A Digital Platform for Information Systems in Dutch first-line healthcare

A study on boundary resources

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A Digital Platform for Information Systems in Dutch first-line healthcare

A study on Boundary Resources

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Preface

In front of you lies my master thesis, which is conducted for the Master Complex System Engineering and Management at the Delft University of Technology. This master thesis explores the boundary resources in Dutch first line healthcare that are required in order to increase the intent of Information Systems suppliers in to join a digital platform. This is researched, as information systems suppliers lack an ability to innovate. Innovation can be increased by an open digital platform for information system suppliers as boundary resources can affect the degree of openness in a platform, which in return affects the willingness to join the platform. When more IS suppliers join a platform, the platform becomes more innovative. This is important, as in Dutch healthcare, IS needs to innovate in order to deal with tomorrows challenges. Currently, unfortunately, this is not happing. The boundary resources are evaluated by industry experts by means of a Multi Criteria Decision Analysis, using the Best-Worst Method.

I would like to express my gratitude for a number of individuals that have contributed to the work of this thesis. I would like to start with the individual members of my graduation committee. It is safe to say that this process could not be described as “an easy ride”. However, you remained supportive and patient throughout the process and helped me get back on track after an initial less successful attempt.

Mark, you have impressed me greatly with your extensive knowledgeability, ability to communicate complex matters very effectively and your provision of extensive and valuable feedback. Your calm, patient, clear and assertive demeanor serves you greatly as a chair of a graduation committee and an educator at the Delft University of Technology. I am very grateful to have followed education from you and have had you as the chair of my graduation committee. Gijs, I have been amazed by how passionately you could tell me how wrong or unclear some of my earlier work was during our earlier feedback sessions. That passion has only been overshadowed by your passion to not only make my thesis a success, but the passion to actually face the issues in Dutch Healthcare that are described in this thesis. You expressed that I showed a strong learning curve throughout the process of writing my thesis, which is a compliment I carry with great pride. I hope and expect you will do well in your future endeavors! Geerten, your positivity is radiant. I can support this by the fact that every feedback session with you started with the same statement: “this is such an interesting topic!” The rest of your feedback was constructive, supportive and helpful, which made me feel lifted and motivated afterwards. I especially value your expertise and comments on the methodology aspect, which proved to be of great value.

I want to thank the respondents for contributing to my thesis. Your valuable time and expert opinion are greatly appreciated. I would like to thank Peter Walrecht in particular, who as my roommate and great friend during the quarantine served as my cook, maid, coach and therapist during the process of writing my thesis. Finally, I would like to thank my family and other friends, who I could count on for great support as well. I would have been possible without you.

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Executive summary

Current IS systems in Dutch first-line healthcare are failing to support a transition towards healthcare capable of treating of chronic disease, preventive care, and high patient participation. These IS systems developers are failing to develop innovations that are able to support this new kind of healthcare. This lack of innovation for IS is caused due to a number of reasons. First, innovation in healthcare is notoriously difficult, because the system has high quality standards for IS, strict rules for management of medical data, which is often a key functionality of IS and finally and a complex legal framework that.

However, innovation is not only difficult, but also purposefully inhibited by IS suppliers. One of the most important issues to address is a lack of standardization among IS solutions that are used by different IS suppliers. This makes collaboration between healthcare professionals challenging, as a lack of standardization makes it difficult to share medical information between healthcare professionals. As standardization and opening up IS solutions poses the risk for IS suppliers to lose their user base, this is purposefully avoided.

Digital platforms are increasingly adopted in all sorts of industries as an approach for orchestrating resources and innovation from different third-party contributors. Thereby, digital platforms are particularly useful to promote innovation for industries that are organized in networks, which the Dutch first-line healthcare system is slowly transitioning towards. Innovation on digital platforms is achieved via the activities of IS suppliers that will fulfill to role of complementors on the platform by developing innovations.

However, innovation requires participation of IS Suppliers on the platform. Therefore, measures should be taken in order to motivate platform adoption. This can be done by opening up the platform, which allows platform complementors to use and control more platform resources. By increasing the degree of openness, more IS Suppliers can access more platform resources. This will motivate platform complementors to join the platform. When more platform complementors join, innovation can be sparked through an increase in network effects. Therefore, platform Boundary Resources (BRs) should be considered.

BRs are artifacts of different sorts that serve to govern the arm's length relationship between platform owner and platform complementor. BRs hereby act extend the scope and diversity of the platform and allow to increase control of a platform and its related activities. These are important functionalities to develop an innovative digital platform. Therefore, these artifacts are critical for a digital platform to design properly. Therefore, in order to design

What boundary resources increase IS suppliers in Dutch first-line care intention to participate with development and operation of applications on a digital platform?

This research uses the Best Worst Method as an MCDA to answer the research question. A conceptual model is used to develop categories by which BRs could be evaluated. The conceptual model distinguishes Application BRs (ABR), Development BRs (DBR) and Social BRs (SBR). Based on research of the Dutch First-line healthcare sector, academic literature, and purposefully selected filtering mechanisms, 16 BRs are identified.

The BWM has considered 31 industry experts to provide their views the relative affect to BRs to motivate platform adoption. The data that was obtained has led to a number of interesting findings. Database Libraries, IAM APIs and tools for the standardization of medical data, were considered to best motivate platform adoption by the pool of industry experts that filled in the survey. Additionally, it was evaluated whether the installed base of the organizations that the companies had an effect on the evaluation of their boundary resources. A Kruskal-Wallis test showed that there were no significant differences between these two groups.

For managers, an important challenge exists for increasing the innovative capability of IS in Dutch first line healthcare, as by doing that, tomorrow's challenges in Dutch first line healthcare can more effectively faced. In order to promote innovation, an open digital platform could be introduced for IS, as this increases network effects. Openness can be affected by carefully designing boundary resources, which can be designed in such a way that it becomes attractive to join the platform. When more complementors join, network effects increase, a positive feedback loop of increasing value of introduced.

Therefore, eventually, it is important for managers in Dutch first line care to understand how BRs should be designed so that platform adoption by complementors is motivated. This thesis prepares for such research by providing a number of prerequisites. First, a list is provided of all BRs that a manager in Dutch first-line healthcare could consider in the design process. Thereby, it is known what BRs can be tuned in order to affect openness of the platform and thereby the intention to adopt the platform of platform complementors. More specifically, a rank order is established by industry experts that have evaluated the ability of these boundary resources to motivate platform adoption. Thereby, managers can evaluate these findings and use them as prioritization. Finally, managers can consider BRs that are within the scope of their control and could design efforts on these specific boundary resources.

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1 Introduction

1.1 Problem statement

"It's a Stone Age in some areas. It is amazing and annoying to see at the same time. Everybody is looking at each other and is waiting if the connection might emerge by accident..." (de Kleijn & van Poelgeest, 2015).

Healthcare providers in Dutch first-line healthcare use Information Systems (IS) systems provided by IS suppliers to support their healthcare related activities. This type of care is defined as is defined as care that can be directly accessed without referral (Rijksoverheid, 2020). IS suppliers are defined as the companies that deliver information systems or products that support healthcare. Examples of these organizations are Information System suppliers, Suppliers of Analysis Tools for advanced diagnostics, data warehouses, community platforms, Personal Healthcare Environments (Dutch: Persoonlijke Gezondheids Omgeving (PGO))(Hermes, 2020). An important functionality of these IS systems is to collect, store redistribute medical data of patients between healthcare professionals. However, as illustrated in the quote, this activity is currently organized inefficiently. As there is a great availability of these systems, leading to a high amount of development labour that is spent on similar tasks. For instance, there are nine IS systems available for General Practitioners.

This lack of interoperability has negative consequences on the short and long term. 78% of healthcare managers state that current IS systems lack of interoperability cause communication errors in between healthcare professionals (de Boer & Bosman 2018; De Kleijn & van Poelgeest, 2015). 62% of these respondents thought this led to issues affecting the patient (Jacobs, 2019; De Kleijn & van Poelgeest, 2015). Consequently, for example, errors emerge on the prescription data of medication for patients. Patients get described the wrong medical dosage, which could have bad consequences for their health. This results in patient hospitals taking up 27.000 patients yearly (Flinterman, et al., 2018; IS & Health, 2018). This issue is illustrated in figure 1.1. In this figure, it is illustrated that multiple healthare professionals use different information systems. Some of

these systems are interoperable, however, most are not or only limited measures. Healthcare professionals use different information systems (IS).

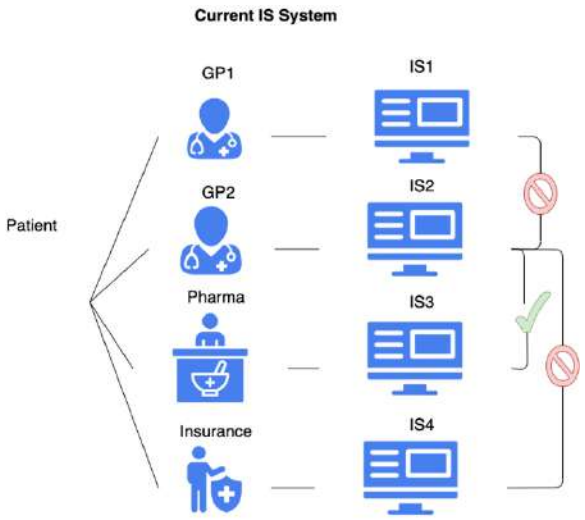

Figure 1.1: An illustration of the current IS-Architecture in Dutch first-line healthcare.

In Dutch first-line healthcare, a shift is taking place towards the treatment of chronic disease, preventive care, and high patient participation (de Boer & Bosman 2018; Fliterman et al., 2018; NFU, 2019; Jansen et al., 2012). Both these developments require healthcare professionals and supporting IS-suppliers to develop an IS-architecture that allows collaboration between healthcare professionals (Aanestad, et al., 2019; Bacigalupe, 2011; Islind, et al., 2019; Javed et al., 2020). Collaboration is defined as the ability to collectively diagnose and treat patients, by sharing medical health records (Bacigalupe, 2011). This is achieved by IS systems that facilitate sharing of data of information related to patients.

Addressing these issues demands innovation of IS systems in Dutch Healthcare. However, innovation in (Dutch) healthcare is known to be notoriously rigid (Omachonu & Einspruch, 2010; Thakur, et al., (2012). This is caused by three reasons. First, Dutch healthcare is both a matter of life and death and, involves distribution of strictly personal data (Burns, et al.; 2012) . Consequently, high-quality norms, IS care protocols and a tightly regulated legal framework inhibit innovation. Second, to innovate in this landscape, collaboration and openness between involved actors is required. However, there is little incentive for collaborative innovation among IS-suppliers, as a result of the privatization of this market. IS-suppliers aim to protect their own user base by purposely failing to adopt standards for information exchange (Alpay et al., 2010; de Kleijn & van Poelgeest, 2015). Additionally, providers of care in first-line healthcare sign long-term contracts, delaying innovation as well (van Hattum, 2020).

Concludingly, Dutch first-line care requires collaborative IS to support new trends in healthcare practices. However, current IS systems are not capable of supporting this transition as they lack interoperability. Furthermore, innovation is notoriously rigid, and collaboration to support innovation is inhibited by dynamics within the current system. To solve these issues, another approach towards orchestrating the IS-architecture might be required. Digital platform could play a role, as digital platforms facilitate acceleration of IS innovation (Boudrea, 2010; Karhu, et al., 2018; De Reuver, 2018; Gawer, 2018; Parker & van Alstyne, 2018; Tiwana, 2010)

1.2 Digital platforms

But what is a digital platform exactly? In less academic terms, a digital platform decentralizes development of software functionalities for a software system. Rather than a single organization developing a range of software solutions for a platform, a digital platform opens up the central code-bass, allowing external parties to develop software for the platform.

Therefore, the technical perspective of a digital platform defines a digital platform as an extensible "codebase of a software-based system" (Schreick, 2020). This software-based system then extends the functionality of the platform by implementation of external modules that are provided by third party complementors. Tiwana and Konsynski (2010, p.679) define these as "add-on platform software subsystems". Consequently, two organizational entities could be defined that are part of the platform architecture.

There are organizations that provide the technological foundations and resources and firms that are specialized in creating innovative solutions for the platform. A digital platform consists of both digital technological artifacts and processes put in place by organizations that govern the technological artifacts. Therefore, a digital platform can be defined as: "*Technical elements (of software and hardware) and associated organizational processes and standards*", thereby adopting the socio-technical definition of a digital platform as identified by de Reuver, et al., 2018, p. 4).

The first example of a digital platform was the WinTel collaboration, which is a joint venture between Microsoft Windows and Intel in the 1980s that published the technical schematics of the PC, so that third-party developers could build complementary software services to it (Gawer, 2010; Wladawsky-Berge, 2016). After that, more and more industries started to adopt digital platforms. Examples of this could be found in telecom, education, banking, governments and other IT intensive industries. More recently, the digital platforms in the domain of healthcare have started to emerge. The differences between the current way in which IS in healthcare is organized in comparison to how ISs could be organized by means of a platform logic is illustrated in figure 1.2. In this figure, the platform architecture is compared with the current architecture. It shows that multiple applications are offered to end-users as interfaces.

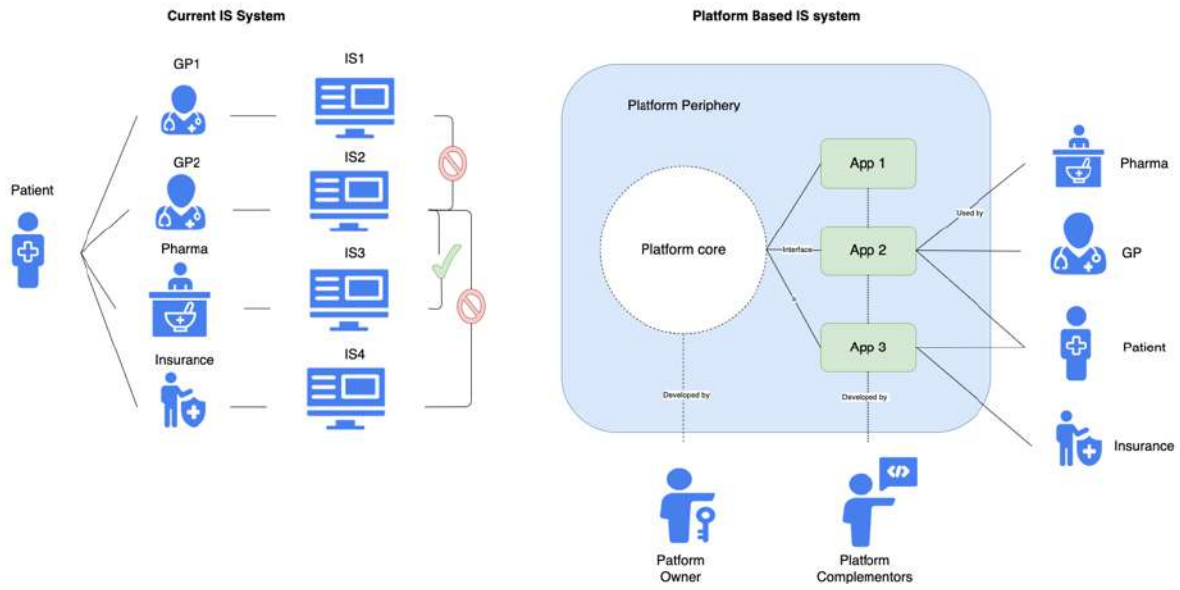

Figure 1.2: the traditional IS system in Dutch healthcare (left) in comparison with an IS based on a digital platform logic (right).

1.3 Affecting Complementor Participation via BRs

Digital platforms are able to increase the innovative capability in an industry, because application developer ecosystems emerge that grow exponentially (Sørensen and Landau, 2015). Through principles of network effects, i.e. that a platforms services become more valuable when more third party developers join the platform. (Karhu & Ritala, 2020; Tiwana, 2014), and modularity, i.e. the software solutions can easily be decoupled from the platform and be reprogrammed, generativity of a platform can greatly increase (Gawer, 2014; Tiwana, 2014). The exponential rate in which these ecosystems grow is so great, that it trumps traditional IS in the ability to develop new functionalities (Sørensen and Landau, 2015).

Participation of a digital platform is a fundamental requirement of a digital platform, as then, valuable applications could be provided to end-users (Lan, 2019), thereby affecting the long term evolvability of the platform. Consequently, the willingness to participate on a platform on a digital platform can be influenced by a number of design choices that are embedded in the initial stages of the design of a digital platform. Among others these design choices are the balance of generativity and control, the balance of stability and evolvability (Brunswicker and Schecter, 2019; Tilson et al., 2010; Tiwana et al., 2010) and determining what parts are part of the platform core part of the platform core (Tiwana, 2014). One of the most important characteristics is platform openness, which is the degree in which a platform complementor can “use, develop and commercialize platform technologies” (Boudreau, 2010, p.6).

For example, the platform owner provides a Software Development Kit (SDK (a tool for software developers to build dedicated software for a specifically defined purpose)) to which is a dedicated tool to build software that can be used by complementors. A number of such tools exist. These

tools are a platform's *boundary resources.* BRs govern the arms-length that between a platform and a platform owner (Ghazawneh & Henfridsson, 2013). These artifacts can be designed specifically, such that the willingness to participate on a digital platform is affected. Consequently, careful governance of these artifacts affects the willingness and capability of the musician to make music (Ghazawneh & Henfridsson, 2013; Tiwana, 2013).

Can be concluded that innovation is achieved through a highly amount of participation of third-party software developers. This participating can be affecting among many other design characteristics by opening up the digital platform can be achieved by opening up the platform. In return, opening up the platform can be achieved by implementation of boundary resources, as BRs are used by platform complementors to access and exploit platform resources by a, whilst exerting control over them. Therefore, in order to increase innovation of IS in Dutch first-line healthcare, a topic for academic research are BRs for a digital platform in Dutch first-line healthcare, and their ability to affect participation on a digital platform.

1.4 Relevance

In previous sections it has been addressed how BRs could affect complementor participation and how this participation on a digital platform could influence the innovativeness of the IS industry in Dutch first-line healthcare. In this section it is explained in further detail why this is relevant. This explanation is given from an academic perspective in section 1.4.1 and a societal perspective in section 1.4.2.

1.4.1 Academic relevance

BRs have been studied in academics for over 10 years. However, in this time span only in recent years the number of publications has started to rise with an exponential trend. This is shown in table 1.1.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
"*Platforms"	57	56	62	79	108	158	243	339	537	834	1233
"*Platform" AND "Boundary Resources"	1	2	3	0	2	2	4	4	4	9	18

*Table 1.1: the number of yearly publications on "*platforms" and "*platforms" AND "Boundary Resources" on Scopus.*

Literature on digital platforms and BRs only have picked up steam in the latest decade.

The topic of digital innovation through digital platforms is a topic that is well researched in academics (Yoo, et al., 2010). The issue of motivating innovation via platforms through an increase in openness has been discussed widely in academic literature (Boudreau, 2010; Karhu, et al., 2018; Lan, et al., 2019; Parker & Van Alstyne, 2018; West, 2003). This research specially

focusses on how openness influences participation on a platform, as participation is required in order to increase the network effects of a platform. Yoo, et al., (2010) calls for research for the roles of boundary resources within a strategic context. This this will be able to address this research topic, as promoting innovation through boundary is the strategic goal of the platform that is discussed in this thesis. This thesis will provide additional knowledge to this subject, as it will show what boundary resources can be used to achieve the strategic goals of the Dutch first line healthcare system.

The first issue that is derived from De Reuver, et al. (2018) is the emergence for specific applications categories (De Reuver et al., 2018). With this, it is meant that research on digital platforms should specifically dynamics that are relevant within the contextual environment in which the digital platform operates. This is because the platform interacts with its context and should therefore be considered of the long term. This issue is addressed by specifically focusing on a digital platform in Dutch first-line healthcare, as this domain is not researched in academic literature. As a result, contextualized understanding of digital platforms in healthcare is built

Research on digital platforms has focused on successful ex-post cases (De Reuver, et al., 2018). It is argued that focus is required on ex-ante research by Yoo, et al., (2010), whom calls for *"understanding of […] methodological and technical principles of the design of technical boundary resources"* (p. 18). Ex-ante research specifies design choices that affect the long term evolvability of the platform. This thesis cannot directly contribute to this type of knowledge. However, the design process among others requires scoping of the design space, in order to make the process more manageable. This research can help with this activity, as it provides indication of what boundary resources are more relevant to motivate platform adoption. The result is that is provides more structure to future research attempts.

1.4.2 Societal relevance

The current lack of innovation is problematic as Dutch healthcare is facing important short term and long-term problems that have been addressed. In the short term, Dutch healthcare is facing interoperability issues that make exchange of medical information a cumbersome and error prone process (de Boer & Bosman 2018; De Kleijn & van Poelgeest, 2015). These issues have an effect on the health of individuals as they could experience severe consequences related to their health as a consequence of wrong medical doses.

On the long term, it is clear that in the Netherlands, healthcare costs per capital will rise. These are caused by various socio-demographic developments in society, such as an aging population and an increase of chronic patients (De Kleijn & van Poelgeest, 2015; Volksgezondheid, 2021). The most important categories of chronic diseases are heart and vascular disease, diabetes, cancer and lung disease (Chronic Obstructive Lung disease, or COPD) (RIVM, 2021). These issues are often caused by unhealthy lifestyle choices such as smoking, excessive eating and not enough exercise, which are promoted by an increase in welfare in a society.

In order to solve these issues, healthcare professions have to change their care processes. Whereas as healthcare used to be a more stage gated process, now within the treatment programs of chronically ill patients, healthcare is organized in a network by multiple healthcare professionals (Cresswell, et al., 2010; Hermes, 2020). Such healthcare requires collaboration between different healthcare professionals which is often achieved via the exchange of medical information and data. Unfortunately, current IS systems are scarcely able ensure this. Therefore, innovation in this sector is required.

In order to stimulate innovation, IS suppliers need to open up their software for third parties that can help in develop extend the capabilities of existing software (Boudreau, 2010; Parker & van Alstyne, 2018, Karhu, et al., 2018). Thereby, the rate in which innovations emerge can grow exponentially. Opening up software can be achieved through participation on a carefully designed digital platform for IS in Dutch first-line healthcare (Ghazawneh & Henfridsson, 2013; Eaton, et al., 2015; Karhu, et al., 2018. In order to motivate IS suppliers to join the platform, resources can be provided through platform openness (Boudreau, 2010: Ghazawned & Henfridsson, 2013). These resources can be accessed through platform boundary resources. Hence, BRs are required to motivate platform adoption. When IS Suppliers adopt the platform, network effects increase and therefore innovation is sparked (Eisenmann, et al., 2009; Karhu, et al, 2018). The sparking of innovation allows to address the current problems in healthcare more efficiently.

1.5 The gap in scientific literature

This research aims to provide a contribution to the state-of-the-art of literature on digital planforms and boundary resources. Thereby, in context of the application domain of Dutch first-line healthcare. However, the state of the art of academic literature regarding this topic needs to be understood, needs to be understood first. This will with formulating a research question that addresses a domain that has not yet been explored. To identify a gap in scientific research, a study of existing scientific literature within this scientific domain is conducted. This will be presented in the following section.

For this literature research, roughly fifteen articles were selected. This number was chosen, as more than fifteen would make the research subject too generic and unspecific. On the contrary, fewer articles would make literature would make it too difficult to differentiate findings. For developing search operator, forward- and backward snowballing was used. The final result is presented below.

"Digital platform" AND "Boundary Resource*"*

This search operator led to 30 results that were collectively obtained from Scopus and Web of Knowledge. 12 articles were removed due to a lack of relevancy to the research topic. The final result was a list of 18 articles that has been displayed in appendix B. The literature was analyzed,

and relevant findings were listed and categorized in three categories. The findings are elaborated upon in the following sections.

1.5.1 Application domain research

"Would the same have been feasible in another context, for instance in an established hospital?" (Bygstad, Øvrelid, 2020, p.16).

This quote represents the main finding that is discussed in this section. Multiple academics state the importance of placing research of digital platforms and BRs in context of the application domain (De Reuver, 2018; Hein, et al., 2019; Ghazawneh & Henfridson, 2013; Bygstad & Øvrelid, 2020). Hein et al. (2018) state that co-creating practices must occur in an environment that is context-dependent, because ecosystems collaborations can only be analyzed from an internal perspective, rather than from an outside perspective. Ghazawneh and Henfridson (2013, p. 179) add to this by stating that such contextualization is a crucial element in interpreting data in interpretive research. Additionally, Bygstad and Øvrelid (2020, p.14) state that *"the interaction between lightweight IT and large first-line health systems by a set of BR sresolves the tension between innovation and infrastructure"*. Hereby, a clear in-practice is given of the relevancy of analyzing digital platforms from the perspective of the platform.

Research of digital platforms and BRs is therefore often conducted within a specific real-world context. Saadatman (2019) states that their analysis is specifically concerned with issues related to the application domain, as well as approaches, processes, and tools to develop a platform. What is noteworthy, is that for every application domain, different BRs are used. This means that relevancy of BRs is context dependent. Therefore, this thesis should focus specifically on BRs in relation to the application domain in Dutch first-line healthcare.

1.5.2 Ex-Ante design of boundary resources

Researchers discuss the importance of approaching research on digital platform form an ex-ante design perspective of boundary resources, rather than an ex-post observation of successful cases. This is because the effect of design choices on the digital platform can then be research in respect to the long term evolvability of the digital platform (Lindroth et al., 2016; Rudmark & Ghazawneh 2011; Ghazawneh & Henfridsson, 2013). To make this discussion more specific, it is debated which platform actor influences platform design most. A first group of academics agree that this is a co-creation process. (Mohagheghzadeh & Svahn, 2016) state that platform owners and complementors are interdependent, yet fundamentally detached. Therefore, they both affect platform design choices. (Islind et al., 2016; Wulf et al., 2019) discusses this process as continuous "tuning," based on input from the platform owner and complementor. A second group of researcher's states that boundary resource design is approached from the perspective of the platform owner. For example, Hein et al. (2020) states that BRscould be developed that are geared towards improving and remixing applications in the periphery. Saadatmand et al. (2019) states that the platform owner could open up access to the platform by providing APIs and SDKs. Also,

access could be provided to platform core resources and IPRs, which lead to an open-source strategy (Blohm, 2020; Mohagheghzadeh & Svahn, 2016). Finally, a third group suggests that design choices related to BRsare influenced mostly by complementors, by stating that: "*In large-scale platforms, the process of developing boundary resources does happen in an unprompted manner from a large uncoordinated group of third-party developers*" (Islind, et al. 2016 p.150).

To conclude, researchers' digital platforms have a great number of interactions, making it difficult to understand how design choices affect the platform and which platform actor causing this change. To get a better understanding of this, research on digital platforms should be conducted from an ex-ante perspective. In order to conduct effective and efficient ex-ante research, it is important to have a scope design choice. Scoping of design choices could be achieved through prioritization of boundary resources. This prioritization be determined by understanding how individual BRs affect the willingness to participate on the digital platform. BRs that more greatly affect willingness to participate, should have a higher priority in future ex ante design research.

1.5.3 How BRs affect participation

In the literature research, it was evaluated how current research addresses the ability of specific BRs to motivate platform complementors to participate on a digital platform in Dutch first-line healthcare. In respect to the previous research question, this was done in two parts. First, research in healthcare was researched in particular. Next, research in other domains was considered.

Four articles have been found that specifically focus research on BRs in relation to various healthcare applications (Aanestad et al., 2020; Farschian and Thomassen, 2019; Msiska et al., 2019). Application domains for this research were hospitals, dementia care services and healthcare platforms in developing countries. Although all these studies elaborate a particular set of relevant BRs and their quality dimensions for their given application domain, it is not explained how these BRs affect participation by platform complementors. Therefore, no relevant findings on the application of healthcare could derived in from these studies.

Consequently, research was considered that did not concern the healthcare domain. One article was identified that considered satisfaction of BRs by complementors of an IoT platform. This was achieved using the Critical Incident Technique (CIT) in order to *"capture the voice of developers"* (Petrik & Herzwurm, 2020 p3.). Karhu, et al. (2018) discussed the effect of BRs on open platform strategies (Boudreau, 2010), which in turn affects platform competitive advantage. Hereby competitive is conceptually linked to platform complementor participation, but not addressed directly.

Only the article of Petrik and Herzwum (2020) discussed how BRs affect platform satisfaction. However, it difficult to compare satisfaction to participation, as satisfaction can only be measured *after* adoption. This is in contrast to the problem domain in this thesis, as the problem domain concerns a digital platform that does not yet exist. Next, the work of Karku et al (2018) cannot be

used for comparison, as does not directly researches the complementor perspective, but rather an ecosystem perspective. Conclusively, no literature directly assesses directly how BRs affect the complementors willingness to participate for a digital platform, let alone for a digital platform in healthcare.

1.5.4 Research gap

This section summarizes previous findings to consolidate a research gap. Hence, it will revisit the main findings that have been addressed in the previous subsections. The first main finding was that BRs of digital platforms should be researched in respect to their application domain, because individual application domains have specific characteristics and dynamics that affect design choices of the digital platform. Secondly, research related to BRs was often conducted ex-post, rather than ex-ante and therefore there is no understanding on how BRs affect long term evolvability of a digital platform in healthcare. Thirdly, there is currently no understanding what BRs specifically affect the platform complementors willingness to participate on a digital platform on in Dutch first-line healthcare, thereby increasing the innovative capability IS suppliers in the system.

Therefore, this thesis will consider how BRs will increase intention to participate of platform complementors to affect platform BRs of a digital platform in the specific application domain of Dutch first-line healthcare. This in return will support future ex-ante research on this topic, as not all potential BRs bear similar ability to promote platform complementor adoption, the identified BRs should be evaluated on their relative perceived ability to motivate IS suppliers to join the digital platform.

This leads to the following research question:

What boundary resources increase IS suppliers in Dutch first-line care intention to participate with development and operation of applications on a digital platform?

1.6 Scoping

Digital platforms are complex to research because of the great number of actors and the even greater number of relationships between these actors. Therefore, both for practical reasons as well a reason of scientific relevance, clear decisions on what parts are included or excluded in this thesis need to be shared. Scoping of research of digital platforms is an issue de Reuver (2018) addresses. The risks of a lack of scoping are that it results in a lack of comparability among studies or that it loses sustainability and relevance of academic discussion (Adner, 2017; Basole et al., 2015; Reuver, 2018). Therefore, in this section specific decisions with respect to selecting a specific context for this research is chosen, so that

1.6.1 Application domain

It has been explained in previous sections that research on digital platforms should be conducted in relation to the application domain. In this research, the research specifically focusses on the first-line healthcare system in the Netherlands. The first-line healthcare system in the Netherlands is the system that can be accessed directly by patients without referral. This research therefore concerns defines healthcare professionals that are part of this system, such as General Practitioners (GP's), pharmacists, informal care givers and takers, physiotherapists and psychologists. When healthcare professionals are addressed in this thesis, a reference is made these occupations.

