie van gebruikers.
- Sociale invloed om de II te gebruiken.
- Aanwezigheid van een help desk en support team.

A.3. Informed Consent in Dutch

As all participants are Dutch, the Dutch informed consent form was shared with the participants and signed by each of them.

U wordt uitgenodigd om deel te nemen aan een onderzoek genaamd *Towards success for an Information Infrastructure*. Dit onderzoek wordt uitgevoerd door Henrieke Martens van de TU Delft. Henrieke Martens voert dit onderzoek uit als haar scriptie om haar Master diploma *Management of Technology* van de TU Delft te halen. De TU Delft functioneert als de begeleidende rol in de scriptie. Het onderzoeksteam gebonden aan deze scriptie bestaat uit Henrieke Martens als onderzoeker en de volgende personen van de TU Delft met een begeleidende functie: Prof.dr.ir. M.F.W.H.A. Janssen & Dr. G. van de Kaa & W. van Donge.

Het doel van dit onderzoek is het achterhalen wat de verschillende actoren, van een informatie infrastructuur, zien als een succesvolle informatie infrastructuur. Dit onderzoek zal zich focussen op verschillende succes metingen van een informatie infrastructuur en hoe en waarom de betrokken actor groepen deze prioriteren. Dit onderzoek vindt plaats in het Nederlandse elektronische procurement domein, waar vier unieke informatie infrastructuren onderzocht worden. Naast een literatuur onderzoek, wat zich focust op het vinden van succes metingen, worden experts geïnterviewd. Eén expert per actor groep wordt geïnterviewd. Deze experts hebben een grondige kennis over het informatie infrastructuur waarin ze betrokken zijn. Het doel van de interviews is het achterhalen van de prioritering van de succes metingen en wat een actor ziet als een succesvolle informatie infrastructuur. Een interview zal ongeveer 60 minuten in beslag nemen.

De data zal gebruikt worden voor het beargumenteren van de op de actor gebaseerde succes metingen van een informatie infrastructuur van de master scriptie. Naast het gebruik van de data in de master scriptie, wordt de data waarschijnlijk gepubliceerd in de vorm van een onderzoeks artikel (research paper).

U wordt gevraagd vragen te beantwoorden gerelateerd aan wat u/uw actor groep ziet als een succesvolle informatie (data uitwisselende) infrastructuur. Ook worden er vragen gesteld gerelateerd aan hoe u denkt dat bepaalde succes metingen beïnvloed kunnen worden. Allerlaatst zal u verscheidene succes metingen prioriteren in de vorm van post-its/kaarten. Tijdens deze prioritering zal u gevraagd worden naar motivaties en beweegredenen van deze prioritering van de succes metingen.

Zoals bij elke (online) activiteit is het risico van een databreuk aanwezig. Wij doen ons best om uw antwoorden vertrouwelijk te houden. We minimaliseren de risico's door uw naam en email adres alleen te gebruiken voor administratieve taken, zoals het versturen van de informed consent. Uw data van het interview wordt zo volledig mogelijk geanonimiseerd voor het gebruik in de scriptie. De participant zal niet bij naam genoemd worden, maar zal als expert van een bepaalde actor groep benoemd worden. De sector/het bedrijf waarin u werkt en uw baan beschrijving zijn nodig om uw kennis als expert van een actor groep te valideren. Echter, doordat dit onderzoek plaatsvindt in een niche, kunnen wij u niet garanderen dat er volledige anonimiteit aanwezig is. Om het risico op persoon beschadigende informatie, concurrentie voordelen en vertrouwelijke informatie te mitigeren zal u uw interview transcriptie ontvangen. Als er ongewenste informatie blootgesteld wordt, kan dit verholpen worden. Het kan voorkomen dat er geanonimiseerde quotes van u gebruikt worden om argumenten te onderbouwen, hiervoor wordt verderop om toestemming gevraagd. De verzamelde data zal bewaard worden op de TU Delft OneDrive, waar alleen het onderzoeksteam toegang tot heeft.

Uw deelname aan dit onderzoek is volledig vrijwillig, en **u kunt zich elk moment terugtrekken zonder reden op te geven**. U bent vrij om vragen niet te beantwoorden. Uw persoonlijke data dat wordt verzameld tijdens dit project zal voor twee jaar worden bewaard bij de TU Delft, tot juli 2027. De data kan hergebruikt worden voor toekomstig wetenschappelijke onderzoek en leerzame activiteiten

Henriëke Martens is de uitvoerende onderzoeker Marijn Janssen is de verantwoordelijke onderzoeker

Ik heb de bovenstaande informatie over het onderzoek gelezen en begrepen en ik geef toestemming om mee te doen aan het onderzoek en de beschreven data behandeling.

Signatures

_____	_____	_____
Naam deelnemer	Handtekening	Datum

Contactgegevens van de onderzoeker voor verdere informatie: [Henriëke Martens, H.M.S.Martens@student.tudelft.nl]

A.4. Participation E-mail

The following e-mail was shared with potential participants to inform them about this case study and ask for their participation in the study.

Geachte [NAAM],

Mijn naam is Henrieke Martens en ik ben masterstudent in de MSc Management of Technology aan de TU Delft. Momenteel werk ik aan mijn scriptie bij professor Marijn Janssen, waarin ik wil kijken wat succes betekend in verschillende data uitwisseling infrastructuren.

Via [NAAM] heb ik je contact gegevens gekregen in de hoop dat je zou willen deel nemen aan mijn onderzoek, gezien uw werkzaamheden rondom [CASUS]. Mocht je hiervoor tijd hebben, zou ik je willen vragen om mij te helpen door middel van een interview. Dit interview duurt ongeveer 1 uur. Het interview kan op locatie, maar is ook mogelijk om online in te plannen. Ook is het mogelijk om hierover eerst even te bellen of een online meeting van een half uurtje in te plannen om je verder te vertellen over het onderzoek.

Over mijn onderzoek

In mijn scriptie focus ik mij op het Nederlandse e-procurement domein, waarin meerde data uitwisseling infrastructuur te vinden zijn. Vanwege de grote verscheidenheid aan stakeholders en actoren in de data uitwisseling keten denk ik dat er verschillende perspectieven in zijn op wat succes betekend. Mijn onderzoek focust zich op deze perspectieven en wil hier verder op inzoomen. In mijn onderzoek wil ik vier verschillende data uitwisseling infrastructuur met elkaar vergelijken. Om zoveel mogelijk perspectieven mee te nemen ga ik kijken naar infrastructuur in zowel de publieke als private sector (B2G en B2B). In de B2G, ga een casus met de Rijksoverheid en een casus met de gemeente Den Haag als end-user onderzoeken. Voor de B2B ben ik nog opzoek naar een cases waarin een groot bedrijf, zoals Albert Heijn een end-user is. Het mijn casus enorm helpen om een interview te kunnen plannen met iemand binnen Albert Heijn, die betrokken is bij de digitalisering/ e-procurement.

Doel van het interview

Vanuit de academische literatuur heb ik een beeld gekregen bij de verschillende perspectieven van stakeholders en actoren op succes van een data uitwisseling infrastructuur. Met de interviews wil ik deze perspectieven op succes inzichtelijker maken en doorgronden. Om succes inzichtelijker te maken ben ik opzoek naar meetinstrumenten van succes en eventueel hoe deze meetinstrumenten beïnvloed kunnen worden. Om een zo overzichtelijk mogelijk beeld te creëren ben ik opzoek naar personen die een aantal jaar in een e-facturatie data uitwisselende infrastructuur werkzaam zijn geweest/ of nog werkzaam zijn. Het liefst in een positie waar hij/zij betrokken was bij besluitvorming rondom implementatie/ontwikkeling van projecten rondom e-facturatie, zoals een management positie.

Indien je interesse heeft voor een interview, of je mij kan doorverwijzen naar een collega ben ik je erg dankbaar.

Bij voorbaat hartelijk dank voor je overweging en tijd. Ik kijk je reactie graag tegemoet.

Met vriendelijke groet,

Henrieke Martens

+31636561294

A.5. Example of the four corner model

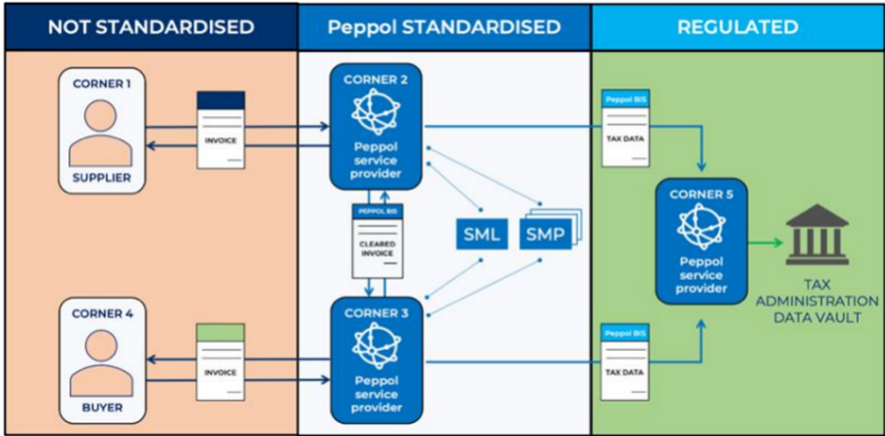


Figure A.1: Four Corner Model via Peppol, with the fifth corner added when VIDA is obligated (Peppol, 2021).

B

Qualitative Data Analysis

B.1. Exemplary piece of coded transcript with Atlas.TI

Figure B.1 shows an exemplary piece of coded transcript in Atlas.TI



Figure B.1: Screenshot of an exemplary piece of transcript with the applied codes in Atlas.TI

B.2. Interview Quotes

The following quotes were used in the results chapter(chapter 6) of this thesis. To maintain a line of evidence, the participant, with the original quote in Dutch, and the English translation by the thesis author is showed, see Table B.1.

Table B.1: Quotes from participants in Dutch and English

Participant	Quote in Dutch	Quote in English
1	Enerzijds intern overheid, dat het tot een efficiënt afgehandeld proces leidt he? ... Denk naar buiten toe als het leidt tot een eenduidige en efficiënte manier van zaken doen voor de leveranciers, he	On the one hand, internal government, that it leads to an efficient process. On the other hand, to the outside if it leads to a simple and efficient way of doing business for suppliers.
1	Dus ik vind juist een gebruiker moet zo min mogelijk technische competentie hebben. Dat moet juist niet	An end-user should have the least amount of technical competency, that shouldn't be the case
1	Wat willen we dan nog? Wanneer is het een succes?	What do we still want? When is it a success?
1	Want kosten zijn wel belangrijk, maar denk ik ondergeschikt aan het doel wat je wil bereiken	Costs are important, but subsidiary to the goal you wish to achieve.
1	En dat is soms wel belangrijk om iets te hebben, want als die ene dan lukt, dan kan je daardoor ook je succes communiceren,	And that is sometimes really important, because as that one works, than you can communicate your success

