Master Thesis

Determining the Criteria and their Importance for the Selection of a Healthcare Platform in the Netherlands

Marit J. M. Kamphuis | **20-07-2021**

University of Twente
Faculty of Science and Technology
MSc Health Sciences
Optimization of Healthcare Processes

1st supervisor: dr. J.A. van Til (Janine)
2nd supervisor: dr. F.G.S. Vos (Frederik)

M&I/Partners
Rutger Leer - Principal Consultant

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List of abbreviations

AHP = Analytic Hierarchy Process
API = Application Programming Interface
EHR = Electronic Health Record
FHIR = Fast Healthcare Interoperability Resources
HCIM = Health and Care Information Model
HIS = Health Information System
Health IT = Health Information Technology
MCDM = Multi-Criteria Decision-Making
NEP = National Exchange Point
PPC = Patient-Centred Care
PHE = Personal Health Environment
RHIO = Regional Health Information Organisation
RFI = Request for Information
SaaS = Software as a Service
VBHC = Value-Based Healthcare
XDS = Cross-Enterprise Document Sharing

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Summary

Platforms are increasingly used by healthcare organisations for information exchange, service integration and service innovation. As a result, the use of platforms has the potential to address current problems in healthcare such as the fragmentation of patient care across providers. However, it is crucial for healthcare organisations to select a platform that offers the functionalities that meet their needs. This can be a challenge as healthcare organisations often have to deal with a lot of different stakeholders that do not always have sufficient experience and competence to select the best platform. Besides, getting oriented in the offer of healthcare platforms is increasingly difficult due to the growing number of alternatives and the variety of features they show. The main problem is that there is no clear overview of the criteria that are relevant to compare the suppliers. It is also expected that different suppliers score differently on multiple criteria and that the preferences of decision-makers regarding the importance of the criteria are dependent on certain characteristics, like their job positions. The platform supplier selection in Dutch healthcare can therefore be considered as a multi-criteria decision problem.

The goal of this research was to determine the relevant criteria and their importance from the perspectives of different stakeholders. The research that was needed to do so can be divided into two parts. The first part was used to determine a complete set of criteria and sub-criteria that are relevant when comparing the existing healthcare platforms. A literature review was executed in which eight relevant articles were selected. Based on these articles, a first set of criteria and sub-criteria was determined. Thereafter, individual and focus group interviews with experts were conducted to be able to confirm, add or discard the criteria based on platform selection in the specific Dutch healthcare sector. In the second part of this study, a questionnaire was distributed to collect judgements on the importance of the criteria from different stakeholders in healthcare. The pairwise comparison technique from the Analytic Hierarchy Process (AHP) method was used to collect these judgements.

In table 1, a summary is shown of the main findings of both part 1 and part 2 of this study.

*Table 1: Summary of main results of both part 1 and part 2 of this study (*significant difference, p<0.05)*

	Part 1: Criteria identification			**Part 2: Criteria importance**	
Criteria	**Literature**	**Experts**	**Implication**	**Total *(rank)***	**Subgroups***
Connection costs	x	x	Confirmation	1.8% *(16)*	
Service costs	x	x	Confirmation	4.6% *(8)*	*Care: 7.6% - Cure: 3.8%*
Transaction costs	-	x	Extension	7.9% *(4)*	
Integration possibilities with healthcare organisations	-	x	Extension	11.3% *(3)*	*Ext: 19.5% - Int: 10.2%*
Connection possibilities with national infrastructures	-	x	Extension	15.6% *(1)*	
Integration possibilities with applications	-	x	Extension	13.2% *(2)*	
Communication services	-	x	Extension	4.4% *(9)*	
Connectivity	-	x	Extension	3.8% *(10)*	
Flexibility	x	x	Confirmation	2.7% *(12)*	
Interoperability	x	x	Confirmation	5.2% *(6)*	
Reliability	x	-	Extension	-	
Completeness	x	x	Confirmation	2.4% *(14)*	
Modularity	x	x	Confirmation	2.2% *(15)*	
Ease of use	x	-	Extension	-	
Security	x	x	Confirmation	7.2% *(5)*	
Scalability	x	x	Confirmation	3.1% *(11)*	
Vision	-	x	Extension	3.1% *(11)*	
Reputation	x	x	Confirmation	2.4% *(14)*	
Financial health	x	x	Confirmation	2.5% *(13)*	
Technical support and service	x	x	Confirmation	4.8% *(7)*	
Social responsibility	-	x	Extension	1.8% *(16)*	

In the first part of this study, 14 experts were interviewed which resulted in a criteria overview of four criteria categories and 19 sub-criteria. The criteria were either a confirmation of criteria found in literature or an extension of the literature as some criteria were suggested by the experts but not found in the literature or vice versa. In the second part of this study, the questionnaire was completed by 50 consultants, project leaders and managers. The analyses resulted in overviews of the importance per criterion for the total sample and for the subgroup samples. These subgroup samples were compiled based on the sector, the organisation type and the job position type. The results of the total sample show that the most important criteria are the functional specifications, including the integration possibilities with healthcare organisations and applications, and the connection possibilities with national infrastructures. In addition, the transaction-based cost model is considered as the most important cost criterion, security is the most important technical specification and the criterion consisting of the technical support and service is the most important supplier specification. Finally, the subgroup analyses show similar distributions in which (significant) differences were found only on some of the criteria.

In conclusion, the study confirms the relevance of certain criteria from existing literature. Besides, it contributes to the literature on supplier selection by pointing out irrelevant criteria and by adding relevant criteria for platform selection in the specific context of the Dutch healthcare sector. Practically, the criteria and their importance make it possible for healthcare organisations to gain more control over the process of selecting a healthcare platform. The results can be used as the basis of an RFI (Request For Information) or as a supplier evaluation scheme to be able to assign scores to each supplier.

Introduction

Healthcare is increasingly provided by collaborating healthcare organisations, healthcare professionals and patients (Karam et al., 2018; Piengang et al., 2019). For healthcare organisations to work together, good coordination and information exchange is essential for patient safety and continuity and quality of care. However, research shows that many organisational, technological and human factors complicate these preconditions for proper collaboration (Karam et al., 2018; Rudin et al., 2014; Sligo et al., 2017; Vest & Gamm, 2010; Vest et al., 2011). These factors not only complicate coordination and information exchange but also the possibility to improve overall healthcare delivery (Porter, 2010).

The rise in healthcare collaborations is largely related to the reorganization of care by the incorporation of new and effective models of care delivery, like Patient-Centred Care (PCC) and Value-Based Healthcare (VBHC)(Kitson et al., 2013; Porter, 2010; Porter & Lee, 2013). PCC models place the individual patient at the centre of the delivery of care and redirects activities so that the right job is performed effectively by the right person at the right time (Kitson et al., 2013; Pelzang, 2010). PCC improves continuity of care and integration of health professionals collaborating on behalf of their patients. VBHC is an example of a PCC model which focuses on delivering value instead of delivering services (Porter & Lee, 2013). The goal is to make the truly delivered value measurable so it can be rewarded and compared (Porter, 2010). This should lead to a more cost-conscious and patient-centred system. The VBHC model consists of six interdependent and mutually reinforcing components. The first five components include the organization of care around the need of the patient in the form of Integrated Practice Units (IPUs); the measurement of outcomes and costs for every patient; the use of bundled payments; the integration of care delivery across separate organisations; and the expansion of geographic reach (Porter & Lee, 2013). The sixth and last component is a supporting information technology system in which a complete overview of the patient data is available for all cooperating organisations. This system enables the preceding five components to be valuable.

However, in the Netherlands, Health Information Systems (HISs) are still often isolated within hospitals, physician practices and pharmacies (Informatieberaad Zorg, 2019; KPMG, 2019b; RSO Nederland, 2019). This fragmentation results in siloed information creation and storage. At this moment, mutual data exchange from these data silos is only possible to a limited extent. In combination with the increasing number of handoffs of patients among providers, the chance of failing to share important information increases (Vest & Gamm, 2010). This may result in the use of redundant healthcare services by patients, but also in serious patient safety and quality issues. Growing evidence shows that improved exchange of patient data has the potential to reduce these problems, which translates into a decrease in mortality and costs (Miller & Tucker, 2014). Especially the latter is relevant for the Netherlands as it is among the countries with the highest health expenditure as a percentage of GDP (Gross Domestic Product)(CBS, 2019a; Kroneman et al., 2016). Moreover, Dutch health expenditure is increasing every single year due to economic growth, technological advances, population growth and ageing.

Back in 2005, Walker et al. (2005) provided a promising business case for spending money on a fully standardized nationwide information system in America. By quantifying the benefits from avoided tests and improved efficiencies, the authors found that fully standardized interoperability between stakeholders in healthcare could yield a minimum of five per cent of the projected total amount spent on U.S. health care in 2003. These results sounded promising, but in more recent literature on the effectiveness of implemented HISs and health Information Technology (health IT), the results are often mixed (Buntin et al., 2011; Reis et al., 2017; Sligo et al., 2017). In a literature review of Buntin et al. (2011), 92 per cent of the researched articles reached positive conclusions overall. The articles evaluated different outcome measures, among which the most important were efficiency and effectiveness of care and patient safety and satisfaction. Several studies found that hospitals with more advanced health IT, including the use of platforms, had fewer complications, lower mortality and lower costs than hospitals with less advanced health IT. In contrast, the paper of Sligo et al. (2017) mainly focussed on the shortcomings of HISs and health IT. The authors state that the healthcare industry, compared to other industries, is slow to adopt technology and that information technology and systems are often underutilised. The authors also claim that publication bias has possibly created an unrealistic impression of the success rates of HIS implementation. In summary, current research suggests that HISs and health IT can be effective at improving healthcare in certain circumstances, although further research is needed to prove that they are also cost-effective in the long term (Reis et al., 2017; Sligo et al., 2017).

Since different organisations in healthcare use different systems, infrastructures and standards, Dutch healthcare organisations have to create a complex landscape of application networks and infrastructures to be able to collaborate with other parties (RSO Nederland, 2019). Nowadays, multiple organisations exist that help to facilitate this process. Besides the emergence of Regional Health Information Organisations (RHIOs), which are provider-led, non-profit associations that facilitate information exchange and innovation within a region, multiple private vendors started to offer healthcare platforms, available for the entire Dutch healthcare sector (Fontaine et al., 2010; Jha et al., 2008; Vest & Gamm, 2010). Healthcare platforms have the potential to address two main problems. The platform's ability to make previously unavailable but critically important health information available is a necessary first step to address the current fragmentation of patient care across providers. Besides, platforms can tackle the current lack of innovation (Fürstenau et al., 2019). The platforms develop shared patient information repositories, enable data and process integration and facilitate the interoperability of systems. One step further, they facilitate innovation ecosystems, building on the collection, integration and analysis of patient data (Adner & Kapoor, 2010). In other words, for healthcare organisations, the selection of the correct healthcare platform shows great promise for improving the quality, safety and efficiency of healthcare within their organisation (Fontaine et al., 2010; Jha et al., 2008). It is, however, crucial for them to choose a platform supplier that offers the functionalities that meet their needs.

When comparing platform suppliers in the Dutch market, the main problem that arises is that there is no clear overview of criteria that are relevant to compare the suppliers. It is also expected that different suppliers score differently on multiple criteria and that different stakeholders value the importance of the criteria differently (Chan et al., 2008; Deng et al., 2014; Kahraman et al., 2003). The platform supplier selection in Dutch healthcare can therefore be considered as a multi-criteria decision problem. Identifying the criteria and the judgments of different decision-makers about the relative importance of the criteria can be the first step to support healthcare organisations in their process of selecting a platform supplier. For the latter, the Analytic Hierarchy Process (AHP) is suitable to use as it can be considered an easy to use and appropriate technique for analysing a large number of both quantitative and qualitative criteria and sub-criteria (Bhutta & Huq, 2002; Velasquez & Hester, 2013).

This research will consist of two parts in which the goal of the first part is to identify a complete set of relevant criteria that can be used in the selection process of a platform supplier. In the second part, the importance of the criteria will be determined with the help of AHP. Differences between the preferences of different decision-makers, working within or for different healthcare organisations and sectors, will also be identified. The research question is therefore formulated as follows:

"What are the relevant criteria and their importance from the perspectives of different stakeholders for the selection of a platform supplier in the Netherlands?"

The academic literature on supplier selection is extensive and several studies exist that focus on the selection of different kinds of software and systems (Cricelli et al., 2020; Efe, 2016; Haddara, 2018; Hanine et al., 2016; López & Ishizaka, 2017; Malindzakova & Puskas, 2018; Piengang et al., 2019; Secundo et al., 2017). However, this study supports the literature by contributing with still missing evidence regarding the effective evaluation and selection of platforms in the Dutch healthcare industry. The practical relevance of this research is that the results can make clear which criteria are relevant and important when selecting a platform. It can form the basis for further support of healthcare organisations to select a platform that best fits the needs of the organisation and that has the greatest potential to improve healthcare within the organisation. It also shows how the AHP method can be used to determine the importance of the criteria and to distinguish between the judgements of different stakeholders.

Theoretical Framework

In this theoretical framework, the definition and characteristics of a healthcare platform will be discussed first. Thereafter, the criteria and sub-criteria that were found through literature research will be discussed. A literature review was performed to search for the criteria that are expected to be relevant for comparing the healthcare platform suppliers. See also appendix I for the description of the search and the supporting flow chart (figure 1). The information from the literature review is adapted to the context of Dutch healthcare platforms where necessary. To get a clear overview, a distinction is made between the product criteria, which are the criteria related to the platform itself, and supplier criteria, which are the criteria related to the supplier of the platform.

Definition of a Healthcare Platform

Within Dutch healthcare, healthcare platforms are increasingly used to increase interoperability, or in other words, to enable systems to exchange and make use of information (Chen et al., 2008; RSO Nederland, 2019). In Dutch healthcare, a complex network of standards, infrastructures and trust frameworks exist that is created to enable connections between systems and applications. To reach interoperability, a platform needs to integrate various standards and infrastructures and needs to comply with several trust frameworks (Nictiz, 2020b). With the help of expert opinions and publicly available documentation from platform suppliers, the following definition of a healthcare platform is determined:

> *"Healthcare platforms enable connections between health information systems (HISs), between HISs and Personal Health Environments (PHEs) and between HIS and healthcare applications in which they comply with existing trust frameworks, laws and regulations. In this way, they provide healthcare organisations with several integration and innovation possibilities and a complete solution for information exchange in Dutch healthcare."*

Healthcare platforms also have to meet certain architectural and functional requirements. These requirements will be discussed in the following two sections. The functioning of a healthcare platform will then be discussed in a subsequent section. As different kinds of companies in healthcare offer products or services that they call "platforms", the definition and the additional requirements serve as a specification of the kind of healthcare platforms that are researched in this study. At this moment, six Dutch healthcare platforms can be identified that match the definition and meet the requirements.

Architectural Requirements

In an explorative multiple case study into four Dutch healthcare platforms, which was carried out simultaneously by the same researcher, it became clear how the platforms deal with the complexity of the Dutch health information exchange landscape.[1] The platforms have the goal to lower the burden for healthcare organisations by taking over the connections with outside parties. Among other things, they do this by consistently complying with the requirements for the different existing initiatives and infrastructures. In the cases, the following were highlighted:

- When an organisation wants to exchange medication or GP summaries, the platform needs to comply with the trust framework of the National Exchange Point (NEP).
- When an organisation wants to exchange information with patients through PHEs, the platform needs to comply with the trust framework of national initiative I (MedMij) with its own standardized APIs (Application Programming Interfaces). The software engineering institute (2003) defines an API as *"a technology that facilitates the exchange of data between two or more different software applications"*. Initiative I consists of a separate trust framework in which FHIR (Fast Healthcare Interoperability Resources) APIs are appointed as the exchange standard for structured data. FHIR creates a common set of APIs that enables healthcare

[1] Kamphuis, M.J.M. (2021) Platforms in healthcare: A qualitative multiple case study to explore how to achieve successful platforms for information, integration, and innovation (Master thesis - BA).

platforms to communicate and share data across facilities in a manner that each party can understand. This is similar to how Open Banking and PSD2 create sharing within the financial services industry.

- When an organisation want to exchange documents or images with other organisations, the platform needs to comply with the requirements of XDS (Cross-enterprise Document Sharing) networks or national initiative II. Initiative II (Twiin) has been set up by associations of healthcare providers and patients with the goal to create a nationwide network for the exchange of images and documents. They want to achieve this by connecting existing infrastructures, like XDS networks, with each other. In a later stadium, they also want to connect the NEP. To achieve this, a trust framework is currently being developed. However, it can take many years before a national network is created.

Besides, for connections that are not covered by existing national initiatives or open standards, point-to-point solutions still need to be implemented. See also figure 1 for a schematic representation of the architecture of the Dutch health information exchange landscape. A more detailed explanation of the Dutch health information exchange landscape, based on publicly available documentation and expert opinions, can be found in appendix II.

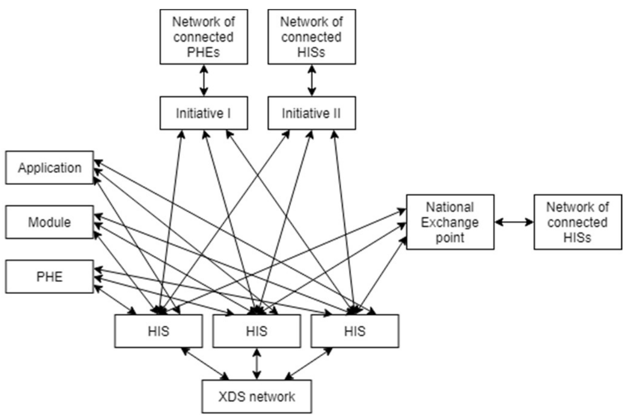

Figure 1: Architecture of Dutch health information exchange landscape

Platforms participate as much as possible in initiatives that already provide a network of connected systems. However, all initiatives are in their infancy and it can still take a while before they realize national infrastructures. Therefore, the platforms also need to provide connections to healthcare applications, PHEs and HISs themselves. They can do this by using their own APIs or XDS infrastructures. In addition, some platforms also combine their solutions for technical integrations with simpler communication services for information exchange, like chat, message and mail services. In figure 2, a schematic overview is shown of the connections the platforms from the cases can provide.

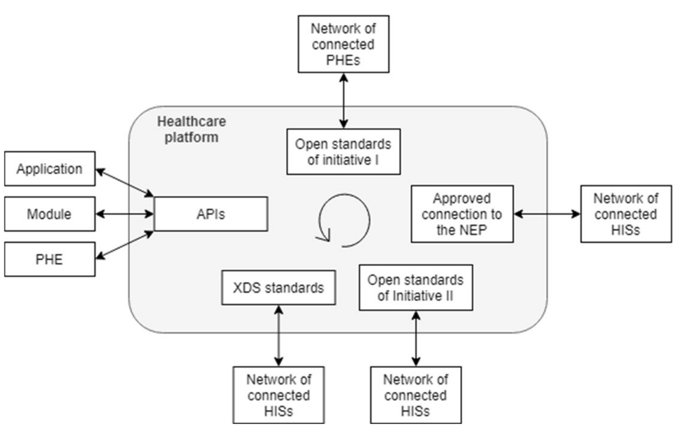

Figure 2: Architecture of healthcare platforms in general

Functional Requirements

Based on the requirements of trust frameworks, laws and regulations, healthcare platforms need to have at least the following functions:

- Authenticate: Check identity and verify trust level.
- Authorize: Assign, revoke and verify rights of individuals, organisations and systems to access data based on their functions and responsibilities.
- Check consent: Assign, revoke and verify rights of individuals and organisations to only access data for which the patient gave consent.
- Use of an address book: Access to relevant information for information exchange about healthcare providers, organisations and informal carers.
- Translate: Translation of data structured in a particular format and code system into another format and code system.
- Log: Recording activities in which access to medical data has been obtained.

Existing laws and regulations require that health information needs to be secured and that only authorized persons may view the information (Autoriteit Persoonsgegevens, 2020). For authentication and authorization, the platform can use authentication and authorization services, such as UZI and DigiD (Informatieberaad Zorg, 2019; KPMG, 2019a; RSO Nederland, 2019). The laws also oblige that patients must always have given prior consent before the information can be released. Since several different networks in Dutch healthcare are not yet connected to each other, it is still often the case that patients have to give their permission multiple times (Rijksoverheid, 2020a). When platforms build new connections, they have to arrange that patient consent is always checked. Other necessary functions are the use of an address book and translation. These functions enable platforms to exchange usable information between relevant parties. Finally, logging is obliged (Rijksoverheid, 2020a). It means that it must always be possible to keep an overview of who made certain information available and who viewed certain information at what times.

Functioning of a Healthcare Platform

Healthcare platforms usually have at least one authorization server and at least one resource server (Informatieberaad Zorg, 2019). The former handles the identification and authentication of a person and the authorization of the system to collect data and share data with the healthcare provider. The latter facilitates the actual data exchange between systems. The basic functioning of a healthcare platform can be described as follows. From a secure connection, an information request arrives at the authorization server. The identity of the applicant and the authenticity and authority of the application are established using DigiD or a UZI card. Subsequently, the request goes to the resource server, which searches for the relevant healthcare provider with the help of an address book. The request is then converted into an information request via the most relevant infrastructure. In the next step, the access is logged. Finally, via a secure infrastructure, the data is authorized from the information system of a healthcare provider to the information system of another healthcare provider or the patient's PHE.

Three core functions of the healthcare platforms can be distinguished (Fürstenau et al., 2019). These functions are all related to interoperability. The first and most important function is the exchange of information. The healthcare platforms facilitate information exchange by retrieving, translating and sharing medical data from various healthcare providers (Informatieberaad Zorg, 2019; KPMG, 2019a). The availability of patient information for healthcare providers makes it possible to enable data-driven medicine as treatments can be adjusted based on the needs of the patient (Rudin et al., 2014). Besides, the availability of information for the patients themselves enables their involvement in and control over their care pathway. The second core function of healthcare platforms is service integration in which platforms enable collaboration between providers and patients by offering digital support of healthcare processes. In this way, continuity of care can be improved and joint care pathways can be realized. A third, final function is service innovation. Most healthcare platforms can connect third-party applications to their platform, which brings possibilities to add functionalities and innovate healthcare processes at a fast pace. See also table 2 for an overview of the functions.

Table 2: Core functions of platforms in healthcare

Core function	Expected impact
Information exchange	Enabling information exchange between healthcare providers and patients.
Service integration	Enabling collaboration between healthcare providers and patients by supporting the healthcare processes digitally.
Service innovation	Facilitating innovation ecosystems by connecting healthcare providers and patients with third-party application developers.

Product Criteria

In this section, all criteria and sub-criteria will be discussed that were expected to relate to the platform itself. Information from the eight scientific articles, which were selected in the literature review (table 1 in appendix I), was supplemented with specific information from available documentation and literature about Dutch healthcare platforms. In table 3, an overview is shown of all product criteria including their literature references. The literature and documents that were additions to the articles from the literature review are shown in italics. In the end, five product criteria and eight sub-criteria were identified. Examples of criteria that were only mentioned in some of the articles and that were not expected to be relevant for this study in advance are portability, scalability, maintainability and customization.

Interoperability is the first included platform criterion as existing documentation and literature show that the main function of healthcare platforms is to achieve interoperability (Chen et al., 2008; Fürstenau et al., 2019; Leal et al., 2019; Nictiz, 2020c; RSO Nederland, 2019; Yaraghi et al., 2015). From the articles of the literature review, one article (article 8) also included this functional criterion in the study. Secondly, reliability is related to the actual functioning of the underlying system and was considered relevant in five of the eight articles from the literature review (articles 2-5, 7). The third criterion is security and was found relevant in five articles (articles 1, 4-6, 8). Modularity is related to the number of modules the platform offers and was included in four of the scientific articles (articles 2, 3, 6, 8). The second-last criterion is the ease of use which is related to user-friendliness and was considered relevant in six of the eights articles (articles 1, 2, 4, 5, 7, 8). Finally, the cost criterion consists of all indirect and direct costs that are related to the purchase of the platform and this criterion was included in all eight articles from the literature review (articles 1-8).