Also, specific information systems that are part of this research are addressed. These concern the information systems that are used by the healthcare professionals in Dutch first-line healthcare in support of their healthcare related activities. These information systems used to include only the systems that helped health care professionals with management of electronic health records, by allowing. However, in respect to de trend of data analytics, new IS solutions start to emerge that provide new functionalities for healthcare professionals and patients alike (Hermes, 2020). For instance, IS exist that use patient data to make more allow for advanced diagnostics or advanced population management. These systems often require Datawarehouse's. Additionally, systems exist that allow patients to obtain transparency on the usage of medical healthcare professionals called Personal Healthcare Environments (Dutch: Persoonlijke Gezondheids Omgeving (PGO)). When a reference is made to the first-line healthcare system, or *system*, a reference is made al said healthcare professionals. This system is further elaborated upon in section 5.

1.6.2 Installed base

The manner in which the current system is addressed should be considered as well. Aanestad et al. (2017) describes the current application domain as the installed base. The installed base is a product of evolution over time that has evolved based on organizational choices related to innovation. Aanestad et al. (2017) suggests that the installed base could be considered in multiple ways with respect to the research that is conducted. First, there is the "installed based friendly"-approach, which means that the installed base will *cooperate* with the innovation that is discussed in the research to make it a success. Secondly, they described the "installed base hostile" approach,

which means that the installed base will *compete* with the innovation that is discussed. Finally, the "installed base ignorant" is discussed, which means that the current installed base is not considered.

This thesis will adopt an installed base friendly approach. this means that the digital platform and the BRswill be analyzed without consideration of the existing information infrastructure. The results that will be obtained in chapter 8 will be discussed in respect of the existing situation in order to develop implications of the results.

1.7 Research questions

In this section, sub research questions are formulated. These sub research questions serve to obtain insights that are required to answer the main research question. These research questions are formulated such that it allows for a guided and structured research process.

Q1: What conceptual framework can be developed to evaluate boundary resource's ability to motivate platform adoption for a digital platform in Dutch first-line Healthcare?

In this thesis it is determined how specific BRs affect the willingness to participate for platform complementors on a digital platform. Therefore, it should be understood how willingness to participate in respect to digital platform BRs could be conceptualized. In that way criteria could be formulated that platform complementors can use to effectively assesses the ability of platform complementors to assess willingness to adopt a digital platform.

Q2: *What does the application domain for a digital platform for healthcare systems in Dutch first-line healthcare look like?*

It has been established by means of literature research that it is important to conduct research of digital platforms in relation to their application domain, as this allows to understand specific dynamics in the system that affect the working of the platform. Therefore, for instance specific dynamics could be identified that have to be addressed by specific BRs in order to make it more useful in a digital platform in Dutch first-line healthcare. Additionally, specific characteristics in the system could be identified that affect willingness of IS suppliers to participate in a digital platform in Dutch first-line care.

Q3. What boundary resources could be derived from literature and analysis of the application domain for a digital platform for IS systems in Dutch first-line care?

In order to evaluate BRs for a digital platform in a given application domain, they have to be derived. Therefore, research will be conducted in order to identify the BRs that are relevant for a digital platform in Dutch first-line healthcare. In order to do this, the conceptual model that has been developed in research 1 will be used to classify the BRs that have been identified. The results of this sub research question are a list of classified BRs for a digital platform in Dutch first-line healthcare, that is ready for evaluation of IS Suppliers.

Q4. What is the relative ability of boundary resources to increase platform adoption of IS Suppliers for a digital platform in Dutch first-line care?

This research question is developed to obtain quantitative findings on the relative effect of BRs to influence the willingness of platform complementors to motivate platform complementors to join the platform.

1.8 Research Design

The conceptual model by which the evaluation of BRs will take place will be derived from research question 1 and 2. After that, the derived results will be evaluated quantitively to answer the research question 3. Several respondents will be requested to validate the results the quantitative results of research question 3. These will be answered in research question 4. This makes this study a mixed-methods approach.

1.8.1 Research outline

To structure a visualization of the research, a diagram has been crafted that illustrates the process of the research steps visually. In the first step a literature will be conducted on different conceptual models for BRs of digital platforms. This will lead to a conceptual model of this research. The conceptual model will be used to derive boundary resources.

After that the BRs need to be evaluated by platform complementors. In order to study the evaluation of boundary resources, Multi Criteria Decision Analysis is used. Multi Criteria Decision Analysis is a suitable method for comparing boundary resources, as multiple aspects affect the evaluation of the alternative that are presented. The specific MCDA that uses the Best Worst Method (Razaei, 2015). The Best Worst Method is a method that uses pairwise comparison to achieve a rank order of alternatives (Razaei, 2015). BWM is a subjective MCDA method (Buchanan, et al., 1998) that assumes expert opinion as the guiding criteria for evaluation of alternatives. A subjective method is used, when comparison of alternatives is difficult with quantitative measures.

The results of the MCDA, the methodology and the conceptual framework are interpreted and discussed in chapter 7. Chapter 8 provides summarizes the answers to all sub research questions and thereby provides the conclusion of this research.

Ch.	Objective	Method	Output for next chapter(s)
1	Discuss Problem, knowledge gap, Relevancy and Objective of Research. Theoretical framework	Literature study	Outline of relevant concepts of the research domain of this thesis
2	Theoretical framework	-	Outline of relevant concepts of the research aimed to conceptually scope this research
3	Methodology	- Literature study	Methods used for answering the research questions.
4	Answer sub research question 1 Conceptual framework for boundary resource evaluation	Literature Study	A conceptual understanding of how BRs affect platform participation A conceptual understanding of
5	Answer sub research question 2 Understanding Dutch first-line healthcare in respect to a digital platform	Literature study	Understanding relevant dynamics that are present in the Dutch first-line healthcare system.
6	Answer sub research question 3 A complete list of BRs for a digital platform in Dutch first-line healthcare	Systematic Literature study	A list of BRs that can be used for evaluation by platform complementors.
7	Answer sub research question 4 Determining the relative ability BRs to affect complementor willingness to participate.	MCDA (BWM) Literature study	Relative scores of boundary resources, evaluated on the relative effect on IS Supplier adoption.
8	Discuss the results Derive conclusions and recommendations.	-	An interpretation of results, Discussion of limitations and future recommendations
9	Provide conclusions	-	Answer of research questions and the main research question.

Table 1.2: a visual representation of the research flow of this thesis.

2 Key concepts

This thesis will research BRs for a digital platform in the application domain of first-line healthcare. To provide a conceptual context and build a shared taxonomy, core concepts related to this research are discussed. In order to provide the key concepts, this chapter is structured as follows. Section 2.1 discusses academic perspectives on digital platforms, platform components, actors, and their related characteristics. Section 2.2 goes a step further by discussing BRs of digital platforms. Finally, a conceptual model is formulated. This conceptual model consolidates the literature in this chapter and is used to structure the first and second sub-research questions.

2.1 Digital platforms

As this research focusses on how willingness to participate on a digital platform by IS suppliers is affected by boundary resources, digital platforms are discussed in this section. Hereby platform perspectives, platform architecture and platform concepts are discussed.

2.1.1 Digital platforms perspectives and definitions

Three perspectives exist that can describe digital platforms. These perspectives are the economical, technical, and socio-technical perspective. These will be considered next. Also, a decision will be made for what perspective will be adopted.

The economical perspective regards platforms as a multisided entity that allocates the supply and demand of a specific good (Baldwin, 2008; Eisenmann et al., 2006; Stolwijk et al., 2019) An example of this is that Facebook attracts both private consumers, advertisers, and data vendors. AirBnB attracts homeowners and temporal home seekers. Value is created when these stakeholders are coupled by a platform.

The technical perspective describes digital platforms as a set of technical components that interact with each other. De Reuver (2018, p.4) frames it as *"an extensible codebase to which third-party modules could be added"*. In the example of the IOS platform, it would consider the central architecture of storage, servers and attached software as the central architecture. The applications of third parties are considered as the modules that could join the platform. This perspective puts a focus on technical alignment of these modules with the central platform (Baldwin & Woodard, 2009). Although this an important perspective, it is incomplete for application in this thesis.

The socio-technical perspective describes these technical components and their relationship with specific actors who own these components (De Reuver et al 2018; Tiwana, 2010; Tiwana, 2013). It implies that technical components of a digital platform serve actors to fulfill specific actions with- and on a digital platform. Therefore, besides the technical components of a platform, it encompasses their related platform actors that are related to these components and their respective positions opposed to each other.

What a platform is not

In defining a digital platform, is also relevant to define what a digital platform is not (Tiwana, 2013). A digital platform should at least facilitate interaction between two distinct user groups. Often single-sided platforms are considered wrongly as platforms as well. In a single sided platform, the platform owner does not interact with two user groups (platform complementors and end-users), but only with one group. These are only end-users. This difference should be understood, because single-sided markets are less complex and can therefore not be compared.

For this thesis, the socio-technical perspective is selected. This is done because of two reasons. First, by definition, BRs are not only technical artifacts but artifacts of governance. This will be further clarified in section 2.4. Additionally, the socio-technical perspective relates technical components and the actors that govern them. This also happens in this thesis, where the role of IS-suppliers in respect to a digital platform is specifically considered.

2.1.2 Digital platforms – Architecture

As has been mentioned in the introduction, digital platforms are conceptually ambiguous and complex. Therefore, a shared taxonomy on the topic needs to be developed. The definition of the platform architecture is:" A *conceptual blueprint that describes how the ecosystem is partitioned into a relatively stable platform and a complementary set of apps that are encouraged to vary, and the design rules binding on both"* (Tiwana, 2013, p. 7).

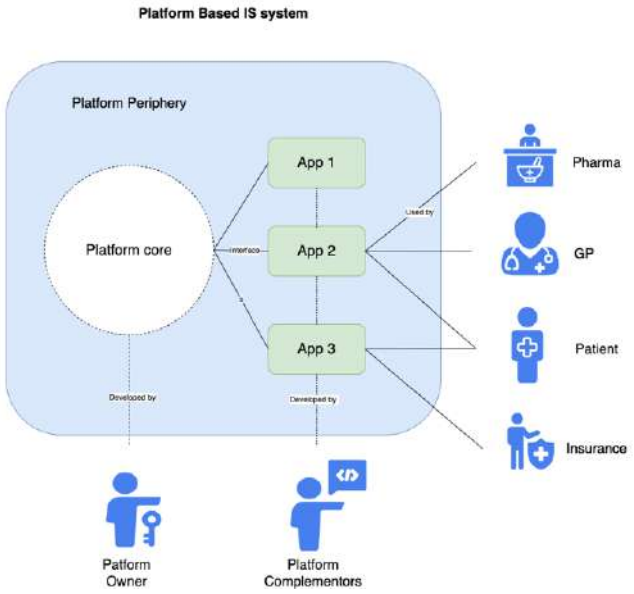

Figure 2.1: current architecture of Dutch first-line healthcare (Tiwana, 2013).

Platform owner – platform core

The architecture and its actors are visualized in figure 2.1. As illustrated in this figure presented, a digital platform ecosystem consists of a shared infrastructure between platforms and applications. This shared infrastructure is connected via interfaces (Tiwana, 2013; Eisenmann, 2006). The platform is developed and controlled by the *platform owner.* This organization provides the shared infrastructure by which complementors can provide their applications. For example, Apple provides the App Store as a core platform, where third-party developers can distribute their applications.

Platform complementor – Third-party applications

Applications are defined as: *"An add-on software subsystem or service that connects to the platform to add functionality to it. Also referred to as a module, extension, plug-in, or add-on*" (Tiwana, 2014, p. 7). Applications are developed by the *platform complementors* (Adner, 2012; Boudreau, 2010; Tiwana, 2014). By providing third-party applications, applications provide functionality on the platform. For example, Skype could provide their service via the App Store of Apple to consumers. In doing so, the platform. With respect to the digital platform in Dutch first-line healthcare, these would be the IS-suppliers that provide applications for end-users.

Platform End – Users

End-users are defined as the collection of an existing collection of existing and prospective adopters of the platform (Adner, 2012; Tiwana, 2014, p.6). When an in-text reference is made the end to with respect to a digital platform in Dutch first-line healthcare, these end-users are the healthcare professionals that make use of the application that are provided through the platform to support their healthcare practices.

Interfaces

The interfaces are the ways in which a platform complementor makes resources available between the platform complementor and platform owner. These platform interfaces explain what the platform does and how to use the platform (Parnas et al., 1985). Therefore, these interfaces are an integral part of the platform architecture. Apple's Testflight application could be considered an interface, as apple uses this application to tests if applications of third-party developers are suitable for the Appstore. Thereby, there it serves to provide resources in the form of information.

Platform ecosystem

Ecosystem is a term that has gained popularity in research. Whereas an ecosystem used to describe a closed-of system of organisms, their surroundings and interactions between, the term has also been applied in business- Peltoniemi & Vuori (2004), innovation-(Jackson, 2011) and platform research (Parker et al., 2017; Tiwana, 2014). Consequently, Tiwana (2014, p.6 defines an ecosystem as *"The collection of the platform and apps that interoperate with it represents the platform's ecosystem"* Tiwana (2014, p. 6). Therefore, when a reference is made to the platform ecosystem in this thesis, a reference is made to the collection the platform owner, platform

complementors, end-users, the platform architecture, applications and interfaces that make up the entire platform system.

Generativity

Generativity can be specified as the ability of the platform to produce software without the platform owner active assistance. This is achieved because platform complementors can provide software solutions, or application as extensible functionalities to the platform that can be coupled or decoupled without interference of the platform owner. Thereby, the behavior of the platform complementor or platform complementors becomes self-sufficient. The ability be generative for the platform therefore allows platform complementors to provide solutions effectively on their own accord, increasing innovation of the platform ecosystem.

2.1.3 Dynamics of Openness and Participation

This thesis focusses on motivating platform complementors to join a digital platform in Dutch first-line Healthcare. Therefore, concepts related to complementor participation will be discussed in this section.

Participation can be defined as the decision of the platform complementor to participate in the development and commercialization of software for the digital platform (Boudreau, 2010; Karhu, et al., 2018). Thereby, openness can be referred to as the degree in which barriers are present to restricts participation in such activities. More specifically, as defined by Boudreau, (2010) it is described as the ability to "*use, development and commercialization of a technology.*" (Boudreau, 2010, p.1815). Openness can be achieved by *"providing them with dedicated resources to act with the platform"* (Karhu, et al., 2018, p.481). Karhu et al., (2018) calls this *access openness*.

When platforms become more open, all else being equal, more platform complementor will join the platform as it is easier to access the platform and its resources (Lan, et al., 2019; Parker & Van Alstyne, 2018; West, 2003). Additionally, when a platform becomes more open, more end-users are keen to join the platform ecosystem, as the fear of being trapped by lock-in mechanisms of single platform complementors is reduced (Lan, et al., 2019).

When more complementors join, the network effects of the platform increase (Parker & Van Alstyne, 2005; Tiwana, 2010). Network effects entails that the value of an individual platform increases when the platform grows in users (Karhu, et al., 2018; Tiwana, 2014). Hence, the overall value of the platform and its individual components are increased. Additionally, network effects can be defined more specifically as cross network effects, where an increase of the platform complementors increase the amount of platform end-users and the other way around (Song, et al., 2018). This is usually measure in *"number of applications, application variety, and users' usage of applications"* (Song et al., 2018, p.1). Hence, network effects are a positive externality of participation. As more complementors join the platform and network effects increase, the

complementors can obtain more resources. Karhu, et al. (2018) explains this previous effect as the rational for adopting access openness, as through network effects, innovation is sparked.

It should be understood that a platform is neither completely open nor closed, but rather has a degree of openness (Boudreau, 2010; Hilkert & Tess, 2015; Karhu, et al., 2018, West, 2003). This is important to consider in the initial design stages of a platform, because too much openness can increase diversity, but decrease control (Boudreau, 2010). Control in a health case-based platform is especially important, as mentioned by in the introduction (Eaton, 2015). In Dutch healthcare numerous regulations affect platform software, therefore a tight amount of control is required. This degree of openness has studied for digital platforms in healthcare (van Hattum, 2020).

2.2 Mechanisms for platform openness - Boundary Resources

A discission in academics concerns the relationship between openness and control. Tilson et al. 2010). In respect of a digital platform, this tension requires a platform owner to balance stability on the one hand and invite a diverse range of complementor on the other hand to promote innovation (Eaton et al. 2015, Ghazawneh and Henfridsson 2013). In order to govern this tension, BRs can be considered.

BRs are defined as the artifacts that *"govern the arms-length relationship between the platform owner and the platform complementor" (*Ghazawneh & Henfridsson, 2013, p.174). Ghazawneh and Henfridsson (2013) state that BRs are crucial to transfer the capability to design solutions to third-party complementors. Therefore, third-party complementors can develop complementary artifacts in the form of software (Karku et al. 2018; Eaton, 2015). Consequently, platform owners could provide specific tools and mechanisms that can allow the use of the core of the platform to develop applications. Therefore, these tools and mechanisms are designed to allow for an interaction between the platform core and the platform complementor (Tiwana, 2011).

In literature, it is identified that BRs fulfill several roles for the digital platform (Eaton, 2015; Rudmark & Ghazawneh, 2011; Ghazawneh, & Henfridsson, 2013). For the platform owner, BRs can *resource* and *secure* the platform core (Ghazawneh & Henfridsson, 2013). Resourcing entails the increasing the amount and variety of platform functionalities (Ghazawneh, & Henfridsson, 2013). Therefore, securing can be described as *"the activities that increase the generative capabilities of the platform owner.* Securing is defined as "*the process by which the control of a platform and its related services are increased"* (Ghazawneh, & Henfridsson, 2013 p.185). This therefore describes a similar activity as exploration.

BRs present themselves for digital platforms in a variety of ways. Digital platforms are specifically known for their APIs and SKD's as tools governing the behavior of platform complementors by platform owners. Furthermore, non-digital solutions exist, which present themselves as guidelines, agreements, and licensing of intellectual property (Ghazawneh & Henfridson, 2013).

<u>API</u>

Application programming interfaces (APIs) are suggested to be common instruments of digital strategy (Liyanage, 2015). APIs can be defined as *"machine-readable interfaces that connect multiple applications, govern application interaction, and remove the need to know the inner workings of how an API is provided"* (Wulf & Blohm, 2020, p.7). In respect to digital platforms APIs allow applications provided by platform complementors to be connected to the platform core. APIs could also by be offered by platform complementors themselves, allowing other applications to communicate and use the functionalities of the application that is being provided.

SDK

Whereas an API also provides building blocks by which a platform complementor can extend the functionality of their app their app, an SDK provides all tools needed to develop applications (Sandoval, 2016). An SDK can be compared to a building set of Legos. A kit of "building blocks" is needed, assembly instructions are presented with specific tools to put them together. Once the entire kit is understood, the builder can use it to create its own creations. Another example is that SDKs are offered by the application store of Android and Apple to allow their users to build applications.

Guidelines and rules

Different kinds of BR's exist that can are used for complementor control (Ghazawneh & Henfridsson, 2013). These are mainly presented as guidelines, platform rules and IPR forms. The iOS service system from Apple has several service systems in place to govern the development, usage and maintenance of applications uploaded to the app store. For instance, there is a general set of DPLA - rules. (Digital Public Library of America). Furthermore, there is an "App Approval Process," by which complementors have to abide before uploading an application. Furthermore, there are different rules proposed by the ASRG-group which are aimed at preventing spam (Anti-Spam Research Group).

3 Methodology

This section will describe the methods which are used to provide an answer to the research questions. Besides this, a justification of the used models will be provided. decision which has been made to use these methods have been selected. This chapter is divided in three sections. The first, 3.1 will provide a description of the selected methods will be described. Section 3.2 describes the survey that is used. Thereafter, 3.3 provides an overview of the respondents who completed the survey.

3.1 Methods

To answer the research questions as they are presented in section 1.8, different research methods have been chosen. This section will explain which methods have been chosen and additionally, argumentation is provided to explain the usage of these methods. This research employs multiple methods and can therefore be considered a mixed-methods research design. The relative weights of the BRs will be collected through quantitively obtained survey data that uses a MCDA method.

3.1.1 Literature Review

Research question 1

To answer research question 2, a literature review was conducted. For this research question, a framework had to be developed that would allow for the evaluation and categorization of boundary resource alternatives.

Research question 2

The same approach is used to answer research question 2. Literature was analyzed for the analysis of stakeholders in the first-line healthcare sector and IS-suppliers in the Dutch first-line healthcare sector. This literature constitutes an overview of relevant actors in the research domain of this thesis. Next, literature research was used to establish the needs of these actors. These needs in return, translate BRs that are required for a digital platform for IS systems in Dutch first-line care.

Research question 3

To find BRs that are required for a digital platform for IS systems in Dutch first-line care, a literature study was conducted on existing cases of digital platforms. To identify relevant literature, online databases such as Web of Knowledge, Scopus, and Google Scholar were used. Therefore, reverse and forward snowballing methods were used to identify relevant literature (Watson and Webster, 2002). In chapter 6, the applied methodology is explained in more depth.

3.1.2 Multi-Criteria Decision Analysis

The main research question will be answered by means of MCDA. This method is chosen as it is the aim of this research to provide a selection of relevant BRs and rank order them accordingly. To rank-order BRs in the Dutch first-line healthcare systems, multiple criteria need to be considered.

To determine the relative weights indicating the relative ability to promote platform adoption of boundary resources, respondents are presented with an MCDA-problem. MCDA is a research method where decision-makers must select an alternative consisting of multiple criteria (Triantaphyllou, 2000). $\{a_1, a_2, \dots, a_m\}$ of alternatives. Additionally, $\{c_1, c_2, \dots, c_m\}$ is the set of decision-making criteria. The goal of an MCDA is to select the best or most desirable alternative that has the best overall value (Guitouni & Martel, 1998); Razeai, 2015; Triantaphyllou, 2000).

3.1.3 MCDA method selection

Multiple methods exist that can be used for MCDA. These methods can either be subjective or objective. Objective MCDA comparison of alternatives based on criteria that are quantifiable. Subjective methods on the other hand are used in case the criteria for evaluation are qualitative (Mühlbacher, & Kaczynski, 2016). Objective methods are methods such as VIKOR (Opricovic & Tzeng, 2004), TOPSIS (Lai et al., 1994), ELETRE (Figueira et al., 2016), and PROMETHEE (Brans & de Smet, 2016). These methods rely on quantitative data with comparable scales per criteria. Subjective methods that exist are AHP (Saaty, 1977) and BWM (Rezaei, 2015). These rely on subjective methods to evaluate the weight of criteria and alternatives.

For this thesis, BWM is selected. This is because this thesis requires evaluation of boundary resource's ability to affect complementor participation. Willingness to participate is not expressed on a quantitative scale. Also, willingness to participate is not possible to relate to other concepts that are objectively measurable. Therefore, BWM and AHP have to be considered as potential alternatives. BWM is both faster and produces results with a higher consistency than AHP (Ajrina et al., 2018; Rezaei, J. (2015). Therefore, BWM is selected as the method for this thesis.

3.1.4 The Best-Worst Method

In this section, the Best-Worst Method (BWM) will be explained. The BWM uses pairwise comparisons to obtain relative weights values. These relative weights present a defined value of relative importance in respect to other alternatives, which in this research is the ability to promote complementor adoption of a digital platform. This pairwise comparison is best illustrated with the following figure. A best and a worst alternative is selected. Next, the others are first evaluated in respect to the best and second in respect to the worst alternative. As these alternatives are compared on subjective criteria, the perspective of the decision maker influences these relative values. The alternatives need to be independent to achieve reliable results. The method calculates consistency of the pairwise comparisons. Perfect consistency is rarely achieved. A small measure of inconsistency which is caused by human error, is allowed.

Razaei (2016) proposes a non-linear method and a linear method. Through its nature, the non-linear model results in multi optimality (Razaei, 2016). On the other hand, the non-linear model provides a unique solution. The linear model is selected, because in this research prefers a single solution, rather than multiple. This is because in case of single solution, more actionable recommendations could be provided to decision makers.

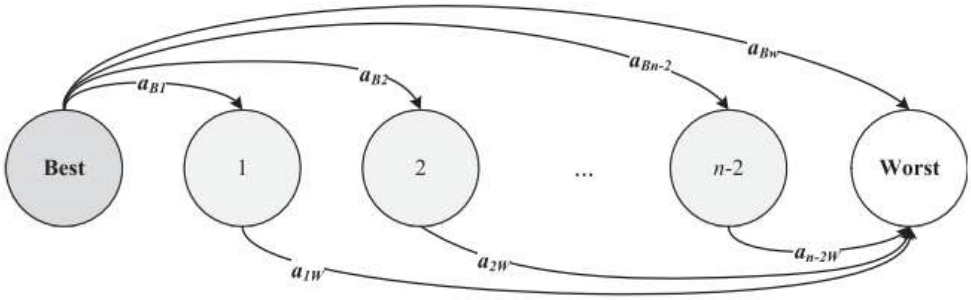

Figure 3.1: illustration of pairwise comparisons, adopted from Rezaei (2015).

To validate whether the data that has been generated by the BWM is valid, a consistency ratio is used. This consistency ratio indicates the consistency by which the survey is filled in and thereby provides an indication for the reliability of the results. The consistency ratio should be as low as possible, meaning that it should approach 0. However, in BWM research, there is not a specific value presented that concludes a research validity. It should be mentioned that for this research, the individual findings will be aggregated. Inconsistent results on an individual level will not necessarily spoil results on an aggregated level, if the aggregate consistency is considered good.

The notion of consistency and inconsistency of input data implies that there is threshold value (or or range of values) that determines consistency or inconsistency. The level of these thresholds has been discussed in literature (Ágoston, Kolos & Csato, Laszlo, 2020; Liang et al., 2020; Mi, et al. 2019). Liang, et al. (2020) have provided an overview of threshold values (table 3) that are dependent on the (1) scale that is used to evaluate alternatives and (2) the number of alternatives, based on extensive Monte Carlo simulations. However, literature does not clearly discuss what these threshold values should be, in case linear BWM is used. Therefore, determining threshold values is difficult.

BWM is performed in five steps (Rezaei, 2015):

1. Establish a set of criteria {c1,c2,…,cn}
2. Identify the most important and least important boundary resources.
3. Compare the best BRs over all other BRs by means of pairwise comparisons. Hereby a number between 1 and 9 is used (where one = equally important, and nine is more important. The resulting vector is the “best-to-others”-vector.

▪

$$A_B = (a_{B1}, a_{B2}, \dots, a_{Bn})$$

Here, a_{Bj} indicates the preference of the best category B over another category j.

4. Next, the same step is taken to determine the relative ability of boundary resources to promote complementor adoption of all other BRs perform over the alternative that is selected as the worst alternative. Hereby again, a number between 1 and 9 is used, where 1 = equally important, and 9 is more important. This results in the "other-to-worst"-vector:

▪

$$A_w = (a_{1W}, a_{2W}, \dots, a_{nW})$$

Here, a_{jW} indicates the preference of the best category B over another category j.

5. Next the optimal weights of weights of the categories or decision criteria $(w_1^*, w_2^*, \dots, w_n^*)$. We achieve this by with several steps. The differences minimalization of the absolute maximum differences. The sum of the all the weights should be equal to one. This means minimizing the maximum $\{|(w_b - a_{Bj}w_j|, |w_j - a_{jW}w_W|\}$

$$minmax_j\{|(w_b - a_{Bj}w_j|, |w_j - a_{jW}w_W|\}$$
$$s.t.$$
$$\sum_j w_j = 1$$
$$w_j \geq 0, for\ all\ j$$

The min max model is transformed to the following linear programming model:

$$\min x^L$$
$$s.t.$$
$$|(w_b - a_{Bj}w_j| \leq for\ all\ j$$
$$|w_j - a_{jW}w_W| \leq for\ all\ j$$
$$\sum_j w_j = 1$$
$$w_j \geq 0, for\ all\ j$$

Solving this equation results in $(w_1^*, w_2^*, \dots, w_n^*)$ and x^{L*}. Here, $(w_1^*, w_2^*, \dots, w_n^*)$ represent the optimal weights and x^{L*}represents the consistency indicator. This factor determines how accurately both relative comparisons compare. Unfortunately, literature does not discuss threshold values the consistency factor to make responses valid or invalid. A value of 0,25 is used, as this has been suggested by previous literature to be an acceptable value (de Priëlle, 2019)

The goal of this thesis is to identify the ability of BRs to motive platform complementor adoption. BRs become more important when their ability to affect complementor participation to the platform increases. First, the local means will be identified of categories of BRs and individual boundary resources. The global weights are obtained through the product of the local weights of the categories and local weights of boundary resources.

3.2 Kruskal-Wallis Test

The Kruska-Wallis test is performed by means of SPSS in order to determine the difference between the evaluation of boundary resources by respondents with a high IB and respondents with a low IB. The Kurkal-Wallis test is named after William Kruskal and Allen Wallis. It is a distribution free test in statistics that is used to test whether there is a difference between distributions of different samples. In this respect, the null hypothesis that is being tested is that the samples are drawn from populations that have a similar distribution. The test is based on rankings of data. The Kruskal-Wallis test can therefore be considered as a single way analysis of variance (ANOVA).

For the test the confidence interval that is selected is 0,95, meaning that the p-value should be bigger than 0,05 to reject the null hypothesis. Consequently, when the p-value is higher than 0,05, there is no significant similarity between the evaluation of complementors with a high IB and a low IB.

3.3 Data collection for BWM

3.3.1 Selection process of experts

This research focusses on the impact of BRs on complementor participation. Therefore, the group that is of interest for considering experts are providers of IS in Dutch first line healthcare. This is because the installed base is comparable of that of the intended end-users of the digital platform, which are healthcare professionals in Dutch first line healthcare. Therefore, professionals working in these companies will understand dynamics in the system of Dutch first line care.

In order to frame the sample of companies, a frame was required of potential types of companies that are present in Dutch first line healthcare as an exhaustive list of the current system is required. The frame had to be recent (later than 2015) as a consequence of the rise of emerging IS as well as established. Additionally, the list had to be exhaustive as in order to make sure no types of organizations could be missed. The work of Hermes (2020) was used, as it provides an extensive overview of both status quo IS organizations and IS organizations that are part of the digital transformation. This extensive overview is complete exhaustive and therefore allows for specific selection of organizations that should be included or excluded.

Not all organizations presented by Hermes (2020) was relevant and were therefore excluded. The scope of experts was narrowed by exclusion of irrelevant options in the work (Hermes, et al.,

2020). Exclusion took place on the basis that an organization provided no service to first-line care. This is an exclusion criterion, because this research solely focusses on first line healthcare.

- Data collection technology (wearables, etc.), as wearables are not part of first line healthcare programs, but rather focus live style.
- Clinical IS' as these are used in second line healthcare.
- Services for remote and on-demand care. The provided examples only focused on non-Dutch healthcare specific examples.

The remaining list of organizations were individually evaluated. Non were excluded, as all organizations provided a relevant IS to Dutch first-line care and would be applicable for a digital platform. The following types of organizations were included.

a. General IS' used by first-line healthcare professionals
b. IS for advanced diagnostics and advanced population management
c. Data warehouses
d. Personal Healthcare Environments (Dutch: PGO's)
e. Suppliers of healthcare information platforms
f. IS that distributing care among informal caregivers

Next, a list of IS suppliers in Dutch first-line care was developed that fit the description of types of IS suppliers mentioned previously. This was done via extensive searching via google and LinkedIn. This resulted in a list of 66 organization that fit the description identified organizations that are mentioned previously.