Continued on next page

Participant	Quote in Dutch	Quote in English
1	Dus dat die e-factuur leidt tot een efficiënte bedrijfsvoering binnen het rijk, dus dan is het meer intern gericht	So the e-invoice leads to an efficient conduct of business within the central government, so more internally focussed
1	dat is weer zo'n middel	that is again a tool
1	Maar dat probeer je juist in positieve zin he? Dus dat je als rijksvoering voorop loopt, ook wel een beetje vanuit die kernwaarden, van nou we willen wel vooroplopen	But you try that (social influence) in a positive way. So you are a pioneer as the central government, which is also reflects one of our core values
1	Dat heeft ook twee kanten, ene kant meer intern gericht van ... Maar ook naar buiten toe zie je steeds dat transparante, ..	It has two sides, one more internally focussed, ... But also more to the outside, the transparency ...
1	Maar daardoor kunnen we de wereld wat efficiënter maken	But we can make the world a bit more efficient
1	Hierachter zit dan eigenlijk die wereld van we willen het naar buiten toe, moeten effectief zijn,	Behind this is the reasoning that we want to be, to the outside, effective
2	Maar als je het echt hebt over de inhoudelijke data van die berichten, ja dat is niet ons ding	But if you are talking about the content of the data, that is not our responsibility.
2	Dat is wat wij nastreven. Dat we echt interoperabel zijn als Rijksoverheid	We strive to be. That we really are interoperable as a central government
2	Want op basis van de expertise die wij inbrengen of in de expertgroepen binnen het rijk, of dan terug in de NEN, terug in de CEN. Ja, dat is wel een groot onderdeel van ons werk	Because on the basis of the expertise we bring to the expert groups in the government, or in the NEN, or the CEN. Yes, it is a large part of our work
2	er zijn gewoon meerdere standaarden. Dit heeft ook met die interoperabiliteit te maken. Als je maar op een standaard focust, hoe interoperable ben je dan. Dus ja, belangrijk	there just are a variety of standards. This also relates to the interoperability. If you only focus on one standard, how interoperable are you. So yes, important
2	Al heb je die netwerken voor elkaar, dan zorgt het er alsnog voor dat het langzaam gaat	Even if you have the networks ready, having no standards will result in the II being slow
2	We kunnen tot op zekere hoogte de datakwaliteit te controleren	We can control the data quality to a certain extent
2	Ik zou ook wel zeggen dat we een doel op zich zou zijn dat we met meerdere open netwerken interoperable kunnen zijn.	a goal on itself would be that we can be interoperable with other open networks
2	als je puur kijkt naar onze organisatie, voor ons is het belangrijkste denk ik, dat men zich geconformeerd aan de standaarden en hoe meer ze dat doen, hoe meer een succes dat wordt	If you only look at our organisation, for us the most important is that people conform to the standards, and the more they do this, the more it becomes a success
3	uiteindelijk leveren wij informatie	In the end, we deliver information
3	Ja dat is weer iets anders wat ik bij veiligheid bedoel	that is something else then what I mean with security
3	Dat is een van onze bouwstenen van het netwerk	It is one of the building blocks of the network
3	omdat het een internationaal netwerk is	it is an international network
3	Want dat is juist marktwerving wat we willen	Because it is market forces we want.
3	Onze organisatie vind de veiligheid het belangrijkste	Our organisation values the safety and security the most

Continued on next page

Participant	Quote in Dutch	Quote in English
3	Ja, en dat maar het is niet belangrijker dan wet en regelgeving	it (the II being a future thing) is not more important than law and regulations
4	Zijn allemaal mensen inderdaad die wel heel duidelijk weten hoe het zou moeten gaan werken. En wat de noodzaak is, dus daarvoor wordt het toch wel redelijk krachtdadig mee bezig gegaan	There are people who know very clearly how it needs to work and what the necessity is. In the end it is handled effectively
4	Nou, Nederland, die zegt ja, zo van ja, moeten we het gaan verplichten? Dat pas niet binnen het liberaal economisch beleid	do we need to obligate it (e-invoicing)? It doesn't fit in the liberal economic policy
5	Ik denk dat de veiligheid ook hoog is. Dat is voor ons erg belangrijk	security, that is for use very important.
5	Maar dat is dan maar de prijs die je hebt te betalen om een ontwikkeling te maken	but that is then the price you have to pay to make that development
5	Kleinere bedrijven vinden het moeilijk om op e-facturatie over te stappen	smaller companies find it difficult to transfer onto e-invoicing
5	Omdat het echt een risico weer zit dat je dan alleen maar weer ja bezig bent met beschrijven in plaats van de inhoud	There is a real risk you are only focussing on describing instead of the content
5	zorgt dat je uiteindelijk een beter overzicht hebt in je data. Betere inzichten eruit kunt halen	it results in creating a better overview of your data. Extracting better insights
5	Ja dus eigenlijk het stukje veiligheid, betrouwbaarheid van informatie dat dat essentieel is	"Yes, so that part safety and reliability of the data is essential"
5	Komt het dan een beetje vanuit het doel wat jullie hebben? En ook de manier waarop jullie graag bedrijfsrelaties aangaan met jullie leveranciers? Ja, dat denk ik wel	Interviewer: Follows that from the goal you have? The type of business relationships you wish to have with your suppliers? Participant 5: Yes, I think so.
6	e-facturatie, voor mij is het succesvol als,.. , als die foutloos zonder interactie met onze helpdesk facturen kunnen sturen die automatisch verwerkt kunnen worden.	e-invoicing, for me it is successful when, errorless without interaction can be automatically processed
6	Het gaat wel om geld, om de efficiëntie	It is about money, about the efficiency.
6	want we willen nooit concurreren met bedrijven. Dus -3	that is irrelevant, as we never wish to compete with companies.
6	Het is niet geheel onbelangrijk, maar dit doen we ook niet. Leveranciers gaan zichzelf on-boarden	it is not totally irrelevant, but it is not something we do. Suppliers are on-boarding themselves
6	het is veel belangrijker om het gebruik terug te dringen dan op te schalen.	It is way more important to reduce our user number than to scale up
6	We hebben een bepaald budget en niet meer	We have a set budget and not anything more
6	Ja dat is dan in een keer goed	Yes, than it is immediately correct
6	Op deze manier gaat het wel in een keer goed	In this way, it is immediately correct
7	Dat is absoluut essentieel dat we met zijn allen een bepaalde richting aan gaan. ... Met ruis en vertraging als gevolg	It is absolutely essential that we all move in a certain direction. ... With noise and delays as a result
7	Da ja levert dat tijd en dus geld op	it saves time and thus money

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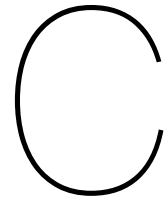
Participant	Quote in Dutch	Quote in English
7	idealiter willen wij graag natuurlijk dat ook die leveranciers hun e-facturatieproces inrichten. Want helemaal hoog over willen we niet alleen business to government, maar ook government to government en business to business en government to business.	ideally, we want that the suppliers have their own e-invoicing process. Because high-over, we do not only want B2G, but also G2G, B2B and G2B
7	dat die irrelevant is heeft te maken dat ik geen plek meer heb	that it is irrelevant has to do with there being no places left.
7	Maar dat kan alleen als je natuurlijk op een wat grotere schaal bent	But it is only possible if you are on a bigger scale
7	Ja dat is iets wat zichzelf ontwikkelt	that is something that develops themselves
7	op essentieel willen zetten omdat wij daar wel behoefte aan hebben	want to place this on essential, as we really need one
8	Ja, wel belangrijk maar we meten er geen succes aan af	It is important, but we do not measure success with it.
8	en daar (wetgeving) moet je aan voldoen. Maar daar meten we nu ons succes niet aan	you have to conform to the laws. But we do not measure our success by it
8	het liefst inderdaad een standaard die we willen verwerken	preferably, we only want one standard to process
8	Maar die standaard is wel belangrijk om die leveranciers aan te schrijven	the standard is important to register suppliers
8	En dat kan fouten veroorzaken, of extra werk, of uitval en dat is zonde. En dan neemt het succes gelijk af	Which can result in errors, or extra work, or failure, ... And then the success automatically decreases
8	Ja, dat is belangrijk. Dat is in het begin ook naar mee gekeken. Is Apro veilig genoeg	Yes, that is important. We have looked at that in the beginning, is Apro safe enough?
8	Maar het is niet iets waar je gelijk aan denkt als je het succes viert.	it is not something where you immediately think about when celebrating success
8	want het gaat immers automatisch	because it is processed automatically
8	Misschien is het wat minder belangrijk dan bij een profit-organisatie, .. Maar hij is zeker belangrijk	"it might be less important than for a profit-organisations, ..., but it is really important"
9	Die bruikbaarheid betekent voor mij dat ik die informatie automatisch kan koppelen aan mijn boekhouding.	The usability means that I can automatically connect that information to my accountancy
9	Als je een factuur ontvangt waarin bijvoorbeeld de btw-berekening niet klopt, ... dan kun je die factuur niet automatisch verwerken in je factuurmatching. ... Dat kost tijd - en tijd is geld	If you for example receive an invoice where the VAT calculation is wrong, ..., then you cannot automatically process the invoice, ..., which costs time, and time is money
9	We verstrekken vaak prive-informatie. ... Data privacy en data security zijn daarom altijd van cruciaal belang	We often provide private information, ... Data privacy and security are of crucial importance
9	managen van damage control	the management of damage control
9	En hoe lager je factuurvolume is, hoe hoger de kosten per factuur relatief worden	how smaller your invoicing volume, how higher the relative costs per invoice will be
9	een gereguleerd onboarding-proces, met gidsen en trainingen - die bestaan simpelweg niet	regular on-boarding processes, they simply do not exist.

Continued on next page

Participant	Quote in Dutch	Quote in English
9	het onderhouden van standaarden is voor mij niet interessant, dat ligt bij externe organisaties	the management of the standards is not interesting for me, that is the task of external organisations
9	Al de e-facturatie werkt en voldoet aan de standaard, dan is er eigenlijk niet meer te verbeteren.	If the e-invoicing works and adheres to the standard, than there is little to improve
9	Je bouwt een systeem en je moet er ook voor zorgen dat het ondersteund wordt	You build a system and you need to ensure that it is supported
9	Als de systemen niet goed interoperabel zijn, dan kan ik versturen wat ik wil - maar dan kan de klant het alsnog niet verwerken. Dat is cruciaal	"If the systems are not interoperable, I can send what I wish, but the client is not able to process it. That is crucial"
10	Het is niet iets waar we dagelijks mee bezig zijn	It is not something we do on a daily basis
10	het vooral waarde heeft als andere mensen het ook doen.	it (the II) mostly has value when other people also use it
10	dat maakt het voor ons ook weer makkelijker om hun te stimuleren om Peppol te gebruiken. ... Dan is de informatie betrouwbaarder in de administratie en kunnen wij ook weer meer automatiseren	it makes it easier for us to stimulate them to use Peppol. ... Than the information is more reliable in the administration and we can automate more.
10	de missie van onze organisatie sluit hier mooi op aan	The mission of our organisation nicely aligns
11	Neutraal. Wij moeten aan standaarden voldoen en daar houden we ons ook aan, dat is gewoon geregeld	Neutral. We need to conform to the standards and that is that
11	Voor ons is het kostenverschil tussen een e-factuur en een PDF verwaarloosbaar	for us, the difference in costs between an e-invoice and PDF is negligible.
11	Dat is wat mij betreft een uitgangspunt van de II: dat het voor iedereen toegankelijk moet zijn	the starting point of the II, should be that it is accessible for everyone
11	Wij garanderen onze klanten dat de factuur, of het nou een PDF is of een Peppol, altijd 100% goed wordt gedigitaliseerd	We guarantee our clients, that the invoice, whether it be PDF or Peppol, will always be 100% digitalised
11	En dat is voor ons gewoon het belangrijkste, want wij geven een bepaalde garantie op die datakwaliteit	That is for us the most important, we guarantee that data quality
12	Maar ook al heb je bij iedere factuur maar twee veldjes van de 100 fout. Dan moet zo'n medewerker moet alsnog door al die veldjes heen, want hij vertrouwt het niet	even if there are two wrong data fields, the employee has to go through the whole document, as he doesn't trust it
12	uiteindelijk draait het om geld	In the end, it is about money
12	het gebruik van het infrastructuur stijgt op alle vlakken en wij moeten het toenemende volume aankunnen	the use of the infrastructure increases and we need to be able to handle the volumes
12	het is heel simpel als de infrastructuur niet functioneert, functioneert de medewerker misschien niet, hebben we uiteindelijk geen klanten	it is very simple if the infrastructure does not function, the employee might not function, and in the end we don't have any clients

