Tampere University

MILLA RATIA

Business Analytics Creating Value in the Private Healthcare Sector

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ACADEMIC DISSERTATION
To be presented, with the permission of
the Faculty of Management and Business
of Tampere University,
for public discussion in the Tampere University,
on 28 January at 12 o'clock.

ACADEMIC DISSERTATION
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Finland

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ISBN 978-952-03-2267-0 (print)
ISBN 978-952-03-2268-7 (pdf)
ISSN 2489-9860 (print)
ISSN 2490-0028 (pdf)
http://urn.fi/URN:ISBN:978-952-03-2268-7

PunaMusta Oy – Yliopistopaino
Joensuu 2022

Acknowledgements

This has been a fascinating journey enabled by amazing people surrounding me. I feel grateful for all the support and opportunities that led me to this point. Without you, I wouldn't be here.

Firstly, I would like to express my deepest gratitude to my supervisor Professor Nina Helander. I really appreciate when you trusted my abilities and challenged me to jump into the process from day one. For giving me the freedom to grow and be there, when I needed support. Also, I want to thank MSc. Tech. Jussi Myllärniemi for being patient, supportive and inspiring.

Secondly, I want to thank the pre-examiners of my dissertation, Professor of Practice, Maritta Perälä-Heape and Deputy Director Mohamed Zaki, for their very valuable feedback to my manuscript and for excellent recommendations. I acknowledge Professor Hannu Kärkkäinen's and Professor Miia Martinsuo's valuable feedback that helped me to improve the manuscript before the pre-examination phase.

Also, I warmly thank Dr. Marco Milardi, for mentoring me through this process. You believed in me, even when I didn't believe in myself. BSc. Aleksander Lempinen, I appreciate a lot challenging me in the field of BA and giving me fresh ideas. Adjunct professor Markus J. Rantala, thank you for inspiring me to this scientific journey.

I am also grateful to Assistant Professor Henri Hussinki, Dr. Miikka Palvalin, Dr. Jari Jussila, Dr. Pasi Hellsten, Dr. Virpi Sillanpää and Dr. Hannele Väyrynen for inspiring me during my journey. I want to thank the Faculty of Management and Business for administrative and practical support.

I am grateful to all active people in organisations that participated in this study in form of interviews. My most sincere thanks go to those organizations and people who opened stories of their BA journeys.

I thank my friends and colleagues for understanding my busy schedule during these years and accepting it. Liikka, Natalie, Irina, Irene, Niina, Matilda, Pia, you have never had doubts. Ilkka, Rauha, Timo, Kirsi, Markus you believed in my skills and motivation.

Also, I want to thank you Repe, Ani, and Rami, for supporting me during my first years. In addition, Janette, Mette, Riitta, Jussi and Micke, I highly appreciate your support during the last years of my research process.

I am very grateful to my family. Mum and Dad, thank you for supporting my aspirations and encouraging me to take the next step. You have always told me that hard work pays off. Grandparents, you have always told me to reach for the stars. Sister, you are one of the most inspiring scientists. Your love and support enabled me to walk through this journey. I am grateful for that.

Helsinki,

December 2021 Milla Ratia

"Knowing is not enough; we must apply.
Willing is not enough; we must do."

– Johann Wolfgang von Goethe

Abstract

Data, and more specifically analytics, have recently become key factors in gaining competitive advantage through digitalization in many businesses and industries. New digital products and services not only require accurate and timely access to data, but also create enormous amounts of new data. Strong analytical capability in an organization can be seen as the key to digitalization; however this requires people, process, technology, and data capabilities. After all, doing good business requires accurate data to enable decision-making. Moreover, organizations, including those in the private healthcare sector, seek operational excellence and effectiveness in their processes and target cost effectiveness.

By optimizing administrative and managerial processes, more cost saving operations can be made. Increasing competition in the market, now including both private and public healthcare operators, has caused managers and executives to show an increasing interest in different data utilization methods and technologies, such as Business Analytics (BA), Business Intelligence (BI), and Artificial Intelligence (AI) practices, to be able to explore and exploit the organizational data siloed in different operational systems, and thus create business value. Previous literature on business analytics and value creation offers a good framework for research. However, there are few research studies that focus on business analytics for value creation, especially in the context of the private healthcare sector.

The purpose of this research is to understand the role of BA in value creation, in the context of the Finnish private healthcare sector. In the theoretical part of this dissertation, the utilization of business analytics is investigated, and a value creation framework is created. The empirical part of thesis consists of 47 semi-structured thematic interviews. The data was collected during 2017-2019. This thesis is a compendium of five individual publications, answering three research questions. The main contribution of this doctoral research fills the gap in understanding BA utilization in the context of the private healthcare sector in Finland.

Keywords: Business Analytics, business analytics tool utilization, value creation, private healthcare sector

Tiivistelmä

Data ja liiketoiminnan analytiikka ovat avainasemassa digitalisaation hyödyntämisessä sekä muodostavat kilpailuetua monissa yrityksissä eri toimialoilla. Samalla kun uudet digitaaliset tuotteet ja palvelut edellyttävät paitsi oikeellista ja oikea-aikaista dataa, niin ne myös synnyttävät valtavia määriä uutta dataa. Tämä edellyttää organisaatiolta erilaisia kyvykkyyksiä, kuten ihmisiä, prosesseja, teknologiaa ja dataa. Menestyksekkään liiketoiminnan rakentaminen edellyttää usein datapohjaista päätöksentekoa. Organisaatiot, kuten myös sosiaali- ja terveudenhuollon alan yritykset, pyrkivät operatiiviseen tehokkuuteen prosesseissaan ja tavoittelevat kustannustehokkuutta.

Optimoimalla hallinnollisia ja johtamisen prosesseja voidaan tehdä huomattavasti enemmän kustannuksia säästäviä toimia. Lisääntyvä kilpailu markkinoilla, joihin lukeutuu sekä yksityisiä että julkisia sosiaali- ja terveydenhuollon toimijoita, on saanut ylimmän johdon kiinnostumaan erilaisista datan hyödyntämisen menetelmistä ja -teknologioista, kuten liiketoiminnan analytiikasta (Business Analytics), liiketoimintatiedon hallinnasta (Business Intelligence) ja tekoälystä (Artificial Intelligence), jotta he voivat hyödyntää eri operatiivisiin järjestelmiin siiloutunutta organisaatiodataa ja siten luoda liiketoiminnalle arvoa. Liiketoiminnan analytiikan ja arvonluonnin tutkimussuunnat ovat olleet ajankohtaisia aiheita myös kirjallisuudessa. On kuitenkin olemassa vain rajallinen määrä tutkimusta, jossa keskitytään liiketoiminta-analytiikkaan sekä arvonluontiin, erityisesti yksityisen sosiaali- ja terveydenhuoltosektorin kontekstissa.

Näin ollen, tämän tutkimuksen tarkoituksena on ymmärtää liiketoiminnan analytiikan roolia arvonluonnissa Suomen yksityisen sosiaali- ja terveydenhuoltosektorin kontekstissa. Väitöskirjan teoriaosuudessa tutkitaan liiketoiminta-analytiikan hyödyntämistä ja luodaan arvonluonnin viitekehys. Tutkielman empiirinen osa koostuu 47 puolistrukturoidusta teemahaastattelusta. Aineisto kerättiin vuosien 2017-2019 aikana. Väitöstutkimus on kooste viidestä yksittäisestä julkaisusta, jotka vastaavat kolmeen tutkimuskysymykseen. Tämän väitöstutkimuksen tärkein kontribuutio on lisätä ymmärrystä liiketoiminta-analytiikan

hyödyntämisen mahdollisuuksista yksityisen sosiaali- ja terveydenhuollon sektorilla Suomessa.

Avainsanat: Liiketoiminta-analytiikka, analytiikkatyökalut, arvonluonti, yksityinen sosiaali- ja terveydenhuoltosektori

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Original publications

Publication I	Ratia, M., Myllärniemi, J. and Helander, N. (2017). Benefits and Required Capabilities of BI-tools in the Private Healthcare. Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland. September 20–21, 2017, pp. 103-110.
Publication II	Ratia, M., Myllärniemi, J. and Helander, N. (2018) The new era of business intelligence: Big Data potential in the private health care value creation, Meditari Accountancy Research, Vol. 26 Issue: 3, pp. 531-546.
Publication III	Ratia, M., Myllärniemi, J. and Helander, N. (2018). Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare?. Proceedings of the 22nd International Academic Mindtrek Conference. ACM. Tampere, Finland. October 10–11, 2018, pp. 222-227.
Publication IV	Ratia, M., 2018. Intellectual Capital and BI-tools in Private Healthcare Value Creation. The Electronic Journal of Knowledge Management, Vol 16, Issue 2, pp. 143-154.
Publication V	Ratia, M., Myllärniemi, J. and Helander, N. (2019), The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics, Measuring Business Excellence, Vol. 23 No. 4, pp. 396-410.

Table 1. Author's contribution to publications

Publication	Author	Role of the author
Benefits and Required Capabilities of BI tools in the Private Healthcare	Lead author	The author made most of the research design, data collection, development of the theoretical framework of the research, positioning of the study and writing the paper.
Intellectual Capital and BI tools in Private Healthcare Value Creation	Solo author	The author was the sole contributor of this article.
Robotic Process Automation Creating Value by Digitalizing Work in the Private Healthcare?	Lead author	The author made most of the research design, data collection, development of the theoretical framework of the research, positioning of the study and writing the paper.
The new era of business intelligence: Big Data potential in the private health care value creation	Lead author	The author made most of the research design, data collection, development of the theoretical framework of the research, positioning of the study and writing the paper.
The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics	Lead author	The author made most of the research design, data collection, development of the theoretical framework of the research, positioning of the study and writing the paper.

1 Introduction

1.1 Background and motivation for the study

Even though digitalization, business analytics (BA), and business intelligence (BI) are relatively novel concepts, supporting organizational and managerial decision-making using data is not a new phenomenon, as in its modern form it has been in use for almost 60 years (Power, 2008). Data and further, analytics, have recently become key factors in gaining competitive advantage through digitalization in many businesses and industries (e.g., Heiling et al., 2019). Yet, in the healthcare sector, data has previously been considered as a side-product that has to be stored, processed, and analyzed, rather than a valuable asset creating competitive advantage (Metha and Pandit, 2018). However, as early as 1995, the Finnish Ministry of Social Affairs and Health introduced the first Finnish national strategy for applying information technology to healthcare and social welfare, where patients and citizens were described as informed and active participants in the healthcare delivery process (Vehko et al., 2019). During the last more than twenty years, there have been many efforts to align those political visions from the past to enhance the everyday routine of healthcare sector performance (Vehko et al., 2019). The vision was still valid in 2020, when the objective was to enable online self-service opportunities for citizens, enable efficient information systems for healthcare professionals, knowledge and data-based management, cooperation between different parties in providing information and information systems, and data-friendly architecture solutions. Successful combination of these digital capabilities can also create potential for new service innovations (Vehko et al., 2019; Finnish Ministry of Social Affairs and Health, 2015). The initiation of new digital services not only require accurate and timely access to data, but also create enormous amounts of new data (Tresp et al., 2016). Nevertheless, seeking operational excellence and effectiveness in processes is not only in the public sector development agenda, as the private healthcare sector is also pursuing the optimization of their services and targeting cost effectiveness (Myllärniemi

et al., 2012; Kujala et al., 2006). Strong analytical capability in an organization can be seen as the key to digitalization. It does however, require people, process, technology, and data capabilities (Carlsson, 2018). After all, doing good business requires accurate data and enables decision-making (e.g., Krumholz, 2014; Spruit et al., 2014; Grierson et al., 2015). Moreover, by optimizing administrative and managerial processes, for example the enhanced allocation of resources and more efficient supply chain management or locating assets and human resources in real-time, even more cost saving operations can be made (Ward et al., 2014).

Digitalization and data-driven decision-making have become a phenomenon in many industries and are also pushing the healthcare sector to innovate new data-based products and services (Vehko et al., 2019). Moreover, changes in the healthcare business environment and legislation have also put significant pressure on the private sector healthcare organizations to enhance their business practices towards data-driven operational efficiency and cost effectiveness (e.g., Demirkan, 2013; Metha and Pandit, 2018; Myllärniemi et al., 2012). Thus, private healthcare is seeking ways to enhance productivity and at the same time compete on the market for the best digital customer experience. Digitalization involves opportunities as well as limitations in the Finnish healthcare sector, such as having a hybrid healthcare system which is a special characteristic of the Finnish healthcare system.