Interoperability

The main goal of the platforms is to ensure interoperability between the different actors in healthcare (Fürstenau et al., 2019; Yaraghi et al., 2015). Interoperability is the capability of a system to integrate or be integrated into software with complementary capabilities (Secundo et al., 2017). It is generally defined as *"the ability of two or more systems or components to exchange information and to use the information that has been exchanged"* (Chen et al., 2008)(p. 648). Interoperability does not only concern ICT, but also the context and processes within an organisation. It is therefore necessary to address all levels of an organisation to create meaningful interoperations (Chen et al., 2008). The Enterprise Interoperability Framework (figure 3) is a model that can be used to analyse and understand the business needs and technical requirements to solve interoperability problems from a holistic perspective (Chen & Daclin, 2006; Leal et al., 2019). The model assumes that interoperations can take place at four levels, namely at the business, process, service and data level. A distinction can be made between interoperability within organisations (intra-enterprise interoperability) and between organisations (inter-enterprise interoperability). In this study, the focus is on inter-enterprise interoperability.

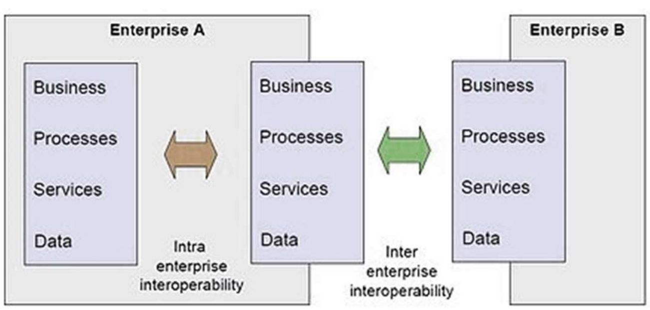

Figure 3: Enterprise interoperability framework (Chen & Daclin, 2006; Leal et al., 2019)

Nictiz, the Dutch knowledge centre for digital information exchange in healthcare, created a similar model for interoperability, specifically for health information exchange in the Netherlands (Nictiz, 2020c). They emphasize that a clearly designed internal architecture within independently operating organisations is necessary to ensure interoperability within healthcare. They distinguish five layers of interoperability in which each layer include their own actors, concepts and standards, namely:

- Organisational policies: Operational ability to cooperate with other organisations.
- Care processes: Creation of cross-organisational processes and service integration.
- Information: Semantic interoperability.
- Applications: The connection of different independent systems.
- IT-infrastructures: The connection of underlying technical infrastructures.

The layers are comparable with the levels of the Enterprise interoperability framework (figure 3). The only differences are that the information and application layers are reversed and that the IT infrastructure layer is not included. The reason for the latter is that the level is seen as a basic condition for interoperability and considered already achieved (Chen & Daclin, 2006; Leal et al., 2019).

Based on the formulated definition of a healthcare platform, the included healthcare platforms offer at least interoperability at the information, application and infrastructure layers by enabling information exchange between healthcare organisations, PHEs and applications. Related to the other main functions of healthcare platforms (table 2), some platforms also actively engage in the integration of healthcare processes or even in the cooperation of organisations on the organisational policy layer (Fürstenau et al., 2019). In summary, different healthcare platform realizes interoperability on different layers and, as a result, interfere with healthcare in different ways (Nictiz, 2020c; RSO Nederland, 2019).

For the interoperability criterion, four sub-criteria were identified. The criteria consisting of the completeness of infrastructure standards and completeness of communication standards are mainly related to the information exchange function of healthcare platforms. Platforms use infrastructure standards to connect organisations and they use communication standards to translate information, like Health and Care Information Models (HCIMs), into technical representations suitable for exchange. The extent to which platforms can exchange information is dependent on the completeness of these standards. The criteria consisting of process integration and the completeness of applications are more related to the service integration and service innovation functions of healthcare platforms.

Completeness of Infrastructure Standards. Completeness of infrastructure standards refers to the ability of a healthcare platform to connect its users and is related to technical interoperability (Stegemann & Gersch, 2021). Technical interoperability is focused on connecting systems through IT-infrastructures. A precondition is that platforms meet the functional and technical requirements of HISs. The IT infrastructure level then concerns the non-healthcare-specific ICT components. It is the technical level on which information exchange is enabled between all involved parties. It is desirable for platforms to use nationally standardized infrastructures, like XDS, for the exchange of documents and images, and the NEP, for the exchange of medication and GP summaries (HL7 Netherlands, 2020b; MedMij, 2019; Nictiz, 2020a, 2020d; RSO Nederland, 2019; VZVZ, 2020). They have to comply with the requirements of the infrastructures or initiatives by using, among other things, XDS profiles, a well-managed network or certain open standards (see appendix II for more information).

Completeness of Communication Standards. Communication standards are related to semantic interoperability (Stegemann & Gersch, 2021). Semantic interoperability refers to the meaning of the exchanged data and the ease to understand the transmitted message. Difficulties arise when different systems use different concepts for similar or identical concepts. To exchange information between a lot of different systems and applications, semantically interoperable data is required, i.e., the exchanged information must be able to be uniformly interpreted and understood. In general, interoperability can be achieved through the use of standards. In the Netherlands, HCIMs are used as the national standards for semantic interoperability. The platform has to use communication standards, which are technical representations of the data, to make it possible for computer systems to exchange and process the data. A platform has to be at least capable to translate the most commonly used communication standards, such as HL7v2, HL7 FHIR and CDA (see appendix II for more information)(HL7 Netherlands, 2020a; Nictiz, 2020b). Examples of other communication standards are EDIFACT, which is an older standard that is no longer being developed, and DICOM, which is used to exchange digital images (RSO Nederland, 2019). The more communication standards the platform supports, the better the platform is able to translate information for its users.

Process Integration. Related to the second main function of healthcare platforms (table 2), platforms often arrange active collaboration between healthcare organisations by enabling digital support and integration of healthcare processes. Within chain care or care pathways, patients often have to deal with a lot of different healthcare providers from different healthcare organisations. Examples of these pathways are COVID19 care, chronic care and obstetric care (Yaraghi et al., 2015). Process integration is related to the extent to which a platform can integrate processes and align policies for two or more organisations. The platform can realize the former by offering digital support of healthcare processes or by facilitating blended care for complete care pathways. An authorization of WTZi (Wet Toelating Zorginstellingen) is necessary for healthcare platforms to be able to also align healthcare processes on the policy level.

Completeness of Applications. Related to the third main function of healthcare platforms (table 2), platforms often offer or provide interfaces with innovative third party healthcare applications. These applications usually enable functional use of the exchanged information. The completeness of applications is related to the number and variety of healthcare applications that the platform provides access to (Haddara, 2018). Examples are collaboration applications that help providers with referring or transferring patients. Healthcare providers within organisations can also use or prescribe the applications to support the care they provide to patients. Examples of the functions of these applications are home-monitoring, remote healthcare, online chatting, referral assistance, decision aids and the collection of patient-reported outcome measures (PROMs). In the future, there may also be the possibility for platforms to connect more commercial apps which are not specifically made for healthcare.

Reliability

The reliability of the software can be defined as the capability to fulfil its aimed operations and functions in a system's environment, without experiencing disturbances (Efe, 2016; López & Ishizaka, 2017). In other words, it is the system's capability to run consistently without crashing, which is also called "uptime" (Piengang et al., 2019). It is also sometimes referred to as the stability of the system (Hanine et al., 2016). In the study of Haddara (2018), the author mentioned that reliability, together with the functionality of the system or software, are often considered as the most important criteria in the supplier evaluation process. The recovery ability is also part of reliability, which is the possibility of the system to provide a backup. Especially within healthcare, it is important for a system to be reliable. An example of a reason for this is that it can have major consequences when healthcare providers are not able to retrieve or send information in an emergency situation.

Security

Security is related to the protection of the system from unauthorized access to records and data (Cricelli et al., 2020; Hanine et al., 2016; López & Ishizaka, 2017). To control and manage security, the supplier should have the ability to set individual and group access rights (Secundo et al., 2017). Besides, the security of the systems of suppliers is usually dependent on a wide range of organizational, personnel and technical activities. The number of cyber-attacks and the extent to which the supplier takes responsibility are examples of measurements for the performance of the supplier on this criterion. As most organisations store or process personal or high-value data, system security is often considered highly important (Malindzakova & Puskas, 2018).

Modularity
When a platform offers modularity, it is possible for users to only use and pay for the functions that they truly need (Haddara, 2018). This not only results in cost savings but also prevents the need for employees to learn functions that do not have an added value to the organisation. Modularity means that suppliers enable organisations to freely choose the modules they seek to implement without the need to implement the whole package. However, the module framework should consist of software units that are designed compatible with each other (Efe, 2016). Modularity increases when a supplier offers more independently installable modules of the software system (Malindzakova & Puskas, 2018; Secundo et al., 2017). It relates to customization since users can choose a set of modules that best meet the needs of the organisation (Cricelli et al., 2020). Especially when costs are adjusted to the chosen modules, this can result in big advantages for potential users.

Ease of Use
Ease of use can be important for potential users to enable a cost-effective relationship with the platform. Ease of use is the capability of the system to be as user-friendly as possible so that limited training is required (Cricelli et al., 2020). Among other things, it relates to the learnability of the system and the intuitiveness and completeness of the interface (Efe, 2016; Hanine et al., 2016; López & Ishizaka, 2017; Piengang et al., 2019). Especially when the learning curve of using the platform is long due to a hard to understand interface or a lot of unneeded functions, the implementation of a platform may require a lot of training, retraining or consulting sessions (Secundo et al., 2017). On the contrary, the easier the platform is to use, the higher the chance of avoiding unexpected time and cost investments. Specific help features or wizards and the availability of guidebooks and user manuals can also increase the ease of use of the system.

Costs
When an organisation decides that they want to start using specific software, a system or a platform, they likely prepared a budget (Haddara, 2018). In this study, the focus is on the one-off purchasing costs as well as the total direct and indirect costs in the years they intend to use the platform. Malindzakova & Puskas (2018) argue that the price is an essential factor in the choice of a system as it is necessary to set a trade-off between the price and the requirements of organisations. Although a platform must have an attractive price, it is crucial to create realistic expectations for future costs of using the platform (Haddara, 2018). Platforms often charge both direct costs, related to the price of the software itself, and indirect costs, related to maintenance of the software.

Direct costs are the costs that are directly related to the services that the platform offers (Secundo et al., 2017). The relevant direct costs for platforms are the connection costs and the license costs (Cricelli et al., 2020; Efe, 2016; Haddara, 2018; Hanine et al., 2016; López & Ishizaka, 2017; Malindzakova & Puskas, 2018; Piengang et al., 2019). The connection costs are the cost of establishing the connection to the platform and it includes the costs of configuring and deploying the platform according to the needs of the firm. Connection costs are often one-time costs. Besides, license costs represent the costs of using the platform. These costs are often calculated based on the number of users within the organisation and are usually annual or monthly recurring costs.

Indirect costs are not directly related to the services of the platform but these are the general business expenses that keep the platform operating (Secundo et al., 2017). Relevant indirect costs for platform companies are service and update costs (Cricelli et al., 2020; Efe, 2016; Haddara, 2018; Hanine et al., 2016; López & Ishizaka, 2017; Malindzakova & Puskas, 2018; Piengang et al., 2019). The service costs are the costs related to service and support, like training, consulting and troubleshooting. Update costs are the costs related to software maintenance and upgrades, such as the costs of implementing new functionalities. Update costs are the necessary costs to get the latest version of the software.

Table 3: Product criteria including literature references

Criteria	Sub criteria	Literature
Interoperability	Completeness of infrastructure standards / Completeness of communication standards / Process integration / Completeness of applications	(Secundo et al., 2017) *(Yaraghi et al., 2015)* *(Chen et al., 2008)* *(Fürstenau et al., 2019)* *(Leal et al., 2019)* *(Nictiz, 2020c)* *(RSO Nederland, 2019)*
Reliability	Stability / Recovery ability	(Efe, 2016) (Haddara, 2018) (Hanine et al., 2016) (López & Ishizaka, 2017) (Piengang et al., 2019)
Security		(Cricelli et al., 2020) (Hanine et al., 2016) (López & Ishizaka, 2017) (Malindzakova & Puskas, 2018) (Secundo et al., 2017)
Modularity		(Cricelli et al., 2020) (Efe, 2016) (Haddara, 2018) (Malindzakova & Puskas, 2018) (Secundo et al., 2017)
Ease of use		(Cricelli et al., 2020) (Efe, 2016) (Hanine et al., 2016) (López & Ishizaka, 2017) (Piengang et al., 2019) (Secundo et al., 2017)
Costs	Direct / indirect costs	(Cricelli et al., 2020) (Efe, 2016) (Haddara, 2018) (Hanine et al., 2016) (López & Ishizaka, 2017) (Malindzakova & Puskas, 2018) (Piengang et al., 2019) (Secundo et al., 2017)

Supplier Specifications

The supplier specifications are directly related to the characteristics of the supplier of the platform. Information from the eight scientific articles from the literature review was used to identify the criteria within this section (table 1 in appendix I). Two criteria and six sub-criteria were expected to be relevant for the context of platforms in Dutch healthcare. In table 4, an overview is shown of the supplier criteria including their literature references.

The first main criterion is the reputation of the supplier. It is related to the extent of trust in the supplier. This criterion was found in six of the eight articles from the literature review (articles 1-4, 7, 8). The second main criterion is customer service and support. This criterion consists of all activities designed to meet the customers' needs and requests and was considered relevant in all eight articles (articles 1-8). In the articles, no additional supplier specifications were found that were not taken into account in this study.

Reputation

The reputation of a supplier is related to the trust of potential users in the supplier. From the articles, it became clear that reputation can be divided into three sub-criteria. These criteria are the market share, the references and the experience of the supplier (Cricelli et al., 2020; Efe, 2016; Haddara, 2018; Hanine et al., 2016; Piengang et al., 2019; Secundo et al., 2017). Cricelli et al. (2020) and Piengang et al. (2019) also refer to the market share as the popularity of the supplier in the market. Regarding the references, Efe (2016) and Haddara (2018) mentioned that the number and quality of references, about products or services supplied in the same type of industry, can be considered vital during the selection process of a supplier. When multiple users are positive about a supplier, there is a higher chance that similar users will also be positive about the supplier and willing to employ its products. Finally, the length and extent of in-depth experience are expected to have an influence on the reputation of a supplier (Secundo et al., 2017). Overall, the supplier's reputation is important in determining the probability of long term contentment of the user with the supplier.

Customer Service and Support

Customer service and support consist of all activities that have the goal to offer customers solutions to a potentially wide range of problems, needs or requests (Cricelli et al., 2020). The criterion can roughly be divided into three sub-criteria, namely: consultancy, training and maintenance. Consultancy is related to the availability of support from suppliers, both in the provision of information technology expertise and in the provision of contextual industrial expertise (Haddara, 2018; Piengang et al., 2019). High-quality consulting services usually include a short response time, which is the time between a notification and the first response from the supplier, and extensive opening hours of the customer service (Secundo et al., 2017). The second sub-criterion is related to the extent to which the supplier provides training and retraining (Malindzakova & Puskas, 2018). The performance on this criterion is dependent on the number and quality of training courses (Piengang et al., 2019; Secundo et al., 2017). Finally, examples of maintenance processes include technical problem solving and troubleshooting as well as the installation of updates and upgrades, like relevant security updates and the implementation of new functionalities (Cricelli et al., 2020; Hanine et al., 2016; López & Ishizaka, 2017; Secundo et al., 2017). Maintenance can also be defined as the extent to which suppliers ensure the best utility and security of their systems. Several components can improve the performance of suppliers on this criterion, such as the existence of a planned roadmap for the next stable software releases, the indication of management priority for identified issues and the maximum time of issue resolution (Secundo et al., 2017). Overall, customer service and support are important for customers to get more value out of the product or service. It also helps to ease transitions to new systems and to realize a smooth running of the current system (Malindzakova & Puskas, 2018).

Table 4: Supplier criteria including literature references

Criteria	Sub criteria	Literature
Reputation	Market share / References / Experience	(Cricelli et al., 2020) (Efe, 2016) (Haddara, 2018) (Hanine et al., 2016) (Piengang et al., 2019) (Secundo et al., 2017)
Customer service and support	Consultancy / Training / Maintenance	(Cricelli et al., 2020) (Efe, 2016) (Haddara, 2018) (Hanine et al., 2016) (López & Ishizaka, 2017) (Malindzakova & Puskas, 2018) (Piengang et al., 2019) (Secundo et al., 2017)

For clarity, table 5 is constructed in which the meaning of all criteria and sub-criteria is summarized. The table provides the complete overview of the criteria that were found through the literature research and that were expected to be relevant for the supplier selection context of this study.

Table 5: Overview of all criteria and sub-criteria including their meaning

	Criteria	Sub criteria	Meaning
Product criteria	Interoperability	Completeness of infrastructure standards	The ability of a platform to comply with trust frameworks and establish or connect to infrastructures (among others): • Comply to AORTA / Use of NEP (Access to medication and GP overviews) • Comply to MedMij / Use of FHIR API (Access to approved PHEs) • Comply to IHE-XDS profiles / Use of XDS (Access to affinity domains and other healthcare organisations)
		Completeness of communication standards	The ability of a platform to translate different communication standards (among others): • HL7v2 • HL7 FHIR (documents) • CDA (documents) • EDIFACT • DICOM
		Process integration	The ability to integrate processes and align policies for two or more organisations.
		Completeness of applications	The number and variety of healthcare applications (among others): • Home monitoring • Remote healthcare • Online chatting • Referral assistance • Decision aids • Collection of PROMs
	Reliability	Stability	Percentage of uptime per day/week/month.
		Recovery ability	The ability to provide backups.
	Security		The extent to which the system is protected from unauthorized access.
	Ease of use		The extent of learnability of the system, the intuitiveness and completeness of the interface and the number of available guidebooks and user manuals.
	Modularity		The extent to which users can choose a customized set of modules/functions and pay accordingly.
	Costs	Direct costs	The total one-off connection costs and the total licence costs per month/year.
		Indirect costs	The total service costs per month/year and the total update costs per month/year.
Supplier specifications	Reputation	Market share	The percentage of the total revenue or sales in a market.
		References	The number and quality of references of products or services supplied in the same type of industry.
		Experience	The length and extent of in-depth experience.
	Service and support	Consultancy	The quality of consulting services, dependent on the length of the response time and the opening hours of the customer service.
		Training	The number and quality of training courses.
		Maintenance	The quality of maintenance, dependent on the number of updates and upgrades per month/year.

Methods

In this study, the goal is to determine the relevant criteria and their importance from the perspectives of different stakeholders in the selection of a platform supplier. The research that is needed to do so can be divided into two parts. The first part is used to determine a complete set of criteria and sub-criteria which are relevant for comparing healthcare platforms. A literature review is executed and individual and focus group interviews are conducted to find this set of criteria. Qualitative research is used because it is associated with a holistic perspective in contrast to a specific focus in quantitative research. The holistic perspective is necessary for the first part of this study to understand the relevance of criteria in their context and to be able to identify and describe their relations and interdependencies (Denscombe, 2014). In the second part, the importance of the criteria is determined with the AHP method where the judgements are collected with the help of a questionnaire. As the goal is to measure the importance weights of a specific, predetermined set of criteria, quantitative research is most suitable in the second part of this study.

Part 1: Individual and Focus Group Interviews

The goal of the individual and focus group interviews was to explore and verify the criteria that are relevant to compare healthcare platforms. The technique of interview emphasizes the in-detail and holistic description of relationships, activities, materials or situations (Dilshad & Latif, 2013). The qualitative research interviews focus on the perspectives of respondents and are used to obtain information based on emotions, experiences and privileged insights.

Whenever possible, group discussions were chosen over individual interviews, because they result in a larger amount of data from a larger number of respondents within a limited time frame, compared to an equivalent number of interviews (Ochieng et al., 2018). A focus group is *"a group comprised of individuals with certain characteristics who focus discussions on a given issue or topic"* (Anderson et al., 1998)(p.241). According to Denscombe (2014), focus groups consist of a small group of people who are brought together by a trained moderator to explore attitudes, perceptions and ideas about a topic. Unlike individual interviews, group discussions build on the group dynamics to explore an issue in context, depth and detail. As a result, the information obtained reflects the social and overlapping nature of knowledge.

As there were many cancellations at the group meetings, several separate in-depth interviews were conducted to be able to include the perspectives of more experts in the research. The advantage is that this type of interview can provide a high level of detailed information as the opinions and experiences of the experts can be explored in more depth (Boyce & Neale, 2006; Morgan, 1996a). Research also shows that focus group participants only produce 60% to 70% as many ideas as they would have from individual interviews and that the quality of ideas from individual interviews is higher. However, the discussions within focus groups make participants question and explain themselves to each other which offers more valuable data on the extent of consensus and diversity among participants, compared to the sum of separate individual interviews.

The focus group method also has some additional limitations. It can be hard to differentiate responses between different participants and to establish equal contributions of all participants to the discussions (Dilshad & Latif, 2013; Smithson, 2000). Examples of issues are that one or several dominant individuals within a group result in limited opinions to be heard and the likelihood of group dynamics resulting in the tendency of participants to reproduce normative discourses. However, these limitations are minimized by taking some measures. Firstly, the group size was limited to reduce disorderly or fragmented discussions. Secondly, in each discussion, a prepared moderator was present who observed the process and intervened when necessary. Finally, the sound and camera images of the sessions were recorded so the researcher could perform a comprehensive analysis of the discussions.

The discussion of the methodology will be divided into five sections. These include the selection of participants, the general interview technique for data collection, the additional features of the focus group technique for data collection, the data analysis and the model development.

Selection of Participants

In the first instance, the goal was to organise two world café sessions of at least twelve experts with diverse backgrounds. However, due to a lack of participants and many cancellations, it was not feasible to perform the sessions. As focus groups usually consist of a minimum of four participants, it was possible to convert both world cafes into focus groups (Denscombe, 2014; Dilshad & Latif, 2013). Ultimately, the groups were large enough to gain a variety of perspectives and small enough to not become disorderly or fragmented (Ochieng et al., 2018).

For the selection of the experts, expert sampling was used. Expert sampling is a purposive sampling technique, which is characterized by the deliberate choice of a participant based on the qualities the participant possesses (Etikan, 2016). Participant identification is one of the most critical steps in group discussion techniques as the success of a discussion is dependent on the participants' ability and capacity to contribute and because the techniques are largely based on group dynamics and synergistic relationships to generate relevant information (MacFarlane et al., 2017; Ochieng et al., 2018). In table 6, the criteria are mentioned which were used to select the participants for the group sessions. The first criterion is used to support homogeneity in the group. The willingness to fully engage in a group discussion is crucial in generating useful data and can be achieved more readily within a homogenous group (Denscombe, 2014; Dilshad & Latif, 2013).

The second criterion is used to ensure that the experts can bring relevant and in-depth knowledge to the discussion. The focus group method is designed with the aim to bring stakeholders together for a specific conversation (MacFarlane et al., 2017). In this study, the specific conversation is related to healthcare platforms and therefore, it is important to select experts based on their relation to the platforms. Firstly, experts with a healthcare perspective, who are working or going to work with the platform, are important to include. These experts may be healthcare providers, but also managers within healthcare organisations. Secondly, experts with a supplier perspective, who have knowledge about the platform's functionalities and the way they are organized, are important to include. Finally, ICT experts, who have knowledge about the underlying mechanisms of the platform and its possibilities, are important to include. By including all different perspectives, the chance to collect an as complete as possible overview about the relevant criteria increases.

In order to compose groups of experts with all relevant points of view, criteria three and four are composed. For the use of expert opinions, it is important to be aware of the potential biases that may invalidate the consultations (Montibeller & Von Winterfeldt, 2015). Especially motivational bias is important in this study because different experts have different opinions about the way information exchange should be organized in Dutch healthcare. Motivational bias occurs when judgements are influenced by the desirability or undesirability of certain outcomes, for example, the attempt of experts to provide optimistic forecasts for a preferred action or outcome. An important technique that is used in this study to mitigate the impact of motivational bias is to include multiple experts with alternative perspectives in the same session. Focus groups, although to a lesser extent than world café sessions, are a suitable approach to do this because it offers the possibility to include several persons with different characteristics (Löhr et al., 2020).

The Dutch ICT-consultancy M&I/Partners, which is also the company that commissioned this study, assisted in the recruitment of the participants. In the first instance, the goal was to contact a minimum of eighteen experts per world café session to anticipate the lack of guarantee that all those recruited will attend the discussion (Ochieng et al., 2018). However, due to a lack of suitable participants and many cancellations, this number turned out not to be enough for world café sessions. As a result, it was chosen to convert the sessions into focus groups for which there were enough experts present per session. In purposive sampling, the sample size is not determined by statistical power analysis, but by data saturation. This means that interviews with experts were scheduled until little to no new information was gathered during the interviews. The goal was to conduct interviews until a clear pattern emerged of a complete set of relevant criteria.