Continued on next page

Participant	Quote in Dutch	Quote in English
13	als de informatie niet nauwkeurig is, heb je niets aan het systeem	If the information is not accurate, there is no benefit to the system
13	Met veel leveranciers kun je echt tijd en geld besparen	With a lot of suppliers, you can really save time and money
13	Als de systemen tussen leverancier en ons niet goed communiceren, dan gaat het mis	If the systems between the supplier and us do not communicate correctly, then it goes wrong
14	Nou, in principe by elektronisch factureren klopt 100% van de data	In principal, with e-invoicing a 100% of the data should be correct
14	als een factuur automatisch verwerkt worden. Nou dan heb je minder personeel nodig	if an invoice is automatically processed. Well, you need less employees
14	namelijk effectiviteit. Dat levert geld op	namely effectiveness. That delivers money



Exploratory interview with a Service Provider

C.1. Summary of an exploratory interview with a service provider in the e-procurement

Standaard voordat Peppol er was: Voordat Peppol er was, was er een standaard EDI, daarbij gingen mensen gegevens uitwisselen, en zorgde ervoor dat mensen in elkaars systemen konden kijken. Mensen konden factureren etc. EDI is nooit van de grond gekomen, ondanks dat er veel aandacht voor was. Dit is niet van de grond gekomen omdat er geen universele standaard was. Ondanks dat partij 1 gebruikt maakt van EDI en partij 2 ook, betekende het niet dat de systemen met elkaar konden praten. Hierdoor waren er veel implementatie kosten en was het ingewikkeld. Door de complexiteit waren er consultants nodig. EDI was vanuit de markt opgezet en er waren wel grote bedrijven over gegaan. Maar het waren wel eilanden. Dus pas als je voldoende marktkracht had konden er leveranciers onboard komen.

Peppol: Voordeel van Peppol is dat je zelf kan besluiten om je te registreren en vervolgens kan je naar meerdere partijen sturen (verbinding waar je van 1 naar alles kan gaan) = interoperabiliteit. Hiernaast zijn er nog 1 op 1 verbindingen, dit is een handelsrelatie die je in het systeem zelf moet vast leggen. Deze 1-op-1 verbindingen zijn: Arriba, Tungsten, Cuba. Deze verbindingen zijn wel concurrenten (alternatieve netwerken). Maar via Arriba verzenden sluit niet het gebruik van Peppol uit. Je ziet wel dat de markt zich richting Peppol beweegt. Wij kunnen ook via Arriba verzenden, eerst checken wij of dat het bedrijf op Peppol zit, als dit niet het geval is kijken ze naar een aansluiting via Arriba. De aansluiting van Peppol is gratis en reken je per transactie af.

De volgende stakeholders zijn aanwezig, volgens het 5 corner model. VIDA is CTC (continuous transaction controls) en zal corner 5 worden.

Corner 1:

- Verzender
- Boekhoudpakket leverancier: belemmerende factor voor de Peppol service provider

Corner 2:

- Service provider met access point aan het peppol netwerk en de verzender (weet dat de factuur is afgeleverd)
- Standaard zettters (Peppol (doet peppol organisatie) en de NLCIUS (doet logius))

Corner 3:

- Service provider met access point aan het peppol netwerk en de ontvanger
- Standaard zettters

Corner 4:

- Ontvanger
- Boekhoudpakket leverancier

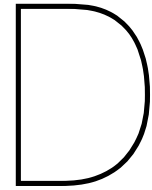
Europese unie als stakeholder omdat ze de regelgeving rondom e-facturatie neerzetten. Andere EU landen, zoals Italië en Spanje, hebben een groter gat van hun belasting inkomsten (VIDA). De e-facturatie zelf bespaart miljoenen kosten omdat factureren geautomatiseerd wordt. ERP kunnen vaak niet een bepaalde type data file maken, welke nodig is voor de e-facturatie. Het is wat lastiger XML maken, de ERP's hebben hier ook moeite mee. Een XML kan je valideren met een XSD, die worden uitgegeven door Peppol. Het gaat vaak fout bij de XSD, de XSD geeft aan dat het een valide e-factuur is. XSD geeft aan dat de tekst in de XML file op de juiste plek staat en wat voor tekst er in mag zitten. De XSD zorgt voor de interoperabiliteit, omdat door de XSD weet je dat het een valide e-factuur is, en dat het systeem het kan lezen. Verzender moet zorgen dat de peppol service provider een valide XML krijgt, dus ook de XSD aanleveren. Boekhoudsoftware geeft een bepaalde XML file aan, maar dat is niet de XML file wat de serviceprovider wil.

Table C.1: Overview of the different standards which can be found in the Dutch e-invoicing II (Exploratory interview participant with a service provider)

Naam Standaard	Functie	Waarvoor verplicht
XML	e-factuur in bepaald format ipv pdf	Meest basis vorm van e-factuur
UBL	e-factuur met afspraken waar data staat, specifiek dan XML	
PeppolBISv3	Data standaard voor e-factuur voor via Peppol versturen. Veel afspraken waar wat moet staan	Peppol
NLCIUS (=SI-UBL2)	Nederlandse data standaard voor e-facturen. Minder streng dan de PeppolBISv3, maar je hebt wel het kvk nummer dat verplicht is	Nederlandse specificering van de Europese EN16931 norm
Rijksfactuur	Data standaard gebaseerd op de NLCIUS maar dan strenger	E-facturen naar de overheid

Daarbovenop heb je ook de XSLT, wat aangeeft wat de waarde is die erin mag staan. Dus op sommige velden mogen getallen, andere velden tekst. De peppol serviceprovider levert de XSLT aan. De XSLT is ook verplicht voor versturen via Peppol, maar de verzender's boekhoudpakket levert dit nog niet automatisch (of überhaupt niet) aan. Veel informatie beschikbaar over wat Peppol zijn afspraken zijn, waar de berichtenstandaard aan moet voldoen (de NLCIUS/ PeppolBISv3). Omdat er bepaalde velden in kunnen staan (zoals notities) en deze niet verplicht is, weten mensen niet precies in welk veld ze het moeten invullen. Doordat de verzender het niet precies goed invult, moet dit weer gewijzigd worden. De verzender kan een UBL aanleveren, dit is niet de juiste datastandaard, dat zou de PeppolBISv3 moeten zijn. Velden in het UBL mogen niet in de PeppolBISv3. De serviceprovider kan dan het bestand (de e-factuur) weigeren, maar bij bepaalde klanten veranderen ze dit zelf. Boekhoudpakketten willen steeds meer dat ze zelf een accesspoint op Peppol hebben. Maar boekhoudpakketten zijn niet van het veranderen, ze hebben eigen belangen zoals de scan en herken die ze proberen te behartigen. Om dan over te gaan op peppol snijden ze in hun eigen vinger. Maar door de toegenomen vraag gaan ze nu wel over op peppol/e-factuur. Als je wil verzenden naar een partij in het buitenland, wat wel op Peppol zit, kan je alleen de peppolbisv3 sturen, en niet de NLCIUS, want dat is de nederlandse norm van de Europese wetgeving. De transformatie van NLCIUS naar PeppolBISv3 kan, maar is wel moeilijk, omdat het veel tijd kost want de benaming van de velden is anders en de structuur ook. Dit is onhandig en er kan beter 1 data standaard komen. Taak aan de rijksoverheid om niet ook nog een eigen standaard te hebben, maar die afspraken die wel in de NLCIUS (zoals kvk nummer) ook op te nemen in de PeppolBISv3. Bij de rijksoverheid mist er kennis over Peppol, maar er is nu meer animo voor om de kennis te vergaren en het beter te laten werken. Overheid heeft gezegd tegen bedrijven van oh als jullie iets willen aanpassen, doe dat zelf maar. Maar bedrijven vinden dit juist de taak van de overheid om issues te verbeteren, naar een standaard. De markt (beroepsgroep) kan "invloed"

hebben op de data standaarden door klachten/comments achter te laten op een overheids websites. Serviceprovider heeft contact met de rijksoverheid en geven ze ook advies vanuit hun markt perspectief. Serviceprovider krijgt betaalt per transactie in het Peppol netwerk. Voor de serviceprovider is hoe complexer hoe beter, want dan kunnen ze transformaties uitvoeren waar ze geld op verdienen. Serviceprovider wil zoveel mogelijk standardiseren, dus als het kan een type bericht standaard. Maar als de klant er het juiste bedrag voor wil betalen dan kunnen ze een type data format omzetten naar het bestand wat het boekhoudprogramma kan gebruiken. Standaard is overheid, als je het bij de Peppol-BISv3 is het via een organisatie, daar kan je een Request for Change indienen vanuit de lidstaten. Kan soms voorkomen, dat een klant niet het e-factuur heeft ontvangen, maar dat zijn serviceprovider wel heeft ondertekend dat het is afgeleverd aan de klant. De klant neemt dan contact op met de leverancier. Dan moet de klant contact opnemen met zijn serviceprovider (corner 3), want die heeft wel gezegd dat het bericht is afgeleverd. Kwaliteit in het Peppol net doordat het bestand tussen corner 2 en 3 eisen heeft. Als het bestand niet aan de eisen voldoet, wordt dit bij de NPa gemeld en dit zorgt ervoor dat de kwaliteit in het netwerk wordt gewaarborgd en alle partijen aan de eisen voldoen. Als je wil handelen tussen andere partijen in Europa heb je te maken met andere regelgeving. Als je op Peppol bent aangesloten, maakt het niet uit naar wie je factureert, het komt goed. Omdat er een type berichtenstandaard is wie iedereen kan lezen en ontvangen, dus je hoeft niet moeilijk te doen.



Quantitative Data Analysis

D.1. Scree Plot

The R analysis resulted in the following scree plot, where the elbow point was determined to be at 2 factors, see Figure D.1.

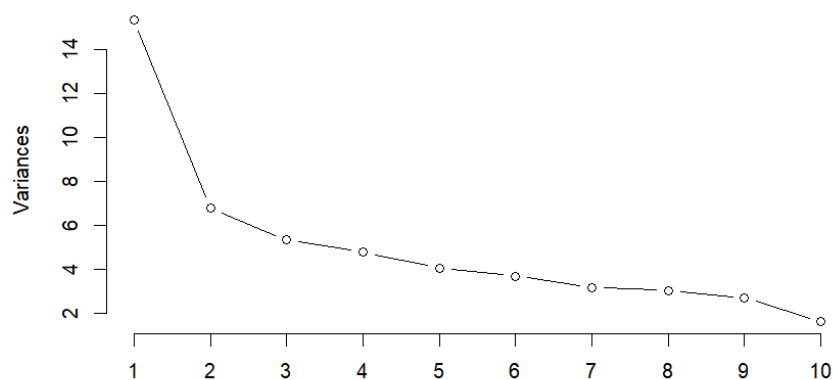


Figure D.1: Elbow Plot of the ideal number of factors for the Q-sort analysis

D.2. Correlation Matrix

The R analysis resulted in the following correlation matrix, see Table D.1.

D.3. Flagged Participants per Factor

The following figure, see Figure D.2, shows the flagged participants for each factor. When a participant is flagged, the participants shares that factors common viewpoint. Note that participant 10's Q-sort data was not used, as there were too many missing values. Therefore, participant 10 in the figure, is in reality participant 11.