First, there is a hybrid system for providing healthcare services, as there are two parallel systems in Finland: the public and the private healthcare sector. Mostly, Finnish healthcare is very similar to that in other Scandinavian countries, basically offering different health services that are primarily delivered by publicly owned and operated service providers, funded mainly through general taxation where the cost is relatively low for the consumers of the services (Teperi et al., 2009; Smith and Rauhut, 2019; Tynkkynen et al., 2018). Nevertheless, the Finnish healthcare sector includes services that are provided by both public and private sectors, which are both under pressure to enhance the productivity of healthcare services (Myllärniemi et al., 2012; Kujala et al., 2006). The whole healthcare system is about to face a major reform and requires new ways of performing (Kaihlanen et al., 2018). The modernization of the healthcare sector will enable more choice for healthcare customers (Smith and Rauhut, 2019).

Many structural changes will be taking place in the near future, creating significant expectations towards efficiency in healthcare operations. Moreover, requirements for operational efficiency will grow, as a shortage of nursing staff and demographic changes in the aging Finnish population will put even more economic pressure on the healthcare sector, which already lacks resources (Rissanen et al., 2020; Hennala et al., 2017; Kilpeläinen et al., 2016). However, expectations regarding quality and availability are also increasing (Hennala et al., 2014; Finne-Soveri et al., 2014). To be able to respond to this challenge, the Finnish government is working on Social and Health Care reform (SOTE in Finnish), which is considered to be the answer to the more cost-effective production of healthcare services. This major change in the healthcare structure also gives an opportunity for new

approaches and technologies (Hennala et al., 2017). Moreover, reform over choice might expand the market into competition between the public and private sectors (Aalto et al., 2017). Digitalization is creating challenges in terms of various different data sources, but could also be a valid solution, as many customers are adapting to different digital service channels and technological development, which has supported available healthcare services (Rissanen et al., 2020). Also, the services of private healthcare are becoming more digitalized, creating a large amount of data (Vehko et al., 2019).

Second, just as in many other European healthcare systems, the Finnish hybrid healthcare system has recognized the potential of data and digitalization in improving care and reducing operational costs (Jormanainen et al., 2019). Increasing costs have forced the healthcare system to seek out new ways to enhance overall productivity and streamline physical services and operations into digital mode (Rissanen et al., 2020). New approaches and technologies, such as BA/BI and artificial intelligence (AI) enable operational efficiency and also new services (Hennala et al., 2017). As one of the most significant value creation factors in many industries, information technology has not been very fast to penetrate the healthcare sector, but now there is pressure for change (Hennala et al., 2017; Teperi et al., 2009). The suggested reform mixes public and private healthcare services even more as well as increasing demands for new innovations and technological solutions to succeed (Hennala et al., 2017). In the private healthcare sector, these changes have demanded new activities from healthcare management and operational clinical staff, who previously concentrated on clinical healthcare, making them also optimize the overall management practices to enhance cost efficiency (Kujala et al., 2006).

The struggle to enhance the operational efficiency of various organizational processes, searching for new ways to make sure resources are utilized efficiently while ensuring high quality patient care at the same time, while the game changes and the digital customer experience is being more and more highlighted in other industries, is enabled by different technological development capabilities (Foshay and Kuziemsky, 2014; Bolton et al., 2018; Breidbach et al., 2018). Also, the amounts of generated organizational data supporting decision-making regarding business activities and data-based service as well as product development are growing significantly (Raghupathi and Raghupathi, 2014; Ratia and Myllärniemi, 2017; Spruit et al., 2014). However, among others, the private healthcare sector is keen to find novel and more beneficial opportunities to understand its business practices to enhance business performance (Demirkan, 2013). The increasing competition in the market, now including both private and public healthcare operators, has caused managers and executives to take increasing interest in different data utilization methods and technologies, such as BA, BI, and AI practices, to be able to explore and exploit organizational data stored in different operational systems, and thus, create business value through improving operational and strategic performance (Elbashir et al., 2013). Thus, the changing healthcare sector demands different kinds of data-enabled and data-driven decisions, both in daily clinical work and in the business operations of the organization

(Bates et al., 2014; Cases et al., 2013; Katsaliaki et al., 2011; Stewart et al., 2016). The overall amount of health-related data that is being generated and stored in healthcare organizations is growing. Moreover, there is also a large amount of operative business data supporting the organizational decision-making on all organizational levels (Spruit et al., 2014; Raghupathi and Raghupathi, 2014; Raghupathi, 2010). As in many other industries, private healthcare sector organizations are also seeking to understand their business practices better to enable better performance (Demirkan, 2013). Clearly, as there is a need to enhance decision-making, there is also a need for tools that can support both the clinical work and also business decisions (Krumholz, 2014; Swanson, 2012). This leads to a situation where managers and organizational executives have shown an increasing interest in BA solutions which enable them to explore and exploit organizational data stored in different systems, and also to gain operational and strategic performance improvements by utilizing BA tools to support their organizational decision-making process (Elbashir, 2013).

However, the concept of BA itself can be considered a rather complex combination of several interchangeable definitions rather than excluding attributes. In other words, different approaches complement each other. Thus, BI can be seen as a unifying phrase or term that combines different tools or technologies, applications, and methods or processes (Turban et al., 2008; Sun et al., 2017; Cao et al., 2015). In addition, BA is a combination of different technologies, tools and techniques, as well as practices and methods enabling business data analysis, to enable the understanding of the impacts of business decision for organizational decision-makers and support the right decisions (Côrte-Real et al., 2014; Nykänen et al., 2016). Nevertheless, it is clear that the definition of BA is multifaceted and is expanding over time. Although some research has been conducted, specializing in BA and overall in digitalization (e.g., Rissanen et al., 2020; Vehko et al., 2019; Hennala et al., 2017; Myllärniemi et al., 2012; Teperi et al., 2009), none of this research resolves the questions of BA utilization from a business perspective. There are also multiple comprehensive governmental reports, focusing on data and digitalization, but none of them have a business perspective (e.g., the Finnish Ministry of Social Affairs and Health, 2015). As in any other business /industry, private healthcare companies seek better performance in their operations and thus, profit (e.g. Elbashir et al., 2013; Raghupathi and Raghupathi, 2014; Raghupathi, 2010; Demirkan, 2013). The main focus of current BA and digitalization research is strongly from the perspective of the public sector or hybrids that combine public and private interests (e.g., Rissanen et al., 2020; Laihonen and Kokko, 2020; Vehko et al., 2019; Raitoharju, 2007). Regarding the special nature of public healthcare (e.g., Laihonen and Kokko, 2020), research conducted in the context of the public sector does not have a monetary business value perspective and the results gained in public sector research cannot be applied to the private sector. As a business-driven organization, private healthcare companies are able to act more freely (e.g., Lakomaa, 2018) and also search for data-based innovations. However, to date there has been no research focusing on the business value of BA in the private healthcare industry in Finland.

Similar to any other business, private healthcare sector companies are also actively seeking for new ways to improve their business operations and practices, while also understanding the relevant organizational data and as a result, improving the overall performance of the organization through enhanced decision-making. As an example, different elements of BA, such as BI, Robotic Process Automation (RPA), and AI can be utilized in automating manual processes, for example, written clinical notes and prescriptions, medical imaging, or processing laboratory results. Also, processing social media data or machine generated sensor data more efficiently enables enhanced decision-making (Ratia and Myllärniemi, 2017; Ratia et al., 2017; Demirkan, 2013). BA can also be used to identify the most efficient treatments from a clinical and cost perspective. Moreover, more advanced BA or AI can also be applied to proactive preventative care (Raghupathi and Raghupathi, 2014). In addition, basic administrative and managerial processes can be optimized in the search for more efficient resource allocation and supply chain management or real-time locating of assets and human resources (Ward et al., 2014). These practical examples show that BA can be seen as a powerful digitalization tool that can bring business value to private healthcare organizations.

This dissertation examines how BA supports decision-making and creates business value from a managerial perspective, in the specific context of the private healthcare sector in Finland. The focus of this doctoral thesis is on examining the phenomenon of BA, providing new insight for both academic and managerial practices.

1.2 Research gap

Organizations operating in the field of private healthcare are striving to improve their operational efficiency in various business processes and are searching for new ways to enhance resource allocation, while ensuring high quality patient care at the same time, digitalization breaks into the industry, and the digital customer experience is gaining more and more importance (e.g., Foshay and Kuziemsky, 2014; Bolton et al., 2018; Breidbach et al., 2018). One result of the breakthrough of digitalization is the amount of organizational data generated which is increasing significantly, supporting decision-making regarding business activities and data-based services as well as product and service development (e.g., Raghupathi and Raghupathi, 2014; Ratia and Myllärniemi, 2017; Spruit et al., 2014).

There are multiple comprehensive governmental reports that focus on data and the breakthrough in data-driven digitalization, but they do not have a business perspective (e.g., the Finnish Ministry of Social Affairs and Health, 2015). However, the concept of BA itself has been widely studied in many industrial contexts, including the healthcare sector (e.g., Demirkan, 2013; Davenport, 2018; Sun et al., 2017; Nykänen et al., 2016; Cao et al., 2015; Turban et al., 2008). In the public healthcare sector, there have been several recent studies (e.g., Rissanen et al., 2020; Vehko et al., 2019; Hennala et al., 2017; Myllärniemi et al., 2012). Yet, none of this research resolves the question of utilizing the capabilities or value creation

of BA from a business or managerial perspective. Still, as any other business industry, private healthcare companies are also seeking the business and managerial perspective, to enhance performance in their operations and maximize business profit (e.g., Elbashir et al., 2013; Raghupathi and Raghupathi, 2014; Raghupathi, 2010; Demirkan, 2013). It is known that different elements of BA, such as BI, Robotic Process Automation (RPA) and AI can enhance performance and reduce costs, and thus, bring benefits to organizations (e.g., Ratia and Myllärniemi, 2017; Ratia et al., 2017; Demirkan, 2013). However, what is still unclear are the capabilities behind BA utilization, the value that can be created, and its future value creation potential.

The aim of this doctoral research is to fill the gap in understanding the utilization of BA capabilities in the context of the private healthcare sector in Finland. The study uses previous academic research on BA and value creation to build a theoretical framework that enables a deeper understanding of BA capabilities and future-oriented value creation potential. Even though, as a concept, both BA capabilities and value creation are well known in the literature, with differing interpretations, the combination of the two in the context of Finnish private healthcare is quite novel (e.g., Davenport, 2018; Brandão et al., 2016; Davenport and Kirby, 2016b; Lu et al., 2017; Chen et al., 2012; Nykänen et al., 2016; Möller et al., 2005; Walter et al., 2001).

In understanding the role of BA capabilities in value creation in the private healthcare sector in Finland, the following gaps are identified in this research:

Regarding the current state of BA capability utilization in private healthcare organizations:

- A more extensive perspective is lacking on the current state of BA capabilities, especially BA tools and their utilization in the Finnish private healthcare sector (e.g., Rissanen et al., 2020; Laihonen and Kokko, 2020; Vehko et al., 2019; Raitoharju, 2007).
- The benefits of BA utilization have been studied previously, especially from the healthcare operations perspective, but the managerial perspective has been less in focus (e.g., Laihonen and Kokko, 2020; Abidi and Abidi, 2019; Lakomaa, 2018; Brandão et al., 2016).

Regarding the value creation of BA utilization in private healthcare organizations:

- The role of BA in value creation has been studied previously but understanding of different levels of value production are lacking (e.g., Raghupathi and Raghupathi 2014; Ward et al., 2014; Božič and Dimovski, 2019).
- The potential of BA value creation in an organizational innovation process, from a business perspective lacks information, especially in healthcare sector research (e.g., Abidi and Abidi, 2019; Sun et al., 2016; Cao et al., 2015).

Regarding the future potential of BA value creation in private healthcare organizations:

- As understanding of different levels of value production has been missing, there is also a lack of understanding of the future potential of BA value creation, limiting understanding to previous value production levels (e.g., Božič and Dimovski, 2019;

Acharya et al., 2018; Vidgren et al., 2017; Raghupathi and Raghupathi, 2014; Elbashir et al., 2013).

Clearly, there is a need to enhance understanding of the role of BA capabilities in value creation in the private healthcare sector in Finland. After all, a successful combination of different digital capabilities can also create potential for new service innovations (Vehko et al., 2019; the Finnish Ministry of Social Affairs and Health 2015).