Table 6: Criteria for expert selection per focus group session

	Criteria	Aim
1	The expert speaks Dutch and followed at least Higher Vocational Education.	Support homogeneity
2	The expert's qualities are based on: - The healthcare perspective: experts with (potential) practical work experience with the platform; or - The platform supplier perspective: experts with knowledge about the selected healthcare platforms and the way they are organized; or - The ICT perspective: experts with knowledge about the relevant infrastructures or standards which are used by healthcare platforms.	Relevant knowledge from all experts
3	In each session, at least one expert with the healthcare perspective, at least one expert with the platform supplier perspective and at least one expert with the ICT perspective needs to be included.	Alternative points of view in each session
4	Experts from the same perspective should complement each other in the field of their main qualities and backgrounds.	Alternative points of view in each session

Data Collection – Interviews

As both individual and group interviews were used, this section will first focus on the general interview technique for data collection that was used in both interview types. In the next section, the additional features of the focus group technique for data collection will be discussed. A minimum of one hour was planned per group interview and a minimum of 30 minutes was planned for the separate interviews.

Standardization was used in both the individual and group interviews. This means that predetermined identical questions and procedures were the basis of every interview. A more standardized approach is appropriate for this research as literature research was already been conducted into the criteria, based on which a first impression of the relevant criteria had already been obtained. Advantages are that a high level of comparability can be produced across participants (Boyce & Neale, 2006). It also ensures consistency between interviews and thus increases the reliability of the findings. To use a standardized approach, semi-structured interviews were conducted using the questions from a protocol. The interview protocol includes the instructions and the theme's that were discussed in each interview (see appendix IV).

In the introduction of each interview, the participants were welcomed, the research was introduced and the purpose and organisation of the gathering were discussed. Then, some background information about healthcare platforms, including the definition, was talked through and some supporting figures were shown. After the introduction, three themes were discussed for approximately 20 minutes each. In the separate interviews, this was approximately 10 minutes each. The three themes were: platform criteria, in which was focused on the characteristics of the platform itself; supplier criteria, in which was focused on the characteristics of the supplier of the platform; and interoperability criteria, in which was focused on the main function of the platforms (see also appendix IV). Per theme, the first set of questions was based on the identification of the relevant criteria and sub-criteria for that theme. As different experts considered different criteria as relevant, they were encouraged to clarify the reasons why they thought certain criteria were more relevant than others. In the second and third set of questions, the experts were given the possibility to go into more detail about the criteria. They were also given the possibility to give their opinion on the relevance or irrelevance of the criteria and to provide missing criteria. When the interview was coming to an end, a deeper line of inquiry was used by discussing the way the criteria can be measured. Also, criteria that had not been mentioned until then, but were found from literature research, could now possibly be brought up for discussion.

The interviews were held online on the Microsoft Teams platform. The reason for the online meeting were the regulations related to the COVID-19 pandemic (Rijksoverheid, 2020b). At the time of conducting the research, there was an urgent advice to work from home and to avoid forming groups of more than two people. Advantages of the online meeting were that the participants did not have to travel to a specific location which could have saved time and lowered the threshold to participate in the study. Disadvantages of the online sessions could be technical problems such as poor or loss of connectivity and failure to capture non-verbal data. The effect of the latter one was mitigated by the use of the camera by all participants during the meeting and by recording the session. For the recording, the consent of all participants was asked before the start of the session.

The main methods of data collection during the interviews included audio and tape recording, note-taking and participant observation (Ochieng et al., 2018; Onwuegbuzie et al., 2009). In this study, the data was collected by the recording option that is incorporated in the Microsoft Team program. Also, handwritten notes were taken where necessary and participants were observed during the discussions via the live camera images.

Data Collection – Focus Groups

Although the data collection of both the individual and group interviews is largely organized in the same way, focus groups have some specific characteristics. The goal of the focus group sessions was to compose groups with homogeneous strangers in which structured discussions were held in a formal setting (Morgan, 1996a). Besides, the presence of a moderator is one of the distinguishing features of focus groups. In this study, the researcher acted as the moderator. The moderator was responsible to organise the session by selecting the members and by arranging the sessions at a time when most members could attend. During the sessions, the moderator introduced the topic; tried to create a comfortable environment; kept the discussion focussed around the topic; and concluded the session at the end. Besides, she made sure that the discussion was recorded and took notes about striking non-verbal behaviours and potential further questions to ask during the discussions. The biggest difference of the moderator's role, compared to the interviewer's role, is that a moderator encourages participants to talk with one another (Denscombe, 2014). Instead of an interviewer, who is the focal point of interactions, posing the questions and dictating the sequencing of talks, a good moderator stands back and let the group talk among themselves. In principle, the moderator helps the group rather than leading it. In this study, the moderator, for example, encouraged all members to participate and requested overly talkative members to let others talk (Ochieng et al., 2018; Onwuegbuzie et al., 2009).

Research suggests that it is also ideal to have an assistant moderator (Ochieng et al., 2018; Onwuegbuzie et al., 2009). The assistant moderator is responsible for the recording of the session, the controlling of the environment and the verification of the data from the focus group discussions. Since the meeting was held online, the recording of the meeting and the controlling of the environment was easier. The moderator was therefore responsible for these tasks. However, the researcher's supervisor, who also possesses the relevant information about the research, was present in the focus group meetings and did also monitor these tasks. After the session, the data was also verified by discussing the main outcomes of the sessions with the assistant moderator.

Data Analysis

A mixed-method, transcript-based content analysis was executed. A transcript-based analysis was used to analyse the data from the focus group sessions and interviews, meaning that that the first step of the analysis was to create a full transcript of the audio or videotapes (Onwuegbuzie et al., 2009). Thereafter, a content analysis was executed which was a mix of both a qualitative and quantitative method. On the one hand, the results included qualitative information in the form of rich descriptions of the relevant criteria (Ochieng et al., 2018; Onwuegbuzie et al., 2009). On the other hand, the results included quantitative information as codes were created and counted for all criteria that were mentioned. According to the three-element coding framework of Morgan (1996b), there are three ways in which classical content analysis can be used with group data, namely: to identify whether each participant used a given code; to identify whether each group used a given code and; to identify all instances of a given code. In this study, quantitative information is provided regarding the frequency of participants that used the code and all instances of the codes. As both individual and group interviews were conducted, the third option for quantitative information was not used.

Model Development

In the first stage of the analysis, a long list of potential criteria was identified. This list was shortened based on the properties that are required for the final set of criteria. These properties include:

- Completeness: All relevant criteria for the decision should be included.
- Non-redundancy: Unimportant and unnecessary criteria should be removed. For example when all alternatives have the same performance on a criterion.
- Nonoverlap: All criteria need to measure separate objectives.
- Preference independence: The performance on a criterion should not depend on the performance of other criteria.

Examples of discarded criteria are criteria that are only evaluable when the platform is actually deployed to the organisation and which are dependent on the organisational environment. Criteria were also discarded when they turned out to be outdated concerning the current functions of healthcare platforms or when they represent basic features that the vast majority of the platforms support, such as identification and authorisation. The remaining criteria were then synthesized and classified in criteria describing conceptually close features, resulting in a final set of criteria and sub-criteria.

To ensure validity and reliability in the second part of the study, it was important to consider the number of criteria (Saaty & Ozdemir, 2003). In AHP, preference judgments are made on pairs of elements in a group. However, there is an upper limit on the capacity of the mind to process information on interacting elements with reliable accuracy and validity. By making all possible paired comparisons, there is redundancy in the information provided, which is needed to improve the validity of the outcome. However, the more judgments are made, the less consistent they become. To ensure an acceptable consistency index, the number of elements per category is limited to seven (Saaty & Ozdemir, 2003).

As a final step, a value tree was constructed to support the identification of criteria (Marsh et al., 2016). A value tree decomposes the objective of an evaluation into sub-objectives, organizing them into a hierarchy by clustering them into higher-level and lower-level objectives. In this study, the first level consisted of the decision problem itself, which is the selection of the most important criteria. In the layers below, a top-down approach was used to decompose the criteria (level 2) into sub-criteria (level 3).

Part 2: Questionnaire

In the second part of the research, the importance of the criteria is determined with the help of the pairwise comparison technique. A questionnaire is designed and answers were collected and analysed from different stakeholders within healthcare. Stakeholders with different job positions and working in different sectors and healthcare organisations were selected to gain more insight into possible differences between their judgments.

The pairwise comparison technique is a technique that is used in AHP. In AHP, decision problems are evaluated by determining the relative importance of criteria and the performance of available solutions (Saaty, 1990). AHP is one of the most extensively used Multi-Criteria Decision-Making (MCDM) methods and is a suitable technique for analysing a large number of both quantitative and qualitative criteria and sub-criteria (Bhutta & Huq, 2002; Velasquez & Hester, 2013). The decision can include medical, technical, economic and social aspects. Subjective judgments on aspects of a problem for which no scale of measurement exists can also be included. Weight elicitation through pairwise comparison of criteria is preferred when taking into account its superior ability to discriminate between criteria and respondents' preferences (van Til et al., 2014). This is of added value for this research where the goal is to compare judgements from different stakeholder groups. Besides, its ability to distinguish between criteria of high and low importance brings advantages in prioritizing the criteria that are most important for estimating the value of healthcare platforms for the decision-makers.

A rating technique is chosen instead of a ranking technique because it has the possibility for equal weight and more weight discrimination. (Guitouni & Martel, 1998; Marsh et al., 2016). One of the reasons why the pairwise comparison technique is chosen over a choice-based technique is that rating tasks result in a lower respondent burden. This is especially important in the decision problem of this study because a lot of criteria and sub-criteria are included. An advantage of a reduced burden for the respondents is that this maximizes the response efficiency. Besides, low analytic skill requirements are needed. Since there is a limited time horizon available for the execution of this study, it is expected that it is not possible to master the analytical skills that are required with the choice based technique.

In the next section, the selection of the participants will be discussed. Then, the judgment stage and synthesis of the results of the AHP analysis are discussed. The remaining sections will include the subgroup analyses and ethical considerations.

Selection of Participants

The sectors in healthcare can be divided into cure and care. It is chosen to focus on hospitals and mental health institutions, belonging to the former sector and nursing homes, care homes, home care and disabled care institutions belonging to the latter sector. See also table 7 for the type and number of small and medium and large organisations in the Netherlands per sector (CBS, 2019b). Important to note is that other organisations, like GPs or organisations focussed on youth care or social relief, are outside the scope of this research. Also, small organisations with less than ten employees are not included. The reason for this is that these organisations are unlikely to use a healthcare platform for their organisation.

*Table 7: Type and number of Dutch healthcare organisations *Small: <10 FTE, medium and large: >10 FTE*

Sector	**Type**	**Number of medium + large organisations**	**Number of small organisations**
Cure	Hospitals	82	0
	Mental healthcare institutions	133	200
Care	Nursing and care homes and home care	992	22.000
	Disabled care institutions	458	1.850

There is no general rule for the sample size in AHP. However, the selection of the respondents should ensure representativeness of the results (Saaty, 2008). The number of organisations that make extensive use of healthcare platforms is expected to be small. Moreover, a limited group of decision-makers are involved in the selection of the platform within a healthcare organisation. This results in a relatively small study population. This means that the required sample size to achieve representativeness can also be small. To ensure representativeness, stakeholders from different sectors and types of organisations are represented that also have different job positions. As healthcare platforms are still mostly aimed at hospitals, it may be the case that fewer stakeholders within the other organisations are able to fill in the questionnaire.

The respondents in this part of the study were recruited by convenience sampling. The practical criteria, which were availability and willingness to participate, were included (Etikan, 2016). The goal was to collect 50 completely filled in questionnaires. It was decided to stop collecting respondents once this number is reached due to the time restrictions. Besides, the customer base of M&I/Partners was used to approach the respondents via mail. This customer base consists of consultants, project leaders and managers, like CIOs (Chief Information Officers) and CTOs (Chief Technology Officers), within healthcare organisations from both the care and cure sectors. In the mail and the introduction of the questionnaire was indicated that the questionnaire is about selecting a healthcare platform. However, since it could not be determined in advance to what extent the approached persons have knowledge about healthcare platforms and influence on the selection of a platform within an organisation, these questions were added to the questionnaire. In this way, respondents without enough knowledge or influence of decision-making could be excluded.

Judgement Stage

In the judgement stage, the data was collected from decision-makers within healthcare organisations using a questionnaire (appendix V). The respondents were individually approached via mail. In the mail and the introduction of the questionnaire, the researcher and the commissioning company were first introduced. Then, a short introduction about the topic was given and information about the structure of the questionnaire, the expected duration to fill in the questionnaire and matters concerning consent, voluntary participation, confidentiality and anonymity were indicated.

The remainder of the questionnaire consisted of questions about background characteristics, questions about knowledge and experience and questions about the importance of different selection criteria. The questions regarding the respondent's background and relevant knowledge and experience were necessary to be able to explain possible differences in respondents' preferences. The background related questions are, among other things, about the respondent's job position and about the kind and size of the healthcare organisation for which he or she works. The questions related to the respondent's knowledge and experience are about the respondent's expertise in the field of healthcare platforms, health ICT and healthcare processes and about the probability of the respondent to have an influence on the choice for a healthcare platform.

In the questions about the importance of the criteria, the criteria were compared using the pairwise comparison technique (Hummel et al., 2014). The respondents were asked to judge the importance of the level 2 criteria on a reciprocal numeric scale ranging from 1 to 9. In AHP, the numbers are associated with verbal statements ranging from equally important (1) to extremely more important (9) (appendix III, table 1). The total number of comparisons is calculated as follows: n(n-1)/2 = … = … comparisons, where n is the number of criteria. In figure 4, an example of the task format is shown in which the two criteria reputation and financial health are compared against each other. Using the slider, the respondents could indicate which of the criteria they considered more important and the extent to which this was the case.

Figure 4: Example of the task format that was used in the questionnaire

Synthesis of Results

The first step in synthesizing the results was to fill in the comparison matrix (Saaty, 1990). The diagonal elements of the matrix always have a value of 1. All the elements that are on the left side of 1 are filled with the actual judgement values and all the elements that are on the right side of 1 are filled with the reciprocal values. When the comparison matrix is filled, the priority vector will be computed to calculate importance weights from the matrix. In this analysis, the priority vector is an approximation of the normalized Eigenvector of the matrix (Saaty, 2003). First, the normalized relative weight can be calculated by dividing each element of the matrix by the sum of its column. Next, the priority vector can be obtained by averaging across the rows. The last step of each individual analysis is to check the consistency of the judgement values. In order to do so, the Principal Eigenvalue (λ_{max}) is obtained by summing the products between each element of the Eigenvector and the sum of the columns of the matrix. The consistency index (CI) is calculated as follows:

$$CI = (\lambda_{max} - n)/(n - 1)$$

The Consistency Ratio (CR) can then be calculated by dividing the CI by the Random consistency Index (RI) value belonging to the matrix size, which can be found in table 2 in appendix III (Saaty, 1980). Analyses with consistency ratios less than or equal to 0.1 are considered acceptable.

Subgroup Analyses

To determine whether the importance weights differ among different stakeholder groups, subgroup analyses have been performed. The subgroups are created based on the sector and organisation type in which the respondents work and on the respondents' job positions. Once the respondents were divided into subgroups, the importance weights per group were determined in the same way as was done for determining the weights for the total group.

As an additional step, it was examined whether there are significant differences between the importance weights of the subgroups. As the sample sizes are small and the data deviates from acceptable distribution patterns, the Mann–Whitney U test and Kruskal–Wallis test are used which are the nonparametric equivalents of the Student's t-Test for independent samples and the parametric One-way Analysis of Variance (ANOVA)(MacFarland & Yates, 2016a, 2016b). The minimum sample size needed to conduct the tests is eight for the Mann–Whitney U test and sixteen for the Kruskal–Wallis test (Dwivedi et al., 2017). This means that the analyses were conducted on all subgroups.

With the Mann–Whitney U test can be determined whether there is a difference in the dependent variable for two independent groups, which is applied for the analyses of the groups that are based on the sector and job position type. Besides, the Kruskal–Wallis test can determine whether there is a difference for comparisons of three or more groups, which is applied for the analysis of the groups based on the organisation type. In this study, the dependent variable consists of the importance judgements. The null hypothesis (H_0) is that there is no statistically significant difference ($p < 0.05$) between the effective weights of respondents from the analysed subgroups.

The only assumptions for carrying out the tests are that the groups are independent, that the dependent variable is ordinal or continuous and that the shape of the distributions of the dependent variable is similar for each group. Prior to the study, it was already clear that the data satisfies the first two assumptions. To check the third assumption, the shapes of the distributions were examined before conducting each test. It could be concluded that the distribution of the importance weights is positively skewed (right-skewed) on most criteria and groups, which means that the third assumption is also met. The SPSS (Statistical Package for the Social Sciences) software was used to conduct the analyses.

Ethical Considerations

The following ethical aspects were taken into account during the research: consent, voluntary participation, confidentiality and anonymity. This was done by deleting all information about the respondents that can be used to trace them back. Besides, each potential respondent was fully informed about the study before he or she gave consent to participate in the study. This means that it was shared what the research goals are; it was indicated how anonymity and confidentiality of the information about the respondent will be taken into account; that participation in the study is voluntary; and that they can withdraw from the research at any time without explanation. For the focus group and separate interviews, this was discussed verbally with all respondents and they were asked, after the recording started, to indicate their willingness to participate in the research. For the data collection in the second part of the study, it was indicated on the questionnaire. The questionnaire included a tick box to indicate their willingness to participate in the research. After the collection of the data, participants received the researcher's contact details, which they could use for questions or remarks. The respondents also received a summary of the research results once the research was completed. In addition, the research proposal is assessed by the ethics committee for Behavioural, Management and Social sciences (BMS) of the University of Twente. This is done to confirm that the research is conducted in an ethically responsible manner.

Results

In this section, the results from the individual and focus group interviews and the results of the questionnaire are discussed. For clarity, this section is again divided into two parts. The first part includes the results of the interviews regarding criteria identification and the second part includes the results of the questionnaire regarding the importance of the criteria.

Part 1: Results from the Interviews

Two focus group sessions with six and five experts and five interviews, of which three with one expert and two with two experts, were conducted. After the final interviews were conducted, enough extensive information about the completeness of the criteria was gathered. No new relevant information emerged during the latest interviews which indicated data saturation. In total, fourteen experts were interviewed with different areas of expertise. Besides, all experts have five or more years of experience in the field they work in. See table 8 for an overview of the experts' characteristics.

Table 8: Characteristics of the experts who participated in the interviews

	Respondent	Expertise		Experience	Duration
Focus group 1	Expert 1	Cure	- Healthcare perspective	>10 years	59:32
	Expert 2	Cure	- Healthcare perspective	>10 years	
	Expert 3	Government	- ICT perspective	>10 years	
	Expert 4	Care	- Healthcare perspective	>10 years	
	Expert 5	Cure	- ICT perspective	>10 years	
	Expert 6	Cure	- ICT perspective	6 years	
Focus group 2	Expert 1	Cure	- Healthcare perspective	>10 years	1:45:42
	Expert 2	Cure	- Healthcare perspective	>10 years	
	Expert 7	Government	- ICT perspective	>10 years	
	Expert 4	Care	- Healthcare perspective	>10 years	
	Expert 5	Cure	- ICT perspective	>10 years	
Interview 1	Expert 8	Cure	- Platform supplier perspective	10 years	17:22
Interview 2	Expert 9	Care	- Healthcare perspective	>10 years	49:28
Interview 3	Expert 10	Care	- Platform supplier perspective	>10 years	18:43
Interview 4	Expert 11	Cure	- Platform supplier perspective	>10 years	27:55
	Expert 12	Cure	- ICT perspective	5 years	
Interview 5	Expert 13	Cure	- Platform supplier perspective	7 years	26:47
	Expert 14	Cure	- Platform supplier perspective	>10 years	

Description of Criteria

In table 9, the complete set of criteria and sub-criteria, including their description, is shown. In this section, the results from the qualitative part of this study will be discussed.

Cost Criteria. In the interviews, three types of cost models were mentioned, namely: one-off connection costs, service or license costs and transaction costs. In one of the focus groups, expert 2 mentioned that different cost models result in different advantages for different organisations. Most platforms charge high one-off connection or purchasing costs in combination with subscription costs for maintenance and management. This means that organisations have to invest a lot before they are able to use the platform. In contrast, other platforms charge costs per transaction in which they invest in the one-off connection costs themselves. The former cost model may be less suitable for smaller organisations, especially when there are no subsidies available. For them, a cost model based on transactions may be cheaper and more feasible as they have the possibility to build up the costs when they start using the platform more. On the other hand, the transaction costs may be less advantageous for large organisations with many transactions for whom the model will result in high recurring costs.

Functional Specifications. Four types of functional specifications were mentioned. Regarding the first criterion, the number and type of connected healthcare organisations were considered relevant. Expert

1 in focus group 2 for example mentioned that some platforms only focus on certain types of healthcare organisations, like hospitals, or only have a few organisations actually connected. Additionally, expert 2 and 5 in the same focus group mentioned that the more connected organisations, the more valuable the platforms becomes to the other users.

The second criterion is related to the possibility and extent to which a platform is connected to national infrastructures and trust frameworks. Examples of initiatives that were mentioned in the interviews are Twiin, NEP and Nuts. These are used for information exchange between organisations. Besides, MedMij was mentioned as an important initiative for exchange between organisations and patients. The possibility of the platform to use communal facilities was also often mentioned. Initiatives are set up in which national tools are being developed in which patient consents can be registered and requested (Mitz) or in which organisations can use a national healthcare address book (Zorg-AB). The goal of these initiatives is to let the tools act as shared services for all parties involved in information exchange. It can be valuable for platforms to start using these tools because, in the current situation, patient consents need to be registered separately for every infrastructure and every infrastructure has its own address books. By using the infrastructures, trust frameworks and tools from initiatives, a platform can offer more efficient and cheaper solutions.

Third, the number and type of connected healthcare applications or modules were considered relevant. For organisations that are looking for additional functionalities, applications can be used to support their healthcare processes. Expert 2 and 4 in focus group 1 mentioned that, when a platform can exchange all kinds of information, they can offer a much more creative and larger market for innovative applications to offer all kinds of functionality and added value. When platforms give applications the possibility to do so, it is no longer necessary for application owners to establish all connections, with their multitude of associated requirements, themselves. Instead, they can focus on the functionality of the application itself. It is expected that, the better the platform opens up to these applications and the more applications they offer, the more valuable the platform becomes. The reason for this is that healthcare organisations can choose from more functionalities to support their processes.

Finally, communication services, like chat, message or mail services were mentioned. Some platforms offer these services and have a large community that can be reached. The number and type of connected healthcare organisations and providers that use these services were again mentioned to be relevant to determine their value for other providers.

Technical Specifications. For the technical specification, seven sub-criteria were identified. About the connectivity of the platform was said that platforms need to collaborate with suppliers of different HISs to be able to provide connections to their systems. Especially experts from the platform supplier perspective, experts 10 till 14, mentioned that platforms sometimes support only one type of HIS or that they enter into preferred partnerships with certain HIS suppliers. The possibility and extent to which platforms support integrations with information systems from different suppliers, possibly via other platforms, therefore belong to this sub-criterion.

Flexibility is defined as the extent to which various standards are supported for the realization of customization in integrations. Expert 11 and 12 in interview 4 for example mentioned that some platforms only support one standard or a fixed set of standards and do not deviate from this. In contrast, others support all kinds of national and custom-made standards which means that an organisation does not have to make large investments in adjustments of its system or used standards before it can connect.

Interoperability is the extent to which different types of information can be shared and used between systems and applications. Expert 5 and 7 in focus group 2 for example mentioned that platforms need to support a lot of different standards to be able to exchange different types of information, such as messages, images, documents and HCIMs. They also should have the possibility to translate the different standards into each other. Expert 11 added that the fact that a platform can integrate two parties does not say a thing about the possibilities to exchange different types of information. He mentioned an example of an integration in which one platform is only able to send some alerts, while others are able to exchange many different types of directly usable information.

Completeness refers to the ability of a platform to offer different functional specifications at the same time. In the focus groups was mentioned that, when a platform offers a broad product offering, organisations can use one platform for all their needs. This is better than when they have to use and manage multiple platforms, resulting in a higher burden.