Table D.1: Correlation matrix of the Q-sorts of the participants

Participant / Participant	1	2	3	4	5	6	7	8	9	10	11	12	13
1	NA	0.090	0.410	0.040	0.305	0.245	0.480	0.175	0.210	0.270	0.220	0.010	0.230
2	0.090	NA	0.230	0.280	0.045	0.065	0.140	0.040	0.090	-0.005	0.015	0.080	0.375
3	0.410	0.230	NA	0.140	0.560	0.210	0.200	0.145	0.350	0.240	0.270	0.210	0.495
4	0.040	0.280	0.140	NA	0.115	-0.015	0.135	0.355	0.170	0.120	0.010	0.110	0.265
5	0.305	0.045	0.560	0.115	NA	0.430	0.145	0.180	0.420	0.315	0.260	0.235	0.500
6	0.245	0.065	0.210	-0.015	0.430	NA	-0.005	0.065	0.300	0.280	0.220	0.265	0.325
7	0.480	0.140	0.200	0.135	0.145	-0.005	NA	0.325	0.025	-0.200	0.030	-0.045	0.255
8	0.175	0.040	0.145	0.355	0.180	0.065	0.325	NA	0.000	0.195	0.260	0.130	0.365
9	0.210	0.090	0.350	0.170	0.420	0.300	0.025	0.000	NA	0.165	0.445	0.095	0.445
10	0.270	-0.005	0.240	0.120	0.315	0.280	-0.200	0.195	0.165	NA	0.325	0.120	0.200
11	0.220	0.015	0.270	0.010	0.260	0.220	0.030	0.260	0.445	0.325	NA	0.175	0.310
12	0.010	0.080	0.210	0.110	0.235	0.265	-0.045	0.130	0.090	0.120	0.175	NA	0.210
13	0.230	0.375	0.495	0.265	0.500	0.325	0.255	0.365	0.445	0.200	0.310	0.210	NA

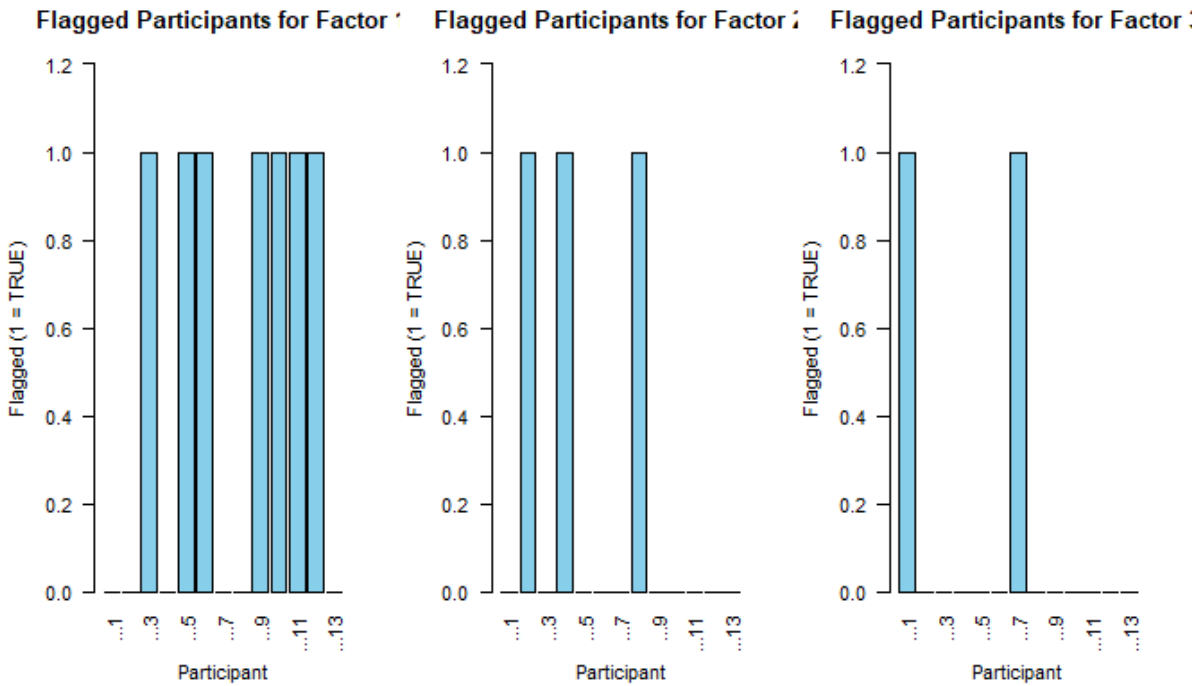
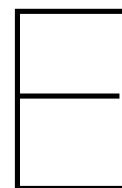
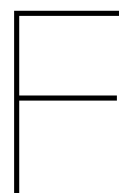


Figure D.2: Flagged participants for each factor.



Reflection on Artificial Intelligence Usage

Throughout this thesis, artificial intelligence (AI) chatbots were used for two main objectives. The first objective was the coding related to the quantitative data analysis of the Q-sort. The basis for the coding in R, were the business analytics course and the package by Zabala (2014). But, AI chatbots, mainly ChatGPT and Gemini were asked to develop histograms and other plots to visualise the data. While most of these plots were not used in the final document, they helped this thesis's researcher to better understand the data. For example, the z-score plot was generated with the help of both ChatGPT and Gemini. The second objective was asking ChatGPT for help related to the layouts of the tables used throughout this thesis. The tables were originally created in Excel, then transferred to a latex tex format, with Latex table generators. However, for most of the tables, the layout was too wide to fit the page. Therefore, ChatGPT was asked to change the layout so the table fitted on the page. Additionally, ChatGPT was asked for advice. Such as listing academic resources related to a certain idea the researcher had. Then, the researcher checked the sources whether the information was indeed present. Or help explain the difference between certain methods, such as between PCA and centroid, for the Q-sort analysis. Lastly, ChatGPT had a supportive role in finding synonyms, or finding a single word for a couple of words and occasionally help in rewriting pieces of text. The researcher checked the input of ChatGPT and when the input was used, rewrote in her own words.



R code for the Q-sort analysis

Q-sort

2025-05-01

Loading Packages

```
# install the packages used in this thesis
packages <- c("apaTables", "cluster", "ggplot2", "factoextra", "gmodels", "NbClust", "qsort", "readxl",
              "qmethod", "ggrepel", "tinytex")

tinytex::install_tinytex(force = TRUE)
```

```
## tlmgr --repository http://www.preining.info/tlgpg/ install tlgpg
```

```
## tlmgr option repository "https://mirror.koddos.net/CTAN/systems/texlive/tlnet"
```

```
## tlmgr update --list
```

```
for (i in packages){
  if(!require(i, character.only = TRUE)) {
    install.packages(i, dependencies = TRUE)
  }
}
```

```
## Loading required package: apaTables
```

```
## Warning: package 'apaTables' was built under R version 4.4.2
```

```
## Loading required package: cluster
```

```
## Loading required package: ggplot2
```

```
## Loading required package: factoextra
```

```
## Warning: package 'factoextra' was built under R version 4.4.2
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
## Loading required package: gmodels
```

```
## Warning: package 'gmodels' was built under R version 4.4.2
```

```
## Loading required package: NbClust
```

```

## Loading required package: qsort

## Warning: package 'qsort' was built under R version 4.4.3

## Loading required package: readxl

## Warning: package 'readxl' was built under R version 4.4.2

## Loading required package: qmethod

## Warning: package 'qmethod' was built under R version 4.4.3

##
## This is 'qmethod' v.1.8.4.
##
## Please cite as:
## Zabala, A. (2014) qmethod: A Package to Explore Human Perspectives Using Q Methodology. The R Journal

## Loading required package: ggrepel

## Loading required package: tinytex

library(qmethod) #Calling to the qsort package
library(factoextra)
library(NbClust)
library(ggplot2)
library(ggrepel)
library(factoextra)
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

library(tidyr)

```

Load the dataset into R

```

library(readxl)

# Import the dataset
df <- read_excel("qsort.xlsx", col_names = FALSE)

```

```
## New names:
## * ' -> '...1'
## * ' -> '...2'
## * ' -> '...3'
## * ' -> '...4'
## * ' -> '...5'
## * ' -> '...6'
## * ' -> '...7'
## * ' -> '...8'
## * ' -> '...9'
## * ' -> '...10'
## * ' -> '...11'
## * ' -> '...12'
## * ' -> '...13'
```

```
# Check whether the dataset is a tibble
class(df)
```

```
## [1] "tbl_df"      "tbl"        "data.frame"
```

```
# Convert a tibble to a regular dataframe
df <- as.data.frame(df)
```

Correlations

Next, the correlations between the participants are checked. So, the Qsort is the entire vector (number range) of the participants sorting of all the statements. Then the correlation is calculated between how well participants 1 Qsort (so all the rankings over all the 49 measures) aligns with that of participants 2 Qsort. So for example, the correlation between participant 4 (column) and participant 7(row) is 0.135. This indicates that there is little to no correlation between their viewpoints (the way they sorted all the 49 measures). But for example, participant 5 and 3 show a correlation of 0.56. This is the highest correlation between the Qsorts of the participants. This correlation indicates that they show a quite similar pattern for their viewpoints. The lowest correlation is between participants 11 and 7 (note that participant 10 was removed from the dataset, so participant 10 is actually participant 11). This correlation is -0.2, which indicates that these participants disagree to some extent on their viewpoints.

```
# Default correlation method is Pearson for Qsort
cor_matrix <- cor(df)
```

```
# Explore the correlations between the participants
```

```
## Remove the 1 (diagonal) as the participants are always perfectly correlated with themselves
diag(cor_matrix) <- NA
print(cor_matrix)
```

```
##      ...1  ...2  ...3  ...4  ...5  ...6  ...7  ...8  ...9  ...10 ...11
## ...1    NA  0.090  0.410  0.040  0.305  0.245  0.480  0.175  0.210  0.270  0.220
## ...2  0.090    NA  0.230  0.280  0.045  0.065  0.140  0.040  0.090 -0.005  0.015
## ...3  0.410  0.230    NA  0.140  0.560  0.210  0.200  0.145  0.350  0.240  0.270
## ...4  0.040  0.280  0.140    NA  0.115 -0.015  0.135  0.355  0.170  0.120  0.010
## ...5  0.305  0.045  0.560  0.115    NA  0.430  0.145  0.180  0.420  0.315  0.260
## ...6  0.245  0.065  0.210 -0.015  0.430    NA -0.005  0.065  0.300  0.280  0.220
```

```
## ...7  0.480  0.140 0.200  0.135 0.145 -0.005      NA 0.325 0.025 -0.200 0.030
## ...8  0.175  0.040 0.145  0.355 0.180  0.065   0.325      NA 0.000  0.195 0.260
## ...9  0.210  0.090 0.350  0.170 0.420  0.300   0.025 0.000      NA 0.165 0.445
## ...10 0.270 -0.005 0.240  0.120 0.315  0.280 -0.200 0.195 0.165      NA 0.325
## ...11 0.220  0.015 0.270  0.010 0.260  0.220  0.030 0.260 0.445  0.325      NA
## ...12 0.010  0.080 0.210  0.110 0.235  0.265 -0.045 0.130 0.095  0.120 0.175
## ...13 0.230  0.375 0.495  0.265 0.500  0.325  0.255 0.365 0.445  0.200 0.310
##      ...12 ...13
## ...1  0.010 0.230
## ...2  0.080 0.375
## ...3  0.210 0.495
## ...4  0.110 0.265
## ...5  0.235 0.500
## ...6  0.265 0.325
## ...7 -0.045 0.255
## ...8  0.130 0.365
## ...9  0.095 0.445
## ...10 0.120 0.200
## ...11 0.175 0.310
## ...12      NA 0.210
## ...13 0.210      NA

## Find the position of the maximum correlation
max_cor_value <- max(cor_matrix, na.rm = TRUE)
max_cor_position <- which(cor_matrix == max_cor_value, arr.ind = TRUE)

# Find the position for the minimum correlation
min_cor_value <- min(cor_matrix, na.rm = TRUE)
min_cor_position <- which(cor_matrix == min_cor_value, arr.ind = TRUE)

# Output results
cat("Highest Correlation: ", max_cor_value, "\n", "At positions: ", max_cor_position, "\n")

## Highest Correlation:  0.56
## At positions:  5 3 3 5

cat("Lowest Correlation: ", min_cor_value, "\n", "At positions: ", min_cor_position, "\n")

## Lowest Correlation: -0.2
## At positions:  10 7 7 10
```