An industry expert was consulted for the completeness of the list. This industry expert was employee in a managerial position at Promedico Group, which is a company established reputation for providing a high quality IS for GP's. The list consisted of 66 potential companies that fit the within the categorization.

Finally, the definition for an "industry expert" *within* the company had to be developed. This was achieved by developing the following criteria of an industry experts. Employees within the companies that would fit these criteria would be selected.

1. Experts would have to have at least 5 years of relevant working experience. 5 years was assumed as a number that was high enough in order to establish well enough understanding of the industry.
2. Experts would occupy a position were decisions of within the company were made related to company strategy, or software development or operation.
3. Experts could fulfill a commercial role, related to business or management. A technical role, related to software development or operation and finally researching role, related to academics researching the system.

Within these companies, the potential exists for multiple respondents to fill in the survey. To increase the number of respondents, multiple methods were used. First, direct contact details of experts were obtained that had a relationship with the research group. Additionally, LinkedIn was consulted to find additional contacts, who were employed within one of the listed organizations.

The organizations were approached using the following procedure:

1. The research was introduced in person via phone. It was asked to forward the upcoming email containing the survey towards employees that would fit the respondent requirements. To ensure information symmetry across respondents, the phone call did not include any specific details on the survey other than a basic outline of the topic.
2. An e-mail was sent to the organization containing information on the survey and a link to the survey.

3.3.2 The survey

In this section it is explained how the data for the BWM analysis is collected. This is done by presenting how the survey was constructed, what method was used to collect the respondents and to show what respondents were obtained. Throughout this section it is explained specific choices for the data collection method are implemented to ensure that the requirements for the wisdom of the crowd are ensured.

A survey so that respondents could provide answers on their own accord ans hence be independent. Furthermore, as there would be no central authority present to ensure central coordination the collection of experts, the third requirement for wisdom of the crowd was fulfilled. The survey was constructed using Google Forms, by suggestions of Researchhub (2021), as this method proofed to be an easy and accessible method to construct the survey, whilst being applicable for the purpose of BWM.

In order to allow aggregation of information, such that there would be less chaos among the respondents of the answers. The survey first an introduction page was provided to introduce the subject. Second, the method of the survey was outlined. Third, the respondent had to fill questions to obtain general information. Fourth, the respondent was asked to consider categories of BRs that were constructed with the conceptual model presented in chapter 4. Fifth, that all alternative boundary resource were evaluated for each separate category.

The survey had to be operationalized, meaning that it allowed for a clear understanding and unambiguous understanding of the questions. This was achieved in multiple ways. First, only relevant concepts were left in the survey. These concepts were digital platforms and application-, development- and social boundary resources. Second, BRs were translated to the term *tool* since from the perspective of the respondents, BRs could be considered as such. The operationalization steps were validated by reconsulting industry experts. This was achieved by validating the survey in the research group and by two industry experts.

In the survey, no personal information was stored on the respondents. The respondents were informed that data obtained through the survey would only be used for the application of this thesis. In case respondents were willing to substantiate their findings in a later stage of the research, they were provided with the option to share their e-mail address. It was explained that this would only be used for this purpose.

For the survey, respondents were asked to evaluate potential boundary resources. The dependent variable that they were asked to consider in their judgement was the ability of a BR to motivate them to join the digital platform. In the survey, it was explained that this variable would be appointed to as *importance*, in order to shorten the phrasing of the questions. To compute the weights, the linear BWM solver as provided by Rezaei (2015) was used. The version that is used has been retrieved on 18-03-2021. The responses of the survey were collected between 12-03-2021 and 28-03-2021.

3.4 Overview of the respondents

In this section, an overview is presented of additional information of respondents. This information reflects additional information of the sample filling in the survey as a contribution to this research. This additional information provides indications on the validity and reliability of this research. Furthermore, based on the information, future research attempts regarding this topic could be improved in case irregularities in the sample are indicated.

First, the affiliation and the provided service of respondents for Dutch first-line healthcare system was questioned. The results of these questions are presented below. It can be seen that most respondents have a technical or commercial background. Additionally, most respondents represent either population management companies or advanced diagnostic companies.

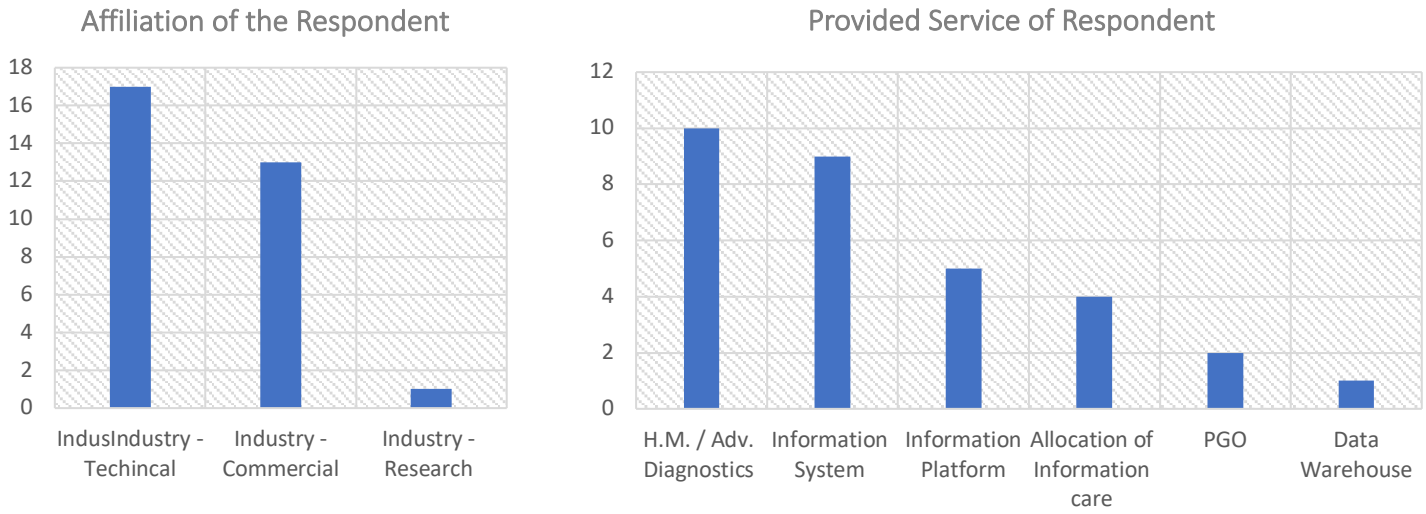

Figure 3.2: results of the survey, aimed to obtain general information of the respondents. Left: Respondent's affiliation. Right: Service provided by the respondent's respective organization.

Figure 3.4 represents the judgment of respondents on their own understanding of the research domain. The results indicate that respondents better understand (1) Dutch first-line healthcare and (2) the Dutch first-line IS landscape. The respondents estimate their understanding of digital platforms lower, grading themselves a 6,5 on average. The phrasing of the questions was: “How high would you grade your understanding of <x>”, where can be the three provided options.

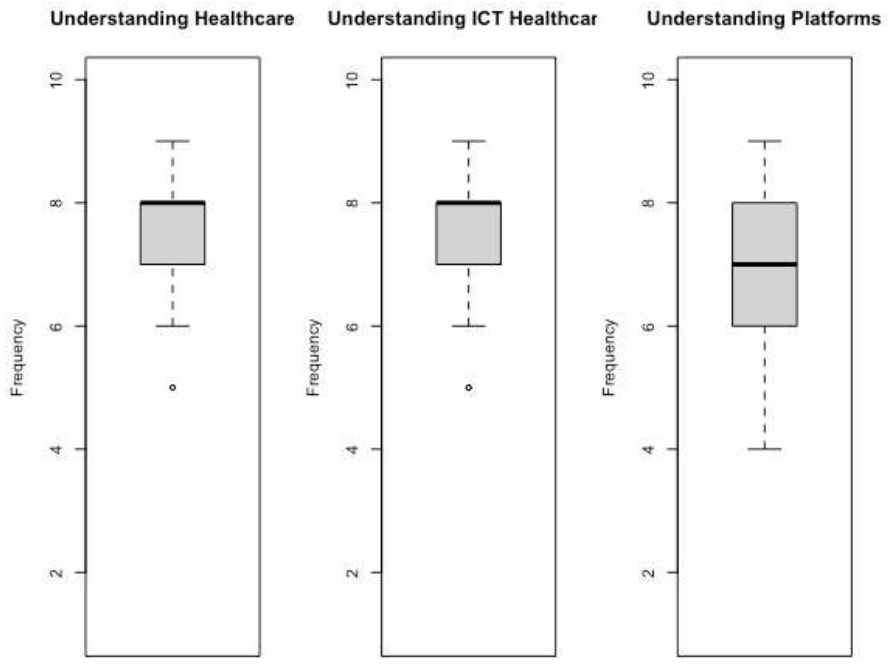

Figure 3.3: the result of the survey. These questions reflect the respondent’s own judgment regarding their understanding of the research domain on a scale from 1 to 10.

3.4.1 Grouping of respondents for comparison

These comparisons lead to additional categorical findings. For grouping, the installed base (IB) was considered, because companies express different behavior based on their IB (Dekker et al. 2013). IB is defined as the number of units of a product or service that are in use by consumers (Dekker et al. 2013; Farell & Saloner, 1986). Therefore, companies with a higher IB were expected to adopt a different perspective in the evaluation of BRs which would consequently affect their results.

Two groups were made, consisting of companies with a high IB and a low IB. It was assumed that the group with high IB consisted of IS Suppliers, because of these companies are longer established and have settled in the current market (Fichman, et al., 2011; Hermes, 2020). The group with a

low IB consisted of companies that operate in a more innovative market and therefore have not settled yet. Other, services are considered by Hermes (2020) as part of a digital transformation. Subsequently, as these companies have not settled yet, their installed base is assumed to be smaller. Therefore, the group with a lower IB existed of respondents representing remaining organizations.

3.5 Discussion of the method

As has been mentioned, BWM as a subjective method for MCDA is preferred as it is less time consuming and more reliable than AHP. However, there remain some limitations of this method that need to be considered for this research.

The first limitation of this method is that this method is that a single method MCDA is used, rather than multiple. For example, both BWM and AHP could be used, as cross validation would allow for better validation of the results (Liang, et al., 2020; Razaei, 2016). However, the surveys would become more complex and longer to fill in, hence decreasing practicality.

Secondly, limited insights can be obtained from the BWM, as it is unclear what rational exactly drove their decision-making process. In order to solve this issue respondents could be presented with an overview of their obtained findings, in order to gain a more complete or complementing insights (Venkatesh et al., 2013) which is called Venkatesh. Although the experts should in theory provide a reflection of their perspective in one attempt, biases might implicitly go into their answers. An extra attempt of critical reflection by respondents might make these biases explicit and consequently allow them to be eliminated (Venkatesh et al., 2013).

4 Conceptual model

This chapter provides an answer to the first research question: *What conceptual framework can be used to develop evaluative criteria for boundary resources for a Digital Platform in Dutch first-line care?* This categorization requires a deeper conceptual understanding of BRs and their relationship towards access openness. In that way, it could be determined how specific BRs affect access openness.

In section 4.1, criteria will be developed that are used for the selected concepts. In section 4.2, three models will be presented that are derived from literature. These models present potential candidates for the research. Section 4.3 evaluates the different models based on the formulated criteria in section 4.1. Section 4.5 discusses the selected model more in-depth.

4.1 Researched models

Research describes multiple models for boundary resources. These models were identified through evaluating the literature used for the literature research. These conceptual categorizations were required, as this would allow to make distinctions between different types of boundary resources. These different kinds of BRs could then be related to the willingness to participate.

Four models were identified in literature, by reviewing the literature obtained for the literature review in section 1.5: first, the standard boundary resource model (Ghazawneh & Henfridson, 2013). Second, the extended boundary resource model (Msiska, 2018). Secondly, the model as presented by Aanestad, et al. (2019). Third, the model as presented by Dal Bianco (2014).

4.2 Model Selection.

In this section, the conceptual model that is used for the MCDA is selected. This selection is based on the criteria that have been formulated in section 4.1.

The model of Ghazawneh & Henfridson (2013), was excluded because it approached BRs from the perspective of the platform owner. However, the main research question is approached from the perspective of the platform complementor. Additionally, the extended boundary resource method presented by Msiska (2019) makes no clear distinction between the role of BRs from the perspective of the platform owner and is therefore disregarded.

The model of Aanestad, et al. (2019) and the model of Dal Bianco (2014) classifies BRs based on the functionality provided to platform complementors. These functionalities serve to promote platform adoption, as the decision to adopt a technology could be based on its perceived usefulness according to the Technology Acceptance Model (TAM) (Lee et al., 2003). However, for developing BWM alternatives, it is required that alternatives are mutually exclusive and unambiguous in their nature. It turned out that for the model of Aanestad, et al. (2019) that BR existed that would fit in both categories of *vesting* and *resourcing*. When considering the model of Dal Bianco (2014), it was found that these BRs could all be classified as Social BRs (4.4).

Therefore, the model of Dal Bianco et al. (2014) presented better applicability for the method that is used for this thesis. Hence, the model of Dal Bianco (2014) is selected.

4.3 The model of Dal Bianco (2014)

First the conceptual model is presented visually. Then the individual components and relationships are further explained.

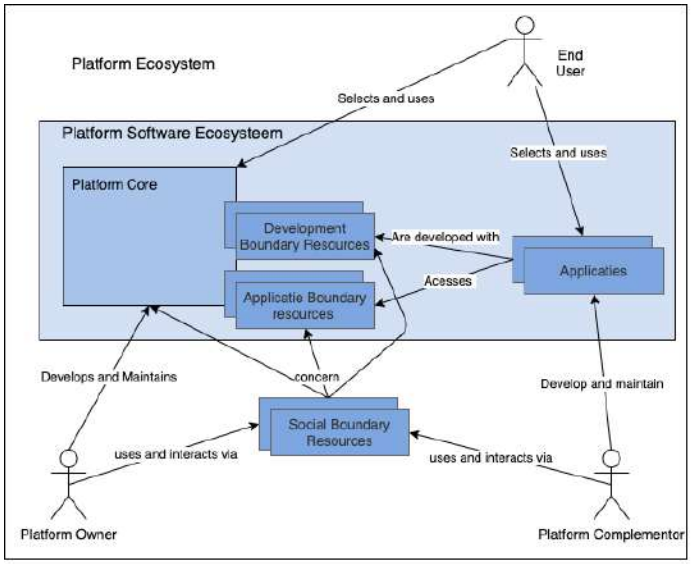

Figure 4.1: a visual representation of the model of Dal Bianco, et al. (2014).

Application Boundary Resources

ABRs are BRs that enable applications that are built by platform complementors to access platform core resources (Dal Bianco, 2014). These BRs are used by applications directly to access services that are provided by the platform (Dal Bianco, 2014). For instance, when a digital platform offers an open data warehouse, and web interface or API can be offered so that the application can access data on the data warehouse. Another way of describing ABRs is that they interface with the platform core.

Development BRs

DBRs are BRs that help developers with design and development of applications that are provided to the platform's user base. This is achieved because BRs support activities such as "*programming, testing, debugging, deploying, and maintaining the applications"* (Dal Bianco, 2014, p.15). Therefore, these BRs often present themselves as Software Development Kits (SDK's) or other kinds of BRs that serve the development of software for third-party complementors.

Social Boundary Resources

Dal Bianco et al., (2014) states that SBRs are used "*are used to transfer knowledge of creating applications and acts as a way of interaction between the platform complementor and platform owner" (*Dal Bianco, 2014, p. 15). This expanded by Dal Bianco et al., (2014), by stating that *"the*

creation of software requires and interaction with all stakeholders. These stakeholders are not only users but managers, administrators, developers, and others." (p. 15).

4.4 Relating the model to access openness

This part of the thesis will explain what relationships exist between the concepts that have been identified in chapter to and further expanded in the previous section. This is done in order to explain how the model of Bianco, et al. (2014) can be used to identify BRs that have an effect on complementor participation on a digital platform, which is the main focus of this thesis.

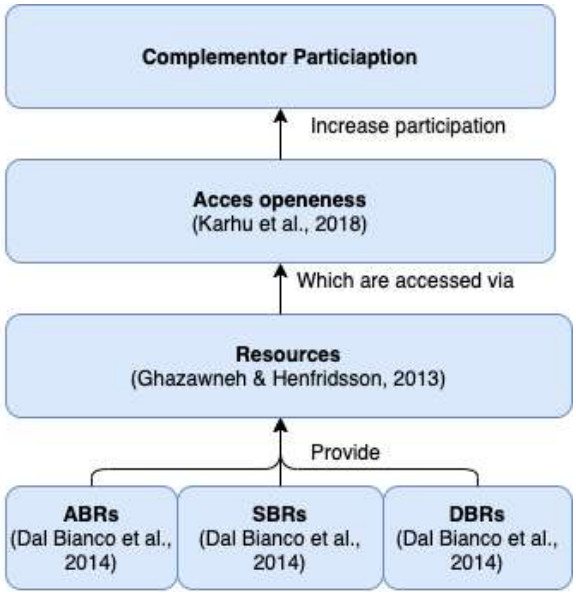

Figure 4.2: a visual representation of the conceptual model.

As discussed in chapter two, innovation on a digital platform requires participation of platform complementors in order to spark innovation through an increase in network effects (Benlian, et al., (2015); Boudreau, 2010; Karhu, et al., 2018). Innovation is promoted by providing platform complementors with dedicated resources in have interactivity with the platform core (Bender, 2020), which is called resourcing (Ghazawneh & Henfridsson, 2013). The access to these dedicated resources can be achieved via boundary resources, such as APIs, SDKs and more (Ghazawneh & Henfridsson, 2013). There are different kinds of resources that platform owner could provide. These are ABRs, DBRs and SBRs. These different kinds of BRs provide different kinds of resources and therefore have differing usability. As the usability of these BRs is different.

Therefore, in order to summarize, when these BRs provide access to resources that can be more easily accessed through an increase in access openness, platform participation is increased. When in turn participation is increased, innovation on the platform will increase.

4.5 Limitations of the model

Dal Bianco describes an important limitation of his model. Between the different kinds of BRs that he illustrates, there a conceptual overlap could be identified. Describes a conceptual overlap between the different types of boundary resources. This conceptual overlap is displayed in figure 4.3 below.

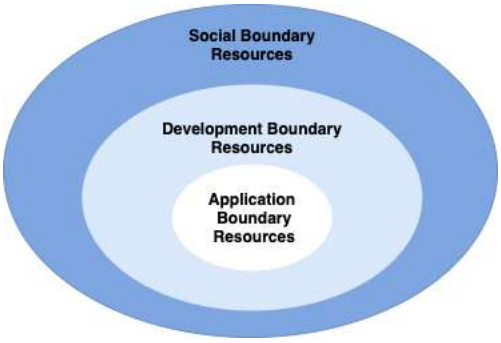

Figure 4.3: a visual representation of the relation of BRs as distinguished by Dal Bianco (2014). The BRs relate to each other, as indicated in the union-shaped model.

The classification that Dal Bianco (2014) provides does not allow for mutual exclusivity. This problem is best illustrated with an example. Considering an API can be used to enrich the functionality of the platform. Therefore, it can be considered an ABR. However, the same API can also be used in the developmental process. Finally, this API could be considered an SBR, as it transfers knowledge on development for the platform, for instance, via implementation of the source code. Concludingly, all ABRs that enhance the functionality of the application can be used in development. All DBRs that serve platform development also transfer knowledge.

It should be noted that these differences are mostly semantic and conceptual. This model will be used for the classification of BRs for a digital platform for IS suppliers in Dutch first-line healthcare. The main functionality of a BRs is therefore not hard to distinguish.

5 An overview of the Dutch first-line healthcare sector

Section 1.6 identified that digital platforms should conduct research based on their application domain. Consequently, the second research question derived: *What does the application domain for a digital platform for healthcare systems in Dutch first-line healthcare look like?* From this research, BRs are established, specifically for a digital platform in Dutch first-line care.

In this chapter, section 5.1 touches upon general information on Dutch first-line healthcare. Following, section 5.2 provides an overview of key stakeholders in Dutch first-line healthcare, as this provides contextual understanding of the application domain. Furthermore, section 5.3 describes IS suppliers in Dutch first-line healthcare, that serve as potential platform complementors. Section 5.4 discusses a previous attempt for the introduction of the Electronic Healthcare Record, as way to expose dynamics in the application domain that influence IS integration. Understanding of these dynamics provides a basis to formulate BRs that are relevant to use in a digital platform in Dutch first-line care. Finally, section 5.5 concludes which appropriate BRs can be derived from this chapter.

5.1 Dutch first-line care – general information

5.1.1 Patient flow

The Dutch first-line healthcare sector was defined in chapter 1. It is defined as healthcare that is directly accessible for patients without referral. Healthcare professionals within this domain include General Practitioners (GP), dentists, physiotherapists, and pharmacists (Donker et al., 2010). After visiting a healthcare professional in the first-line care, the patient can get referred to the second-line healthcare system if more specialized care is required (Vissers & Beech, 2005). Moreover, if highly specialized care is required, the patient can be referred to the third-line healthcare system (Vissers & Beech, 2005).

Figure 5.1 visualizes the flow of a patient through the different healthcare systems. In this process, the GP acts as a navigator and gatekeeper to the second-and third-line healthcare system. During the referral process through the healthcare system, the GP remains responsible for the patient (Daley et al., 2013). Thus, they hail responsibility to balance healthcare costs caused by referral and the patient's health (Donker et al. 2010).

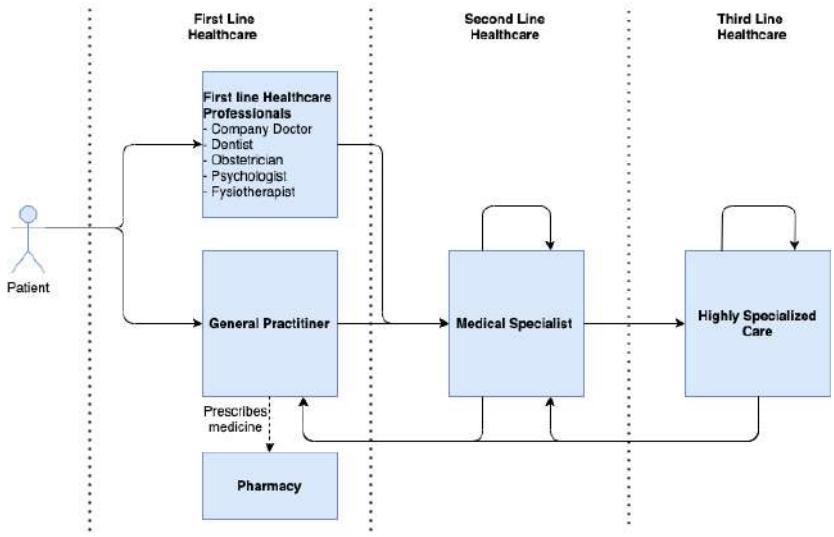

Figure 5.1: the referral of patients within the Dutch first-line healthcare system (Vissers & Beech, 2005). The arrows represent the ways in which the patient can flow through the Dutch first-line healthcare system by means of referral.

5.1.2 General developments

When examining the healthcare expenditure and demand for care, it was found that the first-line healthcare sector spent 9,5 billion euros in 2017 *(*volksgezondheidzorg.info, 2020*)*. This is roughly 10% of the entire healthcare budget in the Netherlands. Additionally, this spending grows yearly by 2%, indicating an increase in healthcare expenditure *(*volksgezondheidzorg.info, 2020*)*.

In addition, figure 5.1 shows that the supply of first-line care (the number of Pharmacists and Dentists) remained consistent with an individual difference between 2013 and 2018 of 1,6% and 5,5%. GP's have steadily increased over recent years, with 12,3% from 2013 to 2018 *(*volksgezondheidzorg.info, 2020*)*. Pediatricians show a likewise increase with 17% from 2013 to 2018 *(*volksgezondheidzorg.info, 2020*)*. This steady increase in healthcare supply in the first-line sector is necessary as demand for care increases. Between 2001 and 2015, the number of visits per patient per 1.000 patients in a GP's practice has increased by 10% *(*volksgezondheidzorg.info, 2020*)*. Thus, the number of visits increased, yet also the duration; an increase of 40% of "long consults" has taken place between 2014 and 2017.

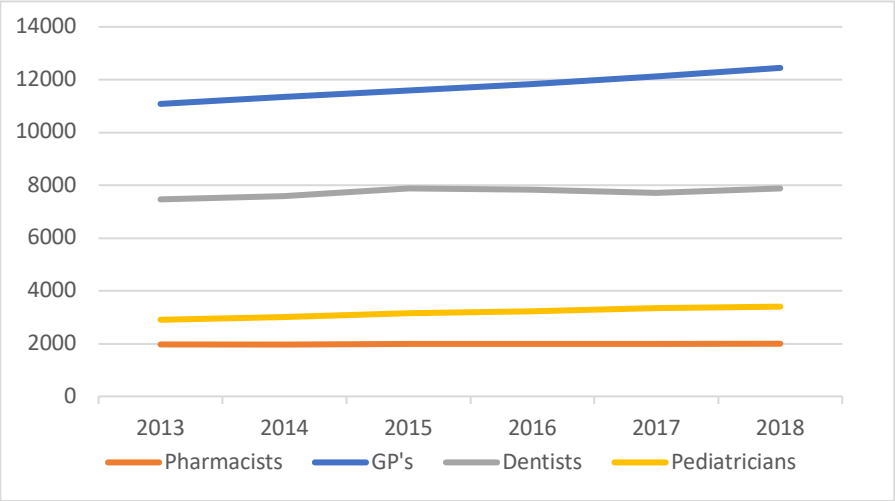

Figure 5.2: development of healthcare professionals in Dutch first-line healthcare (volksgezondheidzorg.info, 2020).

5.2 Key stakeholders in Dutch first-line care healthcare

This section outlines relevant stakeholders above the common caregivers in the Dutch first-line healthcare system. These stakeholders play essential roles in financing and governing healthcare.

5.2.1 Key stakeholders – governance of healthcare

Firstly, the ministry of HW&S is obligated to ensure that Dutch citizens can access high-quality, affordable, and available healthcare. The ministry privatized part of healthcare to ensure these objectives are met (Van Ginneken et al. 2007). It could be argued that the quality of healthcare has increased due to increased average life expectancy and an increase in treatable illnesses. Furthermore, the length of waiting lists has declined (Zwart et al., 2009). However, the private system does not always promote high-quality care, as healthcare professionals get compensated for the number of treatments they provide. Finally, healthcare costs have only risen in the last few years (Van Ginneken et al. 2007). The ministry aimed to achieve its objectives by delegating tasks to the municipalities. Among others, these are elderly care, youth care, and the chronically ill. Municipalities can fund these tasks with a budget provided by the minister (Van Ginneken et al. 2007). The effects of decentralization have caused issues, such as a disperse of knowledge. Consequently, healthcare professionals experience trouble finding information. In the future, eHealth is an essential factor to solve these issues.

Secondly, insurance companies play an important role. An insurance companies' duty is to finance healthcare on behalf of the insured, which is mandated by law in the Netherlands (Van Ginneken et al. 2007). Furthermore, insurance companies are responsible for determining which treatments should be covered by the insurance. Due to this responsibility, healthcare insurers have an essential role in the adoption of innovations. Insurance companies are registered by the Supervisory Board for Healthcare Insurance (Van Ginneken et al. 2007). which allows supervision of the selection of

treatments included in the insurance policy. When adopting new treatments in their portfolio, a cost-effectiveness assessment is created. Moreover, different healthcare insurers insure different types of treatment. A patient is able to select their preferred insurance company, and insurers are obligated to accept every citizen.

A third party that affects Dutch first-line healthcare is the European Union (EU). EU plays a vital role in the protection of patient's privacy. For instance, the EU introduced General Data Protection Regulation (GDPR) to safeguard an individual's privacy as a fundamental right. This new regulation governs the usage and securitization of private data. The main topic addressed is the transfer of medical information to third countries. For more information, refer to section 5.1.5. However, the extent to which the EU can influence healthcare in the Netherlands is relatively low.

5.3 IS-suppliers in first-line care

Another important group of stakeholders is the Dutch first-line healthcare IS-suppliers, as these suppliers will be potential complementors of a digital platform in Dutch first-line care. It should be mentioned that these companies have been approached for evaluation of Boundary Resources. Six different groups of IS suppliers have been identified and will be further discussed. These stakeholders are adopted from Hermes et al. (2020), who analyzed the healthcare industry's current digital transformation. Through figure 5.2, individual stakeholders will be analyzed. Green boxes represent different kinds of IS-suppliers. Dotted arrows represent actions taken by the stakeholder. Full arrows repreFull arrows represent an exchange of data or information.

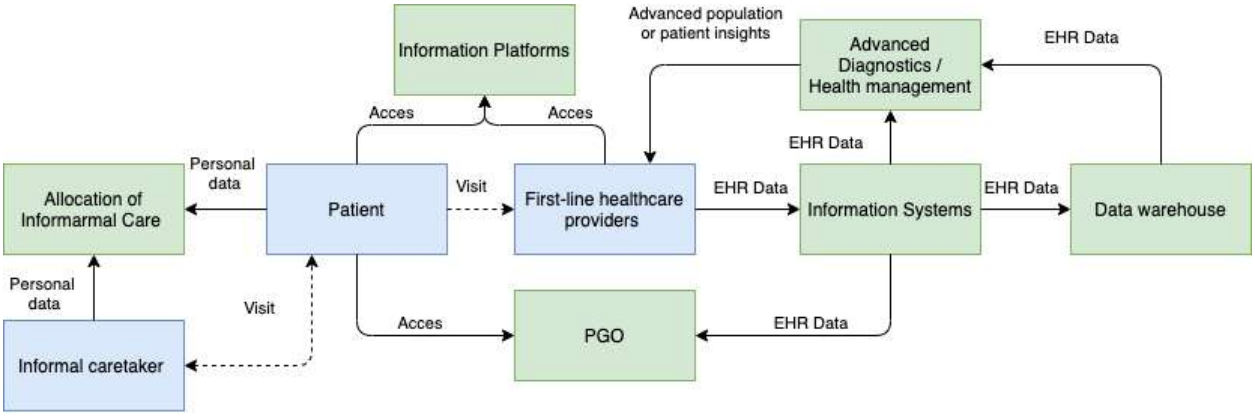

Figure 5.3: an overview presenting the IS system for healthcare. Blue boxes represent stakeholder in Dutch first-line care.

Information Systems.

Information Systems (IS) are a collection of tools that healthcare professionals use to manage patient's healthcare records (Fichman et al., 2011). These information systems' primary

functionalities include storing patients' medical records, prescribing medication, and planning appointments (Duan et al., 2011). The software is developed by a multitude of different vendors and includes tailor-made instruments for different healthcare professionals. Various vendors offer ISs to GPs and pharmacies, for instance: Promedico, Chipsoft, Pharma Partners.