Modularity refers to the number of modules that can be purchased independently. Expert 7 in focus group 2 mentioned possible differences between platforms, where customers, on the one hand, only have the possibility to pay one price and are stuck to the whole package or where they, on the other hand, can license connections separately and pay for it separately. Also, expert 9 empathized the relevance of modularity as some customers are only interested in one module and do not have the financial ability to pay for additional functionalities that they do not need.

The degree of security of the platform itself and the transport and processing of data is also considered a relevant criterion. Especially in focus group 2, a discussion between experts arose in which it became clear that it is not always clear what the minimum security requirements for a platform are. Especially uncertainties about whether platforms store and transform data and whether platforms need to use end-to-end encryption were topics of the discussion. Laws, regulations and trust frameworks consist of some requirements concerning the necessary security. However, platforms have different ways to adhere to these requirements, which was also the reason to include this criterion in the study. Besides, existing nonmandatory certifications, like NEN 7510, are important standards for information security in healthcare under the GDPR (General Data Protection Regulation). The number of NEN or ISO certifications can give a proper indication of the degree of security that the platform maintains.

The final technical specification is scalability. Scalability is defined as the extent to which an increasing number of users and transactions can be supported by, among other things, the reuse of infrastructures. Expert 11 mentioned that, when platforms reuse connections, it is no longer necessary for customers to pay a large amount of money every time they need a new connection.

Supplier Specifications. In the last category, five supplier specifications were included. The first sub-criterion is the vision of the company. In the interviews, this criterion was often related to the roadmap. Expert 7 explained in focus group 2 that he understands the vision of the supplier as the way in which they deal with the implementation and development of all kinds of new standards, innovations, updates and all kinds of versions of existing standards. It also includes the extent to which they follow this plan closely or whether they deal with it lousier. Expert 1 added to this that the vision of the supplier should match the customers' vision and needs towards the future. The vision is thus defined as the extent to which a sustainable and long-term relationship can be entered into based on a joint vision and roadmap.

The second sub-criterion is the reputation of the platform company. In the interviews was indicated that the degree of trust in a platform supplier is dependent on the market share, the number and quality of references, the experience and the performance. Experts 1 and 7 mentioned the number of transactions per unit of time and the availability, which is often displayed as the percentage of time at which the platform is available to use, as examples of performance.

Regarding the third sub-criterion, financial health, four of the most commonly used measures are included, namely: liquidity, which is the degree to which current payment obligations can be met; solvency, which is the degree to which total debts can be met; profitability; and operational efficiency, which is the efficiency of the profit achieved as a function of the operating costs. Expert 1 mentioned in focus group 2 that he expects that there is quite a difference in the performance of the suppliers on this criterion. The reason for this is that some platforms have a lot of capital as they are established from existing companies and that others are very dependent on incentive schemes from the government and the use of cheap (ICT) employees, such as school leavers.

About technical support and service, the fourth sub-criterion, a lot of different details were mentioned that can all be assigned to this criterion. For example, the ratio in which the platform uses Software as a Service (SaaS) and on-premise software. In the former, the software is licensed on a subscription basis and is centrally hosted. The latter means that the software is installed and runs on the computers of the persons or organisations using the software. In this case, the customer is in control, but also responsible for maintenance and management of the software. Regarding the measurement of the quality of this sub-criterion, the respondents suggested to look at the number of updates and upgrades per unit of time, the response and delivery time and the provision of certain guarantees, such as the delivery of a message and the possibility to terminate the contract in case of dissatisfaction.

The final supplier specification is social responsibility. This sub-criterion is defined as the extent to which the platform cooperates with the social objective of healthcare. Examples are the extent to which they are open to other suppliers and participate in national initiatives. Expert 2 mentioned in focus group 2 that it is most desirable when the clearance between platforms is zero. By this, he means that the costs should be the same when an organisation wants to exchange information with another organisation within the same platform or with an organisation that uses a different platform.

Table 9: Final set of criteria and sub-criteria including their description

Criteria		Sub criteria	Description
Cost criteria	C1	Connection costs	The total one-off costs for connecting
	C2	Service costs	The total subscription costs for maintenance and management
	C3	Transaction costs	The costs per transaction
Functional specifications	F1	Integration possibilities with healthcare organisations	The number and type of connected healthcare organisations
	F2	Connection possibilities with national infrastructures / trust frameworks	The extent to which can be connected to national infrastructures/trust frameworks (Like MedMij, NEP, Twiin, Mitz)
	F3	Integration possibilities with applications / modules	The number and type of connected (healthcare) applications/modules
	F4	Communication services	The number and type of connected healthcare organisations that can be reached through communication services
Technical specifications	T1	Connectivity	The extent to which integrations with information systems from different suppliers are supported (possibly via other platforms)
	T2	Flexibility	The extent to which various ((inter) national and custom-made) standards are supported for the realization of customization in integrations
	T3	Interoperability	The extent to which different types of information can be shared and used between systems/applications
	T4	Completeness	The number of different integration possibilities, supported standards/infrastructures/trust frameworks and other additional services
	T5	Modularity	The number of modules that can be purchased independently
	T6	Security	The degree of security of the platform itself and the transport and processing of data
	T7	Scalability	The extent to which an increasing number of users and transactions can be supported
Supplier specifications	S1	Vision	The extent to which a sustainable/long-term relationship can be entered into on the basis of a joint vision/roadmap
	S2	Reputation	The degree of trust in the supplier through the market share, the number and quality of references, the experience and the performance
	S3	Financial health	The liquidity, solvency, profitability and operational efficiency
	S4	Technical support and service	The extent to which technical support and service are provided
	S5	Social responsibility	The extent to which is cooperated with the social objective of healthcare

Content Analysis

In the analysis of the interviews, it was also identified whether each participant used a given code, designated to one of the criteria (Morgan, 1996b). In appendix VI, the table with the complete content analysis is shown. In the last columns, the total number of mentions per sub-criterion and criterion was calculated.

The results of the content analysis show that the cost criteria got the least mentions overall. All the other criteria categories are a combination of criteria that were mentioned more and criteria that were mentioned less. For example, all functional specifications were mentioned a lot, except for the communication services criterion. Regarding the technical specifications, the criteria interoperability and security were mentioned more and the criteria modularity and scalability were mentioned less. Finally, for the supplier specifications, the criteria consisting of technical support and service and social responsibility were mentioned more and the financial health and reputation criteria were mentioned less.

Value Tree

As a final step of the results of the first part, a value tree is constructed to support the identification of the criteria (see figure 5). The first level includes the decision problem itself, which is the selection of the most important criteria. The second level, consisting of the thick-lined boxes, describes the criteria categories. The third and final level, consisting of the thin-lined boxes, describes the sub-criteria.

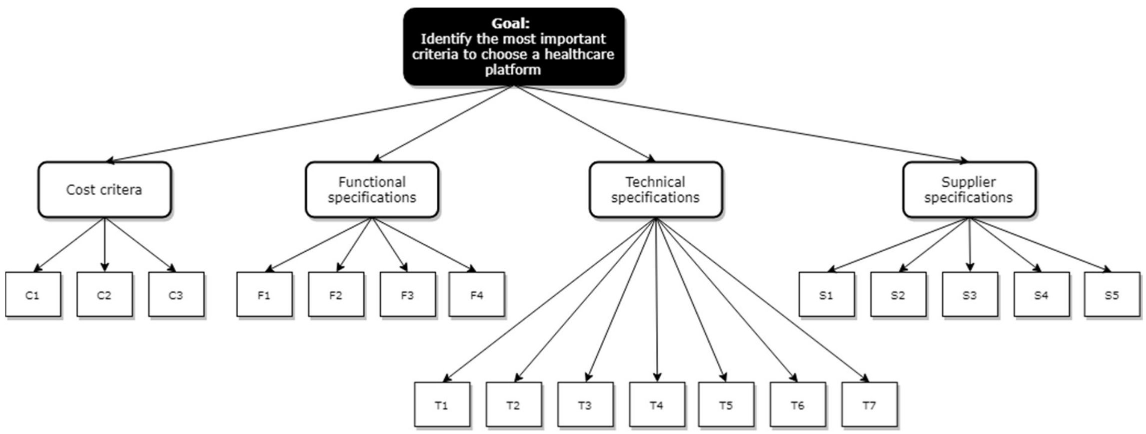

Figure 5: Value tree of all criteria and sub-criteria (see table 9 for the names of the sub-criteria)

Part 2: Results from the Questionnaire

From the 3rd of May 2021 until the 2nd of June 2021, the questionnaire was sent to 320 people. On the 2nd of June 2021, 79 respondents filled in the questionnaire. 29 respondents were excluded, of which 26 respondents did not complete the questionnaire and of which 3 respondents completed the questionnaire but filled in that they are not at all knowledgeable about healthcare platforms and unlikely to have an influence on the choice of a healthcare platform within their organisation. This resulted in 50 completed questionnaires. See table 10 for a complete overview of the characteristics of these respondents.

From the included respondents, 15 persons work in the care sector of which 12 work in nursing or care homes (24%) and 3 work for an RHIO (6.0%). The remainder of the respondents works in the cure sector of which 30 work in hospitals (60%) and 5 work in mental healthcare institutions (10%). In total, respondents work in or for 45 different healthcare organisations. All respondents indicated that these healthcare organisations have more than 250 employees. Examples of respondents' jobs are consultant, project leader, ICT manager and CIO (Chief Information Officer). 43 of the respondents have an internal position, working within a healthcare organisation, and 7 respondents have an external position, working for a healthcare organisation and from a consultancy for example.

Regarding the relevant knowledge of the respondents, all included respondents were at least somewhat knowledgeable about healthcare platforms, health ICT and healthcare processes in general. Most respondents indicated that they were knowledgeable or very knowledgeable in these areas. Finally, all respondents were at least "neither likely nor unlikely" to influence the choice of a platform within their organisation. However, most respondents indicated that they are either likely or very likely to have an influence on the decision for a healthcare platform.

Table 10: Characteristics of the respondents who participated in the questionnaire

Characteristic	Number (N=50)	%
Gender		
Woman	13	26.0
Man	36	72.0
Unknown	1	2.0
Educational level		
Higher professional education (HBO)	15	30.0
University education (WO)	35	70.0
Sector		
Care	**15**	**30.0**
Nursing or care home	12	24.0
RHIO	3	6.0
Cure	**35**	**70.0**
Hospital	30	60.0
Mental healthcare institution	5	10.0
Job position		
Internal	43	86.0
External	7	14.0
Knowledge platforms		
Somewhat knowledgeable	7	14.0
Knowledgeable	19	38.0
Very knowledgeable	19	38.0
Extremely knowledgeable	5	10.0
Knowledge ICT		
Somewhat knowledgeable	5	10.0
Knowledgeable	13	26.0
Very knowledgeable	22	44.0
Extremely knowledgeable	10	20.0
Knowledge healthcare		
Somewhat knowledgeable	7	14.0
Knowledgeable	29	58.0
Very knowledgeable	12	24.0
Extremely knowledgeable	2	4.0
Influence on decision making		
Neither likely nor unlikely	4	8.0
Likely	20	40.0
Very likely	26	52.0

22 of the 26 persons who did not completely fill in the questionnaire, did fill in the questions about their knowledge on healthcare platforms and their influence on decision making. 2 persons indicated that they were not at all knowledgeable and 12 persons indicated that they are only somewhat knowledgeable about healthcare platforms. The other 8 respondents indicated that they are at least knowledgeable about them. Moreover, 12 persons indicated that they are very unlikely, unlikely or neither likely nor unlikely to have an influence on the decision for a healthcare platform.

Of the people who were approached to complete the questionnaire, 7 people contacted the researcher with the statement that they were unable to complete the questionnaire. One respondent indicated that it was impossible for her to answer the questions since she had no experience in assessing the content of the platforms and all sliders would have remained at 1, which means that all criteria would be equally important if she did fill in the questionnaire. Another respondent indicated that the way the questions were asked went against her way of thinking. She believes that all identified criteria are valuable and important and she was not able to say whether one is more important than the other. She also mentioned that there are so many interrelationships and nuances, that it is impossible for her to quantify. Besides, one respondent indicated that it was too hard for him to distinguish between the criteria and that he, therefore, stopped filling in the questionnaire. Another respondent was unable to move the sliders within the questionnaire due to technical difficulties with his computer. As external consultants were also asked to fill in the questionnaire, three respondents indicated that they were unable to fill in the questionnaire as they were not connected to a healthcare organisation at that moment.

Besides, about half of the respondents mailed the researcher to indicate that they are interested in the results of the research. Two respondents even mentioned that they would like to use the criteria and their importance to support in the process of selecting a healthcare platform they are currently working on.

Criteria Importance

From the results of the AHP analysis (table 11) can be concluded that the functional specifications, apart from the communications services, are considered as the three most important criteria. The transaction-based cost model is the most important cost model, the security is the most important technical specification and the criterion consisting of the technical support and service is the most important supplier specification. The comparison matrices, including all normalized Eigenvectors, principal Eigenvalues, consistency indices and consistency ratios, for all criteria and criteria categories can be found in tables 1-5 in appendix VII.

Table 11: Criteria importance and ranking according to the total number of respondents (N=50)

Criteria	Weight	Sub criteria	Weight	Effective weight *(criteria weight * sub-criteria weight)*	Rank
Cost criteria	14.3%	Connection costs	12.5%	0.143 * 0.125 = 1.8%	16
		Service costs	32.2%	0.143 * 0.322 = 4.6%	8
		Transaction costs	55.3%	0.143 * 0.553 = 7.9%	4
Functional specifications	44.5%	Integration possibilities with healthcare organisations	25.4%	0.445 * 0.254 = 11.3%	3
		Connection possibilities with national infrastructures	35.0%	0.445 * 0.350 = 15.6%	1
		Integration possibilities with applications	29.7%	0.445 * 0.297 = 13.2%	2
		Communication services	9.9%	0.445 * 0.099 = 4.4%	9
Technical specifications	26.6%	Connectivity	14.2%	0.266 * 0.142 = 3.8%	10
		Flexibility	10.2%	0.266 * 0.102 = 2.7%	12
		Interoperability	19.7%	0.266 * 0.197 = 5.2%	6
		Completeness	9.0%	0.266 * 0.090 = 2.4%	14
		Modularity	8.2%	0.266 * 0.082 = 2.2%	15
		Security	27.0%	0.266 * 0.270 = 7.2%	5
		Scalability	11.7%	0.266 * 0.117 = 3.1%	11
Supplier specifications	14.6%	Vision	21.1%	0.146 * 0.211 = 3.1%	11
		Reputation	16.2%	0.146 * 0.162 = 2.4%	14
		Financial health	17.1%	0.146 * 0.171 = 2.5%	13
		Technical support and service	32.9%	0.146 * 0.329 = 4.8%	7
		Social responsibility	12.7%	0.146 * 0.127 = 1.8%	16
Total	100%			100%	

The consistency indices ranged from 0.016 to 0.053. As analyses with consistency ratios less than or equal to 0.1 are considered acceptable, all respondents have consistently answered the pairwise comparisons and the analyses are acceptable. As, in this analysis, the priority vector is an approximation of the normalized Eigenvector of the matrix, the two columns called “weight” in table 11 represents the normalized Eigenvectors. To calculate the overall importance of the sub-criteria, the effective weights were calculated by multiplying the weights of the criteria categories with the weights of the sub-criteria. Finally, the rank was assigned where the criterion with the highest weight ranked first and the criterion with the lowest weight ranked last.

Criteria Importance per Subgroup

Besides the criteria importance weights for the total number of respondents, three separate analyses into subgroups were executed. Tables 6-45 in appendix VII show the comparison matrices, normalized Eigenvectors, principal Eigenvalues, consistency indices and consistency ratios per criterion and criteria category and per subgroup. The consistency ratios ranged from 0.000 to 0.098, which means that all analyses can be considered acceptable.

Sector Type. The first analysis makes a distinction between sectors in which the respondents work, which are the care and cure sector. The care subgroup includes respondents (N=15) working in nursing or care homes or RHIOs. The cure subgroup includes respondents (N=35) working in hospitals or mental healthcare institutions. Table 1 in appendix VIII shows the effective importance weights of the criteria for the subgroups and figure 6 shows the same results in a schematic representation.

Looking at the cost criteria, the care subgroup finds the service costs 2 times more important than the cure subgroup. Regarding the functional specifications, the cure subgroup finds it 1.3 times more important for a platform to have connection possibilities with national infrastructures. On the contrary, the care subgroup finds it 1.2 times more important for a platform to have integration possibilities with applications. Finally, looking at the technical specifications, the cure subgroup finds it 1.3 times more important for a platform to offer technical support and service.

Organisation Type. In the second subgroup analysis, a distinction is made between the four organisation types: nursing and home care (N=12), RHIOs (N=3), hospitals (N=30) and mental healthcare institutions (N=5). Table 2 in appendix VIII shows the results of the criteria importance weights for the subgroups and figure 7 shows the same results in a schematic representation.

It becomes clear that the nursing subgroup finds the service costs 1.8 to 2.5 times more important than the other subgroups. Besides, looking at the functional specifications, the RHIO subgroup finds it 1.7 to 3.5 times more important for a platform to have integration possibilities with healthcare organisations than the other subgroups. Regarding the technical specifications, the subgroup concerning mental healthcare finds it 2.1 to 2.8 times more important for a platform to have good security than the other subgroups. Finally, looking at the supplier specifications, the hospital subgroup finds the technical support and service 1.2 to 1.5 times less important than the other subgroups.

Position Type. The third analysis makes a distinction between the job positions of respondents, namely external or internal positions. The extern subgroup includes respondents (N=7) working for consultancy agencies. The intern subgroup includes respondents (N=43) working within a healthcare organisation. Table 3 in appendix VIII shows the results of the criteria importance weights for the subgroups and figure 8 shows a schematic representation of the same results.

Scoring on certain criteria stands out. Looking at the cost criteria, the intern subgroup finds the service costs 1.6 times more important than the extern subgroup. Regarding the functional specifications, the extern subgroup finds it 1.9 times more important for a platform to have integration possibilities with healthcare organisations. On the contrary, the intern subgroup finds it 1.5 times more important for a platform to connect with national infrastructures and 1.2 times more important to have integration possibilities with applications. Besides, looking at the supplier specifications, the extern subgroup finds the social responsibility of the supplier 2.8 times more important than the intern subgroup.

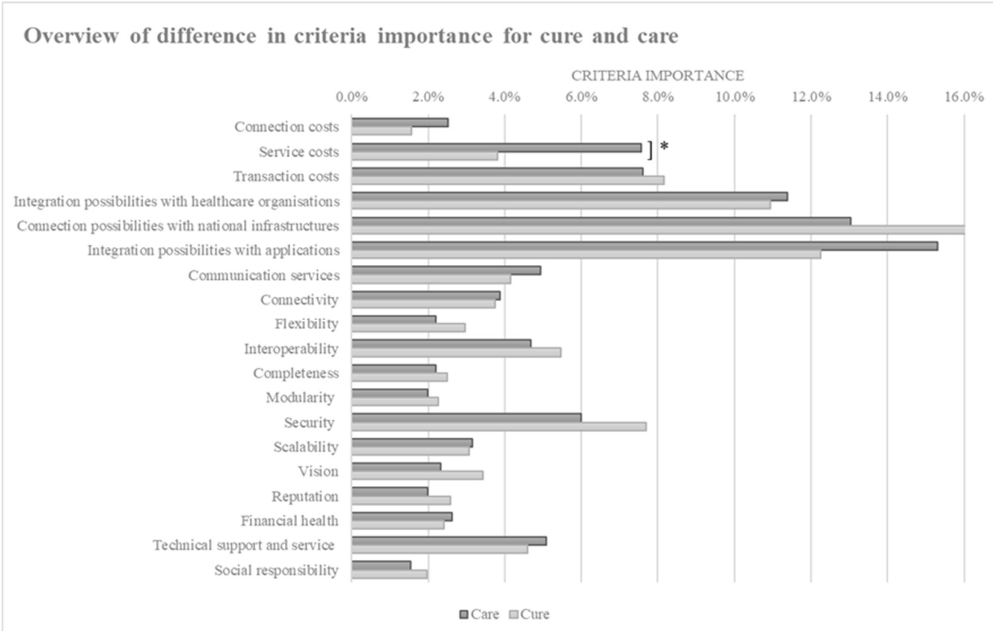

*Figure 6: Schematic representation of the difference in criteria importance of the care and cure subgroups (*significant difference, $p<0.05$)*

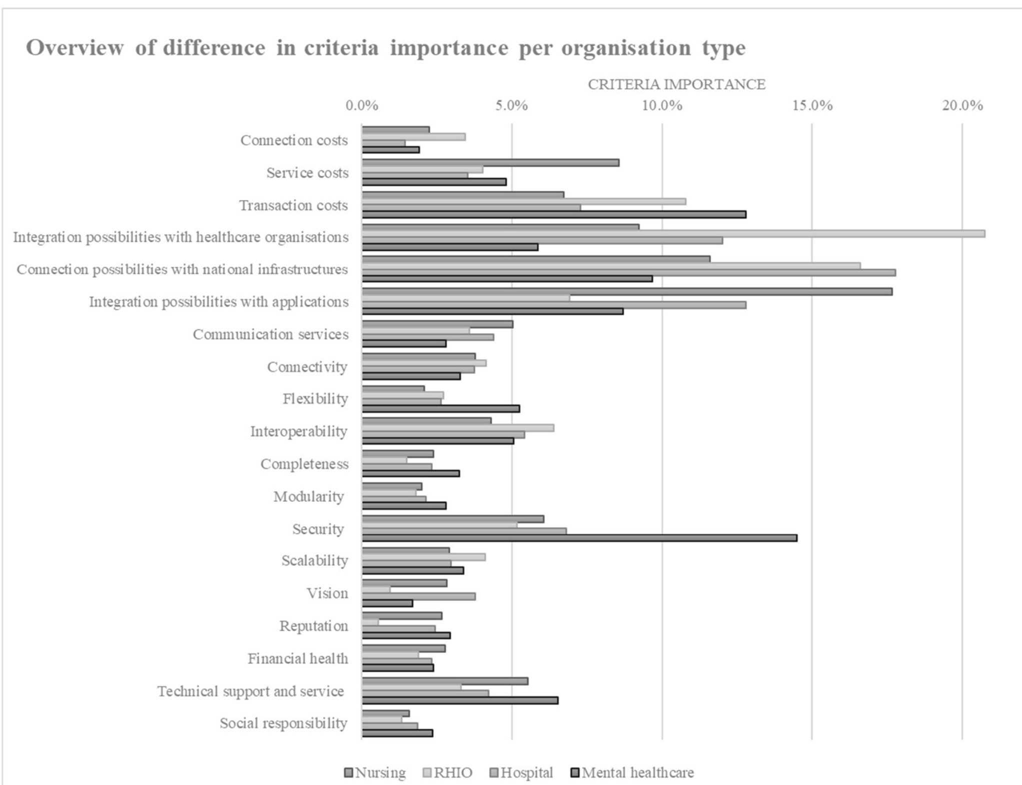

Figure 7: Schematic representation of the difference in criteria importance per organisation type subgroup

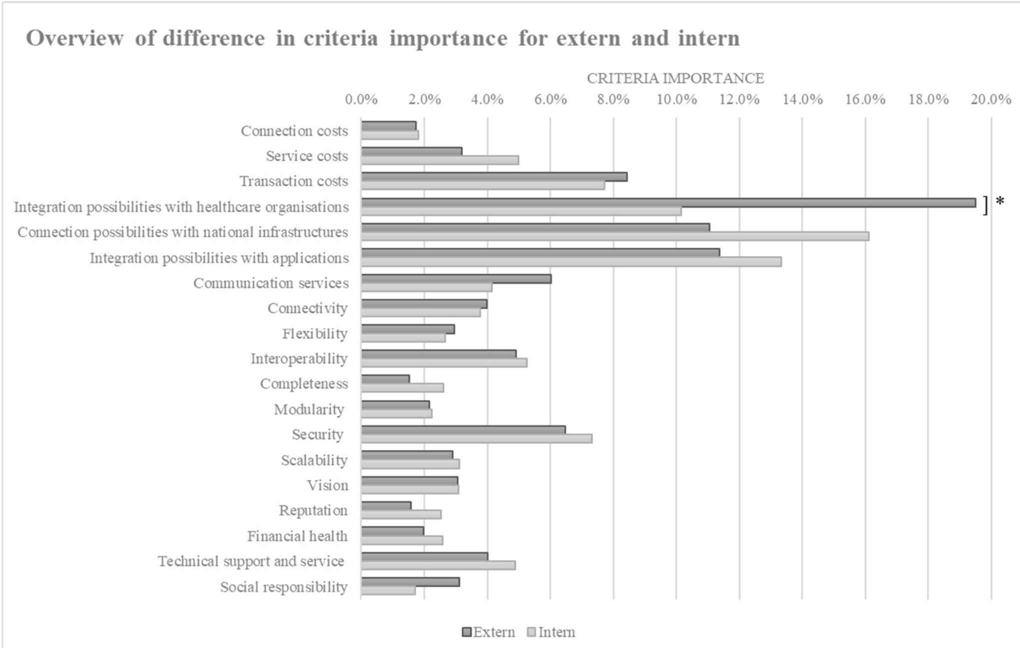

*Figure 8: Schematic representation of the difference in criteria importance of the extern and intern subgroups (*significant difference, p<0.05)*

As a final step in the analysis, it was determined whether there are statistically significant differences between the importance weights of the subgroups. For the sector type subgroups, a significant difference (U = 358000, p = 0.043) was found between the importance weights of the service cost criterion (see table 2 in appendix IX). The mean importance weight of this criterion is 3.8% for the cure group compared to 7.6% for the care group. This suggests that for stakeholders working in the care sector, the service costs are more important than for stakeholders working in the cure sector. No significant differences were found between the importance weights of the sector type subgroups for the other criteria (see table 1 in appendix IX).