Then, the factor loadings are explored with the default settings, to explore how many factors would be relevant to explain the variance in the dataset. Note that on average for the Q-sort, it is preferable that the factors explain around 50 to 60% of the variance. ## Explore the factor loadings with the default settings (PCA and varimax)

```
# Run the qmethod analysis and place the results in the dataframe
results_pca <- qmethod(df, nfactors = 3) #Change the nfactors to see which number of factors is most re

## Q-method analysis.
## Finished on:          Tue Jun 17 10:38:43 2025
## 'qmethod' package version: 1.8.4
```

```
## Original data:          49 statements, 13 Q-sorts
## Forced distribution:    TRUE
## Number of factors:     3
## Extraction:            PCA
## Rotation:              varimax
## Flagging:              automatic
## Correlation coefficient: pearson
```

```
# Look at the factor loadings
round(results_pca$loa, digits = 2)
```

```
##          f1    f2    f3
## ...1  0.35 -0.04  0.76
## ...2  0.02  0.64  0.03
## ...3  0.57  0.25  0.36
## ...4  0.01  0.78 -0.05
## ...5  0.72  0.13  0.24
## ...6  0.65 -0.04  0.01
## ...7 -0.13  0.26  0.85
## ...8  0.12  0.54  0.28
## ...9  0.64  0.11  0.07
## ...10 0.60  0.00 -0.10
## ...11 0.61  0.03  0.08
## ...12 0.40  0.28 -0.27
## ...13 0.53  0.56  0.23
```

```
# See the flagged q-sorts: those indicating TRUE
results_pca$flag
```

```
##      flag_f1 flag_f2 flag_f3
## ...1   FALSE   FALSE   TRUE
## ...2   FALSE   TRUE   FALSE
## ...3    TRUE   FALSE   FALSE
## ...4   FALSE   TRUE   FALSE
## ...5    TRUE   FALSE   FALSE
## ...6    TRUE   FALSE   FALSE
## ...7   FALSE   FALSE   TRUE
## ...8   FALSE   TRUE   FALSE
## ...9    TRUE   FALSE   FALSE
## ...10   TRUE   FALSE   FALSE
## ...11   TRUE   FALSE   FALSE
## ...12   TRUE   FALSE   FALSE
## ...13   FALSE   FALSE   FALSE
```

```
# Print the table of factor loadings with an indication of flags
loa.and.flags(results_pca)
```

```
##      fg1    f1 fg2    f2 fg3    f3
## ...1    0.35   -0.04 *  0.76
## ...2    0.02   *  0.64    0.03
## ...3   *  0.57    0.25    0.36
## ...4    0.01   *  0.78   -0.05
```

```
## ...5 * 0.72 0.13 0.24
## ...6 * 0.65 -0.04 0.01
## ...7 -0.13 0.26 * 0.85
## ...8 0.12 * 0.54 0.28
## ...9 * 0.64 0.11 0.07
## ...10 * 0.60 0.00 -0.10
## ...11 * 0.61 0.03 0.08
## ...12 * 0.40 0.28 -0.27
## ...13 0.53 0.56 0.23
```

```
str(results_pca, max.level = 2)
```

```
## List of 8
## $ brief :List of 11
## ..$ date : chr "Tue Jun 17 10:38:43 2025"
## ..$ pkg.version:Classes 'package_version', 'numeric_version' hidden list of 1
## ..$ nstat : int 49
## ..$ nqsorts : int 13
## ..$ distro : logi TRUE
## ..$ nfactors : num 3
## ..$ extraction : chr "PCA"
## ..$ rotation : chr "varimax"
## ..$ cor.method : chr "pearson"
## ..$ info : chr [1:10] "Q-method analysis." "Finished on: Tue Jun 17 10:38:43 2025"
## ..$ flagging : chr "automatic"
## $ dataset:'data.frame': 49 obs. of 13 variables:
## ..$ ...1 : num [1:49] 0 4 2 -1 0 1 0 3 1 4 ...
## ..$ ...2 : num [1:49] 0 0 0 1 -2 1 2 2 2 0 ...
## ..$ ...3 : num [1:49] 2 2 0 1 -2 1 0 0 0 1 ...
## ..$ ...4 : num [1:49] 4 1 2 3 -2 1 0 0 0 -1 ...
## ..$ ...5 : num [1:49] 2 3 3 1 -3 1 -1 -3 -3 3 ...
## ..$ ...6 : num [1:49] 0 3 -1 -2 -4 2 1 -4 1 4 ...
## ..$ ...7 : num [1:49] -1 3 3 0 1 3 1 0 -2 1 ...
## ..$ ...8 : num [1:49] 3 4 4 -1 -1 1 1 -4 0 1 ...
## ..$ ...9 : num [1:49] 3 -1 2 -2 2 1 0 -1 0 1 ...
## ..$ ...10: num [1:49] 3 3 4 -3 -4 -4 -3 2 0 1 ...
## ..$ ...11: num [1:49] 3 1 3 -3 -2 0 1 1 -1 0 ...
## ..$ ...12: num [1:49] 0 4 -3 3 -1 0 4 0 2 2 ...
## ..$ ...13: num [1:49] 1 1 2 -4 -4 0 2 -3 0 2 ...
## $ loa : num [1:13, 1:3] 0.34582 0.01501 0.57307 0.00975 0.7191 ...
## ..- attr(*, "dimnames")=List of 2
## $ flagged: logi [1:13, 1:3] FALSE FALSE TRUE FALSE TRUE TRUE ...
## ..- attr(*, "dimnames")=List of 2
## $ zsc : num [1:49, 1:3] 1.496 1.548 1.177 -0.707 -1.609 ...
## ..- attr(*, "dimnames")=List of 2
## $ zsc_n : num [1:49, 1:3] 2 3 2 -1 -3 1 0 -2 -1 2 ...
## ..- attr(*, "dimnames")=List of 2
## $ f_char :List of 3
## ..$ characteristics:'data.frame': 3 obs. of 6 variables:
## ..$ cor_zsc : num [1:3, 1:3] 1 0.197 0.208 0.197 1 ...
## ..- attr(*, "dimnames")=List of 2
## ..$ sd_dif : num [1:3, 1:3] 0.263 0.334 0.382 0.334 0.392 ...
## ..- attr(*, "dimnames")=List of 2
## $ qdc : 'data.frame': 49 obs. of 7 variables:
```

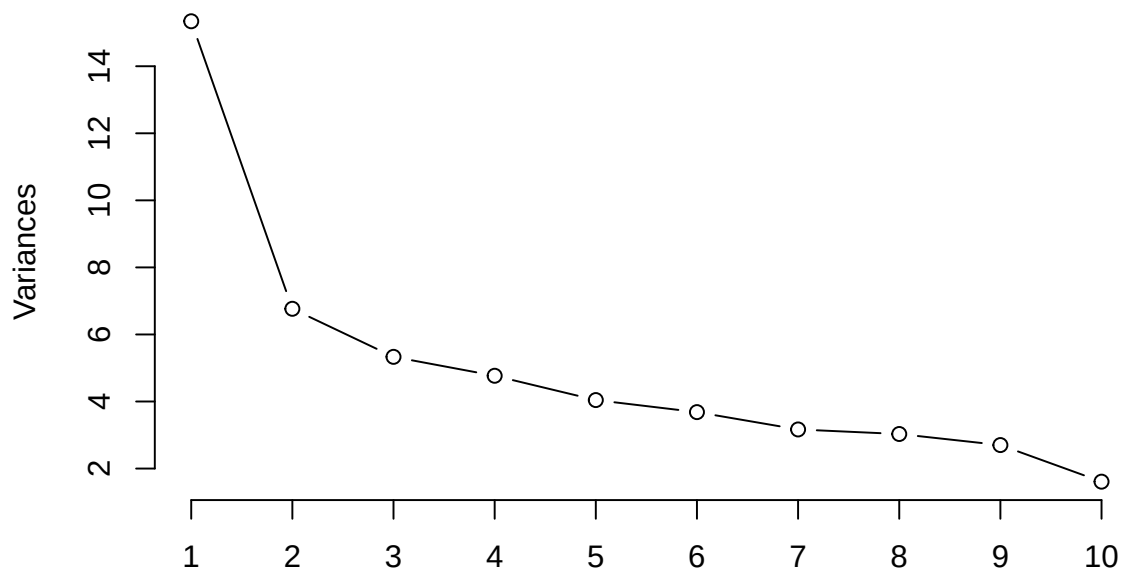
```
## ..$ dist.and.cons: chr [1:49] "Distinguishes f3 only" "Distinguishes f2 only" "Consensus" "Disting
## ..$ f1_f2 : num [1:49] -0.269 0.684 -0.0311 -1.7947 -0.4168 ...
## ..$ sig_f1_f2 : chr [1:49] "" "*" "" "6*" ...
## ..$ f1_f3 : num [1:49] 1.848 -0.352 -0.302 -0.496 -1.962 ...
## ..$ sig_f1_f3 : chr [1:49] "****" "" "" "" ...
## ..$ f2_f3 : num [1:49] 2.117 -1.036 -0.271 1.299 -1.545 ...
## ..$ sig_f2_f3 : chr [1:49] "****" "*" "" "**" ...
## - attr(*, "class")= chr "QmethodRes"
```

Another tool to help determine the ideal number of factors is the scree plot, which shows an elbowpoint at the ideal number of factors.

```
results_pca$f_char$characteristics
```

```
## av_rel_coef nload eigenvals expl_var reliability se_fscores
## f1 0.8 7 3.015360 23.19507 0.9655172 0.1856953
## f2 0.8 3 1.857762 14.29048 0.9230769 0.2773501
## f3 0.8 2 1.712028 13.16945 0.8888889 0.3333333
```

```
screeplot(prcomp(df), main = "",
          type = "lines")
```