1.3 Purpose of the study and research questions

The doctoral dissertation concerns utilization of BA capabilities in the private healthcare sector in Finland. As described previously, there has not been much research in this field from a business or managerial perspective in Finland and worldwide. The existing research focuses mostly on either BA utilization in general or, in a few minor cases, BA utilization in the public healthcare sector. Even though the amounts of data generated for clinical purposes have increased enormously, BA utilization can clearly be beneficial for managerial purposes. Therefore, the purpose of this dissertation is to examine the role of BA capabilities for the creation of business value in the specific context of the private healthcare sector in Finland, from a managerial perspective. However, the focus is also strongly on a holistic understanding of the BA concept, capabilities, evolution of BA-related methods and technologies, and business value creation in the context of private healthcare.

The research also has a practical purpose: to support managers and executives to identify the practical potential of the business value that BA utilization brings. Practitioners need the potential of different BA evolution stages to be described, to be able to make the required stages of implementations in their own organizations. Also, it is important to understand what the BA capabilities are that enable business value creation. The research objective, supported by three more detailed research questions (RQ1-RQ3) together form a combination that covers the aim of the research to increase knowledge of BA utilization in the private healthcare sector in Finland. Therefore, this doctoral dissertation is focused on a research objective, as shown in Figure 1:

What is the role of BA capabilities in value creation in the private healthcare sector in Finland?

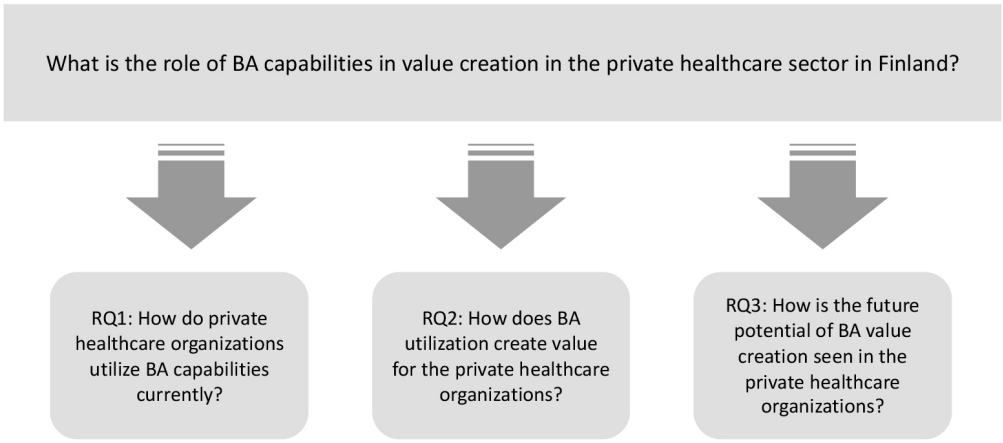
The main research objective is tackled by answering three more detailed research questions:

RQ 1: How do private healthcare organizations utilize BA capabilities currently?

RQ 2: How does BA utilization create value for the private healthcare organizations?

RQ 3: How is the future potential of BA value creation seen in private healthcare organizations?

Figure 1. The relationship between the research objective and the research questions.



A literature review is conducted in this research to find answers to these research questions along with practical methods described in published research papers. The first research question is very practical, as understanding of the basics, such as methods, technologies and available resources is essential, before moving on to the more complex research questions. This includes a literature review of the BA field as well as the current state introduced by the recent literature on BA utilization in healthcare. The purpose is to identify the technologies or tools in use and what the required capabilities are in order to succeed in BA practices. A theoretical framework for BA utilization is formed on the basis of previous literature and it is also reinforced by empirical findings. Typical features of BA utilization are well described in the literature; however, private healthcare has its own specifications.

After understanding the overall process and elements of BA, a more detailed perspective can be taken. The second research question seeks deeper understanding. Even though there is limited research in the previous literature on value creation in the private healthcare, moreover, there is even less research from the managerial perspective where the focus is on business value creation. The purpose of this research question is to examine the different levels of business value creation enabled by different BA practices and how they benefit the organizational processes. The qualitative case study approach utilized in answering this research question is required to gain a deep understanding of what is actually considered valuable in terms of business value creation. The research question sheds light on the steps can be taken to utilize BA in terms of business value.

After obtaining knowledge about the current state of BA utilization and understanding the business value creating elements, the observation of the future can take place. The third and final research question dives into the world of potential enabled by BA utilization. Here, the attention is on the future potential and understanding of how private healthcare organizations can benefit from the capabilities provided by BA.

1.4 Positioning the concept of Business Analytics, scope of the study and key concepts

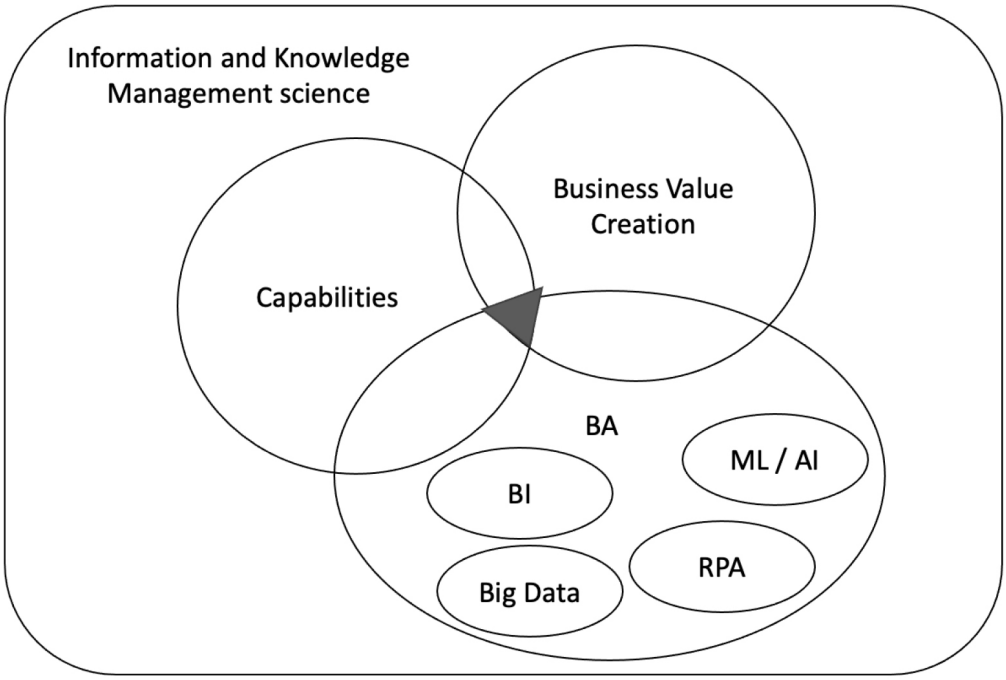
As already mentioned above, research in academic literature concerning BA utilization in the private healthcare from managerial perspective is still quite limited. Even though the need has existed for many years and private healthcare organizations have performed practical activities, there is a need to establish a discussion of BA utilization, data-driven decision-making, and its further potential in new product development. Thus, the intent of this doctoral dissertation is to provide an understanding of the phenomenon of BA utilization in the private healthcare sector in Finland, from the viewpoint of management of organizations and academic dialogue. In this study, the researched phenomenon is business value creation enabled by BA. However, the theoretical ground is based on the literature dealing with BA, especially focusing on the evolution of the concept, and in the literature of value creation, more closely business value creation. The empirical context of the research is the Finnish private healthcare sector. The study contributes to the crossroads of BA and value creation research. The results of the research establish a discussion on BA-enabled business value creation. As there is a limited amount of previous research showing the business value of BA utilization in private healthcare, this study offers a major contribution to the discussion.

The private healthcare sector is continuously looking for better ways to understand its business operations and the relevant related organizational data in its operational environment to be able to achieve better performance, with efficient organizational decision-making (e.g., Demirkan, 2013; Spruit et al., 2014). As organizational decision-making itself is likely to be based on data, thus efficient decision-making support processes, methods, and tools are required (Bolloju et al., 2002). Since the amount of data generated in the modern business environment has increased almost uncontrollably, organizations need to grow their capabilities in BA, to ensure enhanced decision-making and business value creation. Even though the decision-making process is based on data, there is a combination of capabilities behind it (e.g., Wang and Wang, 2008). Organizational decision-making in the healthcare sector may concern, for instance financial information, cost evaluation, and performance evaluation (Bose, 2003). However, now that the concept of BA has faced changes as new methods and concepts such as the recent emergence of Big Data, machine learning (ML), and AI, the benefits have also expanded from supporting decision-making to business value creation, thus bringing competitive advantage to the organization (Aydiner et al., 2019; Ratia and Myllärniemi, 2018; Trieu, 2017; Wang et al., 2016).

The concept of BA is multi-faceted, and covers several fields of research (e.g., Pirttimäki, 2006; Nykänen et al., 2016). However, this doctoral thesis is positioned in the field of knowledge and information management science. To gain a holistic overview of the examined concepts, it is also necessary to some extent to study elements that could be seen as part of the Information System (IS) research agenda, such as capabilities or functions of technologies (e.g., Brandão et al., 2016; Chen et al., 2012). In terms of the research on BA

utilization in the healthcare sector, there are several studies that looking at the capabilities of BA and other related concepts such as BI, Big Data and AI, but the focus of their research is on the clinical, not the managerial perspective, or on new products and innovations (e.g., Ratia and Myllärniemi, 2017; Wang et al., 2016; Wang et al., 2015; Jiang et al., 2014; Murdoch and Detsky, 2013).

Figure 2. Scope of the study.



Business Analytics

The literature shows that the concept of BA is a complicated combination of several different approaches. The approaches complement each other, rather than being mutually exclusive. For instance, Turban et al. (2008) have suggested that BA is a unifying phrase or term, combining different tools, applications, and methods. BA can also be described is a combination of technology and processes for information processing capabilities (e.g., Nykänen et al., 2016; Sun et al., 2017; Cao et al., 2015). However, BA can also be considered to be a process that produces data, information, and knowledge for organizational decision-making (Pirttimäki, 2006; Gilad et al., 1985; Nykänen et al., 2016). In addition, BA can be seen as the selection of different tools, technologies and techniques, practices and methods enabling business data analysis, and enabling understanding of the impacts on business decisions for organizations and supporting appropriate business decisions (Côrte-Real et

al., 2014; Nykänen et al., 2016). As Davenport (2018) has suggested, the organizational concept of BA can be divided into four consecutive stages, starting with BI and data management (Davenport, 2018). Further, the updated concept of BA also includes new methods and related concepts, e.g., Big Data, ML, and AI, which create a positive impact on organizational performance (Kakhki and Palvia, 2016; Trieu, 2017; Wang et al., 2016).

Nevertheless, it is certain that the field of BA, a disruptive technology and enabler of innovation, as an emerging and fast-growing sector, is bringing business decision-making to the next level, and creating competitive advantage (e.g., Sun et al., 2017; Cao et al., 2015; Cosic et al., 2015; Davenport and Harris, 2007; Kakhki and Palvia, 2016). Recent studies also show that there is a connection between BA and the organizational value creation process, for example, when there is timely access to relevant information, or by connecting various data types from different internal and external sources to be used efficiently in decision making (e.g., Krishnamoorthi and Mathew, 2018; Fink et al., 2017; Ratia et al., 2018; Ratia, 2018; Jinpon et al., 2011; Wang et al., 2016; Wang et al., 2015).

Business value creation

In academic research, value and value creation is not a novel field of study; however, there is no unified definition of the concept. The meaning of the concept has also changed as time has passed: In the mid 1980s, value creation described high-level organizational activities that bring value to the customer (Porter, 1985). However, later on, the perspective of business networks was added (Håkansson and Shehota, 1995). Closer to the millennium, value creation was described as a monetary and non-monetary trade-off between benefits and sacrifices (Lapierre, 2000; Parolini, 1999). For example, monetary value can enhance productivity or efficient resource utilization, whereas non-monetary value can include competence, market position, social rewards, time, and effort (Ojala and Helander, 2014; Myllärniemi and Helander, 2012; Nordgren, 2009). However, the essential factor here is that the value is defined as benefits relative to costs and not just benefits per se (Porter and Kramer, 2019; Ojala and Helander, 2014). In Möller et al.'s (2005) research, it is shown that value creation itself can have several layers of value, where it is created by utilizing value creating capabilities of different complexities that are also positioned on different value creation levels. (Möller et al., 2005). Where the complexity of value creation is increasing when moving towards the next level. However, the study points out that the former levels need to be stable and have a solid platform before moving up to the next level of value creation, where the importance of inter-organizational relationships and networks in a complex business environment is emphasized (Möller et al., 2005; Håkansson and Snehota, 1989).