Regarding the organisation type subgroups, evidence was found for a significant difference between the mean ranks of at least one pair of groups for the criterion consisting of the connection possibilities with national infrastructures and the vision criterion. Dunn's pairwise tests were carried out for the four pairs of groups in both criteria. However, no strong evidence ($p < 0.05$, adjusted using the Bonferroni correction) was found for a difference between any of the pairs (see table 4-7 in appendix IX). Besides, no evidence for significant differences was found between the importance weights of the organisation type subgroups for the other criteria (see table 3 in appendix IX).

For the position type subgroups, a significant difference (U = 221000, p = 0.049) was found between the importance weights of the criterion consisting of the integration possibilities with healthcare organisations (see table 9 in appendix IX). The mean importance weight was 10.2% for the intern group compared to 19.5% for the extern group. This suggests that for stakeholders working in external positions, it is more important for a platform to have integration possibilities with healthcare organisations than for stakeholders in internal positions. No significant differences were found between the importance weights of the position type subgroups for the other criteria (see table 8 in appendix IX).

Discussion

The aim of this study was to identify the relevant criteria and their importance from the perspectives of different stakeholders in the selection of a platform supplier in the Netherlands. The first part of this study, in which individual and group interviews with experts were conducted, resulted in a criteria overview of four criteria categories and 19 sub-criteria. The criteria were either a confirmation of criteria found in literature or an extension of the literature as some criteria were suggested by the experts but not found in the literature or vice versa. The second part of this study, in which a questionnaire was distributed among healthcare consultants, project leaders and managers, resulted in an overview of the importance per criterion for the total sample and for subgroup samples. The results of the total sample show that the most important criteria are the functional specifications, including the integration possibilities with healthcare organisations and applications and the connection possibilities with national infrastructures. In addition, the transaction-based cost model is considered as the most important cost criterion, security is the most important technical specification and the criterion consisting of the technical support and service is the most important supplier specification. Finally, the subgroup analyses show similar distributions in which (significant) differences were found only on some criteria. In table 1, a summary is shown of the main findings of both part 1 and part 2 of this study.

*Table 1: Summary of main results of both part 1 and part 2 of this study (*significant difference, p<0.05)*

	Part 1: Criteria identification			**Part 2: Criteria importance**	
Criteria	**Literature**	**Experts**	**Implication**	**Total *(rank)***	**Subgroups***
C1	x	x	Confirmation	1.8% *(16)*	
C2	x	x	Confirmation	4.6% *(8)*	*Care: 7.6% - Cure: 3.8%*
C3	-	x	Extension	7.9% *(4)*	
F1	-	x	Extension	11.3% *(3)*	*Ext: 19.5% - Int: 10.2%*
F2	-	x	Extension	15.6% *(1)*	
F3	-	x	Extension	13.2% *(2)*	
F4	-	x	Extension	4.4% *(9)*	
T1	-	x	Extension	3.8% *(10)*	
T2	x	x	Confirmation	2.7% *(12)*	
T3	x	x	Confirmation	5.2% *(6)*	
Reliability	x	-	Extension	-	
T4	x	x	Confirmation	2.4% *(14)*	
T5	x	x	Confirmation	2.2% *(15)*	
Ease of use	x	-	Extension	-	
T6	x	x	Confirmation	7.2% *(5)*	
T7	x	x	Confirmation	3.1% *(11)*	
S1	-	x	Extension	3.1% *(11)*	
S2	x	x	Confirmation	2.4% *(14)*	
S3	x	x	Confirmation	2.5% *(13)*	
S4	x	x	Confirmation	4.8% *(7)*	
S5	-	x	Extension	1.8% *(16)*	

Criteria and their Importance

All functional specifications, apart from the communication services criterion, are considered most important. From the qualitative part of the research can be concluded that the reason for the high importance weights on the first three functional specifications can probably be assigned to the fact that information exchange in Dutch healthcare is more and more arranged and the focus is shifting towards the more advanced solutions that platforms offer. The communication services criterion, which was considered less important, is an example of a simpler way to exchange information and has already been realized within most healthcare organisations. Remarkably, especially respondents working for RHIOs and in external positions assigned significantly higher weights to the integration possibilities with healthcare organisations, compared to the respondents in internal positions. RHIOs are often provider-led, non-profit associations that facilitate information exchange and innovation within a region (Fontaine et al., 2010; Jha et al., 2008; Vest & Gamm, 2010). Persons working for RHIOs, similar to persons in external positions in healthcare, often commit to the relatively difficult tasks to realize universal connectivity in a region. They, for example, support smaller organisations that cannot finance expensive ICT solutions and thus focus more on the organisational level instead of national infrastructures and additional functionalities in the form of applications.

Contrary to expectation, the cost criteria are considered almost three times less important than the functional specifications. In the first part of the research, the cost criteria were also mentioned least overall by the experts compared to the criteria in the other categories. However, similar results are found in other research where they give as the explanation for this that the initial proposal of the best suppliers can still change a lot during the last phase of contract negotiations (Secundo et al., 2017). Nevertheless, information about the costs cannot be totally neglected at this stage because of the limitations of project budgets. López and Ishizaka (2017) gave as the reason for the low weights of the cost criteria that cloud solutions, like healthcare platforms, reduce costs in comparison with on-premise solutions. Reasons related to the healthcare industry may be the fact that healthcare organisations often receive subsidies from the government for implementing new technologies, resulting in fewer budget constraints to purchase the appropriate technology (Fontaine et al., 2010; Miller & Tucker, 2014).

Besides, from the cost criteria category, the transaction and service costs were given the highest weights. Service costs are related to maintenance and system upgrading activities and the transaction costs are dependent on the use of the platform. Unlike the connection costs, which are direct, initial, fixed costs, these cost models represent recurring costs that can quickly become relatively high (Secundo et al., 2017). Healthcare platforms often offer SaaS and have the potential to scale rapidly, which may be the reasons the respondents assigned higher weights to the transaction and service cost models. In the organisation type subgroups, it was remarkable that respondents working in the care sector assigned significant higher weights to the service cost model compared to the other subgroups. A possible reason for this, which was also mentioned during the qualitative part of this research, is that nursing and home care organisations often have less well-developed ICT departments. This makes them more dependent on support and service provided by the platform supplier, resulting in higher service costs. For them, it is thus more important that the platform offers attractive service costs.

Security is considered the most important technical specification. Its importance weight is 1.4 to 3 times greater than the weight of the other technical specifications. In interviews with experts, this criterion can also be ranked third in the criteria mentioned most often. This result is in line with previous studies where security has also been highlighted as an important criterion (Cricelli et al., 2020; Hanine et al., 2016; López & Ishizaka, 2017). Besides, research shows that cloud solutions remark increases in risks related to security compared with on-premise solutions. All healthcare platforms that were included in this study offer SaaS. This means that the software is installed and maintained by the platform supplier itself on large central servers in the cloud. A customer of a SaaS platform buys the right to use services. The advantage is that the customer is no longer responsible for maintenance. An important disadvantage is that all data is processed by the provider of the platform, which entails security risks. Moreover, the healthcare industry can be considered data-intensive because a large amount of data is created, sent, stored and accessed daily. The fact that a healthcare platform exchanges sensitive data from organisations, applications and PHEs, usually in cloud-based solutions, implies the need for strategies and mechanisms to ensure adequate security and privacy (Esposito et al., 2018). An example of a promising technology that can be used to protect healthcare data within platforms is Blockchain.

Another outstanding result was that respondents working in mental healthcare institutions find the security criterion 2.1 to 2.8 times more important than respondents working in one of the other organisation types. Existing research shows that there is an even greater need to address ethical issues related to consent, data security and privacy in the field of mental healthcare as the data are often highly sensitive and personal (Lustgarten et al., 2020). Besides, within mental healthcare, it is the case that without privacy and confidentiality, therapy may not be effective.

Furthermore, respondents weighted the interoperability criterion slightly higher than the other technical specifications. In the interviews with experts, however, this criterion was mentioned most of all criteria. Reasons for this are probably related to the fact that interoperability is seen as the basis for more efficient communication, more comprehensive and consistent healthcare and more effective use of services (Jha et al., 2008; Reis et al., 2017; Sligo et al., 2017). The other technical specifications were considered as less important criteria. Important to note is that this not means that the respondents believe that these criteria are not important. The importance weights are relative which means that the criteria with low importance weights may still be considered important because the weights only indicate that they consider these criteria less important compared to the other criteria.

Finally, examining the supplier specifications, only the criterion consisting of the technical support and service was considered relatively important. Compared to the other supplier specifications, it was judged to be 1.9 to 2.7 times more important. Similar results from other research are explained by the fact that the majority of organisations face technical issues with new ICT solutions during the implementation, execution, or after the go-live period (Haddara, 2018; López & Ishizaka, 2017). Integration with existing systems, customization and security measures are indicated as the most severe problems. For handling these difficulties, organisations require support from suppliers, both in the provision of ICT expertise and the availability of contextual field or industrial knowledge. Especially within healthcare organisations, there is often a lack of knowledge and expertise about new ICT innovations, like healthcare platforms, which makes them even more dependent on the technical support and service of suppliers (Stegemann & Gersch, 2021). Additionally, the results show that respondents working within nursing or home care or mental healthcare institutions assigned the highest weights to the criterion. A logical reason for this may be that these organisations often have less well-developed ICT departments, systems and personnel, increasing the need for technical support and services.

Theoretical Implications

The literature review and the results from the interviews with experts were combinedly used to identify a complete set of relevant criteria. Since the use of platforms in Dutch healthcare is relatively new and unknown, the results of the interviews with experts complemented the information from the literature review (appendix I). Currently, a lot of research is executed about supplier evaluation. Various studies address the process of defining criteria and calculating the criteria importance and supplier performances. Moreover, in the literature review, several articles were selected that focus on software or system selection. The articles focus, for example, on the selection of ERP (Enterprise Resource Planning) software (Efe, 2016; Haddara, 2018; López & Ishizaka, 2017; Malindzakova & Puskas, 2018), APS (Advanced Planning and Scheduling) software (Piengang et al., 2019) and ETL (Extract, Transform and Load) software (Hanine et al., 2016). Although this existing research was of added value to gain a first impression of relevant criteria for the selection of a healthcare platform, this study was valuable to obtain an understanding of relevant criteria in the specific context of the Dutch healthcare sector.

The results of this study showed that the criteria that were found in advance in the articles from the literature review were also often suggested by experts. This confirms the relevance of these criteria for the context in this study. The same is the case for the criteria that were suggested by experts and confirmed afterwards in the articles from the literature review. Prior to the study, these criteria were not expected to be relevant, but the opposite was proven during the interviews with experts. The remainder of the criteria can be considered as possible extensions of the literature. Criteria that were only suggested by experts and not found in the articles were suggested to be relevant for the specific context of platform selection in Dutch healthcare. In addition, two criteria were found in articles but not suggested by experts. This suggests that these criteria are relevant for supplier selection in other fields, but not for the supplier selection context of this study. See also table 1 for an overview of the results of the criteria identification including the theoretical implications and table 2 in appendix I for a more extensive overview of the criteria identification per article.

Practical Implications

The criteria and their importance that were found in this study (table 1) make it possible for healthcare organisations to have a greater share in the selection of a platform themselves as it shows where they should pay attention to. This is relevant because there is a growing interest in tools that can support healthcare organisations to select the most suitable platform. Platforms have the potential to address the current fragmentation of patient care and the lack of innovation, but a precondition for users is to choose a platform that offers the functionalities that meet their needs (Fürstenau et al., 2019). This can be a challenge as healthcare organisations often have to deal with a lot of different stakeholders that do not always have sufficient experience and competence to select the best platform (Stegemann & Gersch, 2021). Besides, getting oriented in the offer of healthcare platforms is increasingly difficult due to the growing number of alternatives and the variety of features they show.[2] With the results from this study, organisations have a higher chance to avoid problems like the late discovery of high indirect costs or poor investments in platforms with a lot of unnecessary functionalities or, on the contrary, in platforms that lack critical functionalities or specifications. Overall, this may result in a lower chance of early abandonment of a platform and the waste of time and resources that are a result of it.

Healthcare organisations can use the criteria as the basis of an RFI to collect information about the capabilities of various suppliers on relevant criteria (Marsh et al., 2016). One step further, healthcare organisations can use the supplier evaluation scheme as a tool to assign scores to each supplier (figure 1 in appendix X). Important to note is that the healthcare organisations themselves still have to determine the performance of the suppliers on the criteria because only the importance weights were determined in this study. Based on information collected about or provided by the different providers, the performance scores can be determined for each criterion that is not dependent on the preference of the decision-maker (Hummel et al., 2014; Saaty, 2006). For the preference-sensitive criteria, AHP can be used to determine the performance of available solutions through pairwise comparisons. In the same manner that was done for the importance weights in this study, the preference weights can be calculated. After that, an end score for each supplier can be calculated by multiplying the value score on each criterion by the weight of that criterion and then adding all those weighted scores together.

In addition, the results from the subgroup analyses show evidence that the importance of criteria is dependent on characteristics of the decision-makers. For the service costs and integration possibilities with healthcare organisations, significant differences were found between subgroups (table 1). The differences between subgroups suggest that the most suitable platform is different for different healthcare organisations. Moreover, it is expected that more significant differences would have been found when the study had been conducted with more respondents per subgroup. Therefore, it is important to conduct further research to confirm the findings and to search for possible additional differences. For the same reason, organisations need to consider whether they agree with the importance weights that were found in this study or whether they will re-weigh the criteria.

Furthermore, during the qualitative part of this research, some relevant recommendations were made by the experts. Experts 13 and 14, who are experts on the platform supplier perspective, mentioned that, when the criteria are used in supplier selection, it should be necessary to distinguish between use cases. Use cases are specific situations in which the platform could potentially be used. Healthcare organisations that consider to start using a platform often have a demand for a specific use case, like the exchange of information with patients or the exchange of images or medication overviews with other healthcare organisations. For each use case, platforms will score differently on the identified criteria. For example, regarding the security of the platform, it differs per use case which NEN-norms are relevant. This means that, when healthcare organisations want to use the criteria as the basis of their RFI, they have to be specific on their use case. In the interviews was also mentioned that when no distinction is made, organisations are at risk of receiving information about the performance of the supplier on the criteria that is too broad and of little added value for making the correct decision.

[2] Kamphuis, M.J.M. (2021) Platforms in healthcare: A qualitative multiple case study to explore how to achieve successful platforms for information, integration, and innovation (Master thesis - BA).

Limitations

The initial intention was to use the world cafe method for the identification of a complete set of relevant criteria. The world café is a suitable method to collect the views and perceptions of a relatively large group of people over a relatively short period of time (The World Café Community Foundation, 2015). The world café, which is a methodology for hosting a large group dialogue, is *"a simple yet powerful conversational process for fostering constructive dialogue, accessing collective intelligence"* (MacFarlane et al., 2017). However, focus groups and interviews were chosen over a world café because limited experts, for whom it was expected that they can have a valuable contribution to the discussion, were available to participate. An advantage was that, in the focus groups and interviews, the discussion and contribution of all experts could be better regulated.

A second limitation was the amount of suitable and available respondents in the second part of the research. Over 300 persons within the network of M&I/Partners were approached. From this group was expected that it consists of almost all persons in the Netherlands with the highest chance to have an influence on decision-making and knowledge about healthcare platforms. However, from the persons approached, a limited amount started to fill in the questionnaire and, from the persons that started to fill in the questionnaire but did not finish it, many indicated that they do not have enough knowledge or influence on decision making. Therefore, the biggest reason for respondents to not start or complete the questionnaire is probably related to their lack of expertise about healthcare platforms and the low likelihood for them to have an influence on the decision for a healthcare platform within a healthcare organisation. Only a small part of excluded respondents indicated that they have sufficient expertise and a reasonable likelihood to influence decision-making. For these respondents, it might have been that the questionnaire was too long, that it was too difficult to provide importance weights with the pairwise comparison technique, that the criteria were not formulated clearly enough, that technical difficulties arose while filling out the questionnaire or that respondents were not able to complete the questionnaire because they are not working for or within a healthcare organisation. In summary, the large group of excluded persons and persons who did not fill in the questionnaire can partly be explained by the fact that it was chosen to approach a large group of persons for whom it was not always clear beforehand whether they had enough knowledge and were employed for or within a healthcare organisation.

Another limitation of this study is that some subgroups were underrepresented. From the respondents that filled in the questionnaire, twice as many persons work in the cure versus the care sector, four times fewer persons work in a mental healthcare institution versus a hospital and no persons work in a disabled care institution. According to CBS (2019b)(Central Office for Statistics), there are more medium and large organisations in the care sector than in the cure sector, there are more mental healthcare institutions than hospitals and there are over 450 disabled care institutions. However, based on the interviews with the experts can be concluded that healthcare platforms are currently mainly used by hospitals, explaining why more respondents, working in hospitals, had enough expertise to fill in the questionnaire. Besides, the fact that some subgroups were (too) small was probably also the reason that no evidence for significant differences was found on most criteria. In other words, the fact that few differences were found, does not mean that there are no differences in reality. More respondents working for different types of healthcare organisations and in different positions would be needed to be able to show valuable insights into the differences in the importance judgments of these different groups.

Conclusion

This study resulted in an overview of criteria and their importance for the selection of a healthcare platform in the Netherlands. The study confirms the relevance of certain criteria from existing literature. Besides, it contributes to the literature on supplier selection by pointing out irrelevant criteria and by adding relevant criteria for platform selection in the specific context of the Dutch healthcare sector. Practically, the criteria and their importance make it possible for healthcare organisations to gain more control over the process of selecting a healthcare platform. The results can be used as the basis of an RFI or as a supplier evaluation scheme to be able to assign scores to each supplier (figure 1 in appendix X).

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Appendix I – Literature Review

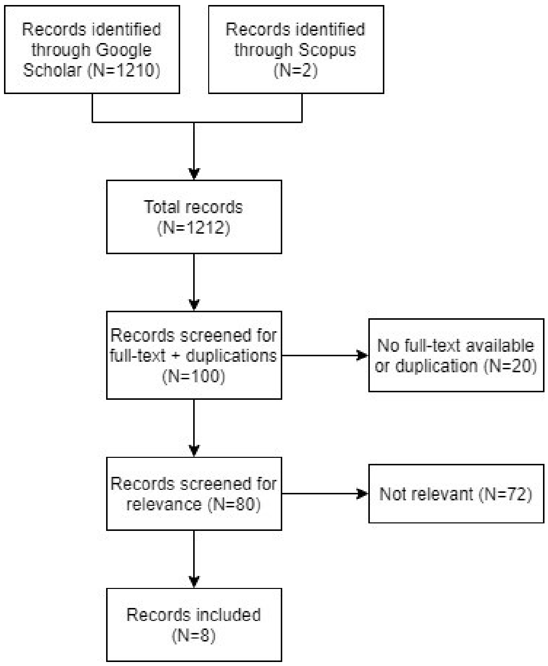


Figure 1: Flow chart of the literature review

Google Scholar and Scopus databases were used to identify relevant studies from January 2016 to January 2021. For the selection of relevant articles, the keywords for the literature searches were ("supplier selection") AND ("software selection" OR "system selection" OR "platform selection") AND ("criteria"). The search resulted in 1212 hits. The first ten pages of search results, which included 100 articles, were checked on duplicity and full-text availability in English or Dutch language. Based on this check, 20 articles were excluded. The remaining 80 articles were screened on title and abstract to determine relevance. Articles were then selected based on the following criteria:

- The authors of the article researched criteria that are relevant to compare suppliers of systems, software or platforms in developed countries.
- The criteria are sufficiently described.

Based on these criteria, eight articles were included. See also figure 1 for a flow chart of the literature review and table 1 for an overview of the selected eight articles.

Table 1: Overview of selected articles from the literature review

Article number	Reference
1	(Cricelli et al., 2020)
2	(Efe, 2016)
3	(Haddara, 2018)
4	(Hanine et al., 2016)
5	(López & Ishizaka, 2017)
6	(Malindzakova & Puskas, 2018)
7	(Piengang et al., 2019)
8	(Secundo et al., 2017)

Table 2: Overview of the criteria suggested by literature (per article) and by experts in the interviews

Criteria	Cricelli et al., 2020	Efe, 2016	Haddara, 2018	Hanine et al., 2016	López & Ishizaka, 2017	Malindzakova & Puskas, 2018	Piengang et al., 2019	Secundo et al., 2017	**Suggested by literature**	**Suggested by experts**
C1	x	x	x	x	x	x	x	x	x	x
C2	x	x	x	x	x	x	x	x	x	x
C3	-	-	-	-	-	-	-	-	-	x
F1	-	-	-	-	-	-	-	-	-	x
F2	-	-	-	-	-	-	-	-	-	x
F3	-	-	-	-	-	-	-	-	-	x
F4	-	-	-	-	-	-	-	-	-	x
T1	-	-	-	-	-	-	-	-	-	x
T2	x	-	x	-	x	-	x	x	x	x
T3	-	-	-	-	-	-	-	x	x	x
Reliability	-	x	-	-	x	-	x	-	x	-
T4	x		x	-	-	-	-	-	x	x
T5	-	x	x	-	-	x	-	x	x	x
Ease of use	x	x	-	x	x	-	x	x	x	-
T6	x	-	-	x	x	x	-	x	x	x
T7	x	-	-	-	-	-	-	x	x	x
S1	-	-	-	-	-	-	-	-	-	x
S2	x	x	x	x	-	-	x	x	x	x
S3	-	-	-	-	-	-	-	x	x	x
S4	x	x	x	x	x	x	x	x	x	x
S5	-	-	-	-	-	-	-	-	-	x

Appendix II – Explanation of the Dutch Health Information Exchange Landscape

- Dutch laws and regulations regarding information exchange in healthcare
- HL7 communication standards
- AORTA / NEP thrust framework
- XDS-networks
- Initiatives like MedMij, Twiin and Mitz

Laws and regulations

The various parties that are involved in the exchange of health information must adhere to certain laws and norms (Informatieberaad Zorg, 2019). Examples are the GDPR (General Data Protection Regulation), the law to use the Citizen Service Number (BSN)(Wet gebruik burgerservicenummer in de zorg (Wbsn-z) and the WGBO (Wet op de Geneeskundige Behandelingsovereenkomst). The GDPR and the WGBO require that health information needs to be secured and that only authorized persons may view the information (Autoriteit Persoonsgegevens, 2020). Logging is permitted by the Wabvpz (Wet aanvullende bepalingen verwerking persoonsgegevens in de zorg).

Examples of norms are the NEN 7510, the standard for information security in healthcare, which is based on the ISO 27000-series. The Code of Conduct for electronic data exchange in healthcare (Elektronische Gegevensuitwisseling in de Zorg (EGiZ)) specifies how the aforementioned laws and standards are applied in practice (KPMG, 2019a).

For a healthcare platform to properly authenticate and authorize, they have to meet the requirements for connecting to DigiD and UZI. A UZI (Unieke Zorgverlener Identificatie) server certificate and a UZI care provider card are necessary to access health information (VZVZ, 2020). A UZI server certificate takes care of the identification of the system and a UZI care provider card ensures the identification of BIG-registered care providers. The DigiD with SMS verification is used for patients to access health information.