Health Management and Advanced Diagnostics

In addition to IS Solutions that manage and store data, IS suppliers seized opportunities in using medical records data to develop solutions (Hermes et al., 2020: Foerderer, 2019). These found solutions can be utilized for decision-making on patients' health management and advanced diagnostics. Fortunately, there is a wide variety of suppliers that offer these add-on solutions. Examples of these companies are Medworq, Beter Dichtbij, and Ross Health.

PGO's

There are Personal Healthcare Environments (Dutch: Persoonlijke Gezondheids Omgeving (PGO)). These solutions provide the functionalities to store, collect, share, and control their medical data (Patientenfederatie.nl, 2021). From a legal standpoint, a patient has the right to know which personal medical data is stored, who can access it, and with what purpose data is stored. Furthermore, patients can authorize further sharing of medical data with other healthcare professionals when the treatment process requires it.

Information platforms

Information platforms are designed for healthcare professionals or patients to provide many functionalities (Hermes et al., 2020). First, there are online community platforms where both patients and healthcare professionals can exchange knowledge regarding medical practices (Hermes et al., 2020). Additionally, there are online learning platforms for healthcare professionals. As healthcare practices change continuously, a significant portion of time is allocated towards schooling. An example of a learning platform in the Netherlands is Artsportaal.nl. Besides, there are platforms developed to allocate informal care, where informal care providers are assigned to informal caretakers. Functionalities of these platforms are planning, journaling, and discussing; the widely used ones are Sharecare, HalloZorg, and Mextra.

Data warehouses

The fifth group within the IS landscape of Dutch first-line care is data warehouses (Hermes et al., 2020). By GP's and patient's consent, data in medical records can be stored in such warehouses (de Mul, 2012). There medical data is stored, processed, governed, and managed data treatments and outcomes of healthcare providers' care processes. Consequently, this data is exploited in two ways; either for analysis tools built internally or redistributed to parties specializing in building such analysis tools (Hermes, 2020). Examples of companies are STIZON and Equinix.

5.4 The role of digital platforms in Dutch healthcare

This section explores how Dutch Healthcare has been developing digital platforms in the past. In healthcare, there is a need for rigid quality control (Thorseng & Jensen, 2015), security, privacy (Constantinides & Barrett, 2014), and certification (Diamond & Shirky, 2008). In extension to other markets, a health care platform must sensibly balance the interests and objectives of multiple parties and underlying accountability and liability issues (Constantinides & Barrett, 2014).

Digital platforms are emergent in a wide variety of industries. However, they have only scarcely emerged in healthcare worldwide (Farchian et al., 2018). This is partly caused by the problematic dynamics of healthcare addressed in section 1.1. The Dutch government attempted to develop a platform to exchange EHR, named the National EHR (Dutch: Landelijk EPD). This attempt could not be considered a digital platform but rather a data platform, since a data platform solely allows facilitating the supply and demand of data, whereas a digital platform supports development and operation of third-party applications (De Reuver, 2018).

Despite the difference between a digital platform and a data platform (Gawer, 2014), the National EHR case can still be explored since both platforms operate in the same application domain. Therefore, both platforms are affected by the same institutions. Also, for the digital platform researched in this thesis, sharing medical data will remain essential because this function is often embedded in the software that IS supplier's design. Subsequently, the National EHR case is comparable with the proposed architecture of a digital platform in this thesis.

The case of the National EHR attempt was discontinued in 2010 because of a multitude of reasons (NRC, 2010) There was a lack of standardization of medical data among different Dutch first-line care IS systems. Developing a standardized format was difficult because of the required agreement of multiple parties (van t' Noordende, 2010). Also, there were issues concerning data security, governance, and ownership. Medical data is firmly embedded in GDPR lawmaking. Accessing medical data requires permission by the patient or a legally determined treatment relationship. Hence, there was a danger of hackers or unauthorized healthcare professionals obtaining medical data by abusing their unique identification.

Implementation was orchestrated publicly by the ministry of HW&S and the NISiz (van t' Noordende, 2010). Thus, the ministry of VWS coordinated development and implementation for another five years. The Dutch Senate (Dutch: Eerste Kamer) rejected further implementation in 2011 after significant financial investment, leading to unfavorable results. Thereafter, healthcare insurance companies started funding the project, further developed as a private initiative by VZVZ.

5.5 Rules in use

The application domain is conducted to derive a general understanding of the Dutch first-line care landscape to provide context for the section. This chapter aims to identify what BRsshould be considered for a digital platform in the Dutch first-line healthcare system. The following section

presents several key developments relevant to consider when researching a digital platform in Dutch first-line healthcare.

MEDMIJ – Data standardization agreement

Data governance in Dutch first-line healthcare is crucial to consider, as an essential function of the information systems in the IS landscape is concerned with distributing medical data. This adds a layer of complexity to a digital platform's operation in first-line care because medical data considered personal data and thereby falls under GDPR. This section shortly elaborates on how data is stored and distributed. The MEMDIJ protocol has been introduced to standardize the transfer of information between healthcare professionals (MEDMIJ.nl, 2021). In this way, medical information regarding healthcare processes, diagnostics, and data are standardized. The used protocol for this transfer is HL FHIR7, which is developed for the first- second-, and third-line patients.

Identity Access Management

In Dutch healthcare, multiple kinds are rulemaking make up the institutional domain. These rules making govern, among other sharing of medical data. There are the WGBO, GDPR, and WABVPZ, which will be elaborated upon next:

WGBO

The law for medical treatment agreement (Dutch: Wet op de geneeskundige behandelingsovereenkomst, WGBO) is the jurisdISion that governs the relationship between caregiver and caretaker (Rijksoverheid, 2020a). WGO authorizes a healthcare professional view medical data of a patient since a treatment relationship is in place. Therefore, not consent of the patient is required. However, the healthcare professional must be able to identify as a registered doctor and, more specifically, to have a treatment relationship with said patient (Rijksoverheid, 2020a).

GDPR

GDPR is rulemaking that protects legal entities for processing and trafficking of personal data, developed to strengthen civilians' constitutional rights in a digital age (ec.europe, 2021). GDPR hails several foundations that can be used to consent sharing of personal data. Other than WGBO, GDPR is applicable when no treatment relation exists between healthcare professional and patient. GDPR is based on consent of the patient to share their data (ec.europe, 2021). . In other other words, a patient must approve that minimally required data is shared with a specified purpose. To prevent fraud, it is required that a patient and doctor are able to identify themselves, for this jurisdISion to fulfill its purpose.

WABVPZ

The law for additional clauses for processing of personal data in healthcare (Dutch: wet aanvullende bepalingen verwerking persoonsgegevens in de zorg (WABVPZ) (Rijksoverheid,

2021b), is a jurisdiction that is developed to govern usage of SSN (social security number) and explicitly variances exchange of medical data between healthcare providers. It also provides patients with the right to have insight in their medical records. This medical record has to be accessible via the system required for medical data exchange after the patients have provided specific authorization. Also, the system requires the specification of what healthcare provider can access the system. It needs to provide the healthcare professional's proper authentication to ensure no fraudulent access takes place by imposters. Also, the system needs to provide specific authorization to other healthcare providers (when authorization is given).

The common denominator of these laws is that they require identification of both patient and healthcare professional to be applicable. Therefore, identification & access management (IAM) tools are relevant solutions to consider for a digital platform. In 2020, the Netherlands tested the proof-of-concept ZorgIdentiteit (healthcare identity). Healthcare suppliers can only decrypt this attribute. This solution might provide a suitable option for IAM.

5.6 Conclusive Statement

This chapter reviewed relevant dynamics in the Dutch first-line healthcare sector, as for digital platform research, it is important to understand to have an understanding of the application domain in which the digital platform operates. Consequently, an outline is provided on the relevant processes and stakeholders. Furthermore, it is explained how a previous attempt of a platform governed by government had failed. From these topics, concrete BRs could be derived that are specifically relevant for a digital platform in Dutch first-line healthcare, and therefore have the potential to motivate IS Suppliers to participate in a digital platform in Dutch first-line healthcare. These BRs have been outlined in section 5.5. To summarize briefly, these potential BRs were IAM APIs and data standardization agreements. These BRs will be added to the complete list of BRs developed in the next chapter, that will be used for the MCDA.

6 Identified boundary resources

In this chapter, the second research question is addressed, which is: *What BRs are relevant to analyze the levering capability for a digital platform for information systems in Dutch first-line care?* In the previous chapter, three BRs have been identified that were retrieved based on analysis of the application domain. In this chapter however, academic literature will be reviewed in order to develop a complete list of potential boundary resources. The individual BRs in this list could serve as the alternatives that will be evaluated by the industry experts that will conduct the MCDA.

Section 6.1 describes the method that is used for the literature review that served to obtain boundary resources. In sections 6.2 to 6.4, all identified BRs are described. These descriptions combine the findings from the literature research with the findings from the ABRs in the previous section. A description of the identified BRs will be given. Additionally, the relevance of a digital platform for Dutch first-line healthcare will be described. Section 6.2 describes all ABR's. Section 6.3 describes all DBRs. Section 6.4 describes all SBRs. The chapter concludes with a complete overview of all BRs that will be used for the best worst method.

6.1 Method of the literature research

The literature research applied a method of diverging and converging. In this way, the risk was reduced of missing BRs that provided potential relevance for complementors of a digital platform in Dutch first-line care. Therefore, a wide array of BRs had to be identified with a low level of abstraction. In order to retrieve BRs with a low level of abstraction, only case studies would be considered. This meant that articles discussing BRs conceptually, would be excluded from the literature. Articles that discuss BRs conceptually, usually discuss them at a higher level of abstraction. This would risk those specific applications of these BRs would be missed. For example, Ghazawneh & Henfridsson, 2013), discuss APIs. However, few concrete examples of APIs are given. A constraint was developed initially in regard to the number of BRs that would be included in the final list. This constraint was based on the maximum number a BWM with 3 categories would allow, which is 9 per category.

A systematic method was produced to retrieve boundary resources. The steps are outlined next and will be discussed in greater detail thereafter. The steps are also visualized in figure 6.1

1. Obtain literature
2. Remove irrelevant articles
3. Scan and list all concrete BRs mentioned in articles
4. Remove end-user focused BRs, as this research focusses on the complementor.
5. Categorize BRs into the model of Dal Bianco, et al. (2014)
6. Identify BR types
7. Exclude irrelevant BRs.
8. Include BRs identified from chapter 5.

▪

6.1.1 Step 1 - Obtaining literature

The first step was to obtain relevant literature in order to identify applied boundary resources. Scopus was used a source for academic literature. Next the search operator had to be developed. A search operator hat was developed that identified articles in all application domains. This is because complementors in other application domains have similar requirements. For instance, all complementors benefit from software that software development. The following search operator was used:

"Digital platform" AND "Boundary Resource*"*

6.1.2 Step 2 – Removing irrelevant literature

This led to 51 results. These 51 results consisted of multiple kinds of studies discussing boundary resources. Articles discussing BRs conceptually were excluded. Also, duplicates, conference papers, articles that were not accessible were and articles outside the research domain of digital platforms were excluded immediately. The remaining list consisted of 17 articles. These have been listed in appendix B.

6.1.3 Step 3 – Scan for BRs

All articles were scanned for concrete mentioning of BRs. These have been listed in a long list. A reference was made to the page number for retractability purposes. 154 BRs were identified. This concludes the diverging stage of the process.

6.1.4 Step 4 – Exclude end-user focused BRs

Some BRs were clearly focused on the end-user. Examples of this are BRs that allowed for the creation of a customer profile. This thesis does not discuss end-user focused BRs and could therefore be excluded. The list was reduced to 130 BRs, by removing 24 BRs.

6.1.5 Step 5 – Categorize BRs according to Dal Bianco, et al. (2014)

This step kicks off the converging process. This was done by categorizing the BRs first according to the model of Dal Bianco et al., (2014). This was done because categorization of 120 BRs individually was too big of a problem. Therefore, splitting the problem up in sub-problems was preferred. 41 ABRs, 23 DBRs and 56 SBRs were identified. Next decision rules for allocating BRs are presented.

BR Type	Decision Rule	Rationale	Examples (Appendix B.)
ABR	Include API's	APIs extend the functionality of the software, thereby abiding the definition of an ABR.	25 - API data formats 131 – adobe flash plugin
	Include libraries	Libraries extend the functionality of the software by allowing for connection with a database, thereby abiding the definition of an ABR.	69 - DHIS2 Data Import Wizard 41 – API to access meta data
DBR	Include tools that *assist in* development activities.	These tools assist in developmental activities of complementors	77– SDK 145- Debugging tools
	Include tools that embody a philosophy for software development.	These tools assist in developmental activities of complementors	76 - DevOps and 60 - Model Driven Development.
	Include tools that allow for value capture	Value capture is required for development of software.	79 – App Store
SBR	Include tools that facilitate physical interaction between platform complementors.	Through physical interaction, information can be exchanged.	62 – Partner Programs 66 – Start up Programs
	Include tools that facilitate digital interaction between platform complementors	Through digital interaction, information can be exchanged.	149 – Fortum live chat support 90 – Help Desk
	The BRs that are used for communication of rules	Rules need to be communicated and therefore are a form knowledge transfer.	48 – Guidelines on datasets 116 – Policy guidelines
	The BRs that are used for education of complementors	Education is a form of interaction and knowledge transfer.	95 – Massive online courses 130 – Technological coaching

Table 6.1: an overview of decision rules for allocating BRs in ABRs, DBRs and SBRs.

6.1.6 Step 6 – Identify BR types per category

Next, the individual categories could be considered. In order to identify types, BRs hat had a similar functionality were grouped. This grouping process can be followed in detail in appendix B. This grouping activity led to 4 types of ABRs, 5 types of DBRs and 5 Types of SBRs.

The grouping activity occurred by developing some general guidelines first.

1. A minimum of 2 and a maximum of 9 where BRs were categorized as these are minimally required and maximally allowed for BWM.
2. The work of Petrik and Herzwurm (2020) was used as initial leeway for categorization as these researchers categorized BRs according to model Dal Bianco (2014) for a digital iOT

– platform. The categorized BRs are generally applicable for a digital platform in Dutch first line healthcare

BR Type	BR Identified by Petrik and Herzwurm (2020)	Decision Rule	Rationale
ABR	API's	Specify REST API's	Identified 5/35 times as a specific API.
		Specify Medical Standardization API	Identified 5/35 times as a specific API.
		Specify API product complementarity	Identified 10 times as BRs with the functionality to connect to existing mainstream software, such as adobe, google, or Microsoft.
	Connectivity libraries	Accept	Identified 15/35 times. No sub-functionalities could be identified.
	Support of multiple open machine protocols	Reject and discard	Specifically required for big data purposes. Expected to be too IT focused for potential experts in the business end to understand.
	Support of different cloud infrastructure providers	Reject and discard	Overlapping with API for product complementarity, as it also provides connectivity to existing mainstream software. However, API product complementarity was a definition that allowed inclusion of other BRs as well, such as Adobe, safari and iTunes.
	DevOps	Move to DBR	DevOps support development activities and operation activities.
DBR	SDK	Accept	Identified 7 times as separate tool
	App Store	Accept	Identified 5 times as separate tool
	Model Driven Development	Accept	7 tools identified with the functionality to provide testing services for software development.
	Integration of a container management service	Reject	Expected to be too IT focused for potential experts in the business end to understand
SBR	Developers' portal	Accept.	Through physical interaction, information can be exchanged.
	Partner Programs	Reject	Not specifically identified as BRs in literature.
	Onsite demonstrators	Reject	Not specifically identified as BRs in literature.
	Events	Accept	Events are a form of interaction and knowledge transfer.
	Trainings and workshops	Accept	Education is a form of interaction and knowledge transfer.
		Introduce terms and conditions	SBR as it communicates information between platform owner and stakeholder. Identified 14 times as an SBR.
		Introduce license agreements	SBR as it communicates information between platform owner and stakeholder. Identified 3 times as an SBR.

			Important requisite for openness of platforms.

Table 6.2: An overview of the selection process of individual BRs.

6.1.7 Step 7 – Disregard irrelevant BRs per category

Irrelevant BRs had to be disregarded. These consisted of BRs that were not classifiable. This was only the case for ABRs, as all DBRs and SBRs could be grouped. These APIs were to abstract to categorize. For example, these were descriptions of "API". In one instance, this was a hardware abstraction layer (Karhu et al., 2018), which was too abstract to categorize.

6.1.8 Step 8 – inclusion of BRs from chapter 5.

For the final list, the BRs were included from chapter 5.

6.1.9 Step 9 – Evaluate number of BRs for reasons of practicality

The number of BRs were researched for reasons of practicality in respect to the BWM. A total of 16 BRs were identified, which was considered practical.

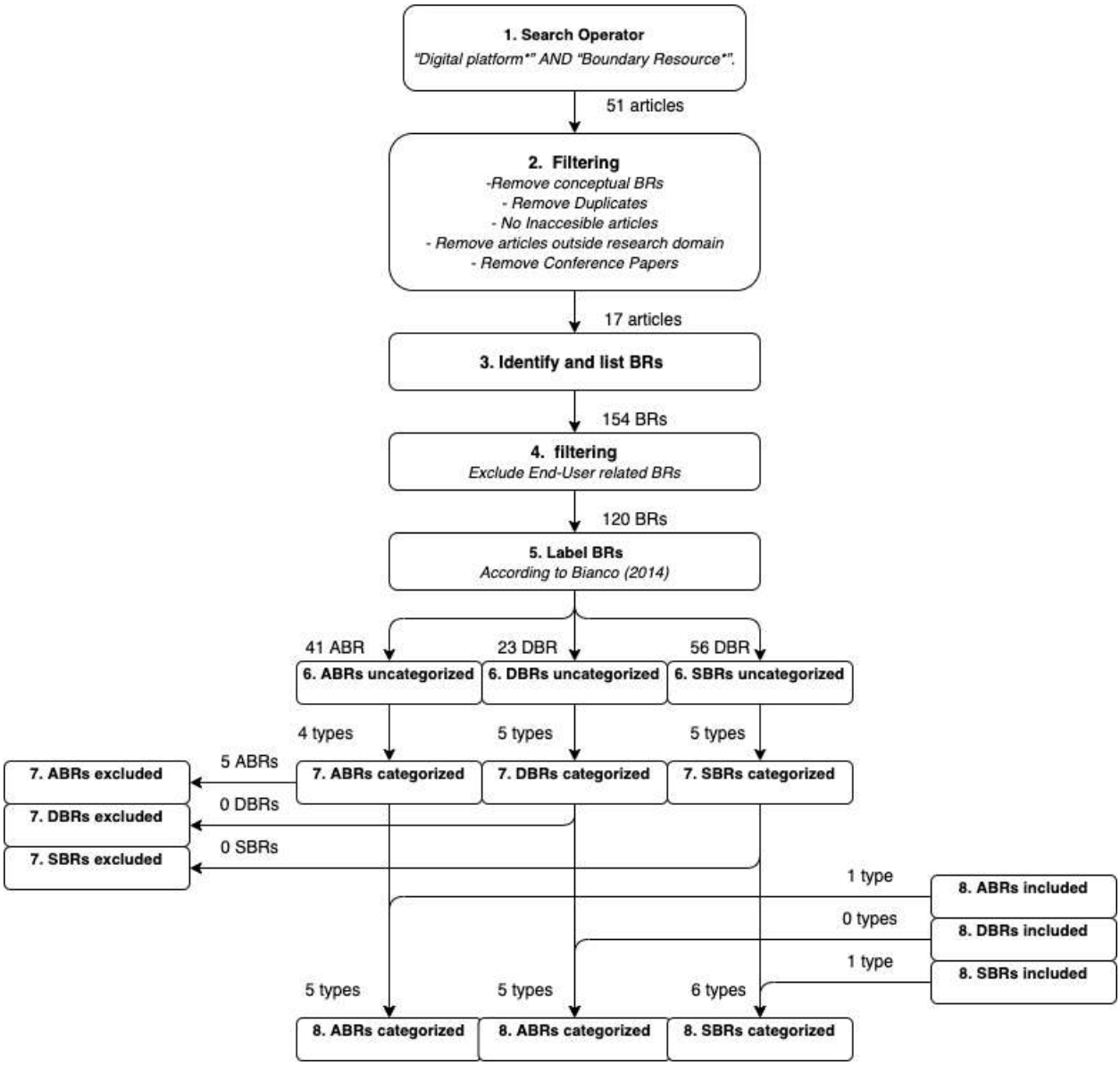

Figure 6.1: a visual representation of steps taken for the literature research

BR category	BR	Description	Identified via	Sources
ABR	REST API's	A REST API allow to make applications or software connect to web base by use of the REST-protocol.	Literature	Dal Bianco et al, (2014); Eaton, (2015); Islind, et al. (2016); Vesselkov, et al. (2019)
	Product complementarity APIs	Ensures functionality of having financial transactions between complementors, platform owners, and end-users	Application Domain (Chapter 5)	Eaton, et al., (2015); Karhu, et al., (2018)
	Database Libraries	These libraries enable applications to connect to databases on the platform. This can be used to connect applications to an EHR's database.	Literature	Bender, (2020); Bonina & Eaton, (2020), Dal Bianco, et al., (2014); Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020); Russpatrick (2019)
	IAM API's	Proper identification is required for end-users (patients, G.P.'s, etc.) for data sharing authorization purposes	Application Domain (Chapter 5)	N.A.
	Medical Data Standardization API	An API that ensures documentation of medical data according to standardized protocols.	Literature	Bender, (2020); Etamesor, et al., (2018); Russpatrick, (2019); Vesselkov, et al. (2019)
DBR	Software Development Kit	Ensures complementors to build applications in accordance with platform core capabilities and rules.	Literature	Dal Bianco, et al., (2014); Eaton, et al., (2015); Islind, et al., (2016); Karhu, et al., (2018); Msiska, et al., (2019); Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020)
	Testing Environment	Provides data models and live datasets for testing purposes of applications.	Literature	Bonina, et al., (2020); Dal Bianco, et al., (2014); Foerderer, et al, (2019); Karhu, et al., (2018)
	App store	Ensures distribution of applications developed by complementors to end-users	Literature	Bender, (2020); Eaton, et al., (2015); Karhu, et al., (2018); Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020)
	DevOps Tools	Tools for debugging applications during development and tools for testing applications (by means of fISive datasets)	Literature	Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020);
	Model Driven Development (MDD)	Development philosophy and tools that enable a standardized design cycle of applications.	Literature	Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020)
SBR	Terms and Conditions	Platform rules offered by the platform owner, that the platform complementor should abide by.	Literature	Bonina, et al., (2020); Dal Bianco, et al., (2014); Eaton, et al., (2015) Foerderer, et al, (2019); Karhu, et al., (2018)
	License agreement	A contract that can be used for licensing of software to third-party platform complementors on the platform.	Literature	Karhu, et al., (2018)
	Developers Portal	Complementors can discuss future challenges on the platform and learn from each other's experiences.	Literature	Dal Bianco, et al., (2014); Foerderer, et al., (2019); Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020); Vesselkov, et al., (2019); Wulf, et al., (2020)
	Trainings and Workshop	Enables complementors to develop applications with a specified programming language in compliance with platform rules and architecture.	Literature	Dal Bianco, et al., (2014); Foerderer, et al., (2019); Petrik & Herzwurm (2019); Msiska, et al., (2019); Petrik & Herzwurm, (2020); Vesselkov, et al., (2019)
	Events	Events were complementors and platform owners can interact.	Literature	Bonina, et al., (2020); Dal Bianco, et al., (2014); Foerderer, et al, (2019); Petrik & Herzwurm (2019); Petrik & Herzwurm, (2020)
	Medical Data Standardization Agreement	Compliance with standards, such as HL7v2, HL7 FHIR, CDA, EDIFACT & DICOM	Application Domain (Chapter 5)	(N.A.)

Table 6.3: an overview of identified BRs from literature and the application domain.

6.2 Application BRs

In this section, the identified ABRs will be discussed. More specifically, only the BRs that have been identified by the literature research will be discussed. Other BRs have already been introduced in section 5.5.

REST APIs

Several researchers discuss the inclusion of REST API's as (Petrik & Herzwurm, 2020; Msiska, 2019; Haarbrandt, 2018). Representational State Transfer (REST) is a is software format to make webbased connections (Codeacademy, 2021). An example is HTTP. REST APIs are used to create applications that to connect with the Web. When an application is built using REST, the application is called RESTfull. As a greater number of healthcare providers adopt web-based applications, RESTfull APIs are important API for a digital platform in Dutch first-line healthcare.

API for Product Complementarity

Noticeably, in the current transition of IS in healthcare, different market segments become more interconnected. Hermes, et al. (2020) finds several types of goods that get transferred. These are data, financial transactions, and medical information. For the iOS and Android platform, numerous APIs are provided to allow for interaction with application providing basic functionalities, such as google chrome, google maps, adobe suite and more (Eaton, et al., 2015; Karhu, et al., 2018) Additionally, services are provided for transactional purposes. For instance, Adyen provides a simple and flexible way to ensure save transactions of money. These standard functionalities should be considered when developing a digital platform, as many interactions are related to transferring these kinds of data.

Database libraries

Database librariesare tools that are used by software to connect to a database. These BRs have been identified by Petrik and Herzwurm (2019; 2020) For example, an information system in a GP practice would use a connectivity library to access the database of another GP to retrieve data. According to Jacobides, et al., (2018) the boundary resource helps to solve unaddressed needs for a digital platform for IoT.

Identity Access Management API's

Using the institutions that are addressed in section 5.5 require identification of patients or healthcare professionals. Often, authorization for sharing of medical data between healthcare professionals is based on GDPR, which in return requires consent. Therefore, when the patient authorizes his or her GP to share their medical information, a form of identification is required. To prevent fraud, Identity Access Management software exists, that validates the identity of the person.

Medical Data Standardization API

Currently, data in EHR's is stored decentral with different formats. Prasser et al. (2018) claim that integration and sharing of medical data will be essential for future healthcare and research. This causes a lot of issues. This is troublesome for the exchange of medical data. Hence, standardized protocols are developed that aim to ensure interoperability between information systems of healthcare professionals. Prasser et al. (2018) discuss a framework that can be used as an API for the integration of medical data according to a number of data protocols. These protocols are HL7, DICOM, CDA, CDISC ODM, and IHE XDS. FHIR is a familiar protocol that has been discussed in section 5.4. The Netherlands have adopted this standard protocol and labeled it MEDMIJ (MEDMIJ, 2021).

6.3 Development BRs

In this section, the DBRs that have been identified through literature research, will be discussed.

Software Development Kit

Software development kits have been discussed in section 2.4.2. In academic literature, it software development kits are discussed often as well (Eaton, 2015; Karhu & Ritala, 2020; Msiska 2018; Petrik & Herzwurm, 2020). SDKs are important DBRs for platform complementors. Eaton et al. (2015) and Petrik and Herzwurm (2019) discuss that the quality of the BRsis very much relevant. SDKs that have a lower level of maturity have a lower level of satisfaction with platform complementors (Petrik & Herzwurm, 2019). SDKs are used to increase the capacity of the platform.

Testing Environment

Different platforms provide resources that platform complementors can use in toder to test their developed software (Bonina, et al., 2020; Dal Bianco, et al., 2014; Foerderer, et al, 2019; Karhu, et al., 2018). These exist of runtime environment (Karhu, et al., 2018), Debugging tools (Dal Bianco, et al., 2014) and test datasets (Bonina & Eaton, 2020). Due to GDPR it is difficult to obtain real world data that can be used by IS-suppliers. It is therefore beneficial to have a test data set at their disposal that resembles the population of a GP or a Group of GPs. In the world, examples exist op open data sets that are made available for these purposes.

Application Store

An application store or app store is an online environment where applications can be distributed (Hein, et al., 2019). Additionally, a monetization scheme can be developed to exchange value for the application (Hein, et al., 2019). The Application Store is a concept that is familiar from the iOS and Android landscape. App stores are mentioned by Petrik and Herzwurm (2019; 2020) as critical BRs for IoT platforms.

DevOps Tools

DevOps can be defined as an organizational approach for the development and operation of I.T. products. DevOps thereby puts a focus on empathy and collaboration between teams. The goal of this approach is to develop IS systems that are robust and increase the rate by which iterations can be delivered (Mala, 2019). Hein, et al. (2019) describe DevOps as BRs that are able to maintain and accelerate substitution economies. DevOps are considered attractive in a case study conducted on platform complementor satisfaction on an IoT platform (Petrik & Herzwurm 2020). However, the adoption of the boundary resource was dependent on the maturity of the DevOps BRs that were provided. A lesson that could be drawn with respect to this finding is that the willingness to adopt a boundary resource could change over time.

Model-Driven Development

Model-Driven Development (MDD) is an approach that is specifically used for the development of software (Steffen, et al., 2006). The method is used to deliver high-quality applications. This rapid deployment of applications is achieved because models and pre-built components are used. Instead of using code, this method allows to visually construct software. Model-Driven Development has been issued as BRs by two papers of the academics Petrik & Herzwurm (2019; 2020). In these papers, MDD is judged negatively by platform complementors as due to a lack of support. Therefore, the amount of support that is provided by a platform owner regarding BRs is relevant as well.

6.4 Social Boundary Resources

In this section, the social BRs will be discussed.

Terms and conditions

Eaton, et al. (2015) describes 13 types of documents that are available on the iOS program. For a digital platform in Dutch first-line healthcare, these rules could describe what protocols can be used and which ones cannot. Android also offers numerous contracts and agreement documents that the platform complementors should sign (Karhu, et al., 2018). Among others, there is an alliance contract, where the interests of the platform complementor and platform owner are safeguarded. Additionally, there are documents for compatibility, policy guidelines, other services, distribution of applications and more. These are all documents that allocate control on a platform (Tiwana, 2011). Hence, for a digital platform in Dutch first-line healthcare, these documents should also exist. To summarize these documents, the description of "terms and conditions" is chosen.

License Agreements

A licensing agreement is an agreement that provides an organization with the right to *"produce and sell goods licensor grants the licensee the right to produce and sell goods, apply for a brand name, or trademark, or use patented technology"* (Investopedia, 2021). The Android platform provides an open-source licensing agreement and an end-user licensing agreement (Karhu et al., 2018; Eaton et al., 2015). These licenses allow complementors to contribute with respect to existing software and develop their own variations. Thereby, releases of iterations of software can

be accelerated. This could be beneficial for a digital platform in first-line healthcare to promote collaborative innovation.

Developers' portal

A developer's portal is a portal that provides a number of community functionalities to developers. In a basic form, documentation that is relevant to platform usage is provided. For instance, terms and conditions, licensing agreements, platform rules and more others could be offered. What makes a platform more valuable when forums, support channels and blogs are offered as supportive tools. Developers can discuss issues and opportunities via blogs or form-based functions. Thereby, the developer's portal serves to create a more open environment between platform-based complementors. Additionally, knowledge transfer is promoted. (Petrik & Herzwurm, 2020; Petrik, & Herzwurm, 2019).

Trainings & Workshops

A platform owner can provide training and workshop to a platform complementors. These trainings and workshops can be about a variety of topics. For instance, Msiska (2019) discusses DHIS2 workshops, where platform complementors learn to develop an application using this specific type of software. DHIS2 is a language specifically focused on developing software for healthcare purposes (DHIS2.org, 2021). Having these workshops leverages both DHIS2 and the platform. For a digital platform in healthcare trainings and workshops can be provided to third-party complementors to learn matters such as training in GDPR, data governance, DevOps development and more.