When it comes to the business value created by BA/BI, it is clear and recognized that it has significant potential, and further, is a source of competitive advantage. It is still unclear exactly how value is created (Côrte-Real et al., 2017; Abbasi et al., 2016). However, there is

no doubt that profitability and productivity can be increased in organizations that utilize BA/BI (Côrte-Real et al., 2017; Barton and Court, 2012; Sharma et al., 2014; Seddon et al., 2017), even though the value of BA technologies is generated only together with other organizational capabilities of BA (Côrte-Real et al., 2017). Especially, the business value is explicit when it comes to using advanced analytics (Krishnamoorthi and Mathew, 2018). To be more specific, AI, ML, data science, predictive analytics, and Big Data are worthy of mention (Vidgren et al., 2017; Waller and Fawcett, 2013). However, to achieve operationally effective BA implementation in practice, and also to be a part of organizational processes can be very difficult to perform, and thus, true business value is also hard to generate (Nalchigar and Yu, 2018). Clearly, the true business value creation of BA requires certain capabilities of people, process, technology, and organization to succeed (Vidgren et al., 2017).

Capabilities

As a concept, the term capability is multifaceted and has several definitions. One view of capabilities is that it is the organizational capacity to implement and utilize combined resources, utilizing organizational processes. Mostly, they are based on organization-specific information, tangible, or intangible knowledge processes. (Amit and Schoemaker, 1997). Capabilities can be generally described as a collection or combination of high-level routines, competences or capacity, which can be learned and are highly patterned, repetitious and created within tacit knowledge (Mikalef et al., 2018; Winter, 2003). On the other hand, strong and complex interactions between organizational resources and competencies are required to build organizational capabilities purposely, so capabilities are merely a combination of organizational core resources that are under the control or orchestration of the organization (Mikalef et al., 2018; Grant, 1996; Amit and Schoemaker, 1997; Mikalef et al., 2019; Gold et al., 2001). This makes capabilities difficult to acquire, as they have to be created within the organization (Mikalef et al., 2018; Teece et al., 1997). In contrast, functionalities, which are sometimes confused with capabilities, of BA tools are functionalities from the information system perspective, which concerns the features of the system (Hawking and Sellitto, 2010). Both the more technically and operatively oriented concept of functionalities and the holistic concept of capabilities have an influence on supporting data-driven decision-making (Wieder and Ossimitz, 2015; Peters et al., 2016; Kulkarni et al., 2017). Also, the available organizational resources such as data, money, and human resources are often used as a supplementary concept to capabilities (Yeoh and Koronios, 2010; Buhasho et al., 2020). However, resources do have an impact on the creation of capabilities (Buhasho et al., 2020).

Nevertheless, capabilities can be considered to be the building blocks of competitive advantage in an organization. The combination of the BA capabilities required for business value creation is divisive. Leadership, technology, and talent capabilities have been mentioned by (Akter et al., 2016). In a broader interpretation, technology, people, data,

processes, and skills have been mentioned (Cosic et al., 2015). BA capabilities can also enhance the creation of organizational innovative capability (Ashrafi et al., 2019).

1.5 Structure of the research

This research consists of five academic publications, which are linked with each other in terms of context as well as through the data compilation part. Even though the publications relate to independent research objectives, the research method is the same. The first part of this doctoral thesis is the compilation or introductory part. In the first chapter of this doctoral dissertation, the motivation for this research is described and the background of the examined phenomena is introduced. Also, the purpose of the study, research questions, and strategy are presented in the first chapter as well as the scope and positioning of the study in the field of Knowledge Management (KM) and IS research; the key concepts are also introduced.

In the second chapter, the theoretical basis for the research is described and explained. The concept of value creation and business value as well as the evolution phases of BA and its capabilities are presented. The theoretical framework is based on Möller et al.'s (2005) model of value production and modified from Seddon et al.'s (2017) BASM process model, together with Davenport's model of analytics evolution. The third chapter explains the methodological selections and describes the research and empirical setting along with data collection. Also, the process of data analysis is explained, and choices are argued. A summarized content of publications, contribution, and results of the individual publications is presented in Chapter 4. Furthermore, the publications and their contributions are listed in Table 3. The results of the research are discussed in Chapter 5. In addition, conclusions and evaluation of the research are presented in the fifth chapter.

The first part, or compilation part of the doctoral thesis, was written after the individual publication process had been completed. The second part of the thesis includes the five original publications, in the format in which they were published.

2 Theoretical background

The purpose of this chapter is to establish a theoretical background for the empirical part of the doctoral dissertation. Previous academic research literature has been used as the foundation for understanding the concepts of value creation and BA. First, this chapter introduces the concept of value creation in general. After this, BA as a business value enabler is introduced, followed by the evolution of BA.

2.1 The concept of value creation

As a holistic concept or field of academic research, value and value creation is not new. The literature, both earlier and more recent, has several definitions that are complementary rather than mutually exclusive (e.g., Winter and Szczepanek, 2008; Ojala and Helander, 2014; Laursen and Svejvig, 2016), although different perspectives on value and value creation often give different meanings to the primary concept over time. A few decades ago, for instance, Porter (1985) utilized the concept of value creation to describe high-level organizational activities that bring value to the customer, in addition to also identifying interorganizational value chains. Value creation was described as creating sustainable competitive advantage (Porter, 1985; Brandenburger and Stuart, 1996; Pagani, 2013). A decade later, Porter's (1985) view was criticized by several authors for excessive linearity and lack of business network perspective (e.g., Normann and Ramirez, 1993; Håkansson and Shehota, 1995). However, at the beginning of the 21st century, value creation was separated from value capture, as it was seen as a contribution to the utility of the final product or service to the end consumer (Bowman and Ambrosini, 2000; Pagani, 2013). A value network can be also defined as a participant in a cluster of economic actors collaborating to deliver value to the end user, with each participant taking responsibility for the success or failure of the established network (Pagani, 2013; Barnes, 2002; Sabat, 2002). Further, especially in business contexts, often the concepts of value and value creation are important issues to discuss, as it is important to understand the elements required and included in

the value creation process (e.g., Ojala and Helander, 2014). Also, concepts such as value, benefits, and value creation have been used interchangeably (e.g., Laursen and Svejvig, 2016). In addition, Holbrook (1999) has suggested a multifaced conceptualization of consumer value having high relevance to complex services, and eight types of value: efficiency, excellence, status, esteem, play, aesthetics, ethics, and spirituality (Holbrook, 1999; Keeling et al., 2021). Especially in healthcare, the benefits of value co-creation are essential, due to the remarkable challenges of managing services over the long term (Keeling et al., 2021). However, the framework suggested by Holbrook is more convenient when the aim is to perform evaluation at an individual level (Keeling et al., 2021). The concept of value creation can be the ultimate goal for organizations that aspire to innovations and adoption of new technologies to create organizational benefits and growth (Elia et al., 2020).

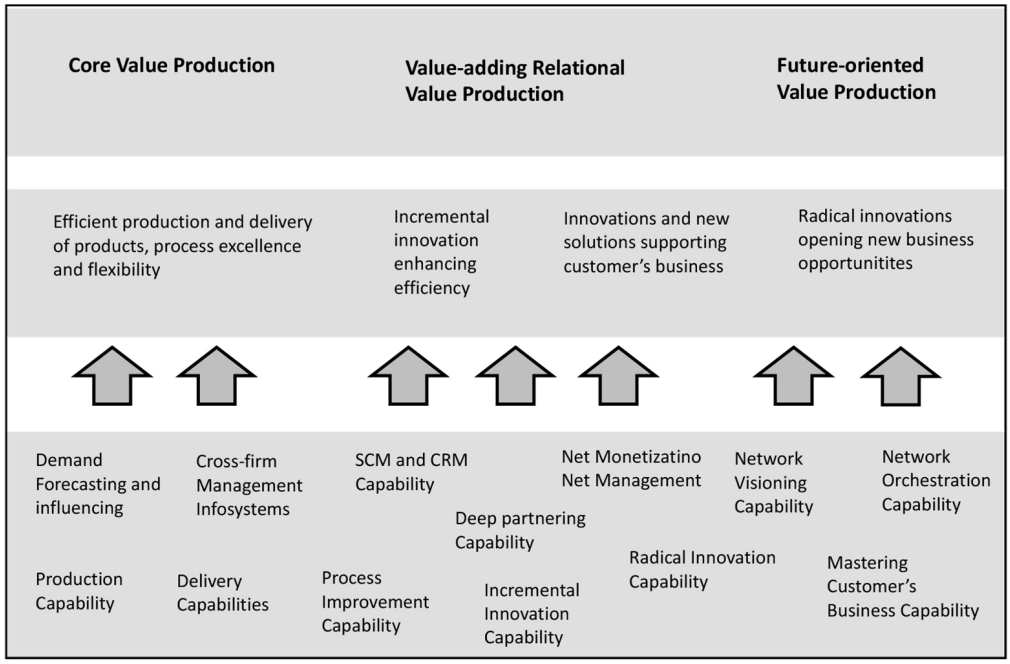
As an extended concept and ongoing discussion, value creation can also be described as a trade-off between benefits and sacrifices or the quotient of benefits/costs. Moreover, value creation can be monetary or non-monetary (e.g., Hugos et al., 2011; Lapierre, 2000; Parolini, 1999; Ojala and Helander, 2014; Laursen and Svejvig, 2016). Nevertheless, it is notable that value is described as benefits relative to costs rather than only benefits per se (Porter and Kramer, 2019). Monetary value can be considered for example as productivity or resource utilization, and non-monetary value can include elements such as competence, market position, social rewards, time, effort, and energy (Ojala and Helander, 2014; Myllärniemi and Helander, 2012; Nordgren, 2009). However, there is a risk in evaluating only the monetary benefits, as many companies seem to have been trapped for the last few decades in a traditional and outdated approach, evaluating value creation in a too narrow way and only optimizing short-term goals, such as financial performance. Practically, this has led to a bubble where the most important factors, the needs and requirements of their customers, have been ignored (Porter and Kramer, 2019). However, this again raises the question of what constitutes value for a company on a practical level? Lindgreen et al. (2012) suggest that business-related value is the monetary value of the various benefits a customer gains from a product or service, compared to the price that has been paid, including the cost of ownership and taking into consideration competitors' offerings. As an output, creating more value is a source of competitive advantage (Lindgreen et al., 2012; Pagani, 2013).

Organizational goals for value creation may vary significantly from value-creating networks enhancing operational efficiency to new product or business innovations (e.g., Parolini, 1999; Amit and Zott, 2001). However, firm-level activities play a significant role, also when describing value on different levels with the increased complexity of the value ecosystem, especially when the goal is to create and capture value which is being generated in complex business networks or ecosystems that requires value exchange (e.g., Westerlund et al., 2014). Also, a wide range of different complex and fewer complex capabilities are involved in the value creation process, which may affect organizational performance and even create competitive advantage. In addition, capabilities may play a significant role in

innovation management. (Story et al., 2017) Radical innovations that enable development of new products and services also require a framework, to promote understanding of how value is created in networks (Story et al., 2011). For the purposes of this research, Möller et al.'s (2005) value production and network capability model was selected, as their work is based on a rather broad review of other research on value creation within business networks and also includes the perspective of innovation capability in their analysis. Accordingly, their research also includes different levels of value creation. In addition, the radical innovation perspective appears.

It is interesting to note that value creation consists of multiple layers of value. From the perspective of this doctoral research, providing a more specific insight into a multi-layered approach to value creation is essential. Möller et. al.'s (2005) research shows that value is created by utilizing value-creating capabilities of different complexities, that are also positioned on different value creation levels. As the level of value creation increases, the required value creation capabilities are becoming more complex, but not less important; in addition to the amount of different capabilities also grows accordingly (Möller et al. 2005). Moreover, as the complexity is increasing when moving towards the next level of value creation, the former levels are required to have a stable relationship of actors and solid platform of previous actions, before reaching up to the next level of value creation. In Figure 1, a simplified model of value creation levels and capabilities linked to those different level is presented. Figure 3 also shows that the bottom level of capabilities presents more simple or traditional competencies whereas the upper row focuses more on the capabilities that are required in the management of strategic relationships and business networks. However, even though the lower capabilities are less complex, they are not considered to be less important than complex ones, as they act as enablers of moving forward to the next level of value creation (Möller et al., 2005). Nevertheless, it is clear that in Möller et al.'s (2005) model, capabilities play a significant role when creating value production.