Communication standards HL7

HL7v2 is used for the exchange of information between systems within the healthcare organisations themselves. Besides, two different communication standards are mainly used in Dutch healthcare to exchange information between actors, namely HL7 CDA (Clinical Document Architecture) and HL7 FHIR (Fast Healthcare Interoperability Resources). The standards are developed by Health Level Seven International (HL7), an international standardization organisation in the field of interoperability of healthcare information (HL7 Netherlands, 2020a).

HL7 CDA is the most successful part of the HL7 version 3 (HL7v3) standard. With HL7 CDA, a patient record can be displayed and exchanged in a single structured document (HL7 Netherlands, 2020a). This document is automatically compiled and received by implemented software in Health Information Systems (HISs). The infrastructure over which the templates are sent is not part of the CDA standard. Examples for transport can be secure email or IHE XDS implementations.

HL7 FHIR consists of HL7 FHIR Documents and HL7 FHIR API (Application Programming Interface) (HL7 Netherlands, 2020a). FHIR Documents simply is a successor to CDA. FHIR API on the other hand focuses on the facilitation of workflow. Information can be exchanged directly between HISs through a question and answer game. Internet is the only infrastructure that is necessary to exchange information between HISs in this way, but both systems need FHIR API software.

A healthcare platform often enables FHIR APIs itself and makes sure it is able to exchange and translate HL7v2 and HL7v3 messages and CDA and FHIR Documents.

Trust framework AORTA / NEP

In 2010, the national roll-out of the Electronic Health Record (EHR) as a national Health Information System (HIS) failed after debate and opposition about the safety of the system (Kroneman et al., 2016). In 2012, a similar system, i.e. the National Exchange Point (NEP), was introduced. The NEP is a highly secured care infrastructure in which the majority of healthcare organisations in the Netherlands is connected (Nictiz, 2019). When the NEP was realized, HL7v3 was chosen as its core mechanism for information exchange (HL7 Netherlands, 2020b). A patient must have given explicit permission (opt-in) to enable the exchange of data from the information systems with other healthcare providers. At this moment, NEP mainly focuses on medication and GP summaries. The NEP is managed by the Vereniging van Zorgaanbieders voor Zorgcommunicatie (VZVZ).

In order to connect to the NEP, a healthcare organisation needs a well-managed HIS and a well-managed network (VZVZ, 2020). A well-managed HIS is the entirety of all hardware, software, processes and organizational components that ensure confidentiality, integrity and availability of information. A well-managed network establishes a secure connection between well-managed HISs and the NEP. Both the information systems and the network must comply with a set of requirements, provided by VZVZ, to be approved to connect to the NEP (VZVZ, 2020). The AORTA trust framework describes the core of the agreements and procedures for the collaboration between the well-managed HISs, the well-managed network and the NEP.

A healthcare platform can take over this function by enabling a connection to the NEP itself and meeting the requirements of a well-managed network. The platform can also ensure that they meet the criteria of well-managed HISs as much as possible and that they adjust their service to new AORTA releases.

Requirements XDS-IHE

Integrating the Healthcare Enterprise (IHE) is an international initiative in which healthcare providers and software suppliers collaborate to improve the way computer systems in healthcare share information (IHE Nederland, 2020). The goal is to create specifications (IHE profiles) for software suppliers that describe how the care processes can best be supported with standards. One of these IHE profiles is XDS (Cross-Enterprise Document Sharing) and in collaboration with other IHE profiles, it can be used to create an infrastructure to exchange all types of health information (including CDA and FHIR Documents). An XDS profile describes a working method for health information exchange with other actors. The goal of XDS is that patient data is made available from the information system and indexed in a registry.

An Affinity Domain consists of a group of healthcare organisations that work together, based on joint agreements and a shared XDS-infrastructure. An Affinity Domain always consists of one registry (an index module that contains information about all documents and images) and multiple sources, repositories (storage locations) and consumers (viewers)(Nictiz, 2020d). For a healthcare organisation to connect to the XDS-infrastructure, they need to integrate software into their HIS. In the Netherlands, Regional Health Information Organisations (RHIO) also sometimes form Affinity Domains (RSO Nederland, 2019). There are currently nine RHIOs in the Netherlands (Nictiz, 2019). However, the XDS-infrastructures of these regions are not always connected to each other (IHE Nederland, 2020; Nictiz, 2020d).

A healthcare platform can take over this function by meeting the requirements of the affinity domains and enabling a connection to these XDS-infrastructures itself.

Trust framework MedMij

MedMij's core task is to facilitate information exchange between residents of the Netherlands and their healthcare providers (MedMij, 2019). MedMij has defined several regulations to which Personal Health Environments (PHEs) and HISs must comply. All parties that comply with the MedMij standard can use the MedMij label. MedMij also manages the exchange of information between HISs and PHEs through HL7 FHIR APIs.

Healthcare platforms need to comply with the MedMij standard to also enable safe information exchange to PHEs. Platforms then fulfil the role of service provider for the healthcare providers (dienstverlener zorgaanbieder (DVZA)). To be able to access data in accordance with MedMij, the healthcare provider must have at least one authorization server and at least one resource server. The authorization server handles the identification and authentication of a person and the authorization of the PGO to collect data and share data with the healthcare provider. The resource server facilitates the actual data exchange between PHEs and HISs through FHIR API.

Appendix III – AHP Scale and RI Values

Table 1: Original Analytic Hierarchy Process scale (Saaty, 2008; Wind & Saaty, 1980)

Numerical rating	Definition
1	Criteria "a" and "b" are of equal importance
3	Criterion "a" is moderately more important than criterion "b"
5	Criterion "a" is strongly more important than criterion "b"
7	Criterion "a" is very strongly more important than criterion "b"
9	Criterion "a" is extremely more important than criterion "b"
2, 4, 6, 8	Intermediate values

Table 2: Random consistency index (RI) values for different matrix sizes (Saaty, 1980)

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Appendix IV –Individual and Focus Group Interview Protocol

Datum:

Voorstellen en alvast bedanken voor tijd.

Introductie:
Dit onderzoek is onderdeel van mijn masteropleiding Health Sciences aan de Universiteit Twente en ik doe dit onderzoek in opdracht van M&I/Partners.

In dit onderzoek wil ik onderzoeken welke criteria relevant zijn bij het vergelijken van zorgplatforms in de Nederlandse markt. Ik ben geïnteresseerd in jullie ideeën, meningen en afwegingen over dit onderwerp, vooral vanuit jullie eigen expertisegebied. Er staan twee uur gepland voor deze sessie en de verwachting is dat we de sessie ook binnen deze twee uur kunnen afsluiten.

Voordat we beginnen, zou ik graag van jullie toestemming willen hebben om deze sessie op te nemen. Wanneer alle resultaten verwerkt zijn zullen de geluidsopnamen worden verwijderd. Daarnaast wil ik nog even benadrukken dat alles wat tijdens deze discussie wordt verteld, alleen word gebruikt voor dit onderzoek en niet zal worden gedeeld met mensen buiten de onderzoeksgroep. Jullie namen zullen nergens gebruikt worden, zodat jullie antwoorden niet naar jullie terug te herleiden zijn. Jullie kunnen daarnaast op elk moment aangeven dat jullie niet meer willen deelnemen aan het onderzoek. Ik zou dan als laatste jullie toestemming willen hebben of ik de informatie die ik uit deze groepsdiscussie haal, mag gebruiken voor mijn onderzoek. Hebben jullie voor we deze sessie starten nog vragen die jullie willen stellen?

Achtergrondinformatie
Ik zal jullie allereerst de definitie van een zorgplatform geven zoals deze door ons is geformuleerd:

"Zorgplatforms maken verbindingen mogelijk tussen zorginformatiesystemen (XISs) onderling, tussen zorginformatiesystemen en persoonlijke gezondheidsomgevingen (PGO's) en tussen zorginformatiesystemen en zorgapplicaties waarbij zij aan de bestaande afsprakenstelsels en wet- en regelgeving voldoen. Zij voorzien zorginstellingen hiermee van verschillende innovatiemogelijkheden en een totaaloplossing voor informatie-uitwisseling in de Nederlandse zorg."

(Figuren "Verbindingen zorgplatform" en "Functies zorgplatform" laten zien ter ondersteuning van definitie)

Criteria zorgplatform
De volgende thema's zullen worden besproken in de interviews:

Table 1: Discussed themes within the interviews

Product/Platform criteria	De focus ligt op de hoofd en sub criteria die kunnen worden gebruikt om het verschil in de kenmerken van de het product, ofwel het platform zelf, te onderscheiden. Deze criteria kunnen bijvoorbeeld zijn gerelateerd aan de modulariteit of de kosten van het platform.
Leverancier criteria	De focus ligt op de hoofd en sub criteria die kunnen worden gebruikt om de kenmerken van de verschillende leveranciers van de zorgplatforms te onderscheiden. Deze criteria kunnen bijvoorbeeld zijn gerelateerd aan de reputatie van de leverancier of de manier waarop de leverancier service en support biedt.
Interoperabiliteit criteria	Het creëren van interoperabiliteit tussen zorgorganisaties is de hoofdfunctie van zorgplatforms. De focus ligt op de hoofd en sub criteria die kunnen worden gebruikt om het verschil in de manier waarop zorgplatforms interoperabiliteit bieden te onderscheiden. Het model van Nictiz kan worden gebruikt als hulpmiddel.

Per thema zullen allereerst de volgende vragen worden gesteld:

- Gebaseerd op de besproken definitie van een zorgplatform, welke criteria binnen *het thema* zijn volgens jullie relevant bij het vergelijken van zorgplatforms in de Nederlandse markt?
- Waarom zijn deze criteria relevant?

De moderator zorgt ervoor dat de criteria één voor één worden besproken en geclusterd. Het is belangrijk dat de redenen van de relevantie van de criteria worden besproken en bediscussieerd. Dit proces wordt gedaan totdat er een compleet overzicht is ontstaan of totdat er 20 minuten zijn verstreken.

Vervolgens zullen de volgende vragen worden gesteld:

- Hoe kunnen de criteria worden verdeeld in hoofd en sub criteria?
- Waarom zijn de tot nu toe gevonden hoofd en sub criteria relevant of niet/minder relevant in deze categorie?
- Welke criteria missen nog?

Eventueel kan er dieper ingegaan worden op:

- De manier waarop de criteria meetbaar gemaakt kunnen worden.
- Vergelijking van gevonden criteria met criteria uit literatuuronderzoek.
- De belangrijkheid van de criteria.

Afronding

We zijn aan het einde gekomen van deze sessie. Met behulp van jullie input ben ik nu een stap verder in het vaststellen van een complete set aan criteria en sub criteria die relevant zijn bij de vergelijking van Nederlandse zorgplatforms. In de komende periode zal ik met mijn andere afstudeeronderzoek interviews gaan afnemen met medewerkers van de geïncludeerde zorgplatforms. Het doel hiervan is aan de ene kant om te kijken in hoeverre zorgplatforms overeenkomen met platforms uit andere industrieën en aan de andere kant om ook hun input te verkrijgen over de criteria die relevant zijn voor de vergelijking van zorgplatforms. Op een later tijdstip zullen er nog andere interviews worden georganiseerd.

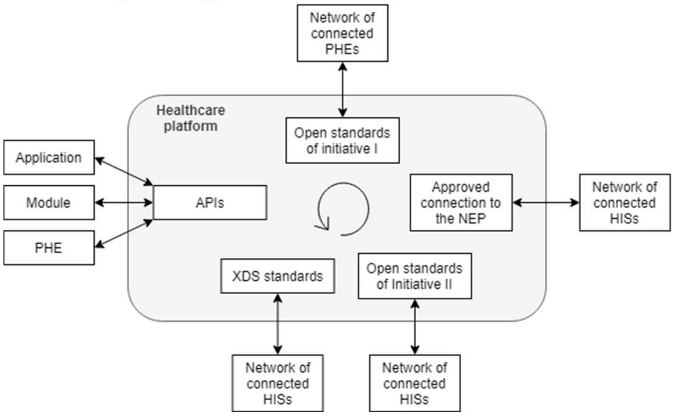
De volgende stap is om de belangrijkheid van de criteria te bepalen volgens de oordelen van verschillen besluitvormers binnen een organisatie. Aan de hand daarvan kan ook worden gekeken welk platform de voorkeur heeft en of dit verschilt per besluitvormer.

Hebben jullie verder nog toevoegingen/opmerkingen/vragen?
Mocht ik nog vragen hebben na het interview, zou ik jullie dan mogen mailen of bellen?
Willen jullie nog een samenvatting van de resultaten uit het onderzoek?

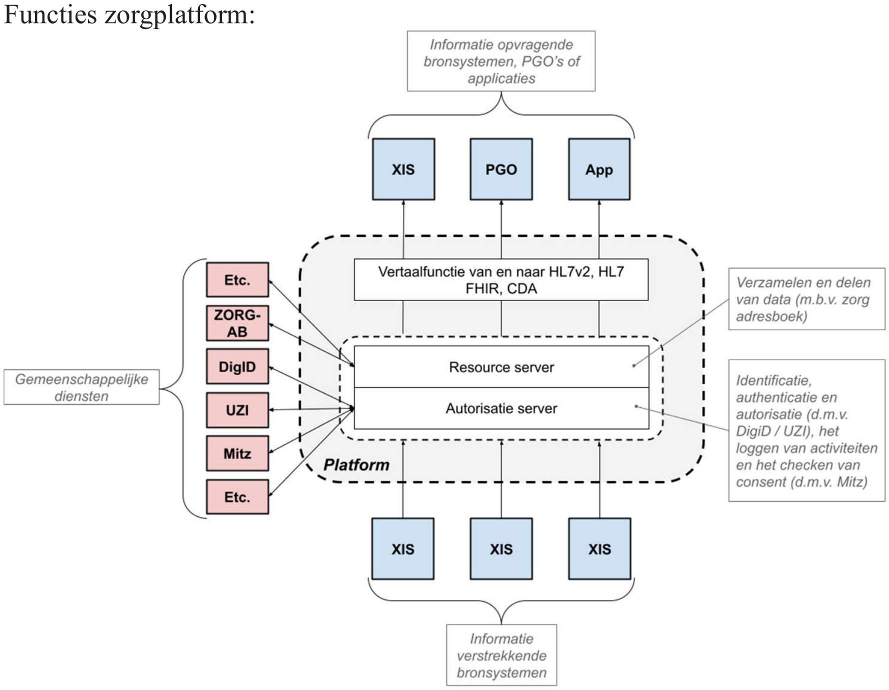
Bedanken voor de sessie.

Bijlage interview protocol

Verbindingen zorgplatform:



Functies zorgplatform:



Appendix V – Questionnaire

Algemeen

Mijn naam is Marit Kamphuis en ik ben op dit moment bezig met afstuderen voor mijn master "Health Sciences" aan de Universiteit Twente. Mijn afstudeeronderzoek wordt uitgevoerd vanuit M&I/Partners en gaat over zorgplatforms in de Nederlandse markt.

We zijn erin geïnteresseerd om in kaart te brengen welke criteria belangrijk zijn bij het selecteren van een zorgplatform. Deze informatie kan zorgorganisaties gaan ondersteunen bij het selecteren van het juiste zorgplatform.

Onze vragenlijst bestaat uit enkele vragen over achtergrondkenmerken, vragen over uw kennis en ervaring met zorgplatforms en vragen over het belang van verschillende selectiecriteria. Wij vragen niet naar persoonlijke gegevens zoals uw naam. Uw antwoorden worden daarnaast volledig vertrouwelijk gehouden. Het invullen van de vragenlijst kost ongeveer 10 minuten.

Door op de onderstaande knop te klikken, erkent u op de hoogte te zijn van het volgende:

- Uw deelname aan de vragenlijst is vrijwillig.
- U bent zich ervan bewust dat u het recht heeft om op elk moment tijdens het invullen van de vragenlijst te stoppen.

Bij vragen kunt u contact opnemen met Marit Kamphuis (*mailadres*).

- ○ Ik stem hiermee in, start met het onderzoek
- ○ Ik stem hier niet mee in, ik wens niet deel te nemen

Achtergrondkenmerken

Wat is uw geslacht?

- ○ Man
- ○ Vrouw
- ○ Niet-binair/derde geslacht
- ○ Ik zeg dat liever niet

Wat is uw hoogste afgeronde opleiding?

- ○ Basisonderwijs
- ○ Lager / voorbereidend beroepsonderwijs (lbo / vmbo)
- ○ Hoger algemeen voortgezet onderwijs (havo)
- ○ Voorbereiden wetenschappelijk onderwijs (vwo)
- ○ Middelbaar beroepsonderwijs (mbo)
- ○ Hoger beroepsonderwijs (hbo)
- ○ Wetenschappelijk onderwijs (wo)
- ○ Anders, namelijk: ____________

In wat voor een soort zorgorganisatie bent u werkzaam?

- ○ Universitair medisch centrum
- ○ Algemeen ziekenhuis
- ○ GGZ-instelling (Geestelijke Gezondheidszorg)
- ○ Huisarts of gezondheidscentrum

- Gehandicaptenzorginstelling
- VVT-instelling (Verpleging, Verzorging en Thuiszorg)
- Anders, namelijk: ____________

Hoeveel medewerkers heeft de zorgorganisatie waarin u werkzaam bent?
- Meer dan 250 medewerkers
- Tussen de 50 en 250 medewerkers
- Minder dan 50 medewerkers

Wat is uw functie binnen de zorgorganisatie? ____________

Introductie

Zorgplatforms maken verbindingen mogelijk met andere zorgorganisaties, maar ook met persoonlijke gezondheidsomgevingen en zorgapplicaties van derde partijen. Zij bieden bijvoorbeeld integratiemogelijkheden aan, zoals XDS voor de uitwisseling van beelden en documenten met andere organisaties en API's voor de verbinding met zorgapplicaties. Daarnaast sluiten zij vaak aan op landelijke infrastructuren en voldoen zij aan afsprakenstelsels, zoals MedMij, Twiin, Mitz en het Landelijk Schakelpunt. Zorgplatforms bieden zorgorganisaties op deze manier verschillende innovatiemogelijkheden en een complete oplossing voor de informatie-uitwisseling in de Nederlandse zorg. De platforms voldoen hierbij aan de bestaande wet- en regelgeving op het gebied van informatie-uitwisseling. Voorbeelden van deze zorgplatforms zijn (*voorbeelden zorgplatforms*).

Hoe deskundig bent u op het gebied van de genoemde zorgplatforms en hetgeen ze kunnen betekenen voor uw organisatie?
- Bijzonder deskundig
- Zeer deskundig
- Deskundig
- Enigszins deskundig
- Totaal niet deskundig

Hoe deskundig bent u op het gebied van de ICT binnen uw organisatie?
- Bijzonder deskundig
- Zeer deskundig
- Deskundig
- Enigszins deskundig
- Totaal niet deskundig

Hoe deskundig bent u op het gebied van de zorgprocessen binnen uw organisatie?
- Bijzonder deskundig
- Zeer deskundig
- Deskundig
- Enigszins deskundig
- Totaal niet deskundig

Hoe waarschijnlijk is het dat u invloed heeft op de keuze voor een zorgplatform binnen uw organisatie?
- Bijzonder deskundig
- Zeer deskundig

- ○ Deskundig
- ○ Enigszins deskundig
- ○ Totaal niet deskundig

Uitleg

De selectie van het juiste zorgplatform kan de kwaliteit, veiligheid en efficiëntie binnen een zorgorganisatie verbeteren. Voor zorgorganisaties is het belangrijk om een platform te kiezen dat aansluit bij de wensen en mogelijkheden binnen hun eigen zorgorganisatie.

Uit de literatuur en door middel van gesprekken met experts hebben wij een lijst met 19 criteria opgesteld die gebruikt kan worden om een zorgplatform te selecteren. De vragen in het resterende gedeelte van deze vragenlijst hebben als doel om erachter te komen welke criteria u belangrijk vindt als u een zorgplatform zou moeten selecteren voor de zorgorganisatie waarvoor u op dit moment werkzaam bent. Hieronder zullen we een voorbeeld van een vraag geven. Twee mogelijke selectiecriteria zijn de "reputatie” van het zorgplatform en de "financiële gezondheid” van het bedrijf dat het zorgplatform aanbiedt. In de onderstaande vraag ziet u links het criterium “reputatie” en rechts het criterium “financiële gezondheid”. Met behulp van de slider geeft u aan welk van deze criteria voor u belangrijker is en de mate waarin dit het geval is.

De nummers op deze schaal moet u als volgt interpreteren:

Numerieke beoordeling	Betekenis
1	De criteria zijn even belangrijk
3	Het criterium is iets belangrijker
5	Het criterium is belangrijker
7	Het criterium is veel belangrijker
9	Het criterium is extreem belangrijker
2, 4, 6, 8	Tussenliggende waarden

Kosten criteria

In dit onderdeel willen wij u vragen om te beoordelen welke van de volgende "kosten" criteria u belangrijker vindt bij het kiezen voor een platform:

- **De aansluitkosten** - De totale eenmalige kosten voor het aansluiten
- **De servicekosten** - De totale kosten per tijdseenheid voor het onderhoud en beheer
- **De transactiekosten** - De kosten per transactie

Welk van de volgende "kosten" criteria is belangrijker bij het kiezen voor een platform?

De aansluitkosten *of* *De servicekosten*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De aansluitkosten *of* *De transactiekosten*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De servicekosten *of* *De transactiekosten*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

Functionele kenmerken

In dit onderdeel willen wij u vragen om te beoordelen welke van de volgende functionele kenmerken u belangrijker vindt bij het kiezen voor een platform:

- **De integratiemogelijkheden met zorgorganisaties** - Het aantal en het soort verbonden zorgorganisaties
- **De aansluitmogelijkheden op landelijke infrastructuren** - De mate waarin kan worden aangesloten op landelijke infrastructuren/afsprakenstelsels (zoals MedMij, LSP, Twiin, Mitz)
- **De integratiemogelijkheden met zorgapplicaties/modules** - Het aantal en het soort verbonden zorgapplicaties/modules
- **De communicatiediensten** - Het aantal en soort verbonden zorgorganisaties dat door middel van communicatiediensten kan worden bereikt (zoals chat-, bericht- of maildiensten)

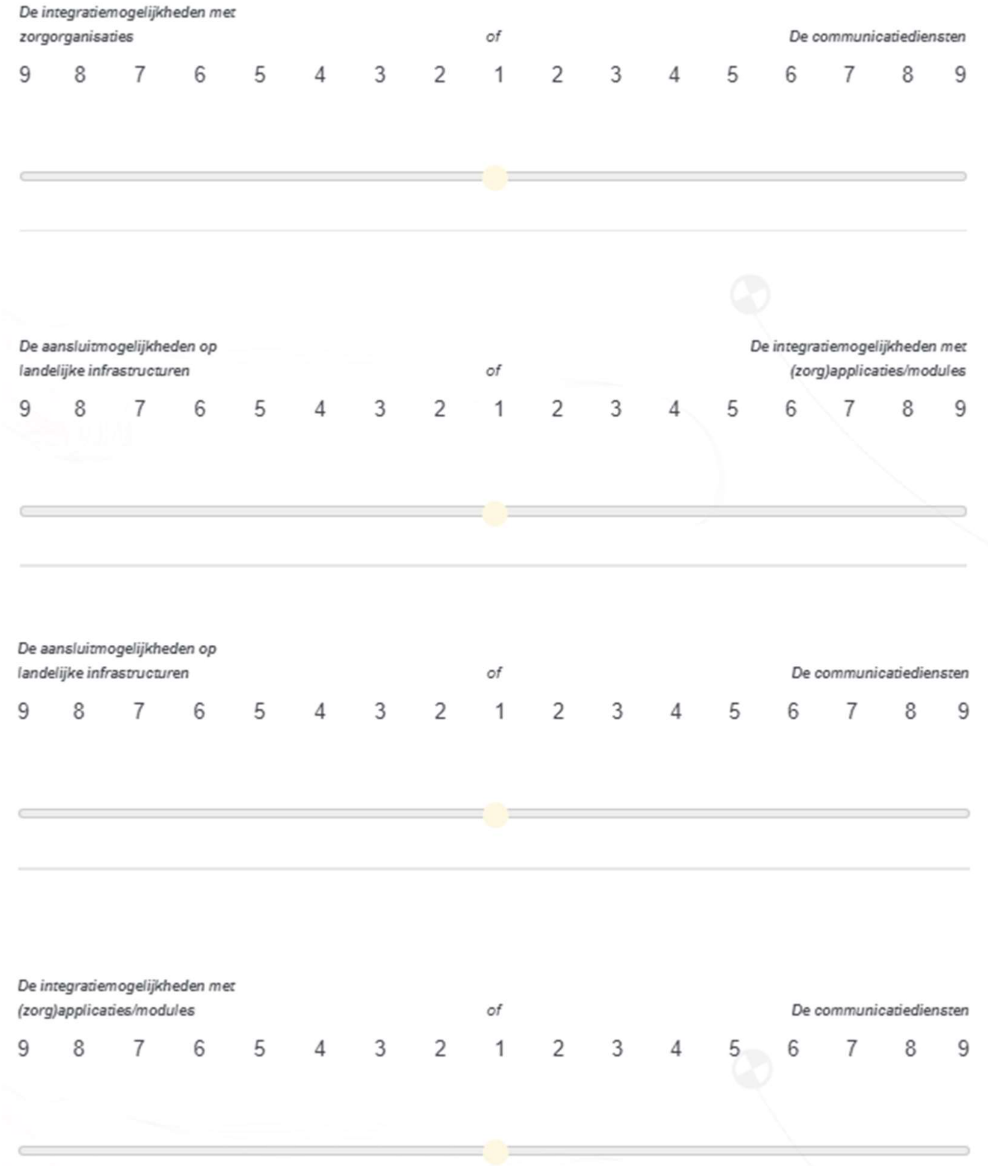
Welk van de volgende "functionele kenmerken" is belangrijker bij het kiezen voor een platform?