While the scree plot shows that the optimal number of factors is 2, the explained variance for three factors is 50%, which is around the preferred value for Q-sort. Therefore, it was chosen to continue with 3 factors. The results from using 3 factors suggests that there are three distinct viewpoints. As some of the participants

have a high correlation (>0.5) with the factors. Therefore, factor 3 might also explain a viewpoint shared by participants and will be taken into account.

```
# Get the flagging matrix
flags <- results_pca$flag

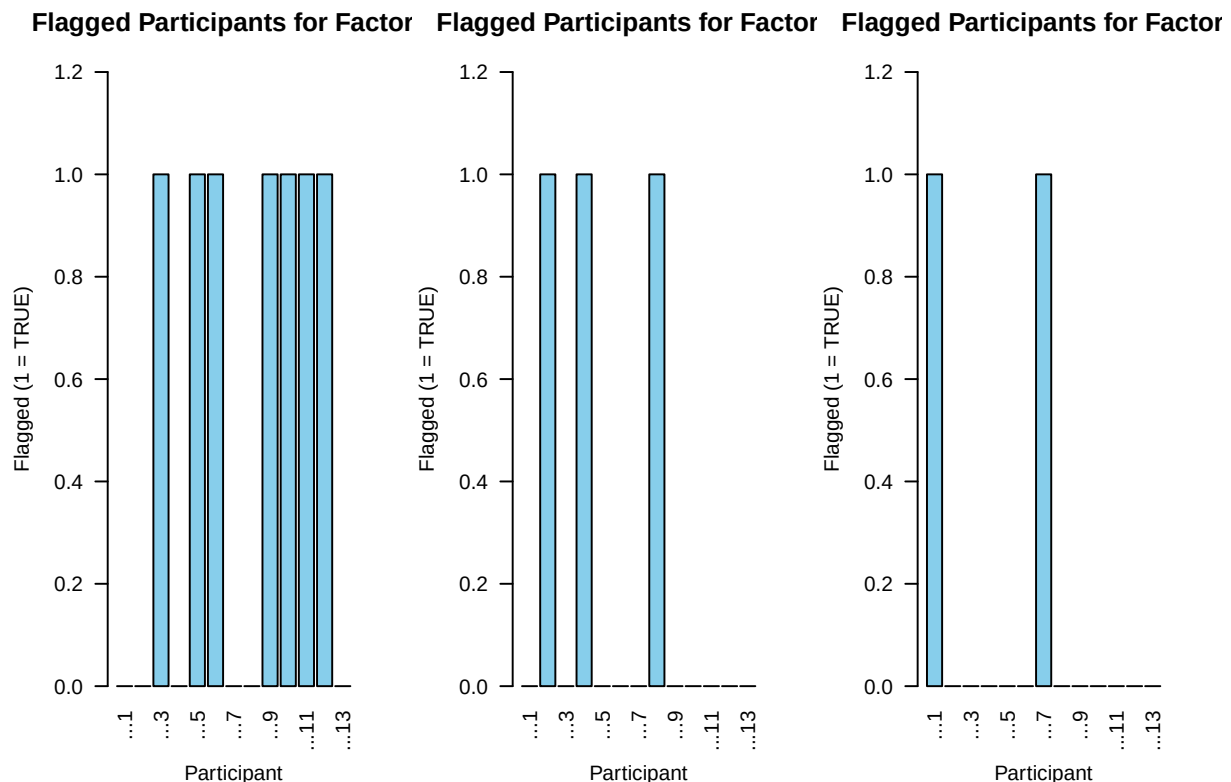
# Get participant (Q-sort) names
participant_ids <- rownames(flags)

# Set up plotting window: 3 plots side by side
par(mfrow = c(1, 3)) # Change to c(3, 1) for vertical layout

# Loop through each factor
for (i in 1:ncol(flags)) {
  # Logical vector: TRUE if participant was flagged for this factor
  flagged <- flags[, i]

  # Convert to numeric for plotting (TRUE = 1, FALSE = 0)
  flagged_numeric <- as.numeric(flagged)

  # Plot barplot
  barplot(
    flagged_numeric,
    names.arg = participant_ids,
    las = 2,
    col = ifelse(flagged, "skyblue", "lightgrey"),
    ylim = c(0, 1.2),
    main = paste("Flagged Participants for Factor", i),
    ylab = "Flagged (1 = TRUE)",
    xlab = "Participant"
  )
}
```

```
# Reset plot layout
par(mfrow = c(1, 1))
```

As the plots show, factor 1 was flagged the most by the participants. This indicates that most participants align with the viewpoint of factor 1.

An alternative analysis can be run, with a centroid approach. However, the alternative analysis does not give additional insights or prominent differing patterns than with the PCA analysis. Therefore the PCA analysis with the rotation varimax was used. Also, PCA is nowadays the most used method for Q-sort.

```
# Run alternative (original) Qsort analysis which allows for a more interpretative results
#results_centroid <- qmethod(df, nfactors = 2, extraction = "centroid", rotation = "varimax")

# See the factor loadings
#round(results_centroid$loa, digits = 2)

# See the flagged qsorts: those indicating TRUE
#results_centroid$flag

# Print the table of factor loadings with an indication of flags
#loa.and.flags(results_centroid)
```

Results

```
# Explore the results
summary(results_pca)

## Q-method analysis.
## Finished on:          Tue Jun 17 10:38:43 2025
## 'qmethod' package version: 1.8.4
## Original data:        49 statements, 13 Q-sorts
## Forced distribution:   TRUE
## Number of factors:     3
## Extraction:           PCA
## Rotation:             varimax
## Flagging:             automatic
## Correlation coefficient: pearson
##
## Factor scores
##      fsc_f1 fsc_f2 fsc_f3
## 1         2      4     -1
## 2         3      2      4
## 3         2      3      3
## 4        -1      2      0
## 5        -3     -3      1
## 6         1      1      3
## 7         0      1      1
## 8        -2     -1      1
## 9        -1      1     -1
## 10        2     -1      2
## 11         0     -1      0
## 12         1      3     -2
## 13         3      2      0
## 14         1      3      2
## 15        -1      1      1
## 16         1      1      0
## 17         0     -1     -4
## 18         2      1      2
## 19         1     -3      0
## 20         2      0      0
## 21        -2      0     -1
## 22         4      0      1
## 23         3      0      0
## 24        -1      2      2
## 25         0     -1      1
## 26        -1      2     -1
## 27        -1      3      2
## 28         0     -2      2
## 29         0      0     -3
## 30        -2     -1      4
## 31        -4     -2     -1
## 32        -2      0     -3
## 33        -2      2      3
## 34         0     -1     -1
## 35        -3     -2      1
```

```

## 36      2      -2      -2
## 37      1       0      -1
## 38     -1       4      -2
## 39     -3      -2      -2
## 40      4      -4       1
## 41      3      -3       0
## 42     -1       0       3
## 43     -3      -3       0
## 44      1       0      -1
## 45      0      -2      -2
## 46     -2      -1      -2
## 47     -4      -4      -4
## 48      0       0      -3
## 49      1       1      -3
##
##                               f1    f2    f3
## Average reliability coefficient  0.80  0.80  0.80
## Number of loading Q-sorts      7.00  3.00  2.00
## Eigenvalues                    3.02  1.86  1.71
## Percentage of explained variance 23.20 14.29 13.17
## Composite reliability           0.97  0.92  0.89
## Standard error of factor scores  0.19  0.28  0.33

```

See full results

results_pca

```

## Q-method analysis.
## Finished on:           Tue Jun 17 10:38:43 2025
## 'qmethod' package version: 1.8.4
## Original data:         49 statements, 13 Q-sorts
## Forced distribution:    TRUE
## Number of factors:      3
## Extraction:             PCA
## Rotation:               varimax
## Flagging:               automatic
## Correlation coefficient: pearson
##
## Original data :
##   ...1 ...2 ...3 ...4 ...5 ...6 ...7 ...8 ...9 ...10
## 1    0    0    2    4    2    0   -1    3    3    3
## 2    4    0    2    1    3    3    3    4   -1    3
## 3    2    0    0    2    3   -1    3    4    2    4
## 4   -1    1    1    3    1   -2    0   -1   -2   -3
## 5    0   -2   -2   -2   -3   -4    1   -1    2   -4
## 6    1    1    1    1    1    2    3    1    1   -4
## 7    0    2    0    0   -1    1    1    1    0   -3
## 8    3    2    0    0   -3   -4    0   -4   -1    2
## 9    1    2    0    0   -3    1   -2    0    0    0
## 10   4    0    1   -1    3    4    1    1    1    1
## (...) See item '...$dataset' for the full data.
##
## Q-sort factor loadings :
##               f1          f2          f3
## ...1    0.3458 -0.04317  0.762
## ...2    0.0150  0.63976  0.031

```

```

## ...3  0.5731  0.24604  0.362
## ...4  0.0098  0.77908 -0.048
## ...5  0.7191  0.12906  0.237
## ...6  0.6547 -0.03983  0.012
## ...7 -0.1285  0.25887  0.849
## ...8  0.1152  0.53565  0.279
## ...9  0.6421  0.11376  0.065
## ...10 0.6013 -0.00091 -0.100
## (...) See item '...$loa' for the full data.
##
## Flagged Q-sorts :
##      flag_f1 flag_f2 flag_f3
## ...1  FALSE  FALSE  TRUE
## ...2  FALSE  TRUE  FALSE
## ...3  TRUE  FALSE  FALSE
## ...4  FALSE  TRUE  FALSE
## ...5  TRUE  FALSE  FALSE
## ...6  TRUE  FALSE  FALSE
## ...7  FALSE  FALSE  TRUE
## ...8  FALSE  TRUE  FALSE
## ...9  TRUE  FALSE  FALSE
## ...10 TRUE  FALSE  FALSE
## (...) See item '...$flagged' for the full data.
##
## Statement z-scores :
##      zsc_f1 zsc_f2 zsc_f3
## 1      1.50   1.76 -0.35
## 2      1.55   0.86  1.90
## 3      1.18   1.21  1.48
## 4     -0.71   1.09 -0.21
## 5     -1.61  -1.19  0.35
## 6      0.21   0.66  1.27
## 7     -0.03   0.51  0.35
## 8     -0.79  -0.15  0.63
## 9     -0.37   0.38 -0.49
## 10     1.40  -0.21  1.20
## (...) See item '...$zsc' for the full data.
##
## Statement factor scores :
##      fsc_f1 fsc_f2 fsc_f3
## 1         2     4    -1
## 2         3     2     4
## 3         2     3     3
## 4        -1     2     0
## 5        -3    -3     1
## 6         1     1     3
## 7         0     1     1
## 8        -2    -1     1
## 9        -1     1    -1
## 10        2    -1     2
## (...) See item '...$zsc_n' for the full data.
##
## Factor characteristics:
##      General factor characteristics:

```

```

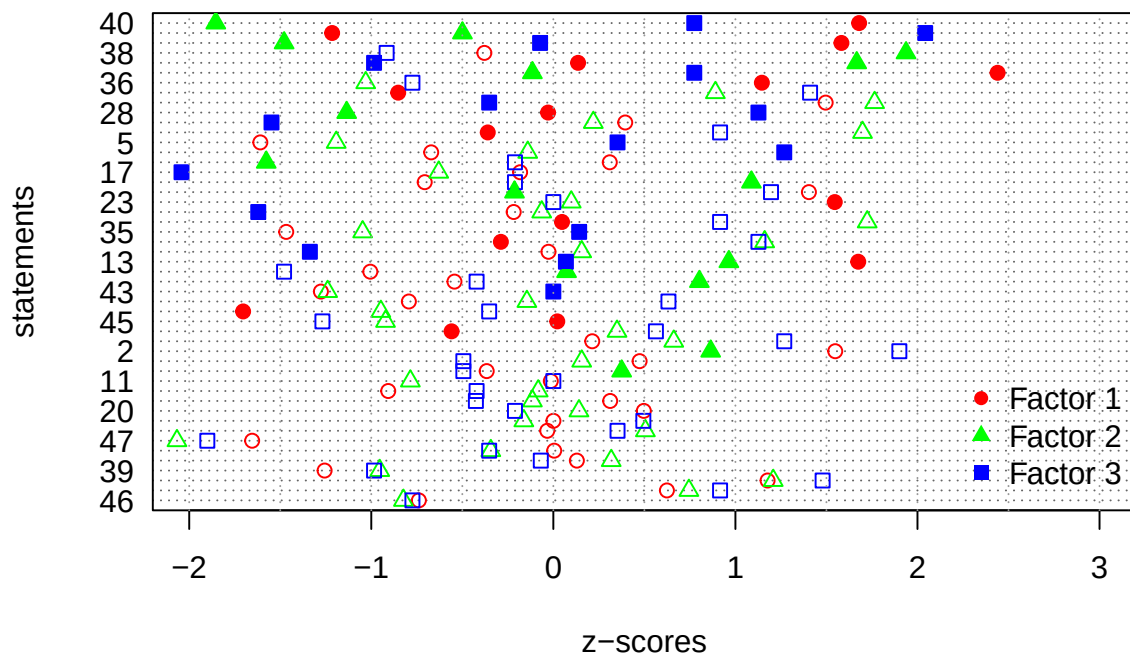
##      av_rel_coef nload eigenvals expl_var reliability se_fscores
## f1          0.8    7      3.0      23      0.97      0.19
## f2          0.8    3      1.9      14      0.92      0.28
## f3          0.8    2      1.7      13      0.89      0.33
##
##      Correlation between factor z-scores:
##          zsc_f1 zsc_f2 zsc_f3
## zsc_f1    1.00  0.20  0.21
## zsc_f2    0.20  1.00  0.22
## zsc_f3    0.21  0.22  1.00
##
##      Standard error of differences between factors:
##          f1  f2  f3
## f1 0.26 0.33 0.38
## f2 0.33 0.39 0.43
## f3 0.38 0.43 0.47
##
## Distinguishing and consensus statements :
##          dist.and.cons  f1_f2 sig_f1_f2 f1_f3 sig_f1_f3 f2_f3 sig_f2_f3
## 1 Distinguishes f3 only -0.269          1.85    ***  2.12    ***
## 2 Distinguishes f2 only  0.684          * -0.35          -1.04    *
## 3          Consensus -0.031          -0.30          -0.27
## 4 Distinguishes f2 only -1.795        6* -0.50          1.30    **
## 5 Distinguishes f3 only -0.417          -1.96        6* -1.55    ***
## 6          -0.448          -1.05    ** -0.61
## 7          Consensus -0.539          -0.39          0.15
## 8          -0.648          -1.43    *** -0.78
## 9 Distinguishes f2 only -0.741          *  0.13          0.87    *
## 10 Distinguishes f2 only 1.617        ***  0.21          -1.41    **
## (...) See item '...$qdc' for the full data.