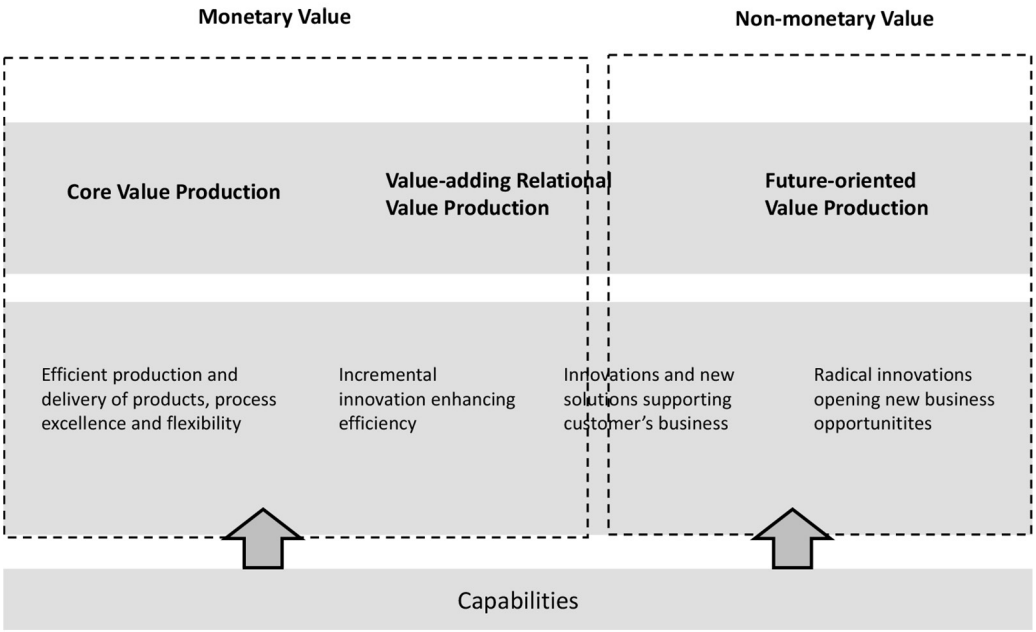
Figure 3. Value production and network capability base (Möller et al., 2005).



Notably, the third level of value creation strongly leans on networks. Therefore, value creation can also be considered as a key driver for building networks. The statement "No business is an island", was pointed out already in the late eighties by Håkansson and Snehota, (1989), flagging the importance of inter-organizational relationships and networks in a complex business environment. Möller et al. (2005) has defined a business network to be an intentional cooperative arrangement including more than two actors and being connected by inter-organizational relationships. Successful business networks are usually considered strategically significant for its members; it has also been likewise discussed widely for the past decades in management literature (Easton, 1992; Gulati et al., 2000; Easterby-Smith et al., 2008). However, business networks enable companies to create value by combining in the most optimal way the available capabilities and resources of different actors of business networks in the inter-organizational networks. It is also clear that value creation of BA requires certain capabilities of people, process, technology, and organization to succeed (Vidgren et al., 2017). Moreover, not only to succeed, but recently also to survive in a data-oriented dynamic environment, companies need to adapt quickly to complex ecosystem networks (Vidgren et al., 2017). However, as shown in Figure 4, both monetary and non-monetary value creation is required on different levels. The further along the value creation levels the organization moves, the more abstract the potential value can become, as future-

oriented value production is more difficult to measure (e.g., Walter et al. 2001; Möller et al., 2005).

Figure 4. Value production levels and benefits (adapted from Möller et al., 2005; Walter et al., 2001).



However, when it comes to digitalization and value creation, expectations extend to all digitalization issues, such as technological, economic, and organizational (Elia et al., 2020). These together with management and talent can deliver value and create competitive advantage to the organization (Elia et al., 2020; Akter et al., 2016; Wamba et al., 2015). The concept of value itself can be the major achievement for organizations that approach innovation and new technologies to generate benefit and growth. Yet, value can be seen as economically and financially beneficial, but it can also create strategic competitive advantages deriving from technological investments (Elia et al., 2020; Kaufman, 2015; Amit and Zott, 2001).

Also, Kothandaraman and Wilson (2001) argue that organizations must be able to create value. The actual value creation is based on the core capabilities. However, their model of value-creating networks focuses on value creating networks bringing value directly to customers (Kothandaraman and Wilson, 2001) rather than focusing on the entire value chain of value production. Therefore, the framework of Kothandaraman and Wilson (2001) has a deeper focus on customer value perspective. Also, Parolini's research (1999) shows the customer perspective of value creation. However, as in this research, the value of

BA is focusing on gradual BA value production, Möller et al.'s (2005) model acts as a great framework to show the evolution of BA value creation.

To add their value creation ability, companies need to find partners with whom to create superior value compared to that of other value creators and to deliver high performance in terms of the attributes that are important to the customer. Companies should also be able to manage these partnerships in a way that allows each partner to profit from being involved in the partnership. The core capabilities of the partners involved in value creation should be complementary, in order to be able to create superior value. Thus, the assembling of core capabilities in the larger unit should extend beyond the capabilities already contained within the company.

So, there are several different approaches towards digitalization and value creation. For instance, Gregor et al. (2006) suggest that there are business value benefits such as informational, strategic, transformational and transactional value (Gregor et al., 2006). In turn, the resource-based view (RBV) theory can be used to explain the contribution of BA-related Big Data to value creation through a competitive edge (Vitari and Raguseo, 2019; Wamba et al., 2017). However, it is clear that the business value of digitalization, together with other organizational capabilities, is a key source of business value (e.g., Dong and Yang, 2020; Nevo and Wade, 2011; Tanriverdi, 2005). Moreover, Brinch et al. (2020) suggest that companies seem to be "digitally immature," and lack the needed capabilities to cope with the challenges of BA-related Big Data (Brinch et al., 2020).

2.2 Business Analytics enables business value

Recent academic research as well as practitioner literature show that organizations are able to create value by utilizing BA (e.g., Božič and Dimovski, 2019; Chen et al., 2012; Larson and Chang, 2016). The latest studies on BA and value creation show that there is a connection between BA and the organizational value creation process (e.g., Krishnamoorthi and Mathew, 2018; Fink et al., 2017). However, even though BA and BA technologies have been recognized as a potential source of business value creation and, further, competitive advantage, it is still unclear exactly how the value is created (Côrte-Real et al., 2017; Abbasi et al., 2016). Nevertheless, as it is clear that BA can increase profitability and productivity of the organization, many companies have made significant investments in BA technologies (Côrte-Real et al., 2017; Barton, 2012; Sharma et al., 2014). However, the investment can be valuable only when combined with other organizational resources (Côrte-Real et al., 2017).

In addition, to identify the potential benefits or business value of BA utilization, organizational executive and managerial levels have to gain a clear understanding of the required organizational BA capabilities that have influence on performance (e.g., Seddon et al., 2017; Ratia and Myllärniemi, 2019). Even though research on BA capabilities is still insufficient, it can still be acknowledged that BA and more specifically advanced analytics

play a significant role in creating business value (e.g., Krishnamoorthi and Mathew, 2018). More precisely, data science, predictive analytics and Big Data are seen to be increasingly important in business value creation (e.g., Vidgren et al., 2017; Waller and Fawcett, 2013). However, operationally comprehensive and effective BA solutions and their implementation in value generating processes is not easy, so true business value can be also difficult to create (Nalchigar and Yu, 2018). In addition, even though practitioners identify BA practices enabling competitive advantage, the literature does not identify such strong theoretical explanations or connections (Torres et al., 2018).

Traditionally, the business value of BA, and especially of BI, is considered to lie in management processes that have an impact on operational processes, driving revenue or reducing costs (Marjanovic, 2010). Also, when having a strong connection and integration to organizational business processes, BA supports organizational strategy as a whole and in addition gives a direction for value creation (Marjanovic, 2010). To succeed and create business value, both business processes as well as BA technology have to support organizational strategy (Marjanovic, 2010). However, organizations are moving from data-driven decision-based value creation, towards value-adding services that create new opportunities (Marjanovic, 2010). The literature also shows several combinations of capabilities that are required, such as analytics capabilities that are affected by management capabilities, technological capabilities, and talent capabilities (e.g., Brinch et al., 2020; Akter et al., 2016).

Seddon et al. (2017) suggests a business analytics success model, also termed a BASM framework, that can be used to evaluate competitive advantage brought about by BA utilization (Seddon et al., 2017; Ratia and Myllärniemi, 2019). The model consists of twenty different concepts presented in Table 2 below.

Table 2. Concepts of the BASM process model (adapted from Seddon et al., 2017; Ratia and Myllärniemi, 2019)

Concept	Explanation
Use analytical capabilities	Utilization of BA capabilities to analyze internal and/or external data to enable evidence-based decision making.
Insights	To gain a deeper understanding enabled by business BA capabilities utilization.
Decisions	Decision-making followed by insights from BA capabilities utilization.
Purposeful actions that create value that use the organization's existing capabilities	Organizational actions targeting the creation of value using existing organizational capabilities or operational use of BA capabilities.
Intendedly value-creating actions to change the existing organization's capabilities	Actions taken by the organization aiming to create business value leading to changes in its current organizational capabilities.
Organizational benefits from BA use	An overall measure of the benefits from BA utilization.

Table 2. Concepts of the BASM process model (adapted from Seddon et al., 2017; Ratia and Myllärniemi, 2019)

Enabling technology	BA hardware, software, data, processing, and governance capabilities.
Analytical people	The people from business units with an analytical mindset who help drive business value from BA.
Analytical resources	The combination of people, technology and BA processes that act as enablers of evidence-based decisions.
Organizational resources	The full set of resources in the organization enables it to provide products and services (i.e. value) to its customers and other stakeholders.
Analytical leadership	The level of leadership of initiatives or projects to increase BA utilization.
Enterprise-wide analytics orientation	The level of adoption of an enterprise-wide orientation to BA utilization.
Clear targets	The selection of targets for new analytical initiatives are selected carefully based on the combination of their business potential and whether the necessary resources, including data, are available.
Extent to which evidence-based decision making is embedded in the organizational culture	The extent to which a culture of evidence-based decision making is embedded in the core values and processes of the organization.
Current BA improvement projects	Ongoing projects can include both the implementation of new BA solutions and initiatives that apply existing functionality to new areas of decision making.
Functional fit of BA tools	Matching of BA tools to the functionalities that the organization needs to access and analyze data effectively and efficiently.
Availability and quality of data	Relevance and accuracy of data that is available for analytics use, from sources both within and external to the organization.
Analytical people	Analytical mindset within people in the organization.
Overcoming organizational inertia	Motivation to learn, use and accept the new system. During initial implementation and subsequent projects, considerable change management effort, training, and support are needed to overcome organizational inertia.
Organizational benefits from BA utilization, from the perspective of senior management	An overall measure of senior management's perception of the benefits from BA utilization. For e.g., enabling visibility into organizational data, enhancing evidence-based decision making.

Nevertheless, the BASM model is a combination of summarized insights from several research studies, but still is a strongly practical framework, including analysis of about 100 cases. However, it still needs further work (Seddon et al., 2017).

In addition, there are also other frameworks to examine business value, e.g., the VRIO framework, evaluating how valuable, rare, costly to imitate, organizationally embedded organizational BA can be (Grover et al., 2018). The VRIO framework with its directive

questions, enables organizations to evaluate business value and the potential competitive advantage of BA. In Vidgren et al.'s (2017) research, it is shown that the sources of value creation of BA in companies can be internal, external, or potential, also having a range of tangible, intangible and social benefits (Vidgren et al., 2017). As an example, internal value is often considered to be enhanced decision-making and operational processes or cost and time savings. (Božič and Dimovski, 2019; Acharya, et al., 2018; Elbashir et al., 2008; Watson, 2009). For instance, an example of external value can be the ability of identifying customer needs and expectations, which can lead to new business opportunities (Božič and Dimovski, 2019; Chen et al., 2012). Some of the value can be easily be measured, such as time and cost savings, and other values are more difficult to measure, such as utilization of information (Božič and Dimovski, 2019; Watson, 2009; Watson and Wixom, 2007).