De integratiemogelijkheden met zorgorganisaties *of* *De aansluitmogelijkheden op landelijke infrastructuren*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De integratiemogelijkheden met zorgorganisaties *of* *De integratiemogelijkheden met (zorg)applicaties/modules*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9


De integratiemogelijkheden met zorgorganisaties | of | De communicatiediensten

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De aansluitmogelijkheden op landelijke infrastructuren | of | De integratiemogelijkheden met (zorg)applicaties/modules

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De aansluitmogelijkheden op landelijke infrastructuren | of | De communicatiediensten

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De integratiemogelijkheden met (zorg)applicaties/modules | of | De communicatiediensten

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

Technische kenmerken

In dit onderdeel willen wij u vragen om te beoordelen welke van de volgende technische kenmerken u belangrijker vindt bij het kiezen voor een platform:

- **De connectiviteit** - De mate waarin integraties met informatiesystemen van verschillende leveranciers worden ondersteund (eventueel via andere platforms)
- **De flexibiliteit** - De mate waarin verschillende ((inter)nationale en custom-made) standaarden worden ondersteund voor het realiseren van maatwerk bij integraties
- **De interoperabiliteit** - De mate waarin verschillende soorten informatie kunnen worden gedeeld en gebruikt tussen systemen/applicaties (zoals berichten, beelden, documenten en het aantal informatiebouwstenen)
- **De compleetheid** - Het aantal verschillende integratiemogelijkheden, ondersteunde standaarden/ infrastructuren/ afsprakenstelsels en andere aanvullende services
- **De modulariteit** - Het aantal modules dat onafhankelijk kan worden afgenomen
- **De beveiliging** - De mate van beveiliging van het platform zelf en van het transport en de bewerking van gegevens

- **De schaalbaarheid** - De mate waarin een toenemend aantal gebruikers en transacties kan worden ondersteund

Welk van de volgende "technische kenmerken" is belangrijker bij het kiezen voor een platform?

De connectiviteit *of* *De flexibiliteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De connectiviteit *of* *De interoperabiliteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De connectiviteit *of* *De compleetheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De flexibiliteit *of* *De interoperabiliteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De flexibiliteit *of* *De compleetheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De flexibiliteit *of* *De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De interoperabiliteit *of* *De compleetheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De connectiviteit *of* *De modulariteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De connectiviteit *of* *De beveiliging*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De connectiviteit *of* *De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De flexibiliteit *of* *De modulariteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De flexibiliteit *of* *De beveiliging*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De interoperabiliteit	*of*	*De modulariteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De interoperabiliteit	*of*	*De beveiliging*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De interoperabiliteit	*of*	*De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De compleetheid	*of*	*De modulariteit*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De compleetheid	*of*	*De beveiliging*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De compleetheid	*of*	*De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De modulariteit	*of*	*De beveiliging*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De modulariteit — *of* — *De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De beveiliging — *of* — *De schaalbaarheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

<u>Leverancier kenmerken</u>

In dit onderdeel willen wij u vragen om te beoordelen welke van de volgende leverancier kenmerken u belangrijker vindt bij het kiezen voor een platform:

- **De visie** - De mate waarin er een duurzame/langdurige relatie kan worden aangegaan op basis van een gezamenlijke visie/roadmap (zoals toekomstige ontwikkelingen van standaarden en innovaties)
- **De reputatie** - De mate van vertrouwen in de leverancier door het marktaandeel, het aantal en kwaliteit van referenties, de ervaring en de prestatie
- **De financiële gezondheid** - De liquiditeit, solvabiliteit, winstgevendheid en operationele efficiëntie
- **De technische ondersteuning en service** - De mate waarin er technische ondersteuning en service wordt verleend
- **De maatschappelijke verantwoordelijkheid** - De mate waarin er meegewerkt wordt aan de maatschappelijke doelstelling van de zorg (zoals openheid voor andere leveranciers en deelname aan landelijke initiatieven)

Welk van de volgende "leverancier kenmerken" is belangrijker bij het kiezen voor een platform?

De visie — *of* — *De reputatie*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De visie — *of* — *De financiële gezondheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De visie — *of* — *De technische ondersteuning en service*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De visie	*of*	*De maatschappelijke verantwoordelijkheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De reputatie	*of*	*De financiële gezondheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De reputatie	*of*	*De technische ondersteuning en service*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De reputatie	*of*	*De maatschappelijke verantwoordelijkheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De financiële gezondheid	*of*	*De technische ondersteuning en service*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De financiële gezondheid	*of*	*De maatschappelijke verantwoordelijkheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De technische ondersteuning en service	*of*	*De maatschappelijke verantwoordelijkheid*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

Criteria categorieën

In dit laatste onderdeel willen wij u vragen om te beoordelen welke van de volgende criteria categorieën u belangrijker vindt bij het kiezen voor een platform:

- **De kosten** - De aansluitkosten, servicekosten en transactiekosten
- **De functionele kenmerken** - De integratiemogelijkheden met zorgorganisaties en met (zorg)applicaties/modules, de aansluitmogelijkheden op landelijke infrastructuren en communicatiediensten
- **De technische kenmerken** - De connectiviteit, flexibiliteit, diepte van integraties, compleetheid, modulariteit, beveiliging en schaalbaarheid
- **De leverancier kenmerken** - De visie, reputatie, financiële gezondheid, technische ondersteuning en service en maatschappelijke verantwoordelijkheid

Welk van de volgende categorieën is belangrijker bij het kiezen voor een platform?

De kosten — *of* — *De functionele kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De kosten — *of* — *De technische kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De kosten — *of* — *De leverancier kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De functionele kenmerken — *of* — *De technische kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De functionele kenmerken — *of* — *De leverancier kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

De functionele kenmerken *of* *De technische kenmerken*

9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9

Bedankt voor de tijd die u heeft genomen om aan deze vragenlijst deel te nemen. Uw antwoord is geregistreerd.

De resultaten zullen worden gebruikt om in kaart te brengen welke criteria belangrijk zijn bij het selecteren van een zorgplatform. Dit kan zorgorganisaties gaan ondersteunen bij hun keuze voor een zorgplatform. Mocht u interesse hebben in de resultaten van het onderzoek, dan kunt u contact opnemen met Marit Kamphuis via (*mailadres*).

Uitgevoerd met Qualtrics

Appendix VI – Content Analysis

			Focusgroup 1						Focusgroup 2					Interview 1	Interview 2	Interview 3	Interview 4		Interview 5				
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 1	Expert 2	Expert 4	Expert 5	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Expert 12	Expert 13	Expert 14	*Expert mentions (EM)*	*EM per sub-criterium*	*EM per criteria*
Knock-out criteria		Voldoen aan internationale kwalificaties													x	x					2		
		Voldoen aan wet- en regelgeving	x																		1		
		Dataminimalisatie								x	x	x									3		
		Aansluiten DigID	x				x		x												3		
		Aansluiten Irma		x																	1		
		Aansluiten UZI	x																		1		
		Identificatie	x	x			x		x												4		
		Authenticatie																	x		1		
		Logging									x										1		
		Zorgadresboek							x												1		
De kosten		Kostenmodel								x			x		x	x			x		5		**22**
	De transactiekosten	Kosten per transactie							x	x	x	x	x				x				6	6	
	De aansluitkosten	Integratiekosten							x	x		x	x		x		x				6	6	
	De servicekosten	Service kosten								x		x					x				3	5	
		Licentie kosten							x			x									2		
De functionele kenmerken	De integratiemogelijkheden met zorgorganisaties	Integratiemogelijkheden zorgorganisaties		x	x	x		x		x	x				x		x		x	x	10	26	**104**
		Dekking per doelgroep							x		x	x									3		
		Marktfocus								x	x	x									3		
		Communicatie tussen zorgprofessionals		x	x	x				x											4		
		Gebruik XDS	x						x	x			x						x	x	6		
	De aansluitmogelijkheden op landelijke infrastructuren/ afsprakenstelsels	Voldoen aan afsprakenstelsels	x	x	x	x			x	x	x										7	57	
		Gebruik van gemeenschappelijke voorzieningen	x	x		x			x	x	x				x						7		
		Aansluiten Mitz		x											x	x			x		4		
		Aansluiten ZORG-AB	x			x			x	x	x				x	x					7		
		Aansluiten Twiin														x					1		
		Aansluiten AORTA/LSP	x	x						x									x	x	5		
		Aansluiten Nuts	x	x		x				x											4		
		Aansluiten MedMij	x	x	x	x			x	x					x	x			x	x	10		

		Patiëntgerichtheid		x		x										x					3		
		Communicatie met patiënten		x	x	x													x		4		
	De integratiemogelijkheden met (zorg)applicaties/ modules	Functionaliteiten zorgproces		x		x			x	x	x					x					6	18	
		Makelaarsfuncties	x	x		x															3		
		Integratiemogelijkheden met applicaties	x	x		x			x	x		x					x	x	x		9		
	De communicatiediensten	Communicatietools				x															1	3	
		Maildienst								x										x	2		
De technische kenmerken		Technische mogelijkheden	x	x										x		x			x		5		**145**
	De connectiviteit	Connectiviteit		x										x	x		x	x			5	17	
		Verbondenheid														x					1		
		Onafhankelijkheid bronsystemen	x	x					x	x		x			x	x	x		x		9		
		Samenwerking met veel leveranciers				x				x				x	x				x	x	6		
		Meerdere koppelvlakken														x					1		
	De flexibiliteit	Flexibiliteit								x		x		x				x			4	20	
		Gemak van aansluiten												x							1		
		Gemak van implementeren		x																	1		
		Mate van plug-and-play												x							1		
		Aanpasbaarheid							x									x			2		
		Gebruik van andere standaarden									x	x		x	x						4		
		Gebruik van meerdere infrastructuren								x	x	x	x								4		
		Ondersteuning custom-made standaarden							x	x					x						3		
	De interoperabiliteit	Interoperabiliteit		x								x		x	x	x	x	x			7	47	
		Technische interoperabiliteit	x	x			x														3		
		Semantische interoperabiliteit		x	x		x		x	x					x			x			7		
		Vertaalfunctie	x	x			x		x	x		x	x		x						8		
		Diepte van integraties															x	x			2		
		Communicatie standaarden	x				x					x	x		x						5		
		Gebruik van veel verschillende standaarden	x	x					x	x	x	x	x		x		x	x			10		
		Mate van ondersteuning van standaarden										x	x								2		
		Push en pull van informatie	x	x				x													3		
	De compleetheid	Compleetheid	x	x		x		x	x						x					x	7	15	
		Aansluiten op alle landelijke infrastructuren/afsprakenstelsels	x	x	x				x	x	x				x					x	8		
	De modulariteit	Modulariteit	x						x	x		x	x		x					x	7	7	
	De beveiliging	Beveiliging								x		x	x								3	32	

		Beveiligingsmechanismen									x	x									2		
		Beveiliging van de bewerking van gegevens							x	x	x	x	x								5		
		Beveiliging van de transport van gegevens								x	x	x	x								4		
		End-to-end encryptie								x	x										2		
		Privacy by design														x					1		
		Veiligheid	x							x											2		
		Pentest	x																		1		
		NEN-certificering	x	x					x				x		x		x		x	x	8		
		ISO-certificering		x									x				x		x		4		
	De schaalbaarheid	Schaalbaarheid																x			1	2	
		Hergebruik van koppelingen															x				1		
De leverancier kenmerken	De visie	Visie		x					x	x		x	x								5	20	**92**
		Roadmap								x		x	x								3		
		Partnership leverancier											x							x	2		
		Aansluiten op toekomstige afsprakenstelsels	x						x	x		x									4		
		Toekomstige ontwikkeling van standaarden							x	x	x	x	x		x						6		
	De reputatie	Reputatie								x											1	14	
		Prestatie		x				x	x			x	x								5		
		Referenties							x				x								2		
		Transacties per tijdseenheid							x				x								2		
		Marktaandeel									x		x								2		
		Beschikbaarheid							x				x								2		
	De financiële gezondheid	Financiële stabiliteit							x				x								2	11	
		Solvabiliteit							x												1		
		Voorinvesteringen							x	x											2		
		Verdienmodel							x	x							x				3		
		Bedrijfsmodel		x					x							x					3		
	De technische ondersteuning en service	Technische ondersteuning en onderhoud	x						x				x	x	x		x				6	25	
		Hoeveelheid updates/upgrades							x				x								2		
		Klantgerichtheid	x	x		x															3		
		Contractontbinding							x												1		
		Reactietijd service											x								1		
		Open documentatie						x						x							2	71	
		Snelheid van aansluiten								x		x		x							3		
		Onderhoudbaarheid								x				x							2		

		Cloud computing														x				1		
		Gegarandeerde aflevering						x	x			x								3		
		Traceerbaarheid							x											1		
	De maatschappelijke verantwoordelijkheid	Maatschappelijke verantwoordelijkheid		x	x					x				x	x						5	22	
		Gebruik van (inter)nationale standaarden				x						x	x		x	x	x	x			7		
		Samenwerking volgens federatief stelsel			x										x						2		
		Samenwerking met andere platforms								x				x	x					x	4		
		Belang in achterliggende producten							x	x		x			x						4		

Appendix VII – Comparison Matrices

Table 1: Comparison matrix including normalized principal Eigenvector of cost criteria

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	1/3	1/4	12.5%	3.039	0.019	0.034
C2	3	1	1/2	32.3%			
C3	4	2	1	55.3%			

Table 2: Comparison matrix including normalized principal Eigenvector of functional specifications

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	5/7	5/6	2 3/4	25.4%	4.049	0.016	0.018
F2	1 1/2	1	1 1/4	3	35.0%			
F3	1 1/5	4/5	1	3 1/7	29.7%			
F4	3/8	1/3	1/3	1	9.9%			

Table 3: Comparison matrix including normalized principal Eigenvector of technical specifications

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	1 8/9	3/5	1 3/4	2	1/2	1	14.2%	7.130	0.022	0.016
T2	5/9	1	1/2	1 1/5	1 2/5	3/7	1	10.2%			
T3	1 2/3	2 1/9	1	2	2 1/6	2/3	1 5/6	19.7%			
T4	3/5	6/7	1/2	1	1	1/3	6/7	9.0%			
T5	1/2	5/7	1/2	1	1	1/3	5/7	8.2%			
T6	2	2 3/7	1 1/2	3	2 5/6	1	2 2/3	27.0%			
T7	1 1/7	1 1/6	4/7	1 1/6	1 3/7	3/8	1	11.7%			

Table 4: Comparison matrix including normalized principal Eigenvector of supplier specifications

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	1 7/9	1 1/5	4/7	1 3/5	21.1%	5.212	0.053	0.047
S2	3/5	1	1 1/3	1/2	1 1/2	16.2%			
S3	1	5/6	1	5/8	1 4/9	17.1%			
S4	2	2 1/3	1 7/9	1	2 1/4	32.9%			
S5	5/8	5/7	3/4	4/9	1	12.7%			

Table 5: Comparison matrix including normalized principal Eigenvector of criteria categories

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	1/3	1/2	1	14.3%	4.057	0.019	0.021
CA2	2 7/9	1	2	2 6/7	44.5%			
CA3	2 1/7	1/2	1	2	26.6%			
CA4	1	1/3	1/2	1	14.6%			

Subgroups care and cure

Table 6: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup care

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	1/3	1/3	14.2%	3.000	0.000	0.000
C2	3	1	1	42.8%			
C3	3	1	1	43.0%			

Table 7: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup cure

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	1/3	2/9	11.5%	3.053	0.027	0.046
C2	3	1	2/5	28.2%			
C3	4 2/5	2 5/8	1	60.3%			

Table 8: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup care

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	3/4	5/6	2 2/5	25.5%	4.015	0.005	0.005
F2	1 1/3	1	3/4	2 1/2	29.2%			
F3	1 1/5	1 1/3	1	3	34.3%			
F4	2/5	2/5	1/3	1	11.0%			

Table 9: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup cure

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	2/3	6/7	3	25.0%	4.050	0.017	0.018
F2	1 1/2	1	1 3/5	3 2/5	37.5%			
F3	1 2/9	2/3	1	3 1/6	28.0%			
F4	1/3	1/3	1/3	1	9.5%			

Table 10: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup care

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	2 2/9	5/6	2 3/7	1 6/7	2/3	5/8	16.1%	7.153	0.026	0.019
T2	4/9	1	3/7	3/4	1 2/7	2/5	1	9.1%			
T3	1 1/5	2 2/7	1	2 2/9	2 1/9	6/7	1 4/7	19.4%			
T4	2/5	1 1/3	4/9	1	1	2/5	5/6	9.1%			
T5	1/2	7/9	1/2	1	1	1/3	2/3	8.3%			
T6	1 1/2	2 1/2	1 1/6	2 5/9	3	1	2 5/7	24.9%			
T7	1 3/5	1	2/3	1 2/9	1 1/2	3/8	1	13.1%			

Table 11: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup cure

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	1 5/7	1/2	1 1/2	2	3/7	1 1/9	13.5%	7.112	0.019	0.014
T2	3/5	1	1/2	1 3/7	1 1/2	3/7	6/7	10.7%			
T3	2	2	1	2	2 1/6	3/5	1 8/9	19.7%			
T4	2/3	2/3	1/2	1	1 1/8	1/3	7/8	9.0%			
T5	1/2	5/7	1/2	8/9	1	3/8	3/4	8.2%			
T6	2 1/3	2 2/5	1 2/3	3 1/7	2 3/4	1	2 2/3	27.8%			
T7	1	1 1/5	1/2	1 1/7	1 3/8	3/8	1	11.1%			

Table 12: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup care

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	1 1/3	6/7	2/5	1 4/7	17.2%	5.028	0.007	0.006
S2	3/4	1	5/6	1/3	1 1/2	14.6%			
S3	1 1/6	1 2/9	1	1/2	1 5/7	19.3%			
S4	2 3/7	3	1 6/7	1	2 2/3	37.4%			
S5	2/3	2/3	4/7	3/8	1	11.4%			

Table 13: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup cure

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	2	1 1/3	3/5	1 3/5	22.9%	5.164	0.041	0.037
S2	1/2	1	1 3/4	1/2	1 3/8	17.2%			
S3	7/9	3/4	1	5/8	1 2/7	16.1%			
S4	1 2/3	2	1 2/3	1	2	30.7%			
S5	5/8	3/4	7/9	1/2	1	13.1%			

Table 14: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup care

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	3/7	1/2	1 3/5	17.7%	4.055	0.018	0.020
CA2	2 1/3	1	2 2/7	3	44.7%			
CA3	1 6/7	3/7	1	1 4/7	24.1%			
CA4	5/8	1/3	5/8	1	13.6%			

Table 15: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup cure

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	1/3	1/2	8/9	13.5%	4.138	0.046	0.051
CA2	3	1	1 8/9	2 3/4	43.8%			
CA3	2 2/5	1/2	1	2 1/7	27.7%			
CA4	1 4/9	1/3	1/2	1	15.0%			

Subgroups nursing, RHIO, hospital, mental healthcare (hc)

Table 16: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup nursing

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	1/4	1/3	12.8%	3.000	0.000	0.000
C2	3 3/4	1	1 2/7	48.8%			
C3	3	7/9	1	38.4%			

Table 17: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup RHIO

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	3/4	1/3	18.9%	3.016	0.008	0.014
C2	1 1/3	1	1/3	22.1%			
C3	2 3/4	3	1	59.1%			

Table 18: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup hospital

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	1/3	2/9	11.8%	3.054	0.027	0.046
C2	2 5/6	1	3/7	28.8%			
C3	4 1/3	2 1/2	1	59.4%			

Table 19: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup mental hc

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	2/7	2/9	9.9%	3.137	0.069	0.118
C2	3 3/5	1	1/4	24.6%			
C3	4 4/7	3 5/6	1	65.5%			

Table 20: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup nursing

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	5/7	5/9	2	21.2%	4.008	0.003	0.003
F2	1 3/7	1	5/8	2 1/9	26.7%			
F3	1 5/6	1 4/7	1	3 4/7	40.6%			
F4	1/2	1/2	2/7	1	11.5%			

Table 21: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup RHIO

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	1	4 1/2	5 1/4	43.3%	4.129	0.043	0.048
F2	1 1/9	1	1 1/2	5 1/5	34.7%			
F3	2/9	2/3	1	1 5/7	14.5%			
F4	1/5	1/5	3/5	1	7.5%			

Table 22: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup hospital

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	5/7	7/8	3	25.6%	4.040	0.013	0.015
F2	1 3/7	1	1 2/3	3 1/2	37.8%			
F3	1 1/6	3/5	1	3 1/4	27.2%			
F4	1/3	2/7	1/3	1	9.3%			

Table 23: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup mental hc

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	1/2	5/8	2 5/6	21.7%	4.054	0.018	0.020
F2	2 1/7	1	1	2 5/6	35.8%			
F3	1 3/5	1	1	2 6/7	32.2%			
F4	1/3	1/3	1/3	1	10.3%			

Table 24: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup nursing

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	2	1	2 1/6	2	2/3	5/9	16.0%	7.254	0.042	0.032
T2	1/2	1	1/2	1/2	1 1/3	1/3	1	8.9%			
T3	1	2 1/6	1	2	1 4/5	6/7	1 6/7	18.3%			
T4	1/2	2	1/2	1	1	3/8	1	10.2%			
T5	1/2	3/4	5/9	1	1	1/3	3/4	8.5%			
T6	1 5/9	3	1 1/6	2 5/8	3	1	3	25.7%			
T7	1 7/9	1	1/2	1 1/9	1 1/3	1/3	1	12.4%			

Table 25: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup RHIO

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	3 1/3	2/7	4	1 1/3	4/5	1	16.0%	7.570	0.095	0.072
T2	1/3	1	1/3	4	1	4/5	5/8	10.6%			
T3	3 3/7	3	1	3 5/9	4	4/5	4/5	24.7%			
T4	1/4	1/4	2/7	1	1	3/7	5/9	5.8%			
T5	3/4	1	1/4	1	1	1/3	3/8	7.0%			
T6	1 1/4	1 1/4	1 1/4	2 2/7	3 1/3	1	2	20.0%			
T7	1	1 3/5	1 1/4	1 4/5	2 5/8	1/2	1	15.9%			

Table 26: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup hospital

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	2	1/2	1 3/5	2 1/8	1/2	1 1/7	14.4%	7.148	0.025	0.019
T2	1/2	1	1/2	1 3/8	1 1/2	1/2	7/9	10.2%			
T3	2	2 1/4	1	2	2 1/3	2/3	1 5/6	20.8%			
T4	5/8	5/7	1/2	1	1 1/9	1/3	8/9	9.0%			
T5	1/2	3/4	4/9	1	1	2/5	3/4	8.2%			
T6	2 1/6	2 1/5	1 1/2	3	2 1/2	1	2 3/7	26.1%			
T7	1	1 1/3	1/2	1 1/8	1 3/8	2/5	1	11.4%			