```

```

# Plot the z-scores for the statements
plot(results_pca)

```



```
## Reorder the statements from highest to lowest scores for each factor
# Put z-scores and factor scores together
scores <- cbind(round(results_pca$zsc, digits = 2), results_pca$zsc_n)
nfactors <- ncol(results_pca$zsc)
col.order <- as.vector(rbind(1:nfactors, (1:nfactors)+nfactors))
scores <- scores[col.order]
scores
```

```
## [1] 1.50 -0.71 1.55 -1.61 1.18 0.21
```

```
str(scores)
```

```
## num [1:6] 1.5 -0.71 1.55 -1.61 1.18 0.21
```

```
#Order the table from highest to lowest z-scores for factor 1
scores[order(scores, decreasing = TRUE) ]
```

```
## [1] 1.55 1.50 1.18 0.21 -0.71 -1.61
```

In addition, the z-scores of each measure per factor is plotted. This plot creates an overview of the outlying measures of the factors.

```

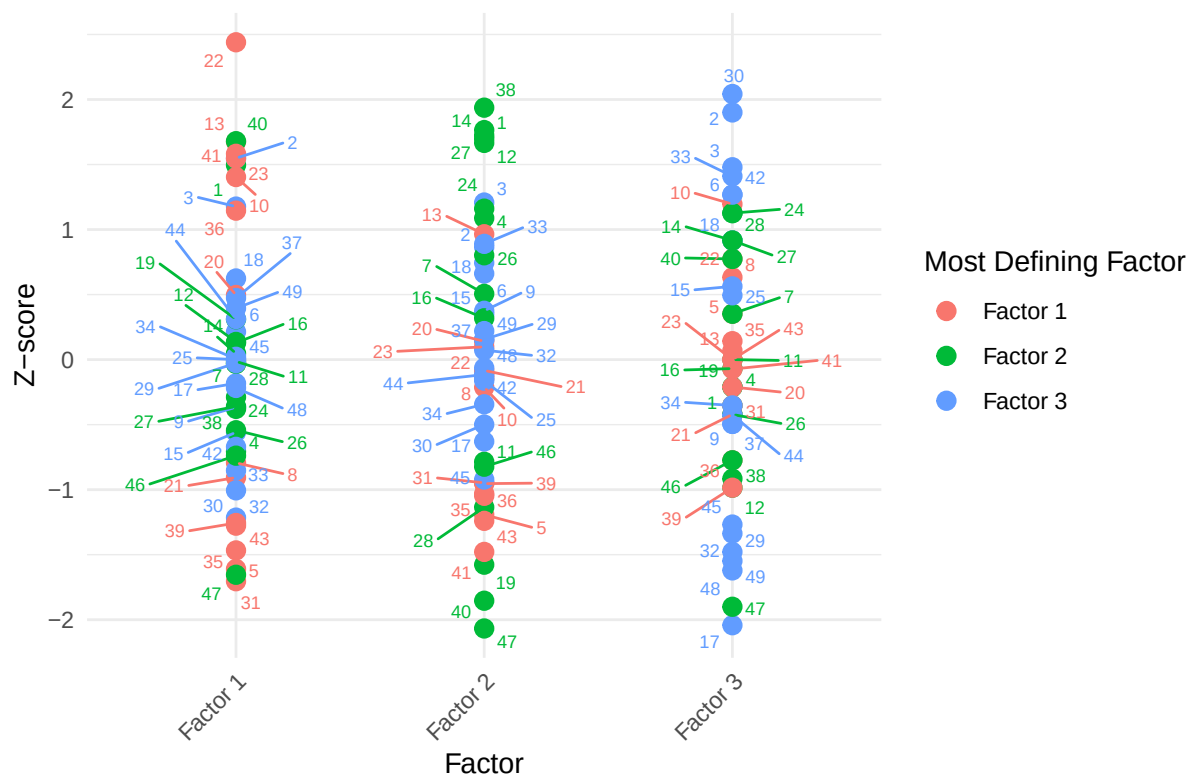
# Assuming you have the z-scores for the statements in 'results_pca$zsc'
zsc_df <- as.data.frame(results_pca$zsc)
zsc_df$statement <- rownames(zsc_df)
zsc_df_long <- pivot_longer(zsc_df,
                           cols = starts_with("zsc_"), # Adjust if your factor names are different
                           names_to = "factor",
                           values_to = "z_score")

# RENAME factors for nice axis labels and legend
zsc_df_long$factor <- recode(zsc_df_long$factor,
                           zsc_f1 = "Factor 1",
                           zsc_f2 = "Factor 2",
                           zsc_f3 = "Factor 3")

# Find the factor with the highest absolute z-score for each statement
zsc_df_long <- zsc_df_long %>%
  group_by(statement) %>%
  mutate(abs_z_score = abs(z_score),
         most_defining_factor = factor[which.max(abs_z_score)]) %>%
  ungroup()

# Create the scatter plot
ggplot(zsc_df_long, aes(x = factor, y = z_score, color = most_defining_factor)) +
  geom_point(size = 3) +
  geom_text_repel(aes(label = statement), size = 2.5, max.overlaps = Inf) + # Using ggrepel for better
  labs(title = "",
       x = "Factor",
       y = "Z-score",
       color = "Most Defining Factor") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))

```



To gain an understanding about the shared viewpoint in each factor, both the outlying success measures were extracted. These outlying measures have a z-score of > 1.5 and < -1.5 .

```
# Convert z-scores to long format
zsc_df <- as.data.frame(results_pca$zsc)
zsc_df$statement <- rownames(zsc_df)

# Reshape to long format
zsc_long <- pivot_longer(zsc_df,
  cols = -statement,
  names_to = "factor",
  values_to = "z_score")

# Filter for z-scores greater than 1.5 or less than -1.5
high_low <- zsc_long %>%
  filter(z_score > 1.5 | z_score < -1.5) %>%
  arrange(factor, desc(z_score))

# Display the result
knitr::kable(high_low, caption = "Statements with High (>1.5) or Low (<-1.5) Z-scores per Factor")
```


Table 1: Statements with High (>1.5) or Low (<-1.5) Z-scores per Factor

statement	factor	z_score
22	zsc_f1	2.440061
40	zsc_f1	1.679427
13	zsc_f1	1.674635
41	zsc_f1	1.582365
2	zsc_f1	1.548254
23	zsc_f1	1.545782
5	zsc_f1	-1.609450
47	zsc_f1	-1.654375
31	zsc_f1	-1.704000
38	zsc_f2	1.937184
1	zsc_f2	1.764651
14	zsc_f2	1.723839
27	zsc_f2	1.698185
12	zsc_f2	1.666327
19	zsc_f2	-1.576959
40	zsc_f2	-1.854020
47	zsc_f2	-2.067366
30	zsc_f3	2.042300
2	zsc_f3	1.900518
49	zsc_f3	-1.547998
48	zsc_f3	-1.620821
47	zsc_f3	-1.900518
17	zsc_f3	-2.042300

Next, we can look deeper into the different statements which are unique per factor, or which statements are in consensus. Consensus indicates that none of the factors are significantly different about the statements. This indicates that the factors all think the same about a statement, thus share a similar perspective. The distinguishes factor f1 (or f2, f3) only, distinguishes only factor f1, but not the other two factors from each other. So, the statement in question is significantly different in one factor, compared to the other two factors. Lastly, the distinguishes all, shows that in each factor, the statement is significantly different. So each factor has a different point of view on said statement. As the top and bottom measures focus on the differences between the participants viewpoint, the next step in the understanding of the participants perspective on II success, is understanding the consensus statements.

```
# Full table
results_pca$qdc
```

```
##          dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3
## 1 Distinguishes f3 only -0.26898867      1.8481830      ***
## 2 Distinguishes f2 only  0.68400229      * -0.3522645
## 3          Consensus -0.03107617      -0.3023375
## 4 Distinguishes f2 only -1.79471116      6* -0.4958800
## 5 Distinguishes f3 only -0.41683057      -1.9619704      6*
## 6          -0.44777313      -1.0546734      **
## 7          Consensus -0.53892881      -0.3858837
## 8          -0.64824356      -1.4258016      ***
## 9 Distinguishes f2 only -0.74140417      *  0.1282818
## 10 Distinguishes f2 only 1.61709483      ***  0.2082715
```