However, it is challenging to define the absolute and identical metrics of value for companies and draw a line between value creation and achieving competitive advantage (Vidgren et al., 2017). Yet, what was identified in the past and confirmed in the latest research, is that value creation in business analytics requires good analytical capabilities and technological capabilities, such as IS as well as high-quality data (Božič and Dimovski, 2019; Hannula and Pirttimäki, 2003). Nevertheless, if analytical culture in the organization does not enable new openings and ideas to be found, value cannot be generated (Božič and Dimovski, 2019; Davenport and Harris, 2007). The literature suggests that capabilities are the primary source of value and actually act as converters of organizational resources into value (Božič and Dimovski, 2019; Fink et al., 2017; Lin and Wu, 2014). Nevertheless, capabilities can be considered as a base and a raw material or enablers of value creation (Božič and Dimovski, 2019).

In Table 3 below, the created value, required capabilities and related key literature related are shown.

Table 3. Capabilities and key literature

Value	Capability	Value Creation Level	References
Operational efficiency	Leadership, Technology, Data, Processes	Core Value Production	e.g., Akter et al.,2016; Brinch et al.,2020; Božic and Dimovski, 2019; Cosic et al., 2015; Möller et al., 2005
Performance excellence	Leadership, Technology, Data, Processes	Core Value Production	e.g., Akter et al., 2016; Brinch et al.,2020; Božic and Dimovski ,2019; Cosic et al.,2015; Möller et al., 2005
Enhanced decision-making	Leadership, Technology, Data, Processes	Core Value Production	e.g., Akter et al., 2016; Brinch et al., 2020; Božic and Dimovski, 2019; Cosic et al., 2015; Möller et al., 2005
Product and service development	Data, Talent and skills	Value-adding Value Creation	e.g., Cosic et al.,2015; Božic and Dimovski, 2019
Creating new innovations	Processes, Talent and skills	Value-adding Value Creation, Future-oriented Value Creation	e.g., Cosic et al., 2015
New core business	Innovation, Talent and skills	Future-oriented Value Creation	e.g., Ashrafi et al., 2015
Radical innovations	Innovation, Talent and skills	Future-oriented Value Creation	e.g., Ashrafi et al., 2015

However, as shown above, when observing the phenomenon of business value of BA utilization in the context of healthcare and private healthcare, and more specifically in the business environment, BA can create remarkable value. It is clear that the healthcare sector is struggling to improve operational efficiency on all levels, and is also trying to find new ways to optimize resource utilization efficiently, such as the optimization of human resource utilization as well as better cost efficiency and improved operational processes (Foshay and Kuziemsky, 2014). Just as the public healthcare, the private sector is also having a pressure to intensify its healthcare services (Myllärniemi et al., 2012; Kujala et al., 2006). Yet, information technology and digitalization, as one of the value creation factors in many other industries, has been slow to penetrate the healthcare sector; now executives and managers influencing in leading positions in private healthcare have expanded their focus of data-driven value creation from clinical healthcare to management practices, seeking for among other benefits or value, cost-efficiency (Brandão et al., 2016; Teperi et al., 2006; Kujala et al., 2006).

In addition, in terms of value, the impact of wearable biosensors is also growing. Those not only track health data, but rather create a business platform for multiple purposes. Especially the new generation of wearable, non-invasive, and real-time sensors create

significant amount of data, making the line between healthcare analytics and sports analytics inconstant (Ye et al., 2020). The business of wearable sensors is growing rapidly with healthcare category leading the market (Alshammari et al., 2020). Analytics gathered can be related for instance to activity, location, voice, or health data. Service concepts built around wearable sensors can be directly supporting users and creating them value, supporting families and creating value to the whole family as well as creating value through social media interaction (Kinnunen et al., 2016). Indisputably, the growing industry of wearable sensors create value to both, economy and users. However, when tracking sensitive personal health data, there are also considerable security and ethical risk to be aware of, such as data misusage, data safety and privacy (Chang et al., 2019). Overall, the healthcare sector has been moving more and more towards data-driven decision-making, and also the private healthcare sector has growing amounts of operative business data that is being generated and used to support the organizational or managerial decision-making process (Ratia and Myllärniemi, 2017; Stewart et al., 2016; Raghupathi and Raghupathi, 2014; Raghupathi, 2010; Spruit et al., 2014; Grierson et al., 2015).

2.3 Evolution of Business Analytics

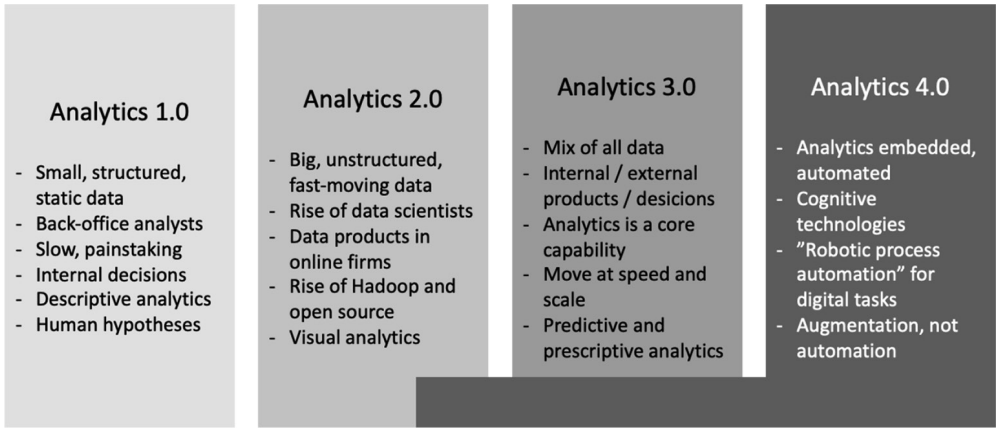
Even though digitalization and business analytics are relatively new concepts, supporting organizational decision-making using data is not a new phenomenon and has appeared over time. However, in its modern form, it has been in use for almost 60 years since military and airlines require operational control systems (Power, 2008). Since then, several other fields followed, such as finance, supply chain management, and marketing, all with big volumes of data and applying statistical techniques and algorithms (Acito and Khatri, 2014). Yet, over the years, the decision-making systems have become more and more sophisticated and experienced several stages of evolution (Power, 2008). BA technologies and BA capabilities have gone from the late 1950s, automatically abstracted and categorized by word pattern documents towards exploiting AI (Luhn, 1958; Davenport, 2018). Nevertheless, what has developed significantly is the range of opportunities to be explored and costs of exploring them. The cost of processing power, data storage, and transmissions has dramatically declined. Also, BA tools have become remarkably easier to use and possess more powerful features. However, this decision-making supporting phenomenon has been developing for decades and undergone several stages of evolution (Acito and Khatri, 2014).

Especially now, when the amount of generated, processed, and stored data in organizations is growing quickly, real-time access of information to support organizational decision-making is crucial. Also, the quality of decision-making can be improved by providing access to relevant and correct information to support fast decision-makers, although efficient data processing requires specific tools and technology to enable value creation in the organization (e.g., Attaran and Attaran 2019; Bordeleau et al., 2018; Wang et al., 2016; Jinpon et al., 2011). In addition, it is clear that BA is an emerging and

fast-growing field, and it can also to some extent be a disruptive technology and enabler of innovation that can bring organizational decision-making to the next level (Sun et al., 2016; Cao et al., 2015). In the healthcare sector too, efficient utilization of data can create competitive advantage by intensifying the overall management practices for cost effectiveness and decision support (Raghupathi and Raghupathi, 2014; Kujala et al. 2006). However, it is clear that different knowledge processes, methods, and technologies, such as BA, are closely connected to healthcare organizations' service provision and value creation (Myllärniemi and Helander, 2012). Here, BA technologies and tools have an important role, as the right selection, together with other capabilities, is also an important factor in decision-making and creating business value in private healthcare (Ratia and Myllärniemi, 2017; Wullianallur et al., 2014; Suomi et al., 2002). Naturally, there is increasing interest in efficient data utilization and in BA as an enabler of even further exploration and utilization of organizational data and also external data sources (Elbashir et al., 2013; Raghupathi and Raghupathi, 2014). Hence, BA utilization can include internal and external data sources, which can be used together or separately, creating new data and information and thus, value (Ratia and Myllärniemi, 2017). However, organizational benefits and business value are built gradually and over time.

Davenport (2018) has divided the organizational concept of analytical activity into four consecutive stages. As Figure 5 shows, the first stage of analytics is considered to be descriptive analytics or business intelligence, where data management and reporting uses simple BI tools and general data management. During the second stage, the focus is on Big Data analytics, and powerful new generation data management platforms are able to process enormous number of data quickly and cost-efficiently. Moreover, during the third phase of analytics, or data economy analytics, traditional industries have also adopted analytics and Big Data as part of their organizational processes and integrated analytics as part of their operations. The fourth phase, or the stage of artificial intelligence, is the stage of cognitive technologies, RPA, and high automation rate (Davenport, 2018).

Figure 5. Evolution of Business Analytics (adapted from Davenport, 2018).



Analytics 1.0 or the phase of Business Intelligence

The beginning of the first stage of analytics is the phase of manually produced descriptive analytics or business intelligence and data management, also later using BI tools. This was the longest lasting phase that dominated the analytics scene for decades. In addition, during the phase, the driver for generating value was primarily internal or supporting the organizational decision-making process. However, it did not yet have predictive capabilities and rather looked backwards than forward. The majority of BI was performed manually and thus, slowly (Davenport, 2018). However, modern BA is much more advanced and complex.

First of all, defining the concept of BI is not easy. Turban et al. (2008) has defined BI as being an umbrella-like combination of different tools, applications and methods (Turban et al., 2008). Whereas Nykänen et al. (2016) describe BI as having two main approaches: technological and process (Nykänen et al., 2016). BI is often seen as a combination of different techniques, technologies, tools, practices, methodologies, and applications that complement each other and enable analysis of critical business data, allowing the organization to understand its internal and external processes, and also enabling data-driven decision-making (Côrte-Real et al., 2014; Nykänen et al., 2016). Hence, sometimes also other similar concepts, such as competitive intelligence, market intelligence, customer intelligence, competitor intelligence, strategic intelligence, technical intelligence, and data analytics (Lönnqvist et al., 2006) are merged to expand the meaning of BI in the literature. Although the literature also introduces BI as a set of tools for value creation, a combination of functionalities, such as collecting raw data, evaluating the validity and reliability of data, analyzing and storing data, as well as for sharing the processed information to support the decision makers and thus, create value. (Pirttimäki, 2006; Gilad et al., 1985; Nykänen et al., 2016). Decision-making support technology, such as BI tools together with data warehouses and other data mining tools, enable organizational data-driven decision making and bring value to the organization. However, to unleash the value of supporting organizational decision-making, fast access to data is critical, and at the same time the amount of data generated in organizations is growing rapidly and thus, placing challenges towards data processing, requiring specific tools and approach to enable value creation to the organization (Jinpon et al., 2011). The value of utilization of BI tools is often created by connecting different data types from different sources enabling them to collect, evaluate, analyze, store, and share up-to-date data to be used efficiently in decision making. Also, timely access to data, real time analysis and visual or storytelling presentation of required information can bring value for the organization (Ratia and Myllärniemi, 2018; Popovič, 2017).

Nevertheless, the traditional concept of BI has changed as new methods and concepts, e.g., Big Data and ML, have emerged recently, in research as well as among practitioners (Ratia and Myllärniemi, 2018; Trieu, 2017; Wang et al., 2016). Still, BA tools are ranked as one of the most important technologies by Chief Information Officers (Yeoh and Popovič,

2015, Visinescu et al., 2016). Also, it is clear that BA enhances the business performance of an organization (Kakhki and Palvia 2016). However, it is also important to acknowledge that BA differs a lot from its previous versions, especially the first ones, through timely access to data, effective or even real-time analysis, and also the intuitive or visual presentation of the required information (Popovič, 2017).

Analytics 2.0 or the phase of Big Data Analytics

As the amount of data, especially automatically generated, has expanded significantly, there is a clear need for powerful new data management platforms, such as Hadoop, and data scientists to analyze that data (Davenport, 2018; Grierson et al., 2015; Dragland, 2013; Davenport and Patil, 2012). Moreover, it is said that most of the data in the world has been created during the past few years (Davenport, 2018; Grierson et al., 2015; Dragland, 2013). During this development stage, the focus has gone from supporting decision-making to supporting business with customer-centric data-based products that have been created out of data or around data and analytics, such as recommendation engines, using ML (Davenport, 2018). However, these kinds of new requirements have created an explicit need to process big amounts of automatically generated data, that is not able to process, using traditional manual analysis or within capacities of conventional databases (Provost and Fawcett, 2013).