Events

Events are organized gatherings for different platform stakeholders. These events mainly serve to discuss innovative ideas and problems related to the platforms. Numerous types of events could be identified, ranging from hackatons, partner programs, to co-innovation activities (Bonina, et al., 2020; Dal Bianco, et al., 2014; Foerderer, et al., 2019; Petrik & Herzwurm, 2020) Additionally, events could serve to ensure an elevated level of excitement on the platform. The various events also ensure increased excitement with the platform (Petrik & Herzwurm, 2020).

7 RESULTS BWM

In this chapter, research question four will be discussed: *What is the relative ability of boundary resources to motivate platform adoption of IS Suppliers for a digital platform in Dutch first-line care?* The conceptual model that is developed in chapter 4, along with the BRs that have been identified in chapter 5 and 6 have will be tested by means of a survey that is presented to industry experts of the IS landscape of Dutch first-line healthcare. To retrieve the relative ability to poromote complementor adoption, 31 industry experts are considered through BWM MCDA.

In section 7.1 the results will start by presenting the consistency of the survey data input. Thereby, inconsistent measurements can be excluded. Next, it is presented how often a given BR is selected as “best” or “worst”, as this provides preliminary insights of the weight distribution of the BRs. Next, the local weights of the BRs are discussed. After that, the global weights are discussed. Finally, the group comparison is made.

For evaluation of the results, the weights will be averaged per BR over all respondents. This is explained in chapter 3, section 3.3 and 3.4. As this action is permitted, not only the weights are calculated, but the standard deviations and the median of the measurements as well. These values provide insight in the distribution of weights per individual considered alternative. The Standard deviation provides insight to how much the respondents are in agreement with each other, as a lower standard deviation indicates a lower spread of weights per BR of category of BRs. A lower spread of weight indicates a BR has been given similar weights and therefore respondents are more in agreement. The median indicates in what direction the measurements are skewed, thereby indicating if the distribution of weights per alternative is distributed more normally, or less normally.

7.1 Results of the BWM

The data generated by each of the respondents is processed by means of the excel solver for linear BWM, as presented by Rezaei (2015). The data provided through the survey is presented in Appendix C. The results of the solver are presented in Appendix D. The weights represent the relative willingness of a respondent to adopt a category of BRs or a specific BR.

A first check to identify processing errors of data can be done by summing the weights per evolution. All weights should add up to one. This can be registered for all measurements. Consequently, it can be concluded that based on this criterion, all measurements are processed accurately.

7.1.1 Consistency

First, the consistency of the responses will be discussing, as this determines the reliability of the response to evaluate relative ability to adopt a specific BR (Razaei, 2015). For, this analysis, either three, five or six alternatives had the be evaluated by respondents. This was done on a scale of 1-9. These threshold values that correspondent to these characteristics is presented in table 7.1. To obtain a complete overview of consistency levels, an all-consistency levels are listed in Appendix E. For ABRs, DBRs and SBRs, all respondents have provided consistent answers. For categories, 15 responses were considered inconsistent. For the individual categories, all measurements were consistent.

ID	Categories	ABRs	DBRs	SBRs
1	0,2361	0,1867	0,1096	0,2323
2	0,2143	0,1140	0,2083	0,0820
3	0,1400	0,1150	0,0879	0,1250
4	0,0769	0,1023	0,0597	0,1192
5	0,0625	0,1000	0,2500	0,1301
6	0,1400	0,1894	0,1454	0,1738
7	0,1429	0,2299	0,1765	0,1261
8	0,1778	0,1647	0,1520	0,1656
9	0,0778	0,1880	0,1630	0,1660
10	0,0893	0,0928	0,1792	0,1644
11	0,1091	0,1053	0,1452	0,1690
12	0,2143	0,1096	0,0615	0,2311
13	0,1944	0,0656	0,1500	0,1619
14	0,2667	0,1164	0,18715	0,1654
15	0,2333	0,1628	0,2222	0,1713
16	0,0741	0,0532	0,1538	0,1333
17	0,1548	0,1434	0,2110	0,0985
18	0,1296	0,1672	0,1140	0,1729
19	0,0833	0,0741	0,0957	0,1008
20	0,1667	0,1627	0,1023	0,1739
21	0,2167	0,1486	0,1520	0,2009
22	0,1231	0,1082	0,1690	0,1071
23	0,1500	0,1895	0,1132	0,1301
24	0,0600	0,1613	0,1019	0,1376
25	0,2143	0,1402	0,1701	0,0967
26	0,0833	0,2180	0,0928	0,0982
27	0,0417	0,1288	0,1190	0,0303
28	0,1231	0,1880	0,1254	0,1932
29	0,1515	0,1176	0,1319	0,1091
30	0,1250	0,1613	0,1579	0,0943
31	0,1818	0,1355	0,1389	0,1372

Table 7.1: overview of consistency factors of all responses.

7.1.2 General overview of the results

In this section, the number of times a category is considered as "best" or "worst" is considered. The results are displayed in table 7.1. This will provide preliminary and crude expectations of the rank-order of weights of categories and boundary resources.

	BRs	Times selected as best		Times selected as worst	
Main Categories	ABRs	8	53%	3	20%
	DBRs	5	33%	6	40%
	SBRs	3	19%	6	40%
ABRs	REST API's	6	19%	9	29%
	Product complementarity APIs	5	16%	9	29%
	Database Libraries	4	13%	4	13%
	IAM	4	13%	4	13%
	Medical data standardization API	12	39%	5	16%
DBRs	SDK	13	42%	4	13%
	Test Environment	2	6%	5	16%
	App Store	7	23%	7	23%
	DevOps Tools	9	29%	4	13%
	Model-Driven Development	0	0%	11	35%
SBRs	Terms and Conditions	13	42%	1	3%
	License Agreement	2	6%	4	13%
	Developers Portal	1	3%	8	26%
	Trainings & Workshops	1	3%	6	19%
	Events	2	6%	7	23%
	EHR Standardization Agreement	12	39%	2	6%

Table 7.1: an overview that shows the frequency by which BRs have been selected as the best and the worst alternative.

Categories

ABRs (8 times) have been selected as the best category of BRs most often. DBRs (5 times) has a second place and SBRs (3 times) is considered relatively lower ability to motivate platform adoption. ABRs have been considered fewest as the worst category (3 times), DBRs (6 times) hold a second place, SBRs (6 times). Consequently, ABRs could be conspired having a better ability to promote platform adoption on the basis of this analysis.

ABRs.

EHR Standardization APIs (12 times) are selected significantly more often than the rest. REST APIs (6 times) are best the second most often. IAM and database libraries (both 4 times) rank third place. REST API's and Product complementarity APIs (9 times) have been selected most often as the worst alternative. Noticeably, IAM API's and Database Libraries have been selected only four times as the worst.

DBRs

SDK's (13 times) has been evaluated as the best most often. DevOps (9 times) have been selected second-most as the best category. Model-Driven Development has not been selected a single time as the best category. For the worst categories, Model-Driven Development has been selected 11 times and thereby being the most. The App Store has been selected 7 times as the best and the worst, thereby indicating a great variability of respondent's judgment regarding this boundary resource. The test environment has only been selected twice as the best and 5 times as the worst, thereby suggesting that it is a boundary resource that does not stand out in either regard.

SBRs

Terms and conditions (13 times) as the best and only once as the worst. Standard Protocols for communication have been selected (12 times) as the best and 2 times as the worst. Trainings & Workshops and a Developers Portal have been selected most often as the worst category, as they are selected 8 as the best and 6 times as worst. Additionally, both have been selected once as the best category. These combinations of findings suggest that these BRs are not considered to have a high ability to promote platform adoption.

7.1.3 Categories of boundary resources.

In this section, the local weights of the categories of BRs are evaluated. These categories are ABRs, DBRs and SBRs. The local weights of these values are later used to calculate the global weights of the individual boundary resources. The results have been presented in table 7.4.

ABRs have been selected as most important by survey respondents. This is supported by the finding in the previous section, indicating that ABRs have been selected often as most important. DBRs have been selected as second most important, which is also supported by the results in table 7.3. SBRs have been selected as least important.

	ABRs	DBRs	SBRs	ξ^L
Mean	49%	29%	22%	0,0985
Median	0,4866	0,3675	0,1459	0,1428

Table 7.2: an overview of the results of the BWM – category weight.

7.1.4 Application BRs– local weights

In this section, the local weights of the ABRs are evaluated. There are five categories of BRs that are considered. These categories are REST APIs, Product Complementarity APIs, Database Libraries, IAM APIs and Medical Data Standardization APIs. As there are five boundary resources, in case of equal weights, the weight should be 0,20. An upward deviation from this value suggests a relative higher ability to promote platform adoption. A downward deviation from this value suggests a relative lower ability to promote platform adoption.

	REST APIs	Standard Application APIs	Database Libraries	IAM APIs	Medical Data Standardization	ξ^L
Average local weights	19%	15%	20%	20%	26%	14%
Median	0,1329	0,1219	0,1639	0,1596	0,2032	0,1355

Table 7.3: an overview of the results of the BWM – ABRs

The discussed results are presented in table 7.4. The Data Standardization APIs (0,26) has been evaluated provided with the highest score. A shared second place is assigned to Database Libraries and IAM API (0,20), having a similar local mean weight. REST APIs (0,19) have been selected third most often. Product Complementarity APIs (0,15). The relative difference of weights between the highest-scoring boundary resource and the lowest boundary resource is 0,11. The consistency value is 0,14 and thereby presents a moderate consistency of answers.

7.1.5 Development BRs– local weights

In this section, the local weights of the DBRs are evaluated. There are five categories of BRs that are considered. These categories are SDK, Test Environment, App Store, DevOps Tools and Model-Driven Development. As there are five boundary resources, the BRs should all have a value 0,20 in case of similar weight. An upward deviation from this value suggests they are the relative weight and a downward deviation from this value suggests relative weight.

	SDK	Test Environment	App Store	DevOps Tools	Model-Driven Development	ξ^L
Mean	29%	17%	19%	22%	13%	14%
Median	0,1887	0,1538	0,1478	0,1491	0,1277	0,1452

Table 7.4: an overview of the results of the BWM – DBRs

The discussed results are presented in table 7.5. The SDK (0,29) has been evaluated as the most important boundary resource. DevOps Tools (0,22) are considered as the second most important boundary resource. The App Store (0,19) is the third most important. The least important boundary resource is Model-Driven Development (0,13). The SDK clearly scores higher than the rest and Model-Driven Development clearly scores lower than the rest. The consistency value is 0,14 and thereby presents a moderate consistency of provided responses.

7.1.6 Social BRs– local weights

In this section, the local weights of the SBRs are evaluated. There are five categories of BRs that are considered. These categories are Terms and Conditions, a License Agreement, a Developers Portal, Training & Workshops, Events and Medical data standardization agreement as a communications protocol for medical data. As there are six boundary resources, the BRs should all have a value 0,167 in case of similar weight.

	Terms and Conditions	License Agreement	Developers portal	Trainings and Workshops	Events	Data sharing Standardization Agreement	ξL
Mean	27%	14%	12%	11%	12%	24%	14%
Median	0,3214	0,1339	0,1091	0,1161	0,1071	0,1774	0,1376

Table 7.5: an overview of the results of the BWM – SBRs

The discussed results are presented in table 7.6. The Terms and Conditions (0,27) have been evaluated as the most important boundary resource. The Data Sharing Standardization Agreement (0,24) has been selected as the second most important boundary resource. A License Agreement (0,14). The Developers portal (0,12), events (0,12) and trainings & workshops (0,11) relatively score the lower. Terms and Conditions and the Data sharing Standardization Agreement are clear outliers in this, both scoring significantly higher than the rest. The consistency value is 0,14 and thereby presents a moderate consistency of answers. As the threshold for this value is at 0,25, the responses can be determined to be valid.

7.1.7 BRs- Global weights

The mean global weights of the BRs are obtained by multiplying the mean local weights of the categories and the mean local weights of the BRs to which they belong. These global weights have been calculated for every respondent to the global weight that correspondents to their results of the BWM review. The global weights allow for the comparison of all factors from the perspective of the decision-maker. Has been done for the global weights, the standard deviation, and the median values for these have been calculated. The global weights are shown in table 7.7.

of the global weights for individual respondents have been displayed in Appendix D. As 16 BRs are compared, the mean value of the boundary resource should be 0,0625 in case no relative ability to motivate platform adoption exists.

Category	Category Weights	Boundary Resource	Mean Local Weight	Mean Global Weight	Rank
Application Boundary	0,4631	REST	0,1901	0,0770	6
		Product complementarity APIs	0,1494	0,0605	10
		Database Libraries	0,2045	0,0829	3
		IAM	0,1976	0,0801	4
		Medical data standardization API	0,2584	0,1048	1
Development Boundary Resources	0,3021	SDK	0,2850	0,1024	2
		Test Environment	0,1176	0,0621	9
		App Store	0,1765	0,0695	7
		DevOps	0,2171	0,0795	5
		Model-Driven Development	0,1340	0,0486	12
SBRs	0,2348	Terms and Conditions	0,2701	0,0631	8
		License Agreement	0,1392	0,0330	13
		Developers' portal	0,1184	0,0269	15
		Trainings & Workshops	0,1107	0,0257	16
		Events	0,1240	0,0288	14
		Medical data standardization Agreement	0,2376	0,0554	11

Table 7.6: *an overview of the results of the BWM – Global mean weights of BRs*

The global weights of the BRs show that strong effect caused by the evaluation of the category of ABRs. This high evaluation has caused high weights to emerge for all ABRs. The best scoring BR is the Data Standardization API (0,1197). These are followed by Database Libraries (0,0947), IAM APIs (0,0915) and REST APIs (0,0880). Of the ABRs product complementarity APIs score worst. Of the DBRs SDKs score best (0,0845). The App Store (0,0580) and DevOp Tools (0,0663) have a relatively average score. The test environment (0,0518) and Model Driven Development (0,0405) score lowest. For the SBRs, Terms and Conditions (0,0636) and the Data Standardization agreement (0,0559) score relatively similar. License agreement (0,0332), Developers Portal (0,0271), Trainings and Workshops (0,0259) and Events (0,0291) score relatively the lowest.

The impact of the local weights of the categories can be observed in the results. The lower local mean weight of the DBRs and SBRs causes them to be lower in global weight. The standard deviation for some the BRs is quite large. For the analysis of the local boundary resources, the standard deviations have been identified to vary depending on the presence of either one peak or two peaks in the distribution of mean local weights. The peak was caused when a single boundary resource was relatively favored and disfavored by two groups of respondents.

7.2 Comparing high and low installed base companies

The sample can be split up into groups that could subsequently be compared. This process of grouping has been elaborated upon in section 3.3.2. In this section, the results for the different groups are presented. Table 7.8. lists the obtained results.

Class		LOW IB	HIGH IB
	N	22	9
ABRs	REST	0.0816	0.0708
	Product complementarity APIs	0.0484	0.0691
	Database Libraries	0.0834	0.1012
	IAM	0.0938	0.0598
	Medical data standardization API	0.0980	0.1045
DBRs	SDK	0.0846	0.1272
	Test Environment	0.0809	0.0568
	App Store	0.0600	0.0620
	DevOps	0.0806	0.0722
	Model-Driven Development	0.0558	0.0462
SBRs	Terms and Conditions	0.0630	0.0635
	License Agreement	0.0209	0.0394
	Developers' portal	0.0208	0.0276
	Trainings & Workshops	0.0276	0.0263
	Events	0.0368	0.0240
	Medical data standardization Agreement	0.0637	0.0520

Table 7.7: an overview of the mean global weights for groups having high and low IBs

For this analysis, only the mean global weights will be discussed. The first noticeable finding is that despite the differentiation, a there is a remarkably similar trend visible with respect to the evaluation of global weights based on the IB. ABR's and DBR's are relatively more important than SBR's for both groups.

As explained in section x, a Kruskal-Wallis test is performed in order to determine whether there is a significant difference between both groups. The p-value is .80647, meaning that the result is not significant at $p < .05$. This means that the null hypothesis can be rejected. This in return means that there is no significant different difference between the selected samples. Consequently, the results suggests that there is not a difference between companies with a high IB and a low IB. The results of the Kruskal-Wallis test are provided in appendix G.

8 Conclusion and Discussion

IS in Dutch first-line healthcare aims to transition to more collaborative care and treatment of chronic patients. This requires an efficiently operating supporting IS architecture that is able to support this transition. However, the current IS architecture is not efficient or interoperable, and innovations are adopted slowly. Consequently, increasing the innovative capability of the domain helps to stimulate the development solutions that could solve these issues.

This thesis is based on the premise that Digital platforms could be introduced in order to stimulate collaborative innovation. However, a digital platform requires BRs to balance simultaneous control and generativity on the platform. As there was limited ex ante research available on BRs in the healthcare application domain of Dutch first-line care, a lack of understanding of required BRs was missing. This led to the following main research question:

What boundary resources increase IS suppliers in Dutch first-line care intention to participate with development and operation of applications on a digital platform?

In this section it is reviewed how 31 industry experts have evaluated the relative ability of a boundary resource to increase the intention to adopt a platform. This was measured, as an increase in platform adoption would spark innovation on a digital platform (Boudreau, 2010; Benlian, et al., 2015), Karhu, et al., 2018; Parker & Van Astyne, 2018). An increase in the landscape of Dutch first-line healthcare is required, in order to be able to cope with the transitions that the system is faced with.

The relevance of BRs was determined with a MCDA using the BWM of Dr. Jafar Razei (2015). This method was extended by using the wisdom of the crowd concept (Surowiecki, 2005). Industry experts were considered potential platform complementors for a digital platform for IS systems in Dutch first-line healthcare. Their willingness to adopt specific kinds of BRs is evaluated. This BRs were retrieved through a systematic literature research and research of the application domain. The results of the global weights were presented in chapter 7.

The discussion section is formulated as follows: first, the results of the global weights of the research will be evaluated. Additionally, the results of the different groups of respondents will be discussed. Furthermore, limitations will be discussed that affect the validity of the results and the method. Finally, based on the analysis of the results, recommendations for future research will be made. Also, recommendations to the application domain will be provided. This chapter concludes with an elaboration on the relevance of this literature in respect to the Complex System Engineering and Management program at the Delft University of Technology.

8.1 Discussion of the Results

8.1.1 Research question 4 – Global weights of boundary resources

The fourth research question was formulated as follows: *What is the relative ability of boundary resources to motivate platform adoption of IS Suppliers for a digital platform in Dutch first-line care?*

In this section, the global mean weights of the BRs will be interpreted. Additionally, the spread of the weights is considered. To increase readability, not all BRs will be considered in full detail. Additionally, it should be noted that the scores for the global weights are greatly affected by the scores that are assigned to the categories of boundary resources, as these function as a multiplication factor of the local weights. Hence, a low local weight can be compensated for by a high local weight for the category and vice versa. Therefore, the local weights will be taken into consideration as well. Finally, it should be noted that the results are a product of the collective expert opinion that participated in the survey. It should therefore be understood that the results reflect their collective view on these boundary resources.

The data standardization API (0,105) and Database Libraries (0,083) have scored the highest and third highest all boundary resources according to respondents. Database libraries access medical data whereas the data standardization API allows for documentation of data according to standardized formats. It is not surprising that these kinds of BRs have high weigts. The benefits of information system integration have been widely argued for in academic literature, as this is an important issue the current system faces (Alshawi, et al., 2003; Bahga & Madesetti, 2015; Jayaratne, et al., (2019). This is further supported by the rise of DHIS2, which an open-source data analytics system for healthcare purposes (Bender, 2020; Russpatrick, 2020; Msiska, et al, 2019, Petrik & Herzwurm, 2019; Petrik & Herzwurm, 2020). Also, in Dutch first-line healthcare, these issues are recognized. Here, data standardization is seen as a vital step in order to prepare for future healthcare challenges (de Kleijn & van Poelgeest, 2015; NISiz, 2021; IS&Health, 2021). This finding contradicts the findings of van Hattum (2020), who found that “stable” BRs rather than “industry-standard” BRs were required as experts feared the establishment of such interfaces would be hindered through political dynamics, hence decreasing innovation (van Hattum, 2020, p,76). Perhaps, this could be explained by the fact that this dynamic was not considered by the experts. Conclusively, an API for data standardization and database libraries are considered to be very important to motivate complementor adoption. For similar reasons the data standardization *agreement* is expected to have a relatively high score for an SBR (0,0558).

The second most important BR is the SDK (0,1024), considered by the industry experts. However, it is considered as the most important DBR. The facts that the SDK is considered important is not surprising. The SDK is offered by numerous established platforms, among which Apple and Android (Eaton et al., 2015; Karhu et al., (2018). The reason that the SDK is popular, is that it provides an all-in-one solution to develop software for a digital platform (Eaton et al., 2015). The generativity - and consequently – the innovative capability of a platform can be greatly increased

when platform complementors are resourced by a tool that allows them to greatly reduce the time spent to develop new software. Consequently, hyper competitive markets can be created (Boudreau, 2010; Bender, 2020; Parker & Van Astyne, 2018). Therefore, in healthcare application DHIS2 SDK have been popularized as well (Msiska, 2019). It should however be mentioned that satisfaction of a BR is dependent on the maturity of the SDK (Petrik & Herzwurm, 2019). However, reaching maturity is not straightforward, which should be taken into consideration through development (Archer et al. 2016). All-in-all will an SDK serve as a good method to promote platform adoption by platform complementors.

The fourth most important BRs is the IAM API (0,0801) according to the industry experts. IAM is a method that allows for authorized access of software, by properly identifying the person that tries to access the software. This BR has been retrieved through research of the application domain. Therefore, it is not considered as a surprise that platform complementors score this boundary resource highly. Sharing of medical data is problematic in Dutch healthcare, as it falls under GDPR regulation. Therefore, in other to comply with GDPR authorization is required (Kammueller, 2018; Fatehi, 2020). Failure to comply with GDPR has caused the Dutch National Program for centralizing Electronic Healthcare Records storage to fail (Eerstekamer.nl, 2011; van Dorresteijn, 2011). Therefore, it is imaginable the platform complementors consider this as very important BR to motivate complementor adoption.

Industry experts that filled in the survey REST API's (0,771) and Product Complementarity APIs (0,801) consider as the sixth and tenth most important BRs are most important BRs are. These are grouped, as they are the lowest scoring ABRs. The relatively high score of these BRs is mainly explained by the high score of ABRs in general, as within this category, these BRs score much lower. The reason platform complementor less prefer these ABRs might be because they do not as much present solutions to current critical issues in Dutch Healthcare as the other ABRs do. This is supported by the fact that REST APIs and Product Complementarity APIs have been identified in case studies that were non-healthcare specific (Fink, et al., 2020; Eaton et al., 2015; Petrik & Herzwum, 2019; Vesselkov, et al., 2019). Therefore, these BRs might be important in a later stage, when the previously mentioned BRs have been provided. Then they might slightly promote complementor adoption.

DevOps Tools are considered the fifth important BR (0,0795) and second most important DBR, according to the experts that filled in the survey. DevOps tools provide tools that are used for the development and operation of software. Usually, a form of agile product is integrated in these kinds of software. Also, they are based on a continuous development cycle. The reason that DevOps tools are considered as relatively important DBRs is quite surprising. This is because in other platform cases, the DevOps was not used very often (Petrik & Herzwurm, 2019: Petrik & Herzwerm, 2020). Although, it was stated that complementors had a relatively high satisfaction for DevOps as well (Petrik & Herzwurm, 2020). Therefore, DevOps will not be very useful to

motivate platform participation, which is not surprising for a digital platform in Dutch first-line healthcare.

The App Store scores has an average overall score and for a DBR (0,0695), according to the experts that filled in the survey. This is quite surprising. App Stores are required for redistribution of application software by providing: *"a catalogue through which application can be browsed, facilitating transactions and offer an institutional infrastructure for application distribution"* (Bender, 2020, p. 519). Therefore, through these mechanisms, complementors are brough into contact with platform end-users and hence ensure reallocation of value. App Stores are applied with within the iOS and Android domain and are beneficial in markets of hyper competition (Bender, 2020). This might explain the relatively average ability to promote platform complementor adoption, as for IS in Healthcare, the market is much less volatile and not hyper competitive. For another study, the app store was therefore also considered more as a "commodity" (Petrik & Herzwurm, 2020, p. 10). This could, explain the relatively average ability to promote platform adoption.

Terms and Conditions are considered as a moderately important BR, but a very important SBR (0,06306), according to the experts that filled in the survey. Terms and Conditions comprise of all the types of documents that are offered by the platform owner in order to ensure control of platform complementors. Control is an essential characteristic of a digital platform, which has to be balanced with openness in order to allow generativity and hence innovation to occur (Boudreau, 2010; Ghazawneh & Henfridsson, 2013; Tiwana, 2010), Therefore, it has been considered in in many case studies as a relevant BR (Bonina, et al., 2020; Dal Bianco, et al., 2014; Eaton, et al., 2015; Karhu, et al., 2018). Although complementors should in theory not prefer control measures (Boudreau, 2019; Tiwana, 2014), in practice this preference could be explained by the research of van Hattums, et al., (2020). It was that complementors preferred "*selectively open interfaces"* (P.76). Therefore, platform complementors expect a governance structure in place, order to protect their IPR.

A testing environment scores low for a DBR (0,06205), according to the experts that filled in the survey. A testing environment is an environment that consists of multiple facets to test the workings of an application. These can consist of test-datasets containing fake yet representative data, debugging tools and or a compatibility test suite. Android and Apple, both have their respective test environments in place (Eaton, et al., 2015; Karhu, et al., 2018). These barriers are put in place so that platform owners enforce their control measures in order ensure quality application on in on their platform. As the volume of applications for both platforms is so high, such measures are required. The reason that a testing environment might less promote platform adoption, is because IS Suppliers operate in a domain where quality measures are already very high (Islind, et al., 2019; Faginni, et al., 2018). Therefore, providing extra testing measures might seem redundant.

Model-Driven Development scores relatively low (0,04858), according to the experts that filled in the survey. This result is rather surprising, as MDD is a method that could greatly increase the level in which the software is produced. However, the dynamic that might be at play, is that current developers are already capable of develop software (Hailpern & Tarr, 2006; Petrik & Herzwurm, 2020; Vallecillo, 2015). This is supported by the following statement: "complementors do not appreciate the MDD support since they know how to code and do not require this BR" (Petrik & Herzurm, 2020, p.10). Therefore, MDD is not a highly viable option to promote complementor adoption. Another reason for the low score is that platfrom complementors in the sample have already developed IS software. However, MDD up to now is not a popular design language, as it is very deifferent from conventional programming languages. As there is great cost involved in switching the from regular coding to MDD, as development pipelines have to be built and programmers have to be reeducated or rehired, managers might be hesitant to make this switch.

A license agreement (0,0395) is one of the lowers scoring BRs according to the experts. Therefore, license agreements are relatively unlikely the motivate platform adoption. The reason for this not surprising as licenses are discussed as open-source licensing (Karhu, et al., 2018). As has been mentioned in the introduction, IS suppliers are reluctant to commit to fully being open as this allows their installed base to potentially leave. Furthermore, perhaps the perceived utility of a license agreement is experienced as low, because in the case IS Suppliers would like to make their IPR accessible, the IS Suppliers can do this on their own accord. Therefore, a license agreement provided by the platform owner is not needed.

The Developers Portal (0,02685), Trainings & Workshops (0,2572) and Events (0,02880), are the lowest scoring BRs. These BRs are grouped because they allow for similar functionality, which is to provide engagement among platform complementors and platform end-users and ensure flow of information across them. It is hard to understand how these SBRs score so low, as these BRs are relevant for an open platform. Interaction of stakeholders on the platform increases network effects and therefore overall value of the platform (De Reuver, et al., 2018). It should be further research how this low score was achieved.

8.1.2 Comparison of low and high IB

This section discusses the results that are provided in section 7.2. In this discussion, a comparison was made between organizations with a high installed base and companies with a low perceived installed base. It was extraordinary to find that the findings that were obtained are remarkably similar, as it was expected that based on the installed base organization would have varying interests. This is supported by the Kruskal-Willes test, that showed that the results showed no significant difference when comparing companies with a high installed base and a low installed base.

This result is surprising, given the different needs of companies with high IBs and low IBs. First, was for instance expected that industry experts from organization with lower IBs would prefer

DBRs in general, as their developmental pipelines are less established, and would therefore experience greater benefit from these kinds of BRs. Second, it was expected that companies with a high IB would more reject data management BRs, such as database libraries and data standardization API's. This is because these companies fail to standardize their data sharing protocols and open up, which on the contrary these BRs support. Third, it was expected for instance that IAM would be more preferred by experts of organizations with a high IB, as these companies Although on a local level the global weights could be compared which each other, the Kruskal-Wallis test has shown that these could not be compared. Therefore, these will not be made.

8.2 Main research question

The main research question fort his thesis was formulated as follows:

What boundary resources best affect IS suppliers in Dutch first-line care to participate with on a digital platform to enhance innovation?

ABRs and DBRs are considered to have the greatest effect to increase intention of industry experts to participate on a digital platform in Dutch first line healthcare. SBR are considered to have the lowest effect. Therefore, it can be concluded that IS suppliers are mainly interested in innovations of their own making and are less interested in working together. Data standardization API's and database libraries should be considered, as the consulted industry experts consider these BRs provide solutions to problem that IS Suppliers currently face. SDKs and DevOps and should be considered, as these reduce time to market. Terms and conditions should be considered as the consulted industry experts consider these allow for proper governance on the platform. REST APIs and Product Complementarily APIs are also considered to have a high ability to promote platform adoption, however, they should be considered in a later developmental stage of the platform, as BRs issues that are of lesser importance.

8.3 Limitations

8.3.1 Reliability

The reliability of this study can be evaluated through the consistency factors that were obtained through the BWM measurements. Fortunately, the selected consistency factor of 0,25 allowed for no exclusions of results. However, this aspect shows a weakness in the results. The setting of the threshold value can greatly affect the outcome of the results, as the threshold determines what results are included and excluded. Literature currently does not report verified threshold values for linear BWM application in which the BWM solver (provided by Rezaei on bestworstmethod.com). This is important to consider, as because of this, threshold value specification becomes a fuzzy business that is difficult to substantiate. For this research, the value of 0,25 was selected as it was published in de Priëlle (2019) that used similar methodology. This work was a master thesis that was co-authored by Rezeai, who is the developer of the method. This threshold value was therefore considered viable. Using this threshold value, all measurements were considered consistent.

8.3.2 Conceptual model

This study focused on identifying It is hereby discussed *what* BRs are required. However, in ex-ante research, it should not only be considered *what* is required but *how* it is required. This sort if research is supported by Petrik and Herzwurm (2020). In their research, respondents often related the usability of a platform to its usefulness. Therefore, specific *tuning* of BRs should be taken into consideration in future research (Mohagheghzadeh & Rudmark, 2017; Islind et al., 2015; Eaton et al., 2015).

This study did not incorporate adopt technology adoption literature into the conceptual framework of this thesis. This literature would have been useful to future derive the rationale for favoring specific type of boundary resource. For instance, the TOE method could have been applied, as this method takes into consideration. Additionally, the TAM model could have been used, where a difference could have been made between the perceived usefulness (illustrated by the functionality of the boundary resource) and the perceived ease of use.