## 11		0.77145123	*	-0.0139264	
## 12	Distinguishes all	-1.53047858	***	1.1205872	**
## 13	Distinguishes all	0.71052073	*	1.6056772	***
## 14	Distinguishes f1 only	-1.67623137	6*	-0.8681729	*
## 15	Distinguishes f1 only	-0.90873190	**	-1.1222608	**
## 16	Consensus	-0.18878445		0.1980470	
## 17	Distinguishes f3 only	0.44702786		1.8597845	***
## 18	Consensus	-0.12075767		-0.2919729	
## 19	Distinguishes f2 only	1.88683671	6*	0.5206169	
## 20	Consensus	0.35619159		0.7076065	
## 21		-0.82366216	*	-0.4853483	
## 22	Distinguishes all	2.55508350	6*	1.6660625	***
## 23	Distinguishes f1 only	1.44745792	***	1.5457817	***
## 24	Distinguishes f1 only	-1.44898911	***	-1.4147465	***
## 25	Consensus	0.16237623		-0.4939640	
## 26	Distinguishes f2 only	-1.34523080	***	-0.1216763	
## 27	Distinguishes f1 only	-2.05845001	6*	-1.2760452	***
## 28	Distinguishes all	1.10607380	***	-1.1555540	**
## 29	Distinguishes f3 only	-0.18260390		1.3104895	***
## 30	Distinguishes all	-0.71564448	*	-3.2573057	6*
## 31	Distinguishes f1 only	-0.75658352	*	-1.3514793	***
## 32	Distinguishes f2 only	-1.07800646	**	0.4737035	
## 33	Distinguishes f1 only	-1.74204898	6*	-2.2622256	6*
## 34	Consensus	0.34813028		0.3571238	
## 35	Distinguishes f3 only	-0.41984657		-1.6089069	***
## 36	Distinguishes f1 only	2.17593714	6*	1.9193553	6*
## 37		0.31793386		0.9680702	*
## 38	Distinguishes f2 only	-2.31603326	6*	0.5369313	
## 39	Consensus	-0.30271381		-0.2715956	
## 40	Distinguishes all	3.53344716	6*	0.9054285	*
## 41	Distinguishes all	3.06100070	6*	1.6551884	***
## 42	Distinguishes f3 only	-0.53022099		-1.9391973	6*
## 43	Distinguishes f3 only	-0.03716735		-1.2768033	***
## 44	Consensus	0.42713665		0.7374581	
## 45	Distinguishes f1 only	0.94340757	**	1.2899455	***
## 46	Consensus	0.08486340		0.0354235	
## 47	Consensus	0.41299022		0.2461431	
## 48	Distinguishes f3 only	-0.15406734		1.4030388	***
## 49	Distinguishes f3 only	0.17524530		1.9427929	6*
##	f2_f3 sig_f2_f3				
## 1	2.117171704	***			
## 2	-1.036266815	*			
## 3	-0.271261329				
## 4	1.298831158	**			
## 5	-1.545139872	***			
## 6	-0.606900285				
## 7	0.153045094				
## 8	-0.777558036				
## 9	0.869685986	*			
## 10	-1.408823303	**			
## 11	-0.785377630				
## 12	2.651065778	6*			
## 13	0.895156458	*			
## 14	0.808058434				

```
## 15 -0.213528935
## 16  0.386831439
## 17  1.412756683      **
## 18 -0.171215203
## 19 -1.366219811      **
## 20  0.351414948
## 21  0.338313889
## 22 -0.889021043      *
## 23  0.098323727
## 24  0.034242600
## 25 -0.656340188
## 26  1.223554509      **
## 27  0.782404825
## 28 -2.261627808      6*
## 29  1.493093438      ***
## 30 -2.541661264      6*
## 31 -0.594895773
## 32  1.551709964      ***
## 33 -0.520176575
## 34  0.008993486
## 35 -1.189060370      **
## 36 -0.256581884
## 37  0.650136370
## 38  2.852964516      6*
## 39  0.031118210
## 40 -2.628018701      6*
## 41 -1.405812277      **
## 42 -1.408976260      **
## 43 -1.239635944      **
## 44  0.310321440
## 45  0.346537978
## 46 -0.049439903
## 47 -0.166847148
## 48  1.557106163      ***
## 49  1.767547559      ***
```

```
# Consensus statements
```

```
results_pca$qdc[which(results_pca$qdc$dist.and.cons == "Consensus"), ]
```

```
##      dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3      f2_f3
## 3      Consensus -0.03107617      -0.3023375      -0.271261329
## 7      Consensus -0.53892881      -0.3858837      0.153045094
## 16     Consensus -0.18878445      0.1980470      0.386831439
## 18     Consensus -0.12075767      -0.2919729      -0.171215203
## 20     Consensus  0.35619159      0.7076065      0.351414948
## 25     Consensus  0.16237623      -0.4939640      -0.656340188
## 34     Consensus  0.34813028      0.3571238      0.008993486
## 39     Consensus -0.30271381      -0.2715956      0.031118210
## 44     Consensus  0.42713665      0.7374581      0.310321440
## 46     Consensus  0.08486340      0.0354235      -0.049439903
## 47     Consensus  0.41299022      0.2461431      -0.166847148
##      sig_f2_f3
## 3
## 7
```

```
## 16
## 18
## 20
## 25
## 34
## 39
## 44
## 46
## 47
```

Statements distinguishing all factors

```
results_pca$qdc[which(results_pca$qdc$dist.and.cons == "Distinguishes all"), ]
```

```
##      dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3      f2_f3
## 12 Distinguishes all -1.5304786    ***  1.1205872      **  2.6510658
## 13 Distinguishes all  0.7105207      *  1.6056772    ***  0.8951565
## 22 Distinguishes all  2.5550835      6*  1.6660625    *** -0.8890210
## 28 Distinguishes all  1.1060738    *** -1.1555540      ** -2.2616278
## 30 Distinguishes all -0.7156445      * -3.2573057      6* -2.5416613
## 40 Distinguishes all  3.5334472      6*  0.9054285      * -2.6280187
## 41 Distinguishes all  3.0610007      6*  1.6551884    *** -1.4058123
##      sig_f2_f3
## 12          6*
## 13          *
## 22          *
## 28          6*
## 30          6*
## 40          6*
## 41          **
```

Statements distinguishing factor 1 (for results of > 2 factors)

```
results_pca$qdc[which(results_pca$qdc$dist.and.cons == "Distinguishes f1 only"), ]
```

```
##      dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3      f2_f3
## 14 Distinguishes f1 only -1.6762314      6* -0.8681729      *  0.80805843
## 15 Distinguishes f1 only -0.9087319      ** -1.1222608      ** -0.21352893
## 23 Distinguishes f1 only  1.4474579    ***  1.5457817    ***  0.09832373
## 24 Distinguishes f1 only -1.4489891    *** -1.4147465    ***  0.03424260
## 27 Distinguishes f1 only -2.0584500      6* -1.2760452    ***  0.78240483
## 31 Distinguishes f1 only -0.7565835      * -1.3514793    *** -0.59489577
## 33 Distinguishes f1 only -1.7420490      6* -2.2622256      6* -0.52017657
## 36 Distinguishes f1 only  2.1759371      6*  1.9193553      6* -0.25658188
## 45 Distinguishes f1 only  0.9434076      **  1.2899455    ***  0.34653798
##      sig_f2_f3
## 14
## 15
## 23
## 24
## 27
## 31
## 33
## 36
## 45
```

```
# Statements distinguishing factor 2 (for results of > 2 factors)
results_pca$qdc[which(results_pca$qdc$dist.and.cons == "Distinguishes f2 only"), ]
```

```
##          dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3      f2_f3
## 2 Distinguishes f2 only  0.6840023      * -0.3522645      -1.036267
## 4 Distinguishes f2 only -1.7947112     6* -0.4958800      1.298831
## 9 Distinguishes f2 only -0.7414042      *  0.1282818      0.869686
## 10 Distinguishes f2 only  1.6170948     ***  0.2082715     -1.408823
## 19 Distinguishes f2 only  1.8868367     6*  0.5206169     -1.366220
## 26 Distinguishes f2 only -1.3452308     *** -0.1216763      1.223555
## 32 Distinguishes f2 only -1.0780065     **  0.4737035      1.551710
## 38 Distinguishes f2 only -2.3160333     6*  0.5369313      2.852965
##      sig_f2_f3
## 2              *
## 4              **
## 9              *
## 10             **
## 19             **
## 26             **
## 32             ***
## 38             6*
```

```
# Statements distinguishing factor 3 (for results of > 2 factors)
results_pca$qdc[which(results_pca$qdc$dist.and.cons == "Distinguishes f3 only"), ]
```

```
##          dist.and.cons      f1_f2 sig_f1_f2      f1_f3 sig_f1_f3      f2_f3
## 1 Distinguishes f3 only -0.26898867      1.848183     ***  2.117172
## 5 Distinguishes f3 only -0.41683057     -1.961970      6* -1.545140
## 17 Distinguishes f3 only  0.44702786      1.859785     ***  1.412757
## 29 Distinguishes f3 only -0.18260390      1.310490     ***  1.493093
## 35 Distinguishes f3 only -0.41984657     -1.608907     *** -1.189060
## 42 Distinguishes f3 only -0.53022099     -1.939197      6* -1.408976
## 43 Distinguishes f3 only -0.03716735     -1.276803     *** -1.239636
## 48 Distinguishes f3 only -0.15406734      1.403039     ***  1.557106
## 49 Distinguishes f3 only  0.17524530      1.942793      6*  1.767548
##      sig_f2_f3
## 1              ***
## 5              ***
## 17             **
## 29             ***
## 35             **
## 42             **
## 43             **
## 48             ***
## 49             ***
```

Laslty, a dendrogram of the factors is plotted, to give a visual representation of the participants correlation and shared perspectives.

```
# Prepare the factor loadings for clustering
loadings <- results_pca$loa
```

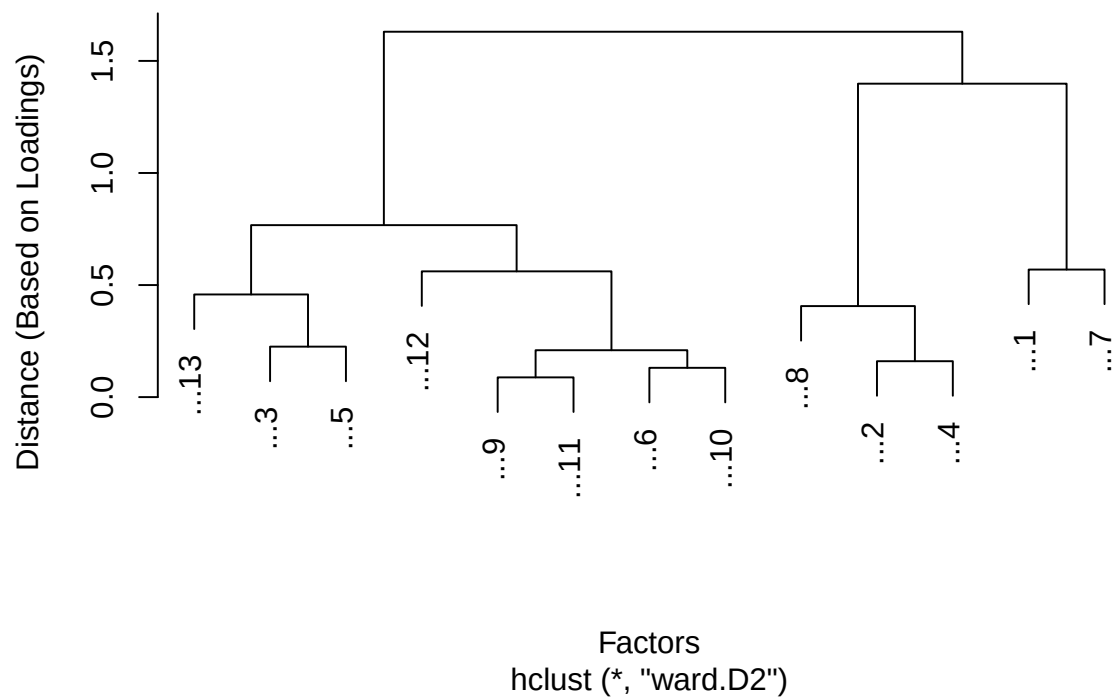
```

# Calculate the distance matrix based on factor loadings
d_loadings <- dist(loadings)

# Perform hierarchical clustering on the factor loadings
hc_loadings <- hclust(d_loadings, method = "ward.D2")

# Plot the dendrogram of factors
plot(hc_loadings, main = "",
     xlab = "Factors", ylab = "Distance (Based on Loadings)")

```





Additional Supplementary Materials

The following data was documented surrounding the systematic literature search and interviews, which is available as supplementary material and can be requested.

- Overview of the screened Scopus and Web of Science articles and which of them were eligible.
- Overview of the copied success measures of the literature search, before generalizing and combining measures.
- Transcripts of the interviews with the participants.
- Coded transcripts of the interviews with the participants.
- Informed consent of the participants.
- Q-sorted success measures of the participants.
- HREC application documents.