Table 27: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup mental hc

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	1/2	2/3	7/8	1 1/4	2/7	1	8.7%	7.086	0.014	0.011
T2	2	1	1 2/9	1 7/9	1 5/7	1/4	1 1/2	14.0%			
T3	1 1/2	5/6	1	1 3/7	1 5/9	1/3	2 1/6	13.5%			
T4	1 1/7	5/9	2/3	1	1 2/7	1/4	3/4	8.7%			
T5	4/5	4/7	2/3	7/9	1	2/9	5/7	7.5%			
T6	3 4/9	4	2 3/4	4 2/7	4 3/8	1	4 2/3	38.6%			
T7	1	2/3	1/2	1 1/3	1 3/8	2/9	1	9.0%			

Table 28: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup nursing

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	1 1/7	1	1/2	2	18.4%	5.057	0.014	0.013
S2	7/8	1	1 1/7	3/8	2	17.4%			
S3	1	7/8	1	1/2	2	18.0%			
S4	2	2 2/3	2	1	2 1/2	36.0%			
S5	1/2	1/2	1/2	2/5	1	10.2%			

Table 29: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup RHIO

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	2 5/8	3/7	2/9	5/7	11.7%	5.207	0.052	0.046
S2	3/8	1	2/9	1/4	1/2	6.8%			
S3	2 2/7	4 1/2	1	2/3	4/5	23.5%			
S4	4 4/7	4 1/6	1 4/9	1	3 3/7	41.2%			
S5	1 2/5	1 7/8	1 1/4	2/7	1	16.8%			

Table 30: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup hospital

	S1	S2	S3	S4	S5	**Normalized Eigenvector**	**Principal Eigenvalue**	**CI**	**CR**
S1	1	2 1/2	1 3/7	5/7	1 4/5	25.8%	5.209	0.052	0.047
S2	2/5	1	1 3/4	1/2	1 1/2	16.7%			
S3	5/7	3/4	1	2/3	1 1/3	16.0%			
S4	1 1/2	1 6/7	1 5/8	1	2	28.9%			
S5	5/9	5/7	3/4	1/2	1	12.7%			

Table 31: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup mental hc

	S1	S2	S3	S4	S5	**Normalized Eigenvector**	**Principal Eigenvalue**	**CI**	**CR**
S1	1	4/9	6/7	1/4	7/9	10.6%	5.119	0.030	0.026
S2	2 1/4	1	1 2/3	2/7	1	18.6%			
S3	1 1/6	3/5	1	5/9	1	15.1%			
S4	3 2/3	3 2/5	1 7/9	1	2 5/7	41.0%			
S5	1 2/7	1	1	3/8	1	14.8%			

Table 32: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup nursing

	CA1	CA2	CA3	CA4	**Normalized Eigenvector**	**Principal Eigenvalue**	**CI**	**CR**
CA1	1	2/5	1/2	1 5/9	17.5%	4.074	0.025	0.028
CA2	2 1/2	1	2 1/5	2 1/2	43.5%			
CA3	1 8/9	4/9	1	1 1/4	23.5%			
CA4	2/3	2/5	4/5	1	15.4%			

Table 33: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup RHIO

	CA1	CA2	CA3	CA4	**Normalized Eigenvector**	**Principal Eigenvalue**	**CI**	**CR**
CA1	1	5/9	3/5	1 7/8	18.2%	4.100	0.033	0.037
CA2	1 4/5	1	2 5/7	5 3/5	47.8%			
CA3	1 5/7	3/8	1	4	25.9%			
CA4	1/2	1/6	1/4	1	8.0%			

Table 34: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup hospital

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	2/7	1/2	5/6	12.3%	4.126	0.042	0.047
CA2	3 3/7	1	2 2/7	3	47.0%			
CA3	2 1/2	3/7	1	2 1/8	26.1%			
CA4	1 1/2	1/3	1/2	1	14.7%			

Table 35: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup mental hc

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	5/7	5/9	1 1/7	19.5%	4.019	0.006	0.007
CA2	1 3/8	1	3/5	2	27.0%			
CA3	1 7/9	1 2/3	1	2 1/7	37.5%			
CA4	7/8	1/2	1/2	1	15.9%			

Subgroups extern and intern

Table 36: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup extern

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	5/9	1/5	13.0%	3.001	0.000	0.000
C2	1 4/5	1	2/5	23.8%			
C3	5	2 3/5	1	63.2%			

Table 37: Comparison matrix including normalized principal Eigenvector of cost criteria of subgroup intern

	C1	C2	C3	Normalized Eigenvector	Principal Eigenvalue	CI	CR
C1	1	2/5	1/4	12.5%	3.196	0.098	0.169
C2	3 1/2	1	4/7	34.4%			
C3	3 4/5	2	1	53.1%			

Table 38: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup extern

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	1 5/6	2 1/3	2 1/4	40.7%	4.080	0.027	0.030
F2	5/9	1	7/8	2 1/4	23.1%			
F3	3/7	1 1/7	1	2 1/3	23.7%			
F4	4/9	4/9	3/7	1	12.5%			

Table 39: Comparison matrix including normalized principal Eigenvector of functional specifications of subgroup intern

	F1	F2	F3	F4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
F1	1	3/5	5/7	2 5/6	23.2%	4.066	0.022	0.025
F2	1 3/4	1	1 2/5	3 1/4	36.9%			
F3	1 3/7	3/4	1	3 1/3	30.5%			
F4	1/3	1/3	1/3	1	9.5%			

Table 40: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup extern

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	2 1/4	2/3	3	1 2/5	3/7	1 5/8	16.0%	7.307	0.051	0.039
T2	4/9	1	4/9	3 3/4	1 1/4	1/2	1	11.8%			
T3	1 1/2	2 1/5	1	3 5/8	3	3/5	1	19.8%			
T4	1/3	1/4	2/7	1	2/3	2/5	4/5	6.2%			
T5	5/7	4/5	1/3	1 1/2	1	1/3	4/5	8.6%			
T6	2 2/7	2	1 2/3	2 4/7	3 1/5	1	2 2/5	26.0%			
T7	5/8	1	1 1/9	1 1/4	1 1/4	3/7	1	11.6%			

Table 41: Comparison matrix including normalized principal Eigenvector of technical specifications of subgroup intern

	T1	T2	T3	T4	T5	T6	T7	Normalized Eigenvector	Principal Eigenvalue	CI	CR
T1	1	1 4/5	5/8	1 3/5	2 1/6	1/2	6/7	14.0%	7.337	0.056	0.043
T2	4/7	1	1/2	1	1 3/7	3/7	8/9	9.9%			
T3	1 5/6	2 1/9	1	2	2	2/3	2	19.5%			
T4	2/3	1	4/7	1	1 1/4	1/3	8/9	9.7%			
T5	1/2	5/7	1/2	8/9	1	3/8	5/7	8.3%			
T6	2 1/4	2 2/3	1 1/2	3 1/6	3	1	3	27.1%			
T7	1 2/9	1 1/5	1/2	1 1/5	1 1/2	3/8	1	11.5%			

Table 42: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup extern

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	3	1 2/5	2/3	4/5	22.3%	5.152	0.038	0.034
S2	1/3	1	5/7	3/7	7/9	11.5%			
S3	5/7	1 2/5	1	5/8	3/7	14.4%			
S4	1 1/2	2 3/8	1 3/5	1	1 2/3	29.2%			
S5	1 1/4	1 2/7	2 2/7	3/5	1	22.6%			

Table 43: Comparison matrix including normalized principal Eigenvector of supplier specifications of subgroup intern

	S1	S2	S3	S4	S5	Normalized Eigenvector	Principal Eigenvalue	CI	CR
S1	1	1 3/5	1 1/8	1/2	1 5/6	20.8%	5.144	0.036	0.032
S2	5/8	1	1 1/2	4/9	1 3/5	17.2%			
S3	1	3/4	1	3/5	1 7/9	17.4%			
S4	2	2 1/4	1 5/7	1	2 1/3	33.1%			
S5	4/7	2/3	3/5	3/7	1	11.5%			

Table 44: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup extern

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	3/8	1/2	3/4	13.4%	4.059	0.020	0.022
CA2	2 5/8	1	2 1/3	3 6/7	48.0%			
CA3	2	3/7	1	2	24.9%			
CA4	1 1/3	1/4	1/2	1	13.8%			

Table 45: Comparison matrix including normalized principal Eigenvector of criteria categories of subgroup intern

	CA1	CA2	CA3	CA4	Normalized Eigenvector	Principal Eigenvalue	CI	CR
CA1	1	1/3	1/2	1	14.5%	4.085	0.028	0.032
CA2	2 5/6	1	2	2 2/3	43.7%			
CA3	2 1/6	1/2	1	2	26.9%			
CA4	1	3/8	5/9	1	14.8%			

Appendix VIII – Subgroup Results

Table 1: Criteria importance according to care subgroup (N=15) and cure subgroup (N=35)

Criteria	Sub criteria	Effective weight care group	Effective weight cure group
Cost criteria	Connection costs	0.177 * 0.142 = **2.5%**	0.135 * 0.115 = **1.6%**
	Service costs	0.177 * 0.428 = **7.6%**	0.135 * 0.282 = **3.8%**
	Transaction costs	0.177 * 0.430 = **7.6%**	0.135 * 0.603 = **8.2%**
Functional specifications	Integration possibilities with healthcare organisations	0.447 * 0.255 = **11.4%**	0.438 * 0.250 = **10.9%**
	Connection possibilities with national infrastructures	0.447 * 0.292 = **13.0%**	0.438 * 0.375 = **16.4%**
	Integration possibilities with applications	0.447 * 0.343 = **15.3%**	0.438 * 0.280 = **12.3%**
	Communication services	0.447 * 0.110 = **4.9%**	0.438 * 0.095 = **4.1%**
Technical specifications	Connectivity	0.241 * 0.161 = **3.9%**	0.277 * 0.135 = **3.7%**
	Flexibility	0.241 * 0.091 = **2.2%**	0.277 * 0.107 = **3.0%**
	Interoperability	0.241 * 0.194 = **4.7%**	0.277 * 0.197 = **5.5%**
	Completeness	0.241 * 0.091 = **2.2%**	0.277 * 0.090 = **2.5%**
	Modularity	0.241 * 0.083 = **2.0%**	0.277 * 0.082 = **2.3%**
	Security	0.241 * 0.249 = **6.0%**	0.277 * 0.278 = **7.7%**
	Scalability	0.241 * 0.131 = **3.2%**	0.277 * 0.111 = **3.1%**
Supplier specifications	Vision	0.136 * 0.172 = **2.3%**	0.150 * 0.229 = **3.4%**
	Reputation	0.136 * 0.146 = **2.0%**	0.150 * 0.172 = **2.6%**
	Financial health	0.136 * 0.193 = **2.6%**	0.150 * 0.161 = **2.4%**
	Technical support and service	0.136 * 0.374 = **5.2%**	0.150 * 0.307 = **4.6%**
	Social responsibility	0.136 * 0.114 = **1.5%**	0.150 * 0.131 = **2.0%**
Total		**100%**	**100%**

Table 2: Criteria importance according to nursing (N=12), RHIO (N=3), hospital (N=30) and mental hc (N=5) subgroups

Criteria	Sub criteria	Effective weight nursing group	Effective weight RHIO group	Effective weight hospital group	Effective weight mental hc group
Cost criteria	Connection costs	0.175 * 0.128 = **2.2%**	0.182 * 0.189 = **3.4%**	0.123 * 0.118 = **1.4%**	0.195 * 0.099 = **1.9%**
	Service costs	0.175 * 0.488 = **8.6%**	0.182 * 0.221 = **4.0%**	0.123 * 0.288 = **3.5%**	0.195 * 0.246 = **4.8%**
	Transaction costs	0.175 * 0.384 = **6.7%**	0.182 * 0.591 = **10.8%**	0.123 * 0.594 = **7.3%**	0.195 * 0.655 = **12.8%**
Functional specifications	IP with healthcare organisations	0.435 * 0.212 = **9.2%**	0.478 * 0.433 = **20.7%**	0.470 * 0.256 = **12.0%**	0.270 * 0.217 = **5.9%**
	CP with national infrastructures	0.435 * 0.267 = **11.6%**	0.478 * 0.347 = **16.6%**	0.470 * 0.378 = **17.8%**	0.270 * 0.358 = **9.7%**
	IP with applications	0.435 * 0.406 = **17.7%**	0.478 * 0.145 = **6.9%**	0.470 * 0.272 = **12.8%**	0.270 * 0.322 = **8.7%**
	Communication services	0.435 * 0.115 = 5.**0%**	0.478 * 0.075 = **3.6%**	0.470 * 0.093 = **4.4%**	0.270 * 0.103 = **2.8%**
Technical specifications	Connectivity	0.235 * 0.160 = **3.8%**	0.259 * 0.160 = **4.1%**	0.261 * 0.144 = **3.8%**	0.375 * 0.087 = **3.3%**
	Flexibility	0.235 * 0.089 = **2.1%**	0.259 * 0.106 = **2.7%**	0.261 * 0.102 = **2.7%**	0.375 * 0.140 = **5.3%**
	Interoperability	0.235 * 0.183 = **4.3%**	0.259 * 0.247 = **6.4%**	0.261 * 0.208 = **5.4%**	0.375 * 0.135 = **5.1%**
	Completeness	0.235 * 0.102 = **2.4%**	0.259 * 0.058 = **1.5%**	0.261 * 0.090 = **2.3%**	0.375 * 0.087 = **3.2%**
	Modularity	0.235 * 0.085 = **2.0%**	0.259 * 0.070 = **1.8%**	0.261 * 0.082 = **2.1%**	0.375 * 0.075 = **2.8%**
	Security	0.235 * 0.257 = **6.0%**	0.259 * 0.200 = **5.2%**	0.261 * 0.261 = **6.8%**	0.375 * 0.386 = **14.5%**
	Scalability	0.235 * 0.124 = **2.9%**	0.259 * 0.159 = **4.1%**	0.261 * 0.114 = **3.0%**	0.375 * 0.090 = **3.4%**
Supplier specifications	Vision	0.154 * 0.184 = **2.8%**	0.080 * 0.117 = **0.9%**	0.147 * 0.258 = **3.8%**	0.159 * 0.106 = **1.7%**
	Reputation	0.154 * 0.174 = **2.7%**	0.080 * 0.068 = **0.5%**	0.147 * 0.167 = **2.5%**	0.159 * 0.186 = **3.0%**
	Financial health	0.154 * 0.180 = **2.8%**	0.080 * 0.235 = **1.9%**	0.147 * 0.160 = **2.3%**	0.159 * 0.151 = **2.4%**
	Technical support and service	0.154 * 0.360 = **5.5%**	0.080 * 0.412 = **3.3%**	0.147 * 0.289 = **4.2%**	0.159 * 0.410 = **6.5%**
	Social responsibility	0.154 * 0.102 = **1.6%**	0.080 * 0.168 = **1.3%**	0.147 * 0.127 = **1.9%**	0.159 * 0.148 = **2.4%**
Total		**100%**	**100%**	**100%**	**100%**

Table 3: Criteria importance according to extern subgroup (N=7) and intern subgroup (N=43)

Criteria	**Sub criteria**	**Effective weight extern group**	**Effective weight intern group**
Cost criteria	Connection costs	0.134 * 0.130 = **1.7%**	0.145 * 0.125 = **1.8%**
	Service costs	0.134 * 0.238 = **3.2%**	0.145 * 0.344 = **5.0%**
	Transaction costs	0.134 * 0.632 = **8.4%**	0.145 * 0.531 = **7.7%**
Functional specifications	Integration possibilities with healthcare organisations	0.480 * 0.407 = **19.5%**	0.437 * 0.232 = **10.2%**
	Connection possibilities with national infrastructures	0.480 * 0.231 = **11.1%**	0.437 * 0.369 = **16.1%**
	Integration possibilities with applications	0.480 * 0.237 = **11.4%**	0.437 * 0.305 = **13.3%**
	Communication services	0.480 * 0.125 = **6.0%**	0.437 * 0.095 = **4.1%**
Technical specifications	Connectivity	0.249 * 0.160 = **4.0%**	0.269 * 0.140 = **3.8%**
	Flexibility	0.249 * 0.118 = **2.9%**	0.269 * 0.099 = **2.7%**
	Interoperability	0.249 * 0.198 = **4.9%**	0.269 * 0.195 = 5.3%
	Completeness	0.249 * 0.062 = **1.5%**	0.269 * 0.097 = **2.6%**
	Modularity	0.249 * 0.086 = **2.1%**	0.269 * 0.083 = **2.2%**
	Security	0.249 * 0.260 = **6.5%**	0.269 * 0.271 = **7.3%**
	Scalability	0.249 * 0.116 = **2.9%**	0.269 * 0.115 = **3.1%**
Supplier specifications	Vision	0.138 * 0.223 = **3.1%**	0.148 * 0.208 = **3.1%**
	Reputation	0.138 * 0.115 = **1.6%**	0.148 * 0.172 = **2.5%**
	Financial health	0.138 * 0.144 = **2.0%**	0.148 * 0.174 = **2.6%**
	Technical support and service	0.138 * 0.292 = **4.0%**	0.148 * 0.331 = **4.9%**
	Social responsibility	0.138 * 0.226 = **3.1%**	0.148 * 0.115 = **1.7%**
Total		**100%**	**100%**

Appendix IX – Results from Mann-Whitney U Tests and Kruskal-Wallis Test

Table 1: Hypothesis test summary of Mann-Whitney U Test of sector type subgroups

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of C1 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.153	Retain the null hypothesis.
2	The distribution of C2 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.043	Reject the null hypothesis.
3	The distribution of C3 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.759	Retain the null hypothesis.
4	The distribution of F1 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.727	Retain the null hypothesis.
5	The distribution of F2 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.067	Retain the null hypothesis.
6	The distribution of F3 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.427	Retain the null hypothesis.
7	The distribution of F4 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.611	Retain the null hypothesis.
8	The distribution of T1 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.799	Retain the null hypothesis.
9	The distribution of T2 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.290	Retain the null hypothesis.
10	The distribution of T3 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.575	Retain the null hypothesis.
11	The distribution of T4 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.240	Retain the null hypothesis.
12	The distribution of T5 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.440	Retain the null hypothesis.
13	The distribution of T6 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.295	Retain the null hypothesis.
14	The distribution of T7 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.832	Retain the null hypothesis.
15	The distribution of S1 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.088	Retain the null hypothesis.
16	The distribution of S2 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.518	Retain the null hypothesis.
17	The distribution of S3 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.680	Retain the null hypothesis.
18	The distribution of S4 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.966	Retain the null hypothesis.
19	The distribution of S5 is the same across categories of Carecure.	Independent-Samples Mann-Whitney U Test	.485	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Table 2: Mann-Whitney U test summary of service cost criterion of sector type subgroups

Independent-Samples Mann-Whitney U Test Summary

Total N	50
Mann-Whitney U	358.000
Wilcoxon W	478.000
Test Statistic	358.000
Standard Error	47.235
Standardized Test Statistic	2.022
Asymptotic Sig.(2-sided test)	.043

Table 3: Hypothesis test summary of Kruskal-Wallis Test of organisation type subgroups

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of C1 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.264	Retain the null hypothesis.
2	The distribution of C2 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.161	Retain the null hypothesis.
3	The distribution of C3 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.192	Retain the null hypothesis.
4	The distribution of F1 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.153	Retain the null hypothesis.
5	The distribution of F2 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.040	Reject the null hypothesis.
6	The distribution of F3 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.326	Retain the null hypothesis.
7	The distribution of F4 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.807	Retain the null hypothesis.
8	The distribution of T1 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.893	Retain the null hypothesis.
9	The distribution of T2 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.092	Retain the null hypothesis.
10	The distribution of T3 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.738	Retain the null hypothesis.
11	The distribution of T4 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.248	Retain the null hypothesis.
12	The distribution of T5 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.736	Retain the null hypothesis.
13	The distribution of T6 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.219	Retain the null hypothesis.
14	The distribution of T7 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.877	Retain the null hypothesis.
15	The distribution of S1 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.049	Reject the null hypothesis.
16	The distribution of S2 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.099	Retain the null hypothesis.
17	The distribution of S3 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.944	Retain the null hypothesis.
18	The distribution of S4 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.311	Retain the null hypothesis.
19	The distribution of S5 is the same across categories of Organisationtype.	Independent-Samples Kruskal-Wallis Test	.816	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Table 4 (left): Kruskal-Wallis test summary of connection possibilities with national infrastructures criterion of organisation type subgroups
Table 5 (right): Dunn's pairwise tests summary of connection possibilities with national infrastructures criterion of organisation type subgroups

Independent-Samples Kruskal-Wallis Test Summary

Total N	50
Test Statistic	8.335[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.040

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Organisationtype

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
GGZ-Nursing	1.183	7.759	.153	.879	1.000
GGZ-RHIO	-11.933	10.646	-1.121	.262	1.000
GGZ-Hospital	13.500	7.041	1.917	.055	.331
Nursing-RHIO	-10.750	9.409	-1.142	.253	1.000
Nursing-Hospital	12.317	4.979	2.474	.013	.080
RHIO-Hospital	1.567	8.827	.177	.859	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 6 (left): Kruskal-Wallis test summary of vision criterion of organisation type subgroups
Table 7 (right): Dunn's pairwise tests summary of vision criterion of organisation type subgroups

Independent-Samples Kruskal-Wallis Test Summary

Total N	50
Test Statistic	7.864[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.049

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Organisationtype

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
RHIO-GGZ	13.133	10.644	1.234	.217	1.000
RHIO-Nursing	16.833	9.408	1.789	.074	.441
RHIO-Hospital	22.467	8.826	2.546	.011	.065
GGZ-Nursing	3.700	7.758	.477	.633	1.000
GGZ-Hospital	9.333	7.040	1.326	.185	1.000
Nursing-Hospital	5.633	4.978	1.132	.258	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 8: Hypothesis test summary of Mann-Whitney U Test of position type subgroups

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of C1 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.743	Retain the null hypothesis.
2	The distribution of C2 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.661	Retain the null hypothesis.
3	The distribution of C3 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.848	Retain the null hypothesis.
4	The distribution of F1 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.049	Reject the null hypothesis.
5	The distribution of F2 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.235	Retain the null hypothesis.
6	The distribution of F3 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.702	Retain the null hypothesis.
7	The distribution of F4 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.379	Retain the null hypothesis.
8	The distribution of T1 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.891	Retain the null hypothesis.
9	The distribution of T2 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.935	Retain the null hypothesis.
10	The distribution of T3 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.622	Retain the null hypothesis.
11	The distribution of T4 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.064	Retain the null hypothesis.
12	The distribution of T5 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.681	Retain the null hypothesis.
13	The distribution of T6 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.661	Retain the null hypothesis.
14	The distribution of T7 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.891	Retain the null hypothesis.
15	The distribution of S1 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.763	Retain the null hypothesis.
16	The distribution of S2 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.193	Retain the null hypothesis.
17	The distribution of S3 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.546	Retain the null hypothesis.
18	The distribution of S4 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.258	Retain the null hypothesis.
19	The distribution of S5 is the same across categories of Positiontype.	Independent-Samples Mann-Whitney U Test	.126	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Table 9: Mann-Whitney U test summary of integration possibilities with healthcare organisations criterion of sector type subgroups

Independent-Samples Mann-Whitney U Test Summary

Total N	50
Mann-Whitney U	221.000
Wilcoxon W	249.000
Test Statistic	221.000
Standard Error	35.765
Standardized Test Statistic	1.971
Asymptotic Sig.(2-sided test)	.049
Exact Sig.(2-sided test)	.049

Appendix X – Supplier Evaluation Scheme

Criteria	Sub criteria	Effective weight	Score (0-100)	Effective score
Cost criteria	Connection costs	**1.8%**		
	Service costs	**4.6%**		
	Transaction costs	**7.9%**		
Functional specifications	Integration possibilities with healthcare organisations	**11.3%**		
	Connection possibilities with national infrastructures	**15.6%**		
	Integration possibilities with applications / modules	**13.2%**		
	Communication services	**4.4%**		
Technical specifications	Connectivity	**3.8%**		
	Flexibility	**2.7%**		
	Interoperability	**5.2%**		
	Completeness	**2.4%**		
	Modularity	**2.2%**		
	Security	**7.2%**		
	Scalability	**3.1%**		
Supplier specifications	Vision	**3.1%**		
	Reputation	**2.4%**		
	Financial health	**2.5%**		
	Technical support and service	**4.8%**		
	Social responsibility	**1.8%**		
			END SCORE:	

Figure 1: Supplier evaluation scheme that can be used for each healthcare platform supplier