8.3.3 Methodology

This research was conducted using linear BWM. Although BWM is a reliable and time efficient method to conduct MCDA (Razaei, 2015; Razaei, 2016), it provides the researcher with no ability to expand on the answers that are provided by the expert. Therefore, it is more difficult the understand the underlying reasoning of a respondent. Therefore, the only way the researcher can make sense of the results is by relating the findings to literature. Alternatively, a mixed research method could be used. Here both a qualitative and quantitative method could be implemented (Venkatesh et al., 2013). The quantitative method is used to observe the relative importance of boundary resources. The qualitative method could have been used to confirm or expand on the findings that are obtained through the BWM (Venkatesh et al., 2013). This could have been achieved through interviews of the respondents.

8.3.4 Survey

The survey has been conducted using a Google Forms, as recommended by researchub.com (2021). The advantage of using this as a survey tool for this method is that it allows to provide a structured and guided process to provide answers. However, this tool makes it more difficult to conduct pairwise comparisons, because the UI does not change based on the input for the “worst” or “best” criteria. Therefore, it becomes more difficult to assign scales, as respondents have to remember what alternative they have selected as best or worst. Although respondents have been well informed on procedure of the survey, four responses from experts were collected stating that the survey was too difficult to complete. Two of these respondents have been contacted to further elaborate. These conversations have been provided in Appendix F. In hindsight, literature supports the notion of not using survey as method for BWM, which is recommended to abide by in future research.

8.3.5 Experts

31 respondents have been categorized as industry experts and thereby supported this study reliably. However, far more organizations have been approached in order to participate in this research. Therefore, the response for the survey could have been higher. The expected reason for the lower participation is that during the writing of this thesis COVID-19 was affecting society. Therefore, organizations in healthcare had to focus more on developing COVID-related solutions. Additionally, this statement is supported as most responses came from experts that were contacted directly, rather than indirectly.

8.3.6 Reproducibility and Understandability

The outcome of the results is highly dependent on the understandability of respondents to understand the concepts. When they clearly understand the concepts, the relative weights that are assigned to the individual BRs locally will more closely resemble the ability of BRs to increase the intention of an expert to join the platform. However, when understandability decreases, biases are introduced that increase the mismatch between the relative weights and the ability to increase intention to participate on the platform.

There are concerns that could be raised with respect to these issues:

- There was a small amount, yet clear signs from respondents that the survey was too difficult to complete. Two of these respondents have been contacted. The summary of these conversations has been listed in appendix G. The conversations provide indications that knowledgeability of these experts was too low.
- The concepts of digital platforms are inherently ambiguous, due to their complex nature. As platforms in common language are used for a variety of architectures that in different measures resemble an actual digital platform, it is difficult for industry experts.

Consequently, it is unclear how understandability of concepts has affected these results. Therefore, is not certain that a similar research approach will produce similar results. In future research, the definitions of the BRs should be explained more extensively or the criteria for industry experts should be made stricter. Additionally, interviews could be conducted rather than surveys, as with interviews there is more time to provide context on the research subject.

8.4 Contributions

8.4.1 Contributions for Academics

By studying this research in relation to the application domain of Dutch first-line healthcare, this thesis addresses the issue mentioned by De Reuver et al. (2018) and Bygstad and Øvrelid, (2020). This is achieved by the research of the application domain of Dutch first-line care. Thereby, dynamics were exposed that were relevant to consider for a digital platform in this application domain. Dynamics could be translated to BRs that are specifically relevant for a digital platform in Dutch first-healthcare.

This study has revealed a total of 130 that could be categorized to 16 different types and categorized according to the model of Dal Bianco, et al., (2014). Thereby it consolidated all practically applied BRs that were identifiable in research published in the database of Scopus. To the understanding of the researcher, this has not been attempted before. This list of BRs could be used for future studies on digital platform related for structuring purposes. Additionally, these findings can be used to gain a better understanding on digital platforms

This thesis specially has specifically focused on how openness influences participation on a platform, as participation is required in order to increase the network effects of a platform. Yoo, et al., (2010) calls for research for the roles of boundary resources within a strategic context. This this will be able to address this research topic, as promoting innovation through boundary resources is the strategic goal of the platform that is discussed in this thesis. The overview of boundary resources that are presented should therefore be considered for future research.

8.5 Future recommendations

8.5.1 Future Recommendations for Academics

On the short term, a recommendation to future research would be to conduct research were the quantitative and qualitative methods are combined to provide more in-depth findings of the results that are obtained. When this research is conducted, differentiation or focus could take place among specific organizations that could act as complementors for a digital platform in Dutch first-line care. Also, the perspective of the platform owner could be considered. Thereby, the results that have been obtained in this research could be further interpreted.

The results of the relative weights of the BRs also provide a contribution. As discussed in section 1.5 and 2.3, platform openness should be understood as a degree to which a platform can be open. Consequently, BRs can be designed to allow for a certain degree for openness, which is described as *tuning* of BRs (Lindroth et al., 2016; Rudmark, & Ghazawneh, 2010; Ghazawneh & Henfridsson, 2013). Therefore, the BRS that are reviewed should be studied in more depth for the purpose of design research on digital platforms in Dutch first-line healthcare. This thesis support scholars by providing a prioritization of BRs that are considered most likely to affect complementor participation

8.5.2 Contributions for managers

This thesis has discussed digital platforms as a method to increase innovation of IS software in Dutch first-line healthcare, as promoting innovation helps to solve issues that are currently facing the Dutch society in respect to healthcare. In order to ensure that a digital platform evolves into an innovation promoting architecture, participation of IS Suppliers in the Dutch first-line healthcare Domain is required. In order to ensure participation managers coordinating the design, development and operation of a platform can focus their attention towards increasing the status

quo of boundary resources, as these are able to provide valuable resources to IS Suppliers to enhance the value of their software.

This research provides a contribution to managers current attempts their design attempts. First a list is provided of all BRs that a manager in Dutch first-line healthcare has at their disposal. Thereby, overview is created, which allows for a more efficient design process of a digital platform, thereby decreasing the amount of time required for the design process. Additionally, the overview of BRs for a digital platform is rank ordered base on the expert opinion. The criteria for rank ordering are the ability to promote platform adoption. Thereby, not only an overview is created. Managers can now also consider BRs that they control and focus their design efforts on these specific boundary resources. Thereby, the design process happens more efficiently, it also becomes more effective, as attention is spent on the right topics.

8.5.3 Future Recommendations for managers

Based on this thesis, a number of recommendations can be made for managers governing design, development and operation of software for future digital platforms in Dutch first-line healthcare

Managers can consider the values of the global weights to prioritize boundary resources. Here, it can be seen that managers should provide APIs that allow for access of medical data and information that is document according to standardized protocols. This can be achieved by implementing database libraries and an API that allows for standardized formatting of medical data. However, this thesis has shown that such indicatives already exist through the implementation of the MEDMIJ standard. Next, IAM APIs are important as they allow for authorized access of medical data, thereby making it easier to comply with GDPR regulation.

Platform complementors especially with a lower IB are motivated by solutions that reduce time to market. These are DevOps tools and SDKs. However, in case of the SDK, its maturity is considered important. Therefore, the SDK of DHIS2 open-source software for governance and analysis of medical data could be considered. DHIS2 is based on the same data format principle of MEDMIJ, named FHIR.

Finally, although terms and conditions did not have a high global weight yet have been scored a as an SBR. As terms and conditions are BRs used for controlling the platform, IS Suppliers show that they are motivated by having a proper governance structure in place. This governance structure will determine among others determine the degree of access openness on the platform, thereby determining to what degree IS Suppliers can use, exploit and alter platform resources. These terms and conditions should be designed that they allow for a "*selectively open*" platform BRs (van Hattum, 2020). It is recommended that terms and conditions are developed with selective openness. In these terms and conditions, it should be governed how open the other BRs are as well.

Managers should not consider APIs for product complementarity, an app store, MDD, a test environment licenses, workshops and training, events, and a developer's portal. According to this research, industry experts are currently not motivated by these BRs to promote platform adoption. However, as a digital platform evolve over time, dynamics and requirements can change. Therefore, managers should reevaluate the ability of these BRs to motivate adoption after maturity on higher scoring BRs have been reached, as IS Suppliers might develop new requirements over time.

8.6 Relevance to the CoSEM master program

The master program of Complex Systems Engineering and Management educates students on designing interventions in complex socio-technical systems. A digital platform is a complex socio-technical system. A complex socio-technical system consists of a multitude of stakeholders where institutional artifacts and technical artifacts interact to govern its operation. A socio-technical system has many attributes such as emergence, adaptiveness and unpredictability. Consequently, these attributes imply a great difficulty to engineer, manage and control such a system. This thesis is a CoSEM thesis, as it deals with complexity with a digital platform in the application domain of first-line healthcare.

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10 Appendices

10.1 Appendix A: Literature used for literature research

This appendix shows the literature obtained for the literature review in section 1.5.

Title	Authors	Year published	Source
Fostering Value Creation with Digital Platforms: A Unified Theory of the Application Programming Interface Design	Wulf, J., Blohm, I.	2020	Scopus
Collaborative innovation in Healthcare: BRsfor peripheral actors	Aanestad, M., Vassilakopoulou, P., Øvrelid, E.	2020	Scopus
The influence of digital affordances and generativity on digital platform leadership	Hein, A., Setzke, D.S., Hermes, S., Weking, J.	2020	Scopus
Slicing the cake without baking it: Opportunistic platform entry strategies in digital markets	Karhu, K., Ritala, P.	2020	Scopus
Exploiting and defending open digital platforms with boundary resources: Android's five platform forks	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	Scopus
Accelerated tuning of platform boundary resources	Mohagheghzadeh, A., Rudmark, D.	2017	Scopus
Transforming organizational resource into platform boundary resources	Mohagheghzadeh, A., Svahn, F.	2016	Scopus
Co-creation and fine-tuning of BRsin small-scale platformization	Islind, A.S., Lindroth, T., Snis, U.L., Sørensen, C.	2016	Scopus
Third-party development for multi-contextual services: On the mechanisms of control	Rudmark, D., Ghazawneh, A.	2011	Scopus
Governing third-party development through platform boundary resources	Ghazawneh, A., Henfridsson, O.	2010	Scopus
Digital platform ecosystems	Hein, Andreas; Schreieck, Maximilian; Riasanow, Tobias; et al.	2020	Web of Knowledge
Coherence or flexibility? The paradox of change for developers' digital innovation trajectory on open platforms	Brunswicker, Sabine; Schecter, Aaron	2019	Web of Knowledge
Configurations of platform organizations: Implications for complementor engagement	Saadatmand, Fatemeh; Lindgren, Rikard; Schultze, Ulrike	2019	Web of Knowledge
Value co-creation practices in business-to-business platform ecosystems	Hein, Andreas; Weking, Joerg; Schreieck, Maximilian; et al.	2019	Web of Knowledge
Leveraging Digital Health Platforms in Developing Countries: The Role of Boundary Resources	Msiska, Brown; Nielsen, Petter; Kaasboll, Jens	2018	Web of Knowledge
Effectiveness of control mechanisms in mobile platform ecosystem	Mukhopadhyay, Sandip; De Reuver Mark; Bouwman, Harry	2016	Web of Knowledge
Shifting Design Capability to Third-Party Developers: An Affordance Perspective on Platform Boundary Resources	Mohagheghzadeh, Amir; Svahn, Fredrik	2016	Web of Knowledge
Architectural alignment of process innovation and digital infrastructure in a high-tech hospital	Bygstad, B., Øvrelid, E.	2020	Web of Knowledge

Table A.1: Literature used to identify the scientific research gap.

10.2 Appendix B: Complete overview of identified boundary resources

The following table presents a complete overview of BRs that have been identified through literature research.

Article ID	Title	Authors	Year published	Source
1	Collaborative innovation in healthcare: BRsfor peripheral actors	Aanestad, M., Vassilakopoulou, P., Øvrelid, E.	2020	Scopus
2	Co-creating platform governance models using boundary resources: A case study from dementia care services	Farshchian, B.A., Thomassen, H.E.	2020	Scopus
3	Leveraging digital health platforms in developing countries: the role of boundary resources	Msiska, B., Nielsen, P., Kaasboll, J.	2019	Scopus
4	*Design and governance of mhealth data sharing*	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	Scopus
5	The Impact of Integration on Application Success and Customer Satisfaction in Mobile Device Platforms	Bender, B.	2020	Scopus
6	The ownership of digital infrastructure: Exploring the deployment of software libraries in a digital innovation cluster	Fink, L., Shao, J., Lichtenstein, Y., Haefliger, S.	2020	Scopus
7	Cultivating open government data platform ecosystems through governance: Lessons from Buenos Aires, Mexico City and Montevideo	Bonina, C., Eaton, B.	2020	Scopus
8	Fostering Value Creation with Digital Platforms: A Unified Theory of the Application Programming Interface Design	Wulf, J., Blohm, I.	2020	Scopus
9	Complementor satisfaction with BRsin iiot ecosystems	Petrik, D., Herzwurm, G.	2020	Scopus
10	Understanding Platform Ecosystems for Development: Enabling Innovation in Digital Global Public Goods Software Platforms	Russpatrick, S.	2020	Scopus
11	IIoT ecosystem development through boundary resources: A siemens mind sphere case study	Petrik, D., Herzwurm, G.	2019	Scopus
12	Knowledge boundaries in enterprise software platform development: Antecedents and consequences for platform governance	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	Scopus
13	Exploiting and defending open digital platforms with boundary resources: Android's five platform forks	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	Scopus
14	Co-creation and fine-tuning of BRsin small-scale platformizationOpen Access	Islind, A.S., Lindroth, T., Snis, U.L., Sørensen, C.	2016	Scopus
15	Distributed tuning of boundary resources: The case of Apple's iOS service systemOpen Access	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	Scopus
16	Service Innovation through Application Programming Interfaces - Towards a Typology of Service Designs	Wulf, J., Blohm, I.	2018	Scopus
17	The role of platform BRsin software ecosystems: A case study	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	Scopus

Table B.1: an overview of literature used for identification of BRs.

Article ID	BR ID	Authors	Year Published	Page nr.	BR	BR Type
4	26	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	19	API REST	REST API
16	142	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	REST API	REST API
14	123	Islind, A.S., Lindroth, T., Snis, U.L., Sørensen, C.	2016	9	RESTful API	REST API
15	133	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	HTML5 (No change)	REST API
16	143	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	External Worker API	REST API
16	150	Sulaiman Etamesor, Chibuzo Ottih, Ismail Ndalami Salihu, Arnold Ikedichi Okpani	2018	2	Standards: tranSMART, HL7, DICOM, IHE, HL7 FHIR, AQL7, SMART, ANALYTICS, ICD-10, LOINC, SNOMED, CT, FHIR, CTS2,	Data standardization API
4	25	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	19	API data formats: XML, GPX, TCX and FIT	Data standardization API
10	67	Russpatrick, S.	2020	6	DHIS2	Data standardization API
5	33	Bender, B.	2020	522	Cross-platform availability (CPA)	Data standardization API
5	31	Bender, B.	2020	522	Platform Application Integration (PAI)*	Data standardization API
5	29	Bender, B.	2020	522	Data integration (DI)*	Database libraries
5	27	Bender, B.	2020	522	Device Ecosystem Integration (DEI)	Database libraries
4	24	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	18	API data access	Database libraries
9	53	Petrik, D., Herzwurm, G.	2020	5	Connectivity Libraries	Database libraries
9	54	Petrik, D., Herzwurm, G.	2020	5	Supporting Mutliple open machine protocols	Database libraries
11	73	Petrik, D., Herzwurm, G.	2019	4	Connectivity Libraries	Database libraries
10	69	Russpatrick, S.	2020	6	DHIS2 Data Import Wizard –	Database libraries
10	70	Russpatrick, S.	2020	6	DHIS2 Web Excel Importer	Database libraries
16	141	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	API and libraries	Database libraries
11	74	Petrik, D., Herzwurm, G.	2019	4	Supporting Mutliple open machine protocols	Database libraries
11	75	Petrik, D., Herzwurm, G.	2019	4	Support of different cloud infrastructure providers	Database libraries
7	41	Bonina, C., Eaton, B.	2020	7	APIs to access meta data	Database libraries

7	42	Bonina, C., Eaton, B.	2020	7	APIs to access datasets	Database libraries
4	23	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	18	API data providers	Database libraries
10	71	Russpatrick, S.	2020	6	Advanced Metadata Export Application	Database libraries
6	34	Fink, L., Shao, J., Lichtenstein, Y., Haefliger, S.	2020	259	Google Libraries	API Product complementarity
6	35	Fink, L., Shao, J., Lichtenstein, Y., Haefliger, S.	2020	259	Oracle Libraries	API Product complementarity
6	36	Fink, L., Shao, J., Lichtenstein, Y., Haefliger, S.	2020	259	Microsoft Libraries	API Product complementarity
6	37	Fink, L., Shao, J., Lichtenstein, Y., Haefliger, S.	2020	259	Mix panel Libraries	API Product complementarity
15	131	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	Adobe Flash Plug-in (Not realized)	API Product complementarity
15	132	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	Safari codebase (No Change)	API Product complementarity
15	135	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	Adobe cross compiler (Emergent)	API Product complementarity
5	28	Bender, B.	2020	522	Operating system integration (OSI)*	API Product complementarity
15	137	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	iTunes subscription payment mechanism (Emergent, No Change)	API Product complementarity
9	55	Petrik, D., Herzwurm, G.	2020	5	Support of different cloud infrastructure providers	API Product complementarity
9	52	Petrik, D., Herzwurm, G.	2020	5	API's	-
11	72	Petrik, D., Herzwurm, G.	2019	4	API's	-
13	106	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	pplication programming interface (API)	-
13	107	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Hardware abstraction layer (HAL)	-
14	121	Islind, A.S., Lindroth, T., Snis, U.L., Sørensen, C.	2016	8	APIs	-

Table B.2: an overview of ABRs and types retrieved from literature.

Article ID	BR ID	Authors	Year Published	Page nr.	BR	BR Type
9	57	Petrik, D., Herzwurm, G.	2020	5	SDK	SDK
11	77	Petrik, D., Herzwurm, G.	2019	4	SDK	SDK
14	120	Islind, A.S., Lindroth, T., Snis, U.L., Sørensen, C.	2016	8	SDKs	SDK
15	126	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	iOS SDK (Emergent)	SDK
16	144	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	SDK	SDK
13	112	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Software development kit (SDK)	SDK
3	21	Msiska, B., Nielsen, P., Kaasboll, J.	2019	123	DHIS2 APIs,libraries and SDKs	SDK
9	56	Petrik, D., Herzwurm, G.	2020	5	DevOps	DevOps
11	76	Petrik, D., Herzwurm, G.	2019	4	DevOps	DevOps
11	80	Petrik, D., Herzwurm, G.	2019	4	Model-Driven Development	Model Driven Develoment
9	60	Petrik, D., Herzwurm, G.	2020	5	Model-Driven Development	Model Driven Develoment
9	59	Petrik, D., Herzwurm, G.	2020	5	App store	App Store
11	79	Petrik, D., Herzwurm, G.	2019	4	App store	App Store
15	125	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	Apple App Store (Emergent)	App Store
13	111	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	App store	App Store
5	30	Bender, B.	2020	522	Marketplace integration (MPI)	App Store
13	109	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Runtime environment	Test Environment
16	145	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	Debuggin Tools	Test Environment
7	39	Bonina, C., Eaton, B.	2020	7	Dataset Templates Datasets 2012: informal template to format datasets	Test Environment
12	93	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Sample code	Test Environment
7	39	Bonina, C., Eaton, B.	2020	7	Dataset Templates Datasets 2012: informal template to format datasets	Test Environment
12	99	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Dataset Templates Datasets 2012: informal template to format datasets	Test Environment
13	118	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Compatibility test suite (CTS)	Test Environment

Table B.3: an overview of DBRs and types retrieved from literature.

Article ID	BR ID	Authors	Year	Page nr.	BR	BR Type
16	146	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	Developer Portal	Developers Portal
11	81	Petrik, D., Herzwurm, G.	2019	4	Developer Portal	Developers Portal
12	91	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Information Portals	Developers Portal
9	61	Petrik, D., Herzwurm, G.	2020	5	Developer Portal	Developers Portal
16	149	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	Fortum live chat Support	Developers Portal
16	147	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	Registration	Developers Portal
4	22	Vesselkov, A., Hämmäinen, H., Töyli, J.	2019	18	Developer registration process	Developers Portal
8	49	Wulf, J., Blohm, I.	2020	10	Professional services	Developers Portal
8	50	Wulf, J., Blohm, I.	2020	10	Mediation services	Developers Portal
8	51	Wulf, J., Blohm, I.	2020	11	Open asset services	Developers Portal
12	98	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Help desk	Developers Portal
9	64	Petrik, D., Herzwurm, G.	2020	5	Events	Events
7	46	Bonina, C., Eaton, B.	2020	7	Initiatives	Events
9	62	Petrik, D., Herzwurm, G.	2020	5	Partner Programs	Events
9	63	Petrik, D., Herzwurm, G.	2020	5	Onsite demonstrators	Events
11	84	Petrik, D., Herzwurm, G.	2019	4	Events	Events
11	82	Petrik, D., Herzwurm, G.	2019	4	Partner Programs	Events
7	45	Bonina, C., Eaton, B.	2020	7	Hackatons	Events
11	89	Petrik, D., Herzwurm, G.	2019	4	PArtner Programs	Events
12	102	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	co-innovation activities	Events
9	66	Petrik, D., Herzwurm, G.	2020	5	Start-up programs	Events
11	86	Petrik, D., Herzwurm, G.	2019	4	Start-up programs	Events
11	87	Petrik, D., Herzwurm, G.	2019	4	On-site Hackatons	Events
11	83	Petrik, D., Herzwurm, G.	2019	4	Onsite demonstrators	Events
13	104	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Open-source license	Licence Agreement
13	113	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	SDK license	Licence Agreement
13	105	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	End-user license agreement (EULA)	Licence Agreement
3	19	Msiska, B., Nielsen, P., Kaasboll, J.	2019	123	DHIS2 manuals	Training
7	38	Bonina, C., Eaton, B.	2020	7	Description and examples	Training
12	92	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Handbooks	Training

12	90	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Techincal documantation	Training
12	94	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	MOdelling guidelines	Training
11	85	Petrik, D., Herzwurm, G.	2019	4	Training & Worksshops	Training
3	20	Msiska, B., Nielsen, P., Kaasboll, J.	2019	123	Academy/workshopfacilitators	Training
3	18	Msiska, B., Nielsen, P., Kaasboll, J.	2019	123	DHIS2 academy orworkshop	Training
9	65	Petrik, D., Herzwurm, G.	2020	5	Training & Worksshops	Training
12	95	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Massive online courses	Training
12	96	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Communities of practice	Training
12	100	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	One-to-obne assistance	Training
12	101	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	Technological coaching	Training
12	103	Foerderer, J., Kude, T., Schuetz, S.W., Heinzl, A.	2019	130	ALignment workshops between third party developers and platform owners	Training
7	44	Bonina, C., Eaton, B.	2020	7	Contractual Rules: formatting datasets	Terms & Conditions
7	47	Bonina, C., Eaton, B.	2020	7	Contractual rules: quality datasets	Terms & Conditions
7	48	Bonina, C., Eaton, B.	2020	7	Guidelines on datasets	Terms & Conditions
13	114	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Distribution agreement	Terms & Conditions
13	115	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Other service agreements	Terms & Conditions
13	116	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Policy guidelines	Terms & Conditions
13	117	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Compatibility definition document (CDD)	Terms & Conditions
13	119	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Alliance contract	Terms & Conditions
15	127	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	App Approval Process (Emergent)	Terms & Conditions
15	128	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	General DPLA rules (Emergent)	Terms & Conditions
15	136	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	General ASRG Rules (Emergent)	Terms & Conditions
15	140	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	DPLA Rule 3.3.9 (Changing)	Terms & Conditions
16	148	Bianco, V.D., Myllarniemi, V., Komssi, M., Raatikainen, M.	2014	15	Documentation	Terms & Conditions
15	134	Eaton, B., Elaluf-Calderwood, S., Sørensen, C., Yoo, Y.	2015	223	BR11 – DPLA Rule 3.3.2 (Changes)	Terms & Conditions
13	108	Karhu, K., Gustafsson, R., Lyytinen, K.	2018	495	Application packaging definition	Terms & Conditions

Table B.3: an overview of SBRs and types retrieved from literature.

10.3 Appendix C: Survey Data

ID	Best	Best to A1	Best to A2	Best to A4	Worst	A1 to Worst	A2 to Worst	A3 to Worst
1	Applicatie Tools	1	1	2	Sociale Tools	2	1	1
2	Ontwikkel Tools	1	3	4	Sociale Tools	4	3	1
3	Applicatie Tools	1	2	4	Sociale Tools	6	5	1
4	Applicatie Tools	1	6	6	Sociale Tools	6	6	1
5	Applicatie Tools	1	3	6	Sociale Tools	6	4	1
6	Ontwikkel Tools	3	1	5	Sociale Tools	4	6	1
7	Ontwikkel Tools	3	1	5	Sociale Tools	4	4	1
8	Ontwikkel Tools	6	1	6	Sociale Tools	1	6	1
9	Sociale Tools	1	3	5	Sociale Tools	7	6	1
10	Sociale Tools	2	3	1	Ontwikkel Tools	2	1	3
11	Ontwikkel Tools	4	1	7	Applicatie Tools	1	6	3
12	Ontwikkel Tools	5	1	2	Ontwikkel Tools	1	4	6
13	Applicatie Tools	1	6	4	Ontwikkel Tools	7	1	5
14	Ontwikkel Tools	3	1	6	Applicatie Tools	3	6	1
15	Ontwikkel Tools	4	1	6	Sociale Tools	4	6	1
16	Ontwikkel Tools	2	1	3	Applicatie Tools	1	2	3
17	Sociale Tools	4	4	1	Ontwikkel Tools	1	1	5
18	Ontwikkel Tools	7	1	5	Sociale Tools	1	7	4
19	Ontwikkel Tools	4	1	3	Sociale Tools	3	4	1
20	Applicatie Tools	1	2	4	Sociale Tools	3	2	1
21	Applicatie Tools	1	6	4	Ontwikkel Tools	4	1	4
22	Applicatie Tools	1	5	4	Ontwikkel Tools	5	1	3
23	Ontwikkel Tools	4	1	5	Sociale Tools	2	5	1
24	Sociale Tools	8	7	1	Applicatie Tools	1	2	7
25	Applicatie Tools	1	5	5	Ontwikkel Tools	5	1	4
26	Sociale Tools	4	6	1	Ontwikkel Tools	5	1	4
27	Applicatie Tools	1	2	7	Sociale Tools	7	6	1
28	Applicatie Tools	1	6	4	Ontwikkel Tools	4	1	3
29	Ontwikkel Tools	3	1	7	Sociale Tools	7	3	5
30	Applicatie Tools	1	3	6	Sociale Tools	7	4	1
31	Applicatie Tools	1	3	8	Ontwikkel Tools	7	5	1

Table C.1: survey data for the evaluation of categories.

ID	Best	Best to A1	Best to A2	Best to A3	Best to A4	Best to A5	Worst	A1 to worst	A2 to worst	A3 to worst	A4 to worst	A5 to worst
1	MEDMIJ API	5	6	3	4	1	MEDMIJ API	4	6	3	4	1
2	MEDMIJ API	2	3	5	3	1	Database Libraries	7	4	1	4	7
3	MEDMIJ API	4	5	3	5	1	REST API	2	3	5	3	5
4	MEDMIJ API	1	6	4	3	3	Standard Application API	7	1	4	5	5
5	MEDMIJ API	4	6	3	5	1	Standard Application API	3	1	6	5	4
6	Standard Application API	9	1	4	6	7	REST API	1	9	5	4	4
7	MEDMIJ API	8	6	3	4	1	REST API	1	3	6	4	9
8	MEDMIJ API	5	7	5	4	1	Standard Application API	4	1	5	6	7
9	REST API	1	6	4	5	2	Standard Application API	7	1	6	5	6
10	Database Libraries	4	6	1	8	4	IAM API	5	3	8	1	3
11	REST API	1	6	3	4	5	Standard Application API	6	1	4	6	6
12	Database Libraries	5	4	1	4	6	MEDMIJ API	3	4	6	4	1
13	IAM API	6	8	6	1	5	Standard Application API	5	1	4	7	5
14	MEDMIJ API	8	6	4	3	1	REST API	1	3	4	5	7
15	REST API	2	8	3	2	1	IAM API	8	1	6	7	8
16	Standard Application API	5	1	1	2	1	REST API	1	5	5	5	5
17	MEDMIJ API	5	7	4	1	5	Standard Application API	4	1	5	6	4
18	MEDMIJ API	6	3	4	1	6	REST API	1	6	4	4	1
19	Standard Application API	2	1	8	2	8	Database Libraries	7	9	1	6	2
20	MEDMIJ API	8	7	2	5	1	REST API	1	7	5	6	9
21	MEDMIJ API	6	7	6	1	2	REST API	2	1	3	8	6
22	REST API	1	5	4	8	3	IAM API	7	4	5	1	7
23	MEDMIJ API	3	3	5	3	1	Database Libraries	5	4	1	4	5
24	Database Libraries	6	5	1	6	7	MEDMIJ API	3	4	6	2	1
25	MEDMIJ API	4	4	5	3	1	Database Libraries	7	7	1	5	7
26	MEDMIJ API	7	5	5	5	1	Standard Application API	1	4	4	3	7
27	REST API	1	3	4	5	7	MEDMIJ API	8	6	4	3	1
28	Standard Application API	1	1	2	3	6	IAM API	5	7	5	1	4
29	Database Libraries	5	4	1	4	5	MEDMIJ API	2	4	5	5	1
30	MEDMIJ API	3	5	3	4	1	REST API	1	5	4	5	7
31	REST API	1	6	4	5	4	Standard Application API	6	4	3	1	6

Table C.2: survey data for the evaluation of ABRs.