As a concept, Big Data is not exactly novel, as it was used to describe big datasets already back in 1997 and in the early 2000s with the three Vs: volume, variety, and velocity, used to describe the meaning of Big Data (Ylijoki and Porras, 2016; Cox and Ellsworth, 1997; Laney, 2001; Chen et al., 2012; Katal et al., 2013; Kwon et al.,, 2014; Gandomi and Haider 2015; De Mauro et al., 2016). Also, literature also brings other dimensions, such as veracity, visualization, variability and value (Gandomi and Haider, 2015). Also, Big Data can be considered as technology, that has a major influence on different industries and organizations, bringing significant benefits to its organizations, for example in the form of competitive advantage (Ylijoki and Porras, 2016; Manyika et al., 2011; Schmarzo, 2013; Davenport, 2014; McAfee et al., 2012; Dehning et al., 2003). However, new generation BA tools and architectures allow to process significantly big amounts of data from different data sources, store, extract, and analyze it as well as share it, to create value (Fosso Wamba et al., 2015). Now, during the last few years, the focus of Big Data has moved into the direction of discussing business value creation (Ylijoki and Porras, 2016). This has increased the focus of academic and corporate or organizational research, as there is a significant operational and strategic potential in terms of value creation (Fosso Wamba et al., 2015).

However, in order to process emerging amounts of data, it is essential to use proper tools to enable efficient, value-adding utilization (Jinpon et al., 2011). The tools and technologies are undergoing through continuous development, and as their significance in enhanced and timely decision-making is growing. Moreover, the functionalities and critical

required capabilities of BA tools are developing to satisfy this demand. While during the first stage of BA, the basic functionalities of most of the BA tools were mainly in database management, where the focus is on data collection, extraction, and analysis technologies, the new generation of BA tool functionalities also require the ability to process a very large amount of data, e.g., sensor and mobile device generated (e.g., Chen et al., 2012; Chaudhuri et al., 2011; Turban et al., 2008; Watson and Wixom, 2007).

Analytics 3.0 or the stage of data economy analytics

During the third stage of evolution, traditional industries have also joined the analytics journey. However, this has led to the transformation of business models and creation of data-driven analytics cultures, that allow scaling and systematic actions, on taking analytic activities from pilot to production use, or "industrialize" the activities, often with a big amount of ML models (Davenport, 2018). Yet, accessing the third stage is not affordable to every organization, as to succeed, it requires different types of investments, a lot of coordination, expertise in content, and business process transformation. Also, a lot of change management initiatives are required, which need massive amounts of time, money, and leadership resources (Davenport, 2018; Rosenbush and Stevens, 2015). Moreover, during the phase of economic analytics, early business utilization of AI methods and technologies, for example fraud prevention in the financial sector or optical recognition of characters in document processing, and adaptive algorithms in video games, is a benefi.

In addition, BA tools and technologies have faced a challenge to become more of self-service tools that can be utilized within business departments. Brandão et al. (2016) and Chen et al. (2012) refer to some distinguished BA technologies, for example QlikView, Tableau, SAP, IBM, Microsoft and Oracle – BA tools that enable ad hoc queries and searches, reporting, dashboards, online analytical processing, interactive visualization, storytelling, predictive modeling, and data mining. Although, regarding capabilities, advanced technologies, even though meant for self-service BA, are not enough. An organization has to have the ability to use them, requiring also internal and external competence to utilize them (Brandão et al., 2016).

Analytics 4.0 or the era of artificial intelligence

Analytics 4.0 is the era of artificial intelligence or cognitive technologies with a high automation adoption rate. Moreover, this is not just a question of the utilization of AI methods, but also about automated ML. However, to be able to utilize the whole potential of AI, this requires a lot of data, enormous data processing ability, and advanced statistical methods (Davenport, 2018). Also, some of the AI capabilities are also part of analytics, as the same capabilities and strategy are required as during the previous stages of evolution,

for example Analytics 2.0 and Analytics 3.0. Moreover, the investments and required skills can be very different. Also, there can be a wider organizational impact, which may change the nature of knowledge work when some of the activities performed become automated (Davenport, 2018; Davenport and Kirby, 2016a). When AI approaches, methods and technologies are concerned, it is clear that ML and its elements, such as predictive analytics, play a key role (Davenport 2018; Siegel, 2016). In addition to basic regression-based ML models, there are many other types of algorithms in ML, such as decision trees, neural networks, and deep learning (Davenport, 2018).

In organizations, AI can be used very diversely, for example in improving existing products or services, physical or digital. Moreover, it can be used in improving the organizational process automation rate or increasing the ability to penetrate new markets, or create new services and products, build new features and enhance performance of existing products and services, and speed up new product development. In addition, in industrial environments, processing sensor data is essential (Davenport, 2018). Recently, there have also been open-source AI services, especially provided among others by Google, Amazon, and Microsoft, which allow cost efficient AI capability utilization if the organization lacks its own AI capabilities (Davenport, 2018). RPA, a software-based business and workflow processes automation, in some cases also including elements of AI, has been a rising trend during the last few years in organizations (Davenport and Kirby, 2016b). When the organizational process is digital, based on routines, and requires a lot of human resources that are either too expensive, inefficient, or the amounts of data to be processed is enormous, the utilization of RPA can be a good fit (Lu et al., 2017). In some cases, as the number of mistakes in data compared to human error is much less, it is even preferable to use an RPA solution in data input rather than humans, to generate better data that enables further analysis (Kirchmer, 2017). The suggested value of RPA utilization, also in the private healthcare sector organizations, is primarily created by increased efficiency in the organization by reducing the human workload in routine business processes, in the quality of the work, as the RPA solution results in fewer mistakes, good scalability, and lower costs (Kirchmer, 2017).

Nevertheless, the above-mentioned journey of BA evolution is not so straightforward in practice, as organizations tend to use elements from different phases from necessity, rather than linearly moving from one phase to the next. At the same time, the needs of an organization can be met, for example, by basic data warehouse based financial reporting, RPA solution, and AI-based dynamic pricing.

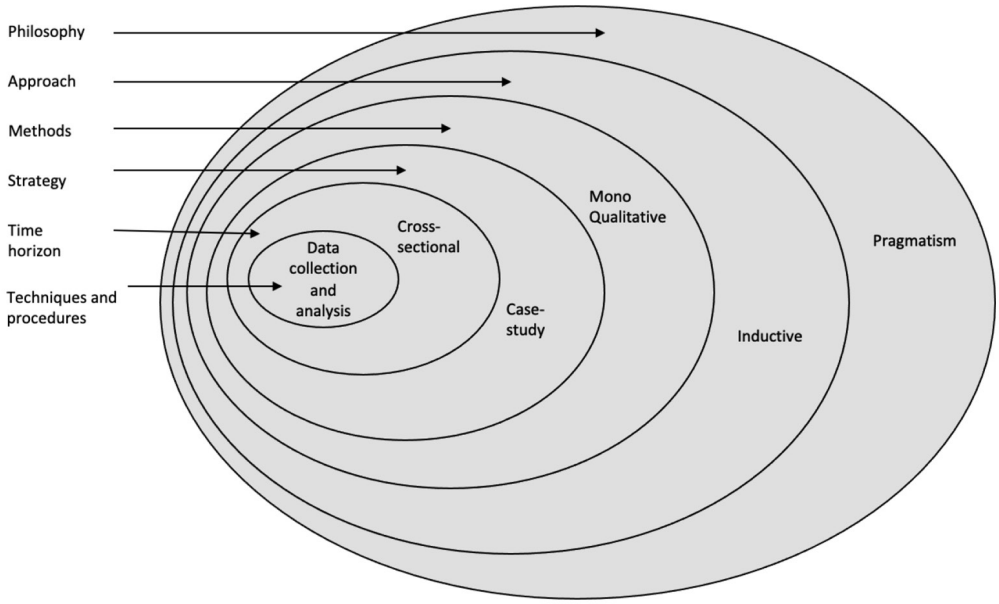
3 Research design

3.1 Research strategy

One of the keys for successful research is choosing the right research method. There are numerous research and scientific approaches to carrying out a study. Selecting the correct research strategy is highly dependent on the research topic and research questions as well as the objective of the conducted research (Hirsjärvi et al., 2000). The methods of research should be chosen before the actual data collection phase (Yin, 2018). The research approach is derived from research questions and, further, from research problems (Hirsjärvi et al., 2000).

In this research, the research paradigm and research approach are presented using the modified Saunders et al.'s (2009) research onion model, with several different layers of research strategy: research philosophy, research approach, research methods, research strategy, time horizon, as well as techniques and procedures. The onion model presented by Saunders et al. (2009) offers a holistic and overall perspective to the methodological choices to be selected for the research. The outer layer of the model describes research philosophy and moves further on to the inner layers, to the innermost layer of practical techniques and actions. The methodological choices are described in Figure 6 below.

Figure 6. The research strategy of the study (adapted from Sanders et al., 2009).



Saunders et al. (2019) suggest that research philosophy refers to a system of beliefs and assumptions about knowledge development. They also introduce five major philosophies used in business and management: positivism, critical realism, interpretivism, postmodernism, and pragmatism. Positivism usually refers to natural sciences, where pure facts and data are not influenced by human interpretation. Critical realism focuses on what is seen and experienced. Interpretivism creates new insights, richer understandings, and interpretations of contexts. Postmodernism seeks to expose and question the power of relations sustaining dominant realities. The last of the five research philosophies described above, pragmatism, that was chosen for this research asserts that concepts are only relevant if they support action. The driver for the research is a problem and seeking for practical solution. Therefore, the interest is more in practical problem, than abstract distinctions. (Saunders et al., 2019). In addition, pragmatism tends to focus on more on actions than the actors behind them, thus the transactional perspective offers a more holistic perspective (Elkjaer and Simpson, 2011). Also in this research, the research objective is rather practical, than abstract, seeking for a practical solution.

In addition to the identified research gap shown in the previous chapters, the content of this dissertation also was derived from the practical needs of healthcare organizations.

3.1.1 Research paradigm and research approach

The driver for this research was a practical need to understand the business value of BA in the context of the private healthcare sector. In these terms, the philosophical research approach is pragmatic rather than any other research philosophy. According to Saunders et al. (2009), the research approach can be deductive, inductive, or abductive (Saunders et al., 2009). The deduction approach is based on the idea that theory is the first source of knowledge. Therefore, focusing on what is known about a phenomenon in theory, one or more hypotheses can be deduced. In the inductive approach, the research process is developing further from empirical findings, rather than from theoretical framework propositions. The abduction approach refers to the process of moving from descriptions and meanings to categories and concepts that enable to describe the phenomenon. (Eriksson and Kovalainen, 2008). Very often, inductive, deductive, or inductive and deductive approaches together, are used in business and management studies (Eriksson and Kovalainen, 2008).

Johnson and Duberley (2000) suggest that induction can be seen as a reasoning process through which theory is generated out of empirical observation and experience. So inductive reasoning requires making general reasoning about a phenomenon through the observation of instances of the phenomenon (Johnson and Duberley, 2000). In this research, the inductive approach was used to ensure a clear picture of the BA business value creation in the private healthcare sector, provided by empirical setting (Saunders et al., 2009; Johnson and Duberley, 2000).

A researcher has also to make a methodological choice that supports the best solution to the research objective and research questions. Practically there are three methods that can be used: quantitative, qualitative, or mixed methods research design. Quantitative method refers to numeric data and is often also used to describe a data collection technique, such as a questionnaire or data analysis procedure, such as statistics. Qualitative method refers to non-numerical data, such as words or pictures. Here, data collection techniques can be for instance interviews and data analysis procedure to categorize data. (Saunders et al., 2019). If simplified to some extent, qualitative research can be explained to be a non-numerical form of data and analysis of research material (Hirsjärvi et al., 2000). Mixed methods utilizes both methods, for example, a questionnaire with open questions or qualitative data that is analyzed quantitatively. Both methods can be mono or multi methods, using one or several techniques (Saunders et al., 2019).