ID	Best	Best to A1	Best to A2	Best to A3	Best to A4	Best to A5	Worst	A1 to Worst	A2 to Worst	A3 to Worst	A4 to Worst	A5 to Worst
1	SDK	1	6	4	6	7	Model driven Development	6	5	4	5	1
2	SDK	1	6	4	5	3	App Store	6	5	1	5	3
3	DevOps Tools	2	3	4	1	5	Model driven Development	2	3	4	6	1
4	SDK	1	5	6	5	5	App Store	6	2	1	3	2
5	SDK	1	4	4	6	3	App Store	5	6	1	6	4
6	SDK	1	3	5	4	6	Model driven Development	7	6	5	4	1
7	DevOps Tools	3	6	3	1	4	Testing Environment	5	1	4	6	4
8	SDK	1	8	8	8	8	SDK	8	1	2	1	2
9	DevOps Tools	4	6	4	1	5	Testing Environment	5	1	6	8	4
10	Testing Environment	4	1	5	3	4	App Store	5	6	1	6	4
11	DevOps Tools	4	6	5	1	4	Testing Environment	3	1	2	6	5
12	DevOps Tools	6	4	7	1	6	App Store	3	5	1	6	4
13	App Store	5	4	1	4	3	SDK	1	4	5	4	6
14	App Store	5	3	1	4	6	SDK	1	3	5	6	2
15	SDK	1	5	4	5	4	DevOps Tools	6	3	4	1	4
16	DevOps Tools	4	4	4	1	4	Model driven Development	4	4	1	4	4
17	Testing Environment	4	1	5	4	7	Model driven Development	6	4	4	5	1
18	SDK	7	5	5	5	1	Testing Environment	1	4	4	3	7
19	DevOps Tools	6	2	7	1	2	App Store	2	6	1	8	5
20	SDK	1	2	3	7	6	Testing Environment	8	7	6	1	3
21	SDK	1	6	7	3	5	App Store	7	5	1	2	4
22	SDK	1	6	4	6	5	Model driven Development	4	6	4	5	1
23	DevOps Tools	3	3	5	1	6	Model driven Development	3	3	4	6	1
24	App Store	4	4	1	4	6	Model driven Development	3	3	8	6	1
25	SDK	1	5	4	5	3	DevOps Tools	6	3	4	1	4
26	App Store	5	3	1	4	5	SDK	1	5	6	4	5
27	SDK	1	3	4	6	7	Model driven Development	7	5	4	3	1
28	App Store	2	2	1	4	5	Model driven Development	5	5	5	5	1
29	App Store	3	4	1	5	4	DevOps Tools	3	2	5	1	3
30	App Store	3	4	1	5	4	DevOps Tools	5	6	7	1	5
31	DevOps Tools	3	3	3	1	5	Model driven Development	2	5	3	3	1

Table C.3: survey data for the evaluation of DBRs.

ID	Best	Best to A1	Best to A2	Best to A3	Best to A4	Best to A5	Best to A6	Worst	A1 to Worst	A2 to Worst	A3 to Worst	A4 to Worst	A5 to Worst	A6 to Worst
1	Terms and Conditions	1	7	4	4	5	3	License Agreement	6	1	3	3	5	6
2	MEDMIJ Protocol	4	2	4	6	4	1	Trainings and Workshops	4	6	4	1	3	6
3	Terms and Conditions	1	5	4	5	6	4	Trainings and Workshops	5	3	4	1	5	4
4	MEDMIJ Protocol	5	5	7	5	5	1	Developers Portal	4	4	1	4	4	7
5	MEDMIJ Protocol	4	3	5	3	5	1	Developers Portal	3	6	1	5	3	6
6	MEDMIJ Protocol	1	4	6	6	7	1	Events	9	6	4	4	1	9
7	Terms and Conditions	1	4	4	5	3	3	License Agreement	5	1	4	6	2	4
8	MEDMIJ Protocol	5	4	4	7	3	1	Trainings and Workshops	4	6	6	1	7	4
9	Training And Workshops	1	1	1	1	3	5	MEDMIJ Protocol	5	5	5	5	3	1
10	Terms and Conditions	1	3	5	4	3	6	Events	7	4	6	5	1	7
11	MEDMIJ Protocol	3	3	5	4	5	1	Developers Portal	6	6	1	4	5	5
12	MEDMIJ Protocol	1	5	4	3	5	2	Events	6	3	4	3	1	6
13	Events	3	4	5	4	1	3	Developers Portal	4	3	1	7	4	5
14	License Agreement	1	2	3	4	5	4	Developers Portal	5	5	1	3	4	5
15	Terms and Conditions	1	4	3	5	4	6	Trainings and Workshops	5	6	4	1	4	6
16	Terms and Conditions	1	4	4	4	4	4	Events	4	4	4	4	1	4
17	MEDMIJ Protocol	3	6	5	7	5	1	Trainings and Workshops	3	2	3	1	3	5
18	MEDMIJ Protocol	2	3	3	5	5	1	Developers Portal	5	4	1	5	4	6
19	Developers Portal	7	5	1	6	3	4	Terms and Conditions	6	1	3	5	4	3
20	Terms and Conditions	1	2	3	5	7	6	Events	7	7	3	6	1	2
21	Terms and Conditions	1	4	3	5	2	6	Developers Portal	2	5	1	3	5	4
22	Terms and Conditions	1	7	4	4	5	3	License Agreement	6	1	3	3	5	6
23	MEDMIJ Protocol	2	3	4	3	4	1	Events	4	3	4	3	1	5
24	MEDMIJ Protocol	2	4	5	3	4	1	Developers Portal	5	1	4	3	3	6
25	Terms and Conditions	1	4	3	5	4	3	Developers Portal	6	3	1	3	4	5
26	Events	5	4	6	6	1	1	Trainings and Workshops	9	4	3	1	4	9
27	Terms and Conditions	1	2	4	4	4	6	MEDMIJ Protocol	5	5	4	3	3	1
28	Terms and Conditions	1	4	6	5	4	5	Events	6	4	5	3	1	5
29	MEDMIJ Protocol	3	5	6	5	4	1	Developers Portal	5	3	1	4	6	8
30	License Agreement	4	1	3	8	4	3	Trainings and Workshops	5	4	4	1	6	7
31	Terms and Conditions	1	5	4	3	4	1	License Agreement	5	1	3	2	5	4

Table C.4: survey data for the evaluation of SBRs.

10.4 Appendix D: Weights and Consistency of BRs

ID	ABRs	DBRs	SBRs	Consistency factor
1	0,4286	0,2857	0,2857	0,1429
2	0,6429	0,2143	0,1429	0,2143
3	0,1000	0,2600	0,6400	0,1400
4	0,5385	0,3077	0,1538	0,0769
5	0,1875	0,6875	0,1250	0,0625
6	0,2600	0,6400	0,1000	0,1400
7	0,1250	0,7361	0,1389	0,2361
8	0,2667	0,6222	0,1111	0,1778
9	0,1000	0,1222	0,7778	0,0778
10	0,5893	0,3393	0,0714	0,0893
11	0,6545	0,2545	0,0909	0,1091
12	0,2143	0,6429	0,1429	0,2143
13	0,6944	0,0833	0,2222	0,1944
14	0,2333	0,1000	0,6667	0,2667
15	0,1667	0,5667	0,2667	0,2333
16	0,1481	0,1852	0,6667	0,0741
17	0,0833	0,7381	0,1786	0,1548
18	0,6852	0,1111	0,2037	0,1296
19	0,7500	0,1389	0,1111	0,0833
20	0,6667	0,1250	0,2083	0,1667
21	0,6333	0,2833	0,0833	0,2167
22	0,6615	0,2615	0,0769	0,1231
23	0,5500	0,3500	0,1000	0,1500
24	0,2400	0,6600	0,1000	0,0600
25	0,7143	0,1000	0,1857	0,2143
26	0,6667	0,2500	0,0833	0,0833
27	0,2917	0,1667	0,5417	0,0417
28	0,2424	0,6667	0,0909	0,2230
29	0,2121	0,6970	0,0909	0,1515
30	0,6970	0,0909	0,2121	0,1515
31	0,4286	0,2857	0,2857	0,1429
Mean	40%	36%	23%	15%
SD	0,2419	0,2343	0,2036	0,0663
Median	0,2917	0,2833	0,1429	0,1500

Table D.1: Mean local weights and consistency factors of categories

REST APIs	Product complementarity APIs	Database Libraries	IAM APIs	Data Standardization API	Consistency factor
0,1379	0,1149	0,2299	0,4598	0,0575	0,2299
0,0614	0,1316	0,1316	0,1316	0,5439	0,1140
0,4809	0,1986	0,1490	0,1192	0,0523	0,2180
0,4432	0,0568	0,1364	0,1818	0,1818	0,1628
0,0500	0,1000	0,2000	0,1500	0,5000	0,1000
0,4884	0,1130	0,1694	0,0598	0,1694	0,1082
0,0667	0,2133	0,1600	0,4533	0,1067	0,1053
0,0749	0,1257	0,2096	0,1257	0,4641	0,1647
0,0938	0,0625	0,0938	0,4688	0,2813	0,1880
0,0580	0,0986	0,1478	0,1971	0,4986	0,0928
0,1579	0,1053	0,5263	0,0526	0,1579	0,1867
0,2404	0,4153	0,0437	0,2404	0,0601	0,0656
0,1228	0,1535	0,5044	0,1535	0,0658	0,1096
0,2457	0,1638	0,0517	0,1638	0,3750	0,1164
0,0357	0,0874	0,3058	0,1223	0,4488	0,1023
0,0426	0,2660	0,2660	0,1596	0,2660	0,0532
0,1311	0,0615	0,1639	0,5123	0,1311	0,1434
0,4599	0,0488	0,2091	0,1568	0,1254	0,1672
0,2222	0,0370	0,1481	0,2222	0,3704	0,0741
0,1202	0,0566	0,1202	0,5587	0,1443	0,1627
0,1329	0,0524	0,1329	0,1661	0,5157	0,1486
0,0513	0,5695	0,1694	0,1130	0,0968	0,1894
0,1579	0,0632	0,2105	0,1263	0,4421	0,1895
0,1163	0,1395	0,5581	0,1163	0,0698	0,1613
0,4206	0,0467	0,1402	0,1121	0,2804	0,1402
0,0694	0,1288	0,2147	0,1610	0,4261	0,1150
0,2761	0,4049	0,2025	0,0491	0,0675	0,1288
0,1553	0,1553	0,0490	0,2071	0,4332	0,1395
0,1765	0,1765	0,0588	0,1765	0,4118	0,1176
0,1290	0,1613	0,4839	0,1613	0,0645	0,0938
0,4741	0,1219	0,1524	0,0484	0,2032	0,1355
19%	15%	20%	20%	26%	14%
0,1484	0,1200	0,1370	0,1396	0,1710	0,0434
0,1329	0,1219	0,1639	0,1596	0,2032	0,1355

Table D.2: Mean local weights and consistency factors of categories

ID	SDK	Test Environment	App Store	DevOps Tools	Model Driven Development	Consistency factor
1	0,5294	0,1176	0,1765	0,1176	0,0588	0,1765
2	0,4987	0,1073	0,0505	0,2146	0,1288	0,1140
3	0,1841	0,1381	0,4644	0,0753	0,1381	0,1096
4	0,6567	0,0746	0,0896	0,0896	0,0896	0,0597
5	0,5000	0,1250	0,1875	0,1250	0,0625	0,2500
6	0,4668	0,2041	0,1224	0,1531	0,0536	0,1454
7	0,2292	0,1728	0,1296	0,4086	0,0598	0,1520
8	0,0585	0,1491	0,4444	0,1491	0,1988	0,1023
9	0,1630	0,0543	0,1630	0,4891	0,1304	0,1254
10	0,0566	0,2138	0,4623	0,1604	0,1069	0,1792
11	0,4647	0,1122	0,0641	0,1346	0,2244	0,2083
12	0,0779	0,2336	0,0492	0,4057	0,2336	0,0615
13	0,1143	0,1714	0,0643	0,5357	0,1143	0,1500
14	0,1210	0,2016	0,4718	0,0847	0,1210	0,1331
15	0,4444	0,1667	0,0556	0,1111	0,2222	0,1132
16	0,1538	0,1538	0,0769	0,4615	0,1538	0,1538
17	0,1688	0,4641	0,1350	0,1688	0,0633	0,2110
18	0,0614	0,1316	0,1316	0,1316	0,5439	0,1452
19	0,5426	0,1277	0,0745	0,1277	0,1277	0,0957
20	0,1818	0,0568	0,1818	0,4432	0,1364	0,1520
21	0,1491	0,4444	0,0585	0,1988	0,1491	0,1019
22	0,1831	0,1831	0,1831	0,3803	0,0704	0,1690
23	0,1887	0,1887	0,1132	0,4528	0,0566	0,2222
24	0,4259	0,2639	0,1759	0,0463	0,0880	0,0879
25	0,2030	0,1522	0,4388	0,0537	0,1522	0,1701
26	0,4986	0,1971	0,1478	0,0986	0,0580	0,0928
27	0,2381	0,2381	0,3571	0,1190	0,0476	0,1190
28	0,4673	0,1185	0,1482	0,0684	0,1976	0,1630
29	0,4916	0,1247	0,1559	0,0719	0,1559	0,1319
30	0,1579	0,1579	0,4737	0,1579	0,0526	0,1579
31	0,1587	0,0595	0,1270	0,4960	0,1587	0,1389
Mean	0,2850	0,1711	0,1927	0,2171	0,1340	0,1417
SD	0,1816	0,0921	0,1457	0,1597	0,0944	0,0447
Median	0,1887	0,1538	0,1478	0,1491	0,1277	0,1452

Table D.3: mean local weights and consistency factors of DBRs

ID	Terms and Conditions	License Agreement	Developers Portal	Training & Workshops	Events	Data sharing aagreement	Consistency Factor
1	0,4049	0,0465	0,1327	0,1327	0,1062	0,1770	0,1261
2	0,1148	0,2295	0,1148	0,0492	0,1148	0,3770	0,0820
3	0,2344	0,0547	0,0937	0,1563	0,1172	0,3438	0,1250
4	0,3482	0,1719	0,2579	0,1032	0,0451	0,0737	0,1676
5	0,1276	0,1701	0,0500	0,1701	0,1021	0,3802	0,1261
6	0,1104	0,1380	0,1380	0,0511	0,1840	0,3783	0,1738
7	0,3752	0,2025	0,1215	0,1519	0,0476	0,1013	0,2323
8	0,4305	0,1192	0,1490	0,0530	0,0993	0,1490	0,1656
9	0,3734	0,1349	0,0692	0,1079	0,1349	0,1798	0,1660
10	0,3385	0,2515	0,0580	0,1257	0,1006	0,1257	0,1644
11	0,2497	0,1665	0,0538	0,0999	0,0999	0,3303	0,1690
12	0,3272	0,1054	0,0702	0,0702	0,0333	0,3937	0,2311
13	0,1286	0,3524	0,1714	0,0476	0,1286	0,1714	0,1619
14	0,0888	0,1110	0,0740	0,0282	0,2784	0,4196	0,1654
15	0,3923	0,1409	0,1878	0,0442	0,1409	0,0939	0,1713
16	0,4000	0,1333	0,1333	0,1333	0,0667	0,1333	0,1333
17	0,1806	0,0903	0,1084	0,0690	0,1084	0,4433	0,0985
18	0,3592	0,0466	0,1330	0,1064	0,1774	0,1774	0,1729
19	0,4049	0,0465	0,1327	0,1327	0,1062	0,1770	0,1008
20	0,1739	0,1304	0,0435	0,1304	0,3478	0,1739	0,1739
21	0,3348	0,1339	0,0670	0,1071	0,2679	0,0893	0,2009
22	0,3214	0,0429	0,1071	0,1429	0,1071	0,2786	0,1071
23	0,1163	0,1163	0,0543	0,1163	0,1163	0,4806	0,1301
24	0,1835	0,1101	0,0459	0,1101	0,1376	0,4128	0,1376
25	0,3605	0,0914	0,1143	0,1524	0,0528	0,2286	0,0967
26	0,3661	0,2321	0,1161	0,1161	0,1161	0,0536	0,0982
27	0,2197	0,2197	0,2197	0,2197	0,0833	0,0379	0,0303
28	0,4309	0,1560	0,1040	0,1248	0,0594	0,1248	0,1932
29	0,2182	0,1455	0,1091	0,1455	0,0545	0,3273	0,1091
30	0,0889	0,0533	0,3911	0,1037	0,2074	0,1556	0,0943
31	0,2463	0,1430	0,0999	0,1264	0,1082	0,2762	0,1372
Mean	0,2726	0,1383	0,1201	0,1106	0,1242	0,2344	0,1433
SD	0,1153	0,0699	0,0712	0,0429	0,0711	0,1311	0,0444
Median	0,3214	0,1339	0,1091	0,1161	0,1082	0,1774	0,1376

Table D.4: mean local weights and consistency factors of SBRs

ID	REST API's	Standard Applications API's	Database Libraries	IAM	Data sharing APIJ	SDK	Test Environment	App Store	DevOps Tools	Model Driven Development
1	0,0270	0,0865	0,0649	0,1838	0,0432	0,0830	0,0625	0,0469	0,1479	0,0216
2	0,0249	0,0533	0,0533	0,0533	0,2204	0,1682	0,0406	0,0232	0,0487	0,0812
3	0,1949	0,0805	0,0604	0,0483	0,0212	0,0666	0,0500	0,1681	0,0273	0,0500
4	0,1796	0,0230	0,0553	0,0737	0,0737	0,2377	0,0270	0,0324	0,0324	0,0324
5	0,0203	0,0405	0,0811	0,0608	0,2027	0,1810	0,0452	0,0679	0,0452	0,0226
6	0,1980	0,0458	0,0687	0,0242	0,0687	0,1690	0,0739	0,0443	0,0554	0,0194
7	0,0559	0,0466	0,0932	0,1864	0,0233	0,1916	0,0426	0,0639	0,0426	0,0213
8	0,0303	0,0510	0,0850	0,0510	0,1881	0,0212	0,0540	0,1609	0,0540	0,0720
9	0,0380	0,0253	0,0380	0,1900	0,1140	0,0590	0,0197	0,0590	0,1770	0,0472
10	0,0235	0,0399	0,0599	0,0799	0,2021	0,0205	0,0774	0,1673	0,0580	0,0387
11	0,0640	0,0427	0,2133	0,0213	0,0640	0,1805	0,0388	0,0183	0,0777	0,0466
12	0,0975	0,1683	0,0177	0,0975	0,0244	0,0282	0,0845	0,0178	0,1468	0,0845
13	0,0498	0,0622	0,2044	0,0622	0,0267	0,0414	0,0620	0,0233	0,1939	0,0414
14	0,0996	0,0664	0,0210	0,0664	0,1520	0,0190	0,0768	0,1626	0,0576	0,0461
15	0,0145	0,0354	0,1240	0,0496	0,1819	0,1609	0,0603	0,0201	0,0402	0,0804
16	0,0172	0,1078	0,1078	0,0647	0,1078	0,0557	0,0557	0,0278	0,1670	0,0557
17	0,0532	0,0249	0,0664	0,2077	0,0532	0,0611	0,1680	0,0489	0,0611	0,0229
18	0,1864	0,0198	0,0847	0,0636	0,0508	0,0222	0,0476	0,0476	0,0476	0,1968
19	0,0901	0,0150	0,0600	0,0901	0,1501	0,1964	0,0462	0,0270	0,0462	0,0462
20	0,0487	0,0229	0,0487	0,2265	0,0585	0,0658	0,0206	0,0658	0,1604	0,0494
21	0,0539	0,0213	0,0539	0,0673	0,2090	0,0540	0,1609	0,0212	0,0720	0,0540
22	0,0208	0,2308	0,0687	0,0458	0,0392	0,0663	0,0663	0,0663	0,1376	0,0255
23	0,0640	0,0256	0,0853	0,0512	0,1792	0,0683	0,0683	0,0410	0,1639	0,0205
24	0,0471	0,0566	0,2262	0,0471	0,0283	0,1542	0,0955	0,0637	0,0168	0,0318
25	0,1705	0,0189	0,0568	0,0455	0,1136	0,0735	0,0551	0,1588	0,0194	0,0551
26	0,0281	0,0522	0,0870	0,0653	0,1727	0,1804	0,0713	0,0535	0,0357	0,0210
27	0,1119	0,1641	0,0821	0,0199	0,0274	0,0862	0,0862	0,1293	0,0431	0,0172
28	0,0630	0,0630	0,0199	0,0839	0,1756	0,1691	0,0429	0,0536	0,0248	0,0715
29	0,0715	0,0715	0,0238	0,0715	0,1669	0,1779	0,0451	0,0564	0,0260	0,0564
30	0,0523	0,0654	0,1961	0,0654	0,0262	0,0571	0,0571	0,1714	0,0571	0,0190
31	0,1922	0,0494	0,0618	0,0196	0,0824	0,0574	0,0215	0,0460	0,1795	0,0574
Mean	0,0270	0,0865	0,0649	0,1838	0,0432	0,0830	0,0625	0,0469	0,1479	0,0216
SD	0,0249	0,0533	0,0533	0,0533	0,2204	0,1682	0,0406	0,0232	0,0487	0,0812
Median	0,1949	0,0805	0,0604	0,0483	0,0212	0,0666	0,0500	0,1681	0,0273	0,0500

Table D.5: mean global weights of Boundary Resources

	Service Group	Analytical Tool	Information System / high IB	Digital Platform	Informal care Allocation	PGO	Data warehouse
	N	2	5	1	3	1	1
Cat	ABR	0,3238	0,5538	0,2914	0,3580	0,3719	0,6545
	DBR	0,4215	0,3076	0,3156	0,4438	0,4007	0,2545
	SBR	0,2547	0,1386	0,3930	0,1982	0,2275	0,0909
	N	10	9	5	4	2	1
ABR	REST	0,1955	0,201376	0,1411057	0,16931	0,213395176	0,157895
	Standard Applications API's	0,1215	0,119474	0,2331055	0,21638	0,191452869	0,105263
	Database Libraries	0,16274	0,205836	0,1667989	0,13126	0,19354803	0,526316
	IAM	0,23471	0,231533	0,171531	0,14841	0,133888062	0,052632
	Data Standardization API	0,28554	0,241781	0,2874589	0,33465	0,267715862	0,157895
DBR	SDK	0,14827	0,140126	0,13295	0,13648	0,136155437	0,105263
	Test Environment	0,33092	0,233818	0,1685694	0,42389	0,335367133	0,498737
	App Store	0,13617	0,223616	0,1875301	0,16961	0,149309418	0,107323
	DevOps Tools	0,23038	0,165823	0,1390205	0,20226	0,234948146	0,050505
	MDD	0,19025	0,222574	0,3346357	0,08948	0,168642722	0,214646
SBR	Terms and Conditions	0,11229	0,154169	0,1702444	0,11476	0,111732581	0,128788
	License agreement	0,15317	0,156732	0,1420459	0,14826	0,161004082	0,145202
	Developers Portal	0,28827	0,270568	0,2673556	0,30871	0,249212014	0,24968
	Training & Workshops	0,15929	0,089819	0,1685841	0,18833	0,163028688	0,166453
	Events	0,10911	0,089575	0,1273644	0,13722	0,164668292	0,053777
	Data Standardization agreement	0,10963	0,118594	0,0647273	0,15151	0,139730976	0,099872

Table D.6: mean local weights per service group

	Service Group	Analytical Tool	Information System/.high IB	Digital Platform	Informal care Allocation	PGO	Data warehouse
	N	10	9	5	4	2	1
ABR	REST	0,0792	0,0816	0,0557	0,0686	0,0865	0,0640
	Standard Applications API's	0,0493	0,0484	0,0880	0,0877	0,0776	0,0427
	Database Libraries	0,0660	0,0834	0,0950	0,0532	0,0785	0,2133
	IAM	0,0951	0,0938	0,0681	0,0602	0,0543	0,0213
	Data Standardization API	0,1157	0,0980	0,0985	0,1356	0,1085	0,0640
DBR	SDK	0,1198	0,0846	0,0610	0,1534	0,1214	0,1805
	Test Environment	0,0621	0,0809	0,0679	0,0614	0,0540	0,0388
	App Store	0,0834	0,0600	0,0503	0,0732	0,0850	0,0183
	DevOps Tools	0,0689	0,0806	0,1211	0,0324	0,0610	0,0777
	MDD	0,0406	0,0558	0,0616	0,0415	0,0404	0,0466
SBR	Terms and Conditions	0,0671	0,0630	0,0622	0,0719	0,0580	0,0581
	License agreement	0,0371	0,0209	0,0392	0,0438	0,0379	0,0387
	Developers Portal	0,0254	0,0208	0,0296	0,0319	0,0383	0,0125
	Training & Workshops	0,0255	0,0276	0,0151	0,0353	0,0325	0,0232
	Events	0,0243	0,0368	0,0302	0,0182	0,0242	0,0232
	Data Standardization API	0,0534	0,0637	0,0564	0,0316	0,0418	0,0769

Table D.7: mean global local weights per service group

Class		LOW IB	HIGH IB
	N	22	9
ABRs	REST	0.0816	0.0708
	Product complementarity APIs	0.0484	0.0691
	Database Libraries	0.0834	0.1012
	IAM	0.0938	0.0598
	Medical data standardization API	0.0980	0.1045
DBRs	SDK	0.0846	0.1272
	Test Environment	0.0809	0.0568
	App Store	0.0600	0.0620
	DevOps	0.0806	0.0722
	Model-Driven Development	0.0558	0.0462
SBRs	Terms and Conditions	0.0630	0.0635
	License Agreement	0.0209	0.0394
	Developers' portal	0.0208	0.0276
	Trainings & Workshops	0.0276	0.0263
	Events	0.0368	0.0240
	Medical data standardization Agreement	0.0637	0.0520

Table D.4: Sample comparison data of groups

10.5 Appendix E: Survey

Een Digitaal Platform in de Eerstelijnszorg

Ontzettend bedankt dat u bij wilt dragen aan het onderzoek in de eerstelijns zorg.

Deze survey bestaat uit 7 delen en kan binnen 15 minuten worden ingevuld.

De enquete is als volgt opgebouwd:

1. Algemene informatie over uzelf en uw bedrijf (max 1 min)
2. Toelichting van de enquete en methode (max 2 min)
3. Uw beoordeling van de categorieën van tools (max 2 min)
4. Uw beoordeling van tools in categorie 1 (max 3 min)
5. Uw beoordeling van tools in categorie 2 (max 3 min)
6. Uw beoordeling van tools in categorie 3 (max 3 min)
7. Afsluiting (max 1 min)

De antwoorden zullen vertrouwelijk en anoniem verwerkt worden. De antwoorden worden alleen gebruikt voor dit onderzoek en niet voor andere doeleinden. Alle data zal veilig op de TU Delft bewaard worden. Hierbij zit een bewaar termijn van 10 jaar.

Uw deelname aan dit onderzoek is vrijwillig. U kunt zich ten alle tijden terugtrekken van deelname.

Mocht u vragen hebben over dit onderzoek, schroom dan niet om contact op te nemen met Sebas Groeneveld via s.groeneveld@student.tudelft.nl of via 06 29 41 20 50

Met vriendelijke groet,

Sebas Groeneveld - Afstudeer student
Dr. ir. Mark de Reuver - Eerste Begeleider (TU Delft)

Via de reguliere markt biedt u aan eindgebruikers in de zorg uw software aan. Stelt u zich nu voor dat u deze via een platform kunt aanbieden aan uw eindgebruikers. Dit platform is vergelijkbaar met de Apple App Store, welke leveranciers van applicaties en eindgebruikers bij elkaar brengt.

De eigenaar van dit platform kan u voorzien van verschillende tools. Deze zorgen ervoor dat specifieke behoeften die u heeft bij het ontwikkelen en aanbieden van software kunnen worden voorzien. Deze tools kunnen u motiveren om deel te nemen aan het platform en hebben daarmee invloed op de lange termijn ontwikkeling van het platform.

Deze tools bestaan uit drie categorieën:

1. Applicatie tools -
Dit zijn tools die helpen bij de ondersteuning en verbeteren van "bestaande applicaties" die u aanbiedt via het platform.
Voorbeelden hiervan zijn Application Programming Interfaces (API's). Deze kunt u implementeren in uw software en maken communicatie met andere software mogelijk. Hierdoor kan de functionaliteit van de applicatie kan worden uitgebreid.

2. Software Ontwikkeling tools -
Deze tools helpen bij de activiteiten die gerelateerd zijn aan de ontwikkeling van "nieuwe applicaties."
Voorbeelden hiervan zijn DevOps tools of een Software Development Kit.

3. Sociale tools -
Deze tools faciliteren communicatie en informatieoverdracht tussen de eigenaar van het platform en de ICT-leveranciers die hun software aanbieden via het platform.
Voorbeelden hiervan zijn gebruikersovereenkomsten, handleidingen, trainingen en evenementen.

Dit onderzoek wilt achterhalen welke tools het belangrijkste zijn voor de industrie om om een overstap te overwegen naar dit platform. Daarom wordt u verzocht deze tools te beoordelen naar relatieve belangrijkheid voor de ondersteuning van uw activiteiten. De vraagstelling zal als volgt geformuleerd zijn:

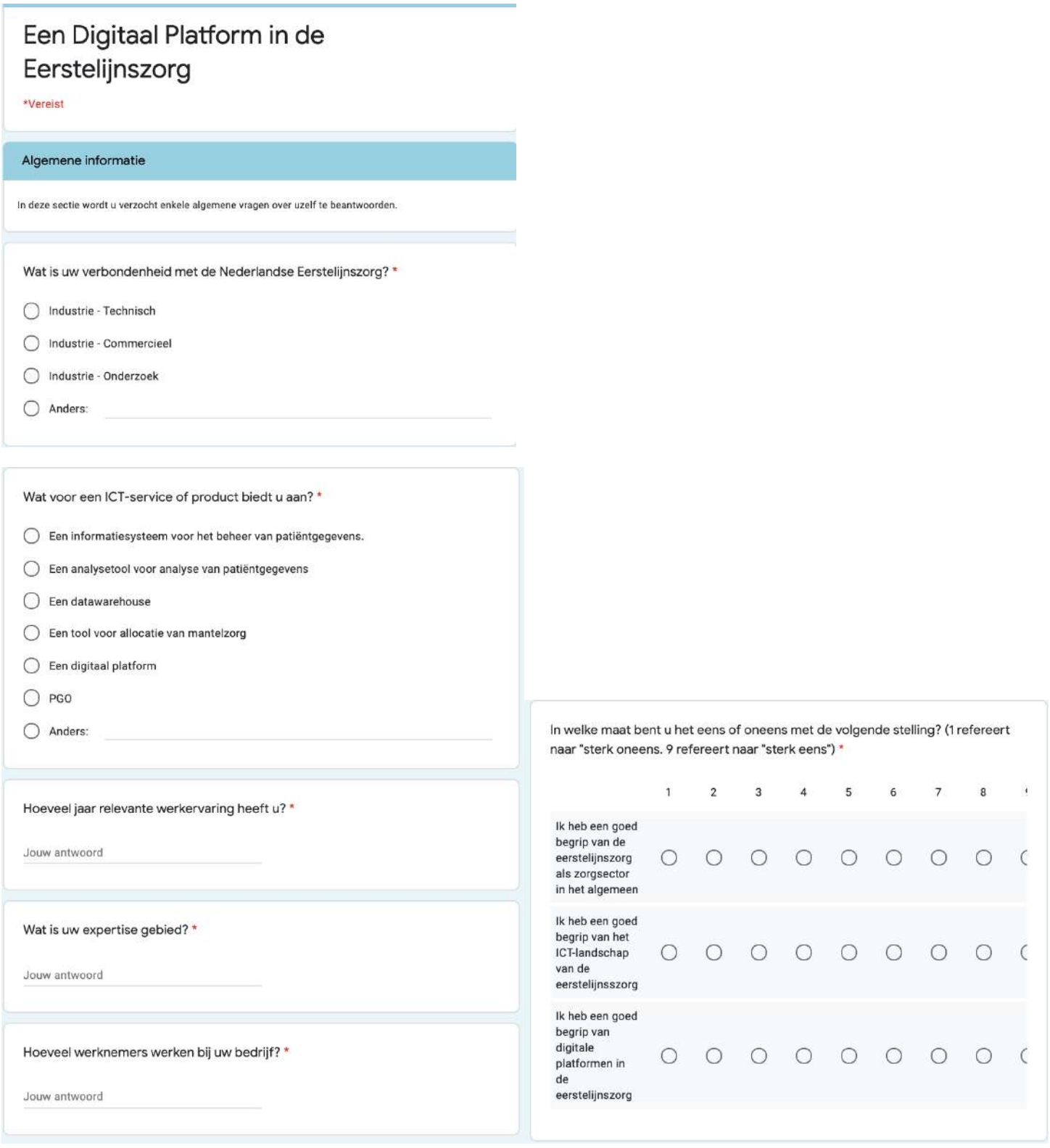
1. Welke "tool/categorie" vindt u het belangrijkste?
2. Hoeveel belangrijker is deze tool/categorie ten opzichte van de andere tools/categorieën?

3. Welke "tool/categorie" vindt u het minst belangrijk?
4. Hoeveel belangrijker zijn andere tools ten opzichte van de minste belangrijke tool/categorie?

Deze stappen doorloopt u voor de categorieën afzonderlijk en alle tools binnen een categorie.

Alvast bedankt voor het invullen van de enquete!

Appendix E.1: Introduction pages



Een Digitaal Platform in de Eerstelijnszorg

*Vereist

Algemene informatie

In deze sectie wordt u verzocht enkele algemene vragen over uzelf te beantwoorden.

Wat is uw verbondenheid met de Nederlandse Eerstelijnszorg? *

- Industrie - Technisch
- Industrie - Commercieel
- Industrie - Onderzoek
- Anders:

Wat voor een ICT-service of product biedt u aan? *

- Een informatiesysteem voor het beheer van patiëntgegevens.
- Een analysetool voor analyse van patiëntgegevens
- Een datawarehouse
- Een tool voor allocatie van mantelzorg
- Een digitaal platform
- PGO
- Anders:

Hoeveel jaar relevante werkervaring heeft u? *

Jouw antwoord

Wat is uw expertise gebied? *

Jouw antwoord

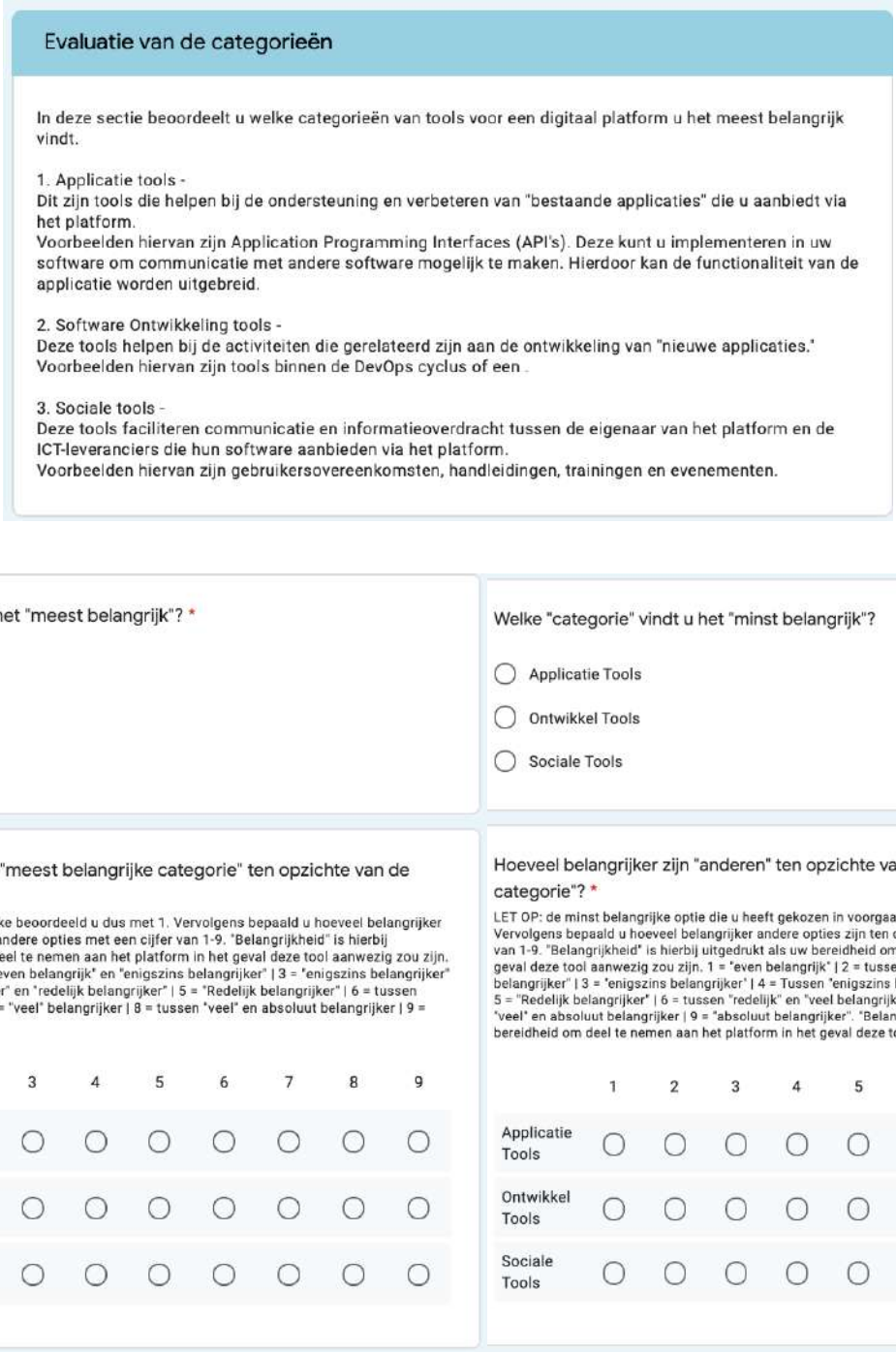
Hoeveel werknemers werken bij uw bedrijf? *

Jouw antwoord

In welke maat bent u het eens of oneens met de volgende stelling? (1 refereert naar "sterk oneens. 9 refereert naar "sterk eens") *

	1	2	3	4	5	6	7	8
Ik heb een goed begrip van de eerstelijnszorg als zorgsector in het algemeen	○	○	○	○	○	○	○	○
Ik heb een goed begrip van het ICT-landschap van de eerstelijnsszorg	○	○	○	○	○	○	○	○
Ik heb een goed begrip van digitale platformen in de eerstelijnszorg	○	○	○	○	○	○	○	○

Appendix E.2: general questions



Evaluatie van de categorieën

In deze sectie beoordeelt u welke categorieën van tools voor een digitaal platform u het meest belangrijk vindt.

1. Applicatie tools -
Dit zijn tools die helpen bij de ondersteuning en verbeteren van "bestaande applicaties" die u aanbiedt via het platform.
Voorbeelden hiervan zijn Application Programming Interfaces (API's). Deze kunt u implementeren in uw software om communicatie met andere software mogelijk te maken. Hierdoor kan de functionaliteit van de applicatie worden uitgebreid.

2. Software Ontwikkeling tools -
Deze tools helpen bij de activiteiten die gerelateerd zijn aan de ontwikkeling van "nieuwe applicaties."
Voorbeelden hiervan zijn tools binnen de DevOps cyclus of een .

3. Sociale tools -
Deze tools faciliteren communicatie en informatieoverdracht tussen de eigenaar van het platform en de ICT-leveranciers die hun software aanbieden via het platform.
Voorbeelden hiervan zijn gebruikersovereenkomsten, handleidingen, trainingen en evenementen.

Welke "categorie" vindt u het "meest belangrijk"? *

- ◯ Applicatie Tools
- ◯ Ontwikkel Tools
- ◯ Sociale Tools

Welke "categorie" vindt u het "minst belangrijk"?

- ◯ Applicatie Tools
- ◯ Ontwikkel Tools
- ◯ Sociale Tools

Hoeveel belangrijker is de "meest belangrijke categorie" ten opzichte van de andere categorieën? *

LET OP: de meest meest belangrijke beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker deze optie is ten opzichte van de andere opties met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker".

	1	2	3	4	5	6	7	8	9
Applicatie Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯
Ontwikkel Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯
Sociale Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯

Hoeveel belangrijker zijn "anderen" ten opzichte van de "minst belangrijke categorie"? *

LET OP: de minst belangrijke optie die u heeft gekozen in voorgaande vraag beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker andere opties zijn ten opzichte van deze optie met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker". "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn.

	1	2	3	4	5	6	7	8	9
Applicatie Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯
Ontwikkel Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯
Sociale Tools	◯	◯	◯	◯	◯	◯	◯	◯	◯

Appendix E.3: evaluation of categories

Evaluatie van de categorie "Applicatie Tools"

Ter herhaling: Applicatie Tools helpen bij de ondersteuning en verbeteren van "bestaande applicaties."

In deze categorie zijn de volgende tools geïdentificeerd.

1. API voor verbinding met het internet
Deze API's (ook wel REST API's) genoemd zorgen ervoor dat uw applicaties zich kunnen verbinden met het internet.

2. API's voor standaard services
Deze API's maken bieden standaard functionaliteiten voor het IS. Denk hierbij aan een mail API van Microsoft, een Bankier API van IDeal, of een kalender API van Google voor het maken van afspraken.

3.Tools om software te verbinden met een of meerdere database
Deze tools (ook wel libraries genoemd) zorgen ervoor dat applicaties kunnen verbinden met een database

4. API voor identificatie
Deze API helpt met identificatie van patiënten, zorgaanbieders of andere gebruikers. Zo kunnen gebruikers met de juiste rechten de juiste acties uitvoeren. Voorbeelden hiervan zijn DIGID of een identificatiesysteem op basis van het BIG-register

5. API voor (medische) dataoverdracht tussen andere informatiesystemen -
Deze API's zijn inzetbaar om een goed beveiligde datastroom tussen informatiesystemen op te kunnen zetten.

Welke "Applicatie Tool" vindt u het "meest belangrijk"? *

- ◯ 1. API's voor verbinding met het Internet
- ◯ 2. API's voor standaard services
- ◯ 3. Tools om software te verbinden met een of meerdere database
- ◯ 4. API's voor identificatie ten behoeve van toegang management
- ◯ 5. API's voor (medische) dataoverdracht met andere apps

Welke "Applicatie Tool" vindt u het "minst belangrijk"? *

- ◯ 1. API's voor verbinding met het Internet
- ◯ 2. API's voor standaard services
- ◯ 3. Tools om software te verbinden met een of meerdere database
- ◯ 4. API's voor identificatie ten behoeve van toegang management
- ◯ 5. API's voor (medische) dataoverdracht met andere apps

Hoeveel belangrijker is de "meest belangrijke Applicatie tool" ten opzichte van de anderen?

LET OP: de meest meest belangrijke beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker deze optie is ten opzichte van de andere opties met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker".

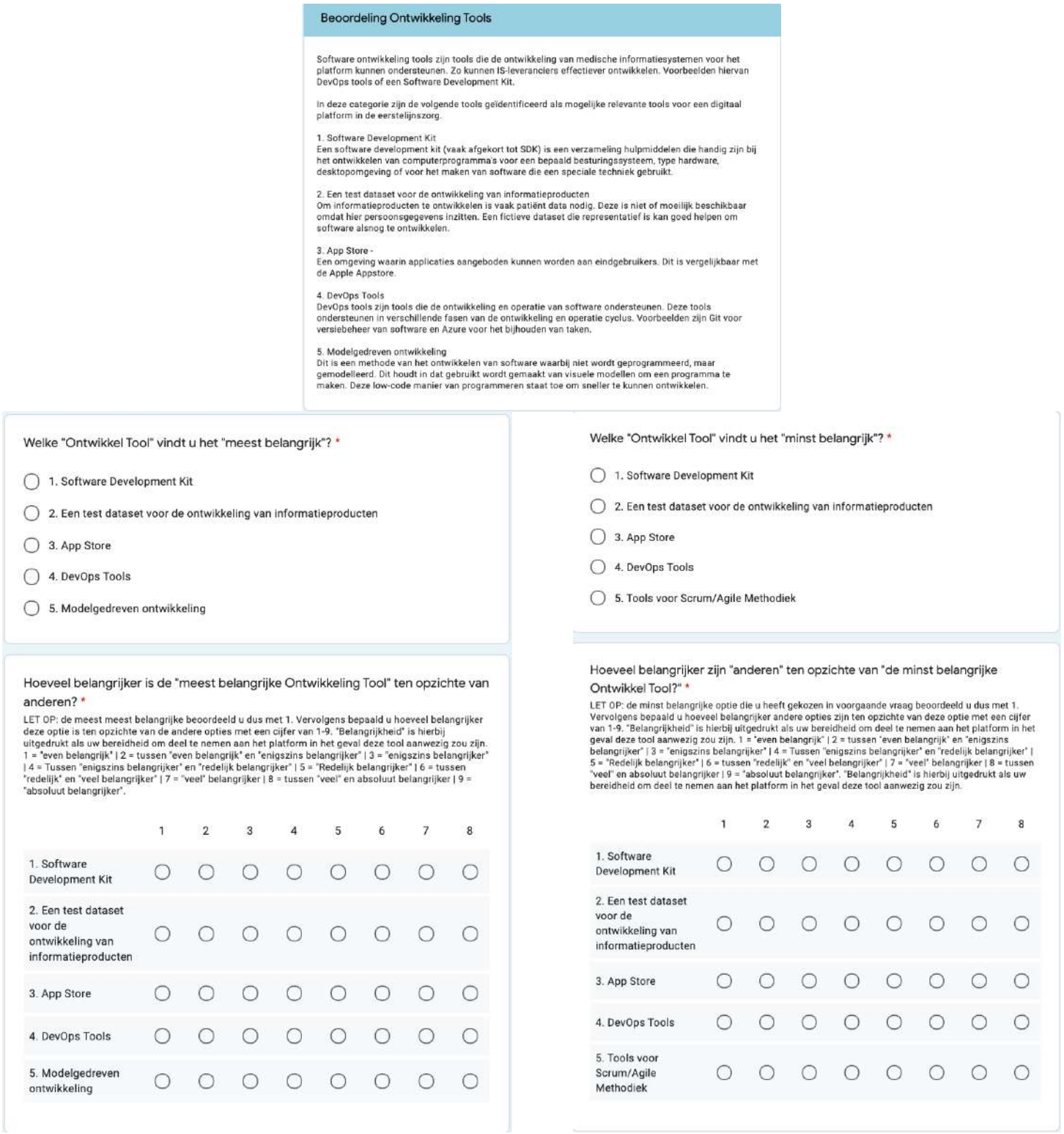
	1	2	3	4	5	6	7	8	9
1. API's voor verbinding met het Internet	◯	◯	◯	◯	◯	◯	◯	◯	◯
2. API's voor standaard services	◯	◯	◯	◯	◯	◯	◯	◯	◯
3. Tools om software te verbinden met een of meerdere database	◯	◯	◯	◯	◯	◯	◯	◯	◯
4. API's voor identificatie ten behoeve van toegang management	◯	◯	◯	◯	◯	◯	◯	◯	◯
5. API's voor (medische) dataoverdracht met andere apps	◯	◯	◯	◯	◯	◯	◯	◯	◯

Hoeveel belangrijker zijn "anderen" ten opzichte van de "minst belangrijke applicatie tool"? *

LET OP: de minst belangrijke optie die u heeft gekozen in voorgaande vraag beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker andere opties zijn ten opzichte van deze optie met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker". "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn.

	1	2	3	4	5	6	7	8	9
1. API voor verbinding met het Internet	◯	◯	◯	◯	◯	◯	◯	◯	◯
2. API voor standaard services	◯	◯	◯	◯	◯	◯	◯	◯	◯
3. Tools om software te verbinden met een of meerdere database	◯	◯	◯	◯	◯	◯	◯	◯	◯
4. API voor identificatie ten behoeve van toegang management	◯	◯	◯	◯	◯	◯	◯	◯	◯
5. API's voor (medische) dataoverdracht met andere apps	◯	◯	◯	◯	◯	◯	◯	◯	◯

Appendix E.4: valuation of ABRs



Beoordeling Ontwikkeling Tools

Software ontwikkeling tools zijn tools die de ontwikkeling van medische informatiesystemen voor het platform kunnen ondersteunen. Zo kunnen IS-leveranciers effectiever ontwikkelen. Voorbeelden hiervan DevOps tools of een Software Development Kit.

In deze categorie zijn de volgende tools geïdentificeerd als mogelijke relevante tools voor een digitaal platform in de eerstelijnszorg.

1. Software Development Kit
Een software development kit (vaak afgekort tot SDK) is een verzameling hulpmiddelen die handig zijn bij het ontwikkelen van computerprogramma's voor een bepaald besturingssysteem, type hardware, desktopomgeving of voor het maken van software die een speciale techniek gebruikt.

2. Een test dataset voor de ontwikkeling van informatieproducten
Om informatieproducten te ontwikkelen is vaak patiënt data nodig. Deze is niet of moeilijk beschikbaar omdat hier persoonsgegevens inzitten. Een fictieve dataset die representatief is kan goed helpen om software alsnog te ontwikkelen.

3. App Store -
Een omgeving waarin applicaties aangeboden kunnen worden aan eindgebruikers. Dit is vergelijkbaar met de Apple Appstore.

4. DevOps Tools
DevOps tools zijn tools die de ontwikkeling en operatie van software ondersteunen. Deze tools ondersteunen in verschillende fasen van de ontwikkeling en operatie cyclus. Voorbeelden zijn Git voor versiebeheer van software en Azure voor het bijhouden van taken.

5. Modelgedreven ontwikkeling
Dit is een methode van het ontwikkelen van software waarbij niet wordt geprogrammeerd, maar gemodelleerd. Dit houdt in dat gebruikt wordt gemaakt van visuele modellen om een programma te maken. Deze low-code manier van programmeren staat toe om sneller te kunnen ontwikkelen.

Welke "Ontwikkel Tool" vindt u het "meest belangrijk"? *

- 1. Software Development Kit
- 2. Een test dataset voor de ontwikkeling van informatieproducten
- 3. App Store
- 4. DevOps Tools
- 5. Modelgedreven ontwikkeling

Welke "Ontwikkel Tool" vindt u het "minst belangrijk"? *

- 1. Software Development Kit
- 2. Een test dataset voor de ontwikkeling van informatieproducten
- 3. App Store
- 4. DevOps Tools
- 5. Tools voor Scrum/Agile Methodiek

Hoeveel belangrijker is de "meest belangrijke Ontwikkeling Tool" ten opzichte van anderen? *

LET OP: de meest meest belangrijke beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker deze optie is ten opzichte van de andere opties met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker".

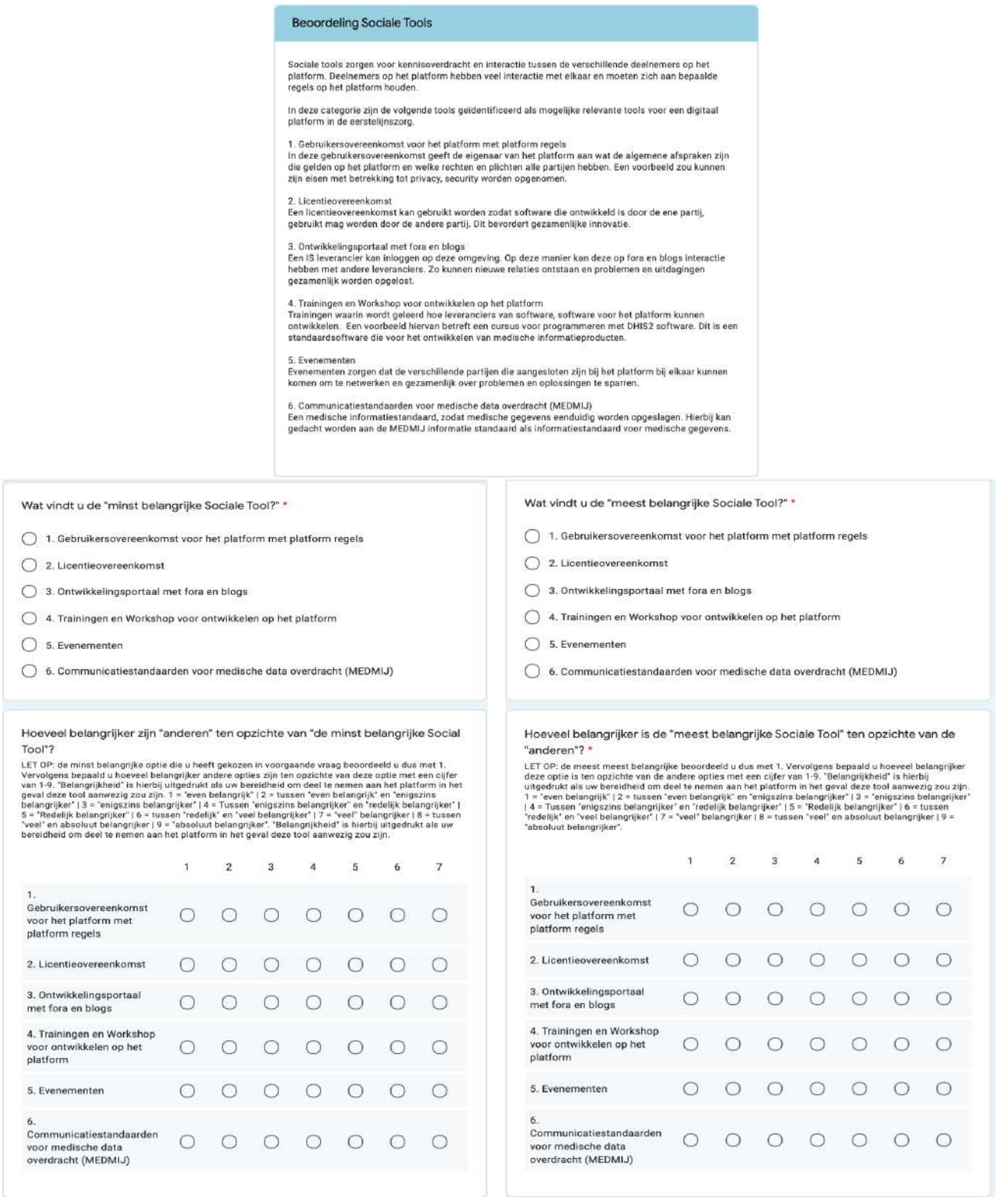
	1	2	3	4	5	6	7	8
1. Software Development Kit	○	○	○	○	○	○	○	○
2. Een test dataset voor de ontwikkeling van informatieproducten	○	○	○	○	○	○	○	○
3. App Store	○	○	○	○	○	○	○	○
4. DevOps Tools	○	○	○	○	○	○	○	○
5. Modelgedreven ontwikkeling	○	○	○	○	○	○	○	○

Hoeveel belangrijker zijn "anderen" ten opzichte van "de minst belangrijke Ontwikkel Tool?" *

LET OP: de minst belangrijke optie die u heeft gekozen in voorgaande vraag beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker andere opties zijn ten opzichte van deze optie met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker". "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn.

	1	2	3	4	5	6	7	8
1. Software Development Kit	○	○	○	○	○	○	○	○
2. Een test dataset voor de ontwikkeling van informatieproducten	○	○	○	○	○	○	○	○
3. App Store	○	○	○	○	○	○	○	○
4. DevOps Tools	○	○	○	○	○	○	○	○
5. Tools voor Scrum/Agile Methodiek	○	○	○	○	○	○	○	○

Appendix E.5: evaluation of DBRs



Beoordeling Sociale Tools

Sociale tools zorgen voor kennisoverdracht en interactie tussen de verschillende deelnemers op het platform. Deelnemers op het platform hebben veel interactie met elkaar en moeten zich aan bepaalde regels op het platform houden.

In deze categorie zijn de volgende tools geïdentificeerd als mogelijke relevante tools voor een digitaal platform in de eerstelijnszorg.

1. Gebruikersovereenkomst voor het platform met platform regels
In deze gebruikersovereenkomst geeft de eigenaar van het platform aan wat de algemene afspraken zijn die gelden op het platform en welke rechten en plichten alle partijen hebben. Een voorbeeld zou kunnen zijn eisen met betrekking tot privacy, security worden opgenomen.

2. Licentieovereenkomst
Een licentieovereenkomst kan gebruikt worden zodat software die ontwikkeld is door de ene partij, gebruikt mag worden door de andere partij. Dit bevordert gezamenlijke innovatie.

3. Ontwikkelingsportaal met fora en blogs
Een IS leverancier kan inloggen op deze omgeving. Op deze manier kan deze op fora en blogs interactie hebben met andere leveranciers. Zo kunnen nieuwe relaties ontstaan en problemen en uitdagingen gezamenlijk worden opgelost.

4. Trainingen en Workshop voor ontwikkelen op het platform
Trainingen waarin wordt geleerd hoe leveranciers van software, software voor het platform kunnen ontwikkelen. Een voorbeeld hiervan betreft een cursus voor programmeren met DHIS2 software. Dit is een standaardsoftware die voor het ontwikkelen van medische informatieproducten.

5. Evenementen
Evenementen zorgen dat de verschillende partijen die aangesloten zijn bij het platform bij elkaar kunnen komen om te netwerken en gezamenlijk over problemen en oplossingen te sparren.

6. Communicatiestandaarden voor medische data overdracht (MEDMIJ)
Een medische informatiestandaard, zodat medische gegevens eenduidig worden opgeslagen. Hierbij kan gedacht worden aan de MEDMIJ informatie standaard als informatiestandaard voor medische gegevens.

Wat vindt u de "minst belangrijke Sociale Tool?" *

- ◯ 1. Gebruikersovereenkomst voor het platform met platform regels
- ◯ 2. Licentieovereenkomst
- ◯ 3. Ontwikkelingsportaal met fora en blogs
- ◯ 4. Trainingen en Workshop voor ontwikkelen op het platform
- ◯ 5. Evenementen
- ◯ 6. Communicatiestandaarden voor medische data overdracht (MEDMIJ)

Wat vindt u de "meest belangrijke Sociale Tool?" *

- ◯ 1. Gebruikersovereenkomst voor het platform met platform regels
- ◯ 2. Licentieovereenkomst
- ◯ 3. Ontwikkelingsportaal met fora en blogs
- ◯ 4. Trainingen en Workshop voor ontwikkelen op het platform
- ◯ 5. Evenementen
- ◯ 6. Communicatiestandaarden voor medische data overdracht (MEDMIJ)

Hoeveel belangrijker zijn "anderen" ten opzichte van "de minst belangrijke Social Tool"?

LET OP: de minst belangrijke optie die u heeft gekozen in voorgaande vraag beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker andere opties zijn ten opzichte van deze optie met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker". "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn.

	1	2	3	4	5	6	7
1. Gebruikersovereenkomst voor het platform met platform regels	◯	◯	◯	◯	◯	◯	◯
2. Licentieovereenkomst	◯	◯	◯	◯	◯	◯	◯
3. Ontwikkelingsportaal met fora en blogs	◯	◯	◯	◯	◯	◯	◯
4. Trainingen en Workshop voor ontwikkelen op het platform	◯	◯	◯	◯	◯	◯	◯
5. Evenementen	◯	◯	◯	◯	◯	◯	◯
6. Communicatiestandaarden voor medische data overdracht (MEDMIJ)	◯	◯	◯	◯	◯	◯	◯

Hoeveel belangrijker is de "meest belangrijke Sociale Tool" ten opzichte van de "anderen"? *

LET OP: de meest meest belangrijke beoordeeld u dus met 1. Vervolgens bepaald u hoeveel belangrijker deze optie is ten opzichte van de andere opties met een cijfer van 1-9. "Belangrijkheid" is hierbij uitgedrukt als uw bereidheid om deel te nemen aan het platform in het geval deze tool aanwezig zou zijn. 1 = "even belangrijk" | 2 = tussen "even belangrijk" en "enigszins belangrijker" | 3 = "enigszins belangrijker" | 4 = Tussen "enigszins belangrijker" en "redelijk belangrijker" | 5 = "Redelijk belangrijker" | 6 = tussen "redelijk" en "veel belangrijker" | 7 = "veel" belangrijker | 8 = tussen "veel" en absoluut belangrijker | 9 = "absoluut belangrijker".

	1	2	3	4	5	6	7
1. Gebruikersovereenkomst voor het platform met platform regels	◯	◯	◯	◯	◯	◯	◯
2. Licentieovereenkomst	◯	◯	◯	◯	◯	◯	◯
3. Ontwikkelingsportaal met fora en blogs	◯	◯	◯	◯	◯	◯	◯
4. Trainingen en Workshop voor ontwikkelen op het platform	◯	◯	◯	◯	◯	◯	◯
5. Evenementen	◯	◯	◯	◯	◯	◯	◯
6. Communicatiestandaarden voor medische data overdracht (MEDMIJ)	◯	◯	◯	◯	◯	◯	◯

Appendix E.6: evaluation of SBRs

10.6 Appendix F: interview notes

Out of four respondents were contacted that stated that they had difficulty conducting the BWM. The notes of these conversations are presented below.

Interview 1
Date: 14-4-2021
Represents: Advanced Diagnostics company

Unclarity regarding the method

- Phrasing of question did not seem to be right for evaluation of categories of boundary resources
- Though 9 was best and 1 was worst in all cases. (not compared to the best or worst selected alternative)
- Method was therefore confusing
- Conclusion: use different tool to use method that allows for better understanding.

Unclarity regarding the boundary resources

- REST API can only be offered by platform complementors, not platform owners
- Understands MEDMIJ very well. Is very familiar. Therefore, considered more important.
- Did not understand what Model Driven Development was. Never heard of it.
- Product complementarity APIs were too vague. Besides the these could be implemented by the platform complementor.
- A testing environment would be very unpractical. It is very complicated to build a test data set that could be used for the purpose as described. Medical data is too complicated for data. Too objections.

Other statements.

- Would have benefited from more background information on the topic.
- Was willing to read more, and spend more time in order to better fill in the survey
- Would have preferred to have interview rather than survey.
- Installed base friendly approach was confusing.

Interview 2
Date: 9-4-2021
Represents: IS

Unclarity regarding the method

- *Method was confusing. did not understand what to fill in. It was a puzzle.*
- *Did not understand the pairwise comparison.*

Unclarity regarding the boundary resources

- Manny years of experience in the field, however met with concepts that he was not familiar with.
- Model Driven Development.
- Terms and conditions were too vague could mean anything. Same goes for SDK. Level of maturity of these is very relevant.

Other statements.

- *Difficult to conceptualize offering service through a digital platform (installed base friendly approach)*
- *Therefore, hard to imagine how specific would work. What does the platfrom do for me? How do I work together with others? Do I want to work together with others?*
- *This would have been clearer in semi structured interviews.*

10.7 Appendix G: Results of the Kruskal-Wallis Test

25	21
10	20
26	30
28	14
29	31
27	32
24	13
15	16
23	22
12	9
17	18
2	8
1	5.5
5.5	4
7	3
19	11
T: 270.5	T: 257.5
N = 16	N = 16

Table G.1: an overview of the results of the Kruskal-Wallis test.