This research has been conducted using the qualitative research design and mono method, as when studying phenomena, it is essential to gain a rich dataset that enables a deep understanding of the researched phenomena (Saunders et al., 2019). Nevertheless, the aim of qualitative research is to clarify the researched phenomena and create new knowledge about studied issues. The goal is to capture the relevant data without losing any information on the way from source to results (Eskola and Suoranta, 1999). However, qualitative research is typically used when the aim is to describe local actions, so it is used when there is a lack of knowledge regarding the researched topic or phenomenon and when

it is required to gain more understanding; it is also commonly used to understand people's experiences and their perspectives (Antwi and Hamza, 2015). Moreover, the purpose is to study the actual life and illustrate it accordingly, with all the relationships related. However, a qualitative study is to research the topic as comprehensively as possible in the existing circumstances (Hirsjärvi et al., 2000). It cannot be certainly stated that there is a specific research paradigm that can be dedicated to the purposes of qualitative methods; however, qualitative researchers often turn towards the hermeneutic approach (Denzin and Lincoln, 1994).

The research strategy is typically associated with a particular research philosophy and research approach, but it also can have open boundaries between them. The research strategy is often guided by research questions, followed by philosophy and approach (Saunders et al., 2019). However, Saunders et al. (2019) suggest eight different research strategies: experiment, survey, archival and documentary research, case study, ethnography, action research, grounded theory and narrative inquiry (Saunders et al., 2019). In this research, the study research strategy is applied. A case study refers to a deep dive into a topic or phenomenon, within its real-life setting (Yin, 2009; Saunders et al., 2019). In addition, VanWynsberghe and Khan (2007) suggest that the typical features of a case study are small sample size, contextual detail, natural setting, boundedness, working hypothesis and lessons learned, multiple data sources and extendibility (VanWynsberghe and Khan, 2007). Even though the case study approach is often considered as a part of qualitative approach, however it can also appear in quantitative research, or have combinations of both approaches (Starman, 2013). Nevertheless, in this research, using the qualitative approach and case study research strategy is justified, as the primary goal of using the case study method is to obtain in-depth details as much as possible about an event, person, or process (Njie and Asimiran, 2014).

As a limited number of studies have focused on BA utilization and business value creation in private healthcare organizations, thus the qualitative, exploratory case study research was considered suitable in providing new understanding about the phenomena in the context of practical business activities that have an impact on organizational performance (Yin, 2009). The approach is used to perform an in-depth analysis of a phenomena happening in real-life, also when it is not yet clear what parts are being exactly researched (Yin, 2018). As the aim is to understand a phenomenon in a specific context and take a deep dive into the researched phenomena, the case study approach is justifiable. Previous research has focused mainly on the healthcare data and data analysis, leaving out the perspective of business value created by BA utilization (Demirkan, 2013). A case study approach can be a single case study or a multiple case study design in order to gain an understanding about the researched phenomena (Yin, 2018).

Yin (2018) suggests four basic types of case study strategies: A holistic or single unit of analysis in single-case design and multiple-case design, as well as embedded or multiple units of analysis in single-case and multiple-case designs. Each of the four case

study research designs analyze contextual conditions in relation to the case (Yin, 2018). Qualitative research, especially the case study approach, is sometimes criticized because the results of this research cannot be directly generalized. (e.g. Guba and Lincoln 1994: Gomm et al., 2009). However, generalization within the case can be applied (Gomm et al., 2009). Here, the aim is to investigate how experience is being created and given a purpose in the researched context. In this research a multiple case study approach was selected to study the different perspectives of stakeholders to achieve a more complete picture of BA utilization and role in business value creation. Nevertheless, five cases were selected based on the stakeholder groups. However, it has to be pointed out that as a research strategy, a case study cannot be considered to be completely qualitative or quantitative, as it can be used for both approaches (Saunders et al., 2009; Yin, 2018). As the evaluation criterion of this qualitative research is trustworthiness, the corresponding criteria of credibility, transferability, dependability, and confirmability are applied (Guba, 1990; Lincoln and Guba, 1986).

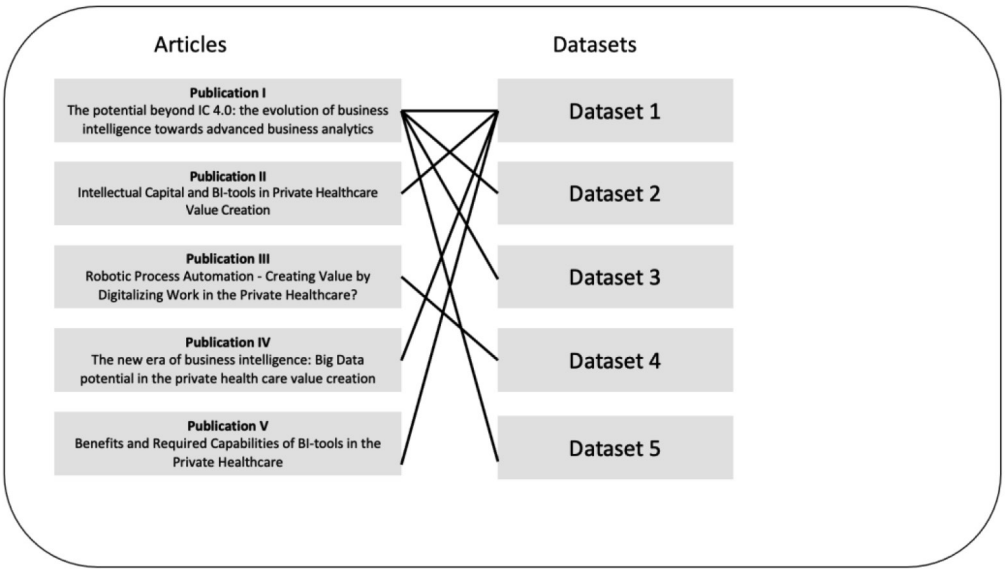
However, the research approach and methods were selected based on the research objective. This research was conducted with a qualitative approach and exploratory design, primarily to improve the understanding of the role of BA capabilities in the private healthcare sector business value creation. The chosen research strategy, a case study approach, with multiple case studies was carried out using qualitative research methods and it was chosen for its applicability for studying complex and context-dependent research topics (Yin, 2018). Nevertheless, a case study approach can provide a detailed and in-depth approach of the researched subject and allows the exploration of the research questions in their natural context (Ramanathan et al., 2017).

3.1.2 Data gathering and analysis

In the previous section, it was explained how research strategy has an impact on the performance of the study. Also, a research strategy for this study was introduced. This section focuses on describing data collection and multiple-cases backgrounds in relation to research publications. Typically, interviews consist of a talk organized into a series of questions and answers and can be taken place face-to-face, over the phone, or through digital channels (Eriksson and Kovalainen, 2008). Interviews can be divided into three types: structured, semi-structured, and unstructured interviews. Structured interviews are standardized and have the same standard questions for all participants, whereas in semi-structured interviews, the focus is on topics or themes, having variations in wording and sequence. Lastly, unstructured interviews are informal and have some guiding questions but also have the freedom to change the direction of conversation (Eriksson and Kovalainen, 2008). However, in this research, semi-structured thematic interviews were used to gain an understanding of the researched phenomena of BA capabilities utilization and value creation in the private healthcare sector in Finland.

In addition to the conducted case-specific thematic semi-structured interviews, there was also open-source information used as background material, also supporting the literature when establishing the research questions. All of the case studies had the same research methodology behind the scenes, to ensure different perspectives on the same research topic. The knowledge and results gathered in the previous case studies, interviews, analysis and results, were utilized to develop further case studies, to gain a holistic and thus, more complete and more overall picture of the researched phenomena. In Figure 7 below a summary of published articles and gathered datasets is shown that were used as data sources for their contribution. In addition, the summary shows the connection between the articles and the datasets.

Figure 7. Summary of articles and related datasets.



In addition, Table 4 below shows how the five gathered datasets are related to the examined target groups when the data was collected; it also shows the collection and analysis method together with the number of interviewees for those datasets and gives the approximate length of the interview.

Table 4. Summarized description of empirical data

Data-set	Target group	Collection period	Collection method	Analysis	Number of inter-viewees	Number of organi-zations	Length of interview
1	Private healthcare organiza-tions	1/2017-5/2017	Phone/Skype, thematic interviews	Content analysis	10	10	25-40 min
2	BA management consulting and technology consulting	4/2017-10/2017	Phone/Skype, thematic interviews	Content analysis	20	20	25-40 min
3	Private healthcare organization, case study	3/2018-4/2028	Phone/Skype, thematic interviews	Content analysis	4	1	45-60 min
4	RPA consultants	3/2018-5/2018	Phone/Skype, thematic interviews	Content analysis	8	8	25-40 min
5	BA technology vendor, case study	1/2019-2/2019	Phone/Skype, thematic interviews	Content analysis	5	1	45-60 min
				Total	47	40	

The first part of the data collection was performed during the period between January and May, 2017. Therefore, the overall duration of the first data set collection was five months. In total, ten thematic semi-structured interviews were carried out in the private healthcare sector companies. The interviews were conducted in a discursive atmosphere, addressing the key themes identified from the literature concerning BA technologies and tools. The dataset was used in the publications: "The new era of business intelligence: Big Data potential in the private health care value creation", "Business Intelligence Tools for Private Healthcare Data-Driven Value Creation" and "Benefits and Required Capabilities of BI tools in the Private Healthcare".

In the second part, conducted between April and October 2017, in order to gather data for the second dataset, altogether 52 consultants were contacted via the professional social networking platform LinkedIn. In total, twenty technology or management consultants were chosen to be interviewed for the study, with the field of responsibility in BA or AI. Also, in this case, the approach was inductive with semi-structured, thematic interviews. From the consulting industry, the interviewees were technology consultants and management

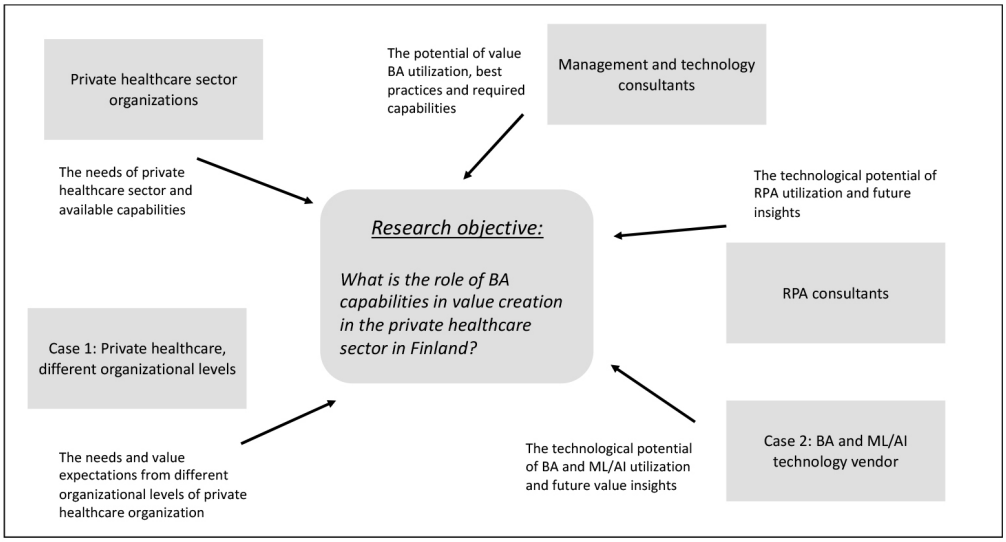
consultants, selected to be a part of the research based on their area of responsibility in BA or AI related consulting within their organization. This dataset was used in the 'Intellectual Capital and BI-tools in Private Healthcare Value Creation' and 'Beyond IC 4.0: The Future Potential of BI-tool Utilization in the Private Healthcare' publications.

In the third dataset, one private healthcare company was chosen for a deeper case study. Altogether, four representatives were interviewed from different organizational levels of the company. However, to avoid the possibility of identifying the organization, no detailed information of the organization can be revealed, as keeping anonymity was required. The interviewees were business and finance directors as well as representatives from the controlling function. Also, these thematic interviews were carried out in a discursive manner, including discussion on issues including the benefits and value of BA and its role in organizational decision-making. The data gathered from the interviews was analyzed and classified according to the interview themes in the first round. This dataset was used in the 'Business Analytics Enabling Future Insights in Private Healthcare' publication.

The fourth dataset, gathered during spring 2018, included five semi-structured thematic interviews from one major international BA technology vendor, an international technology company that was chosen for a deeper case study. Interviewees were BA, BI, AI and ML consultants and architects who divulged their perspectives on BA and AI utilization and business value creation. Also, BA capabilities and BA enabled innovation and new business opportunities were discussed. This dataset was used in the 'Business Analytics Enabling Future Insights in the Private Healthcare' and 'The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics' publications.

The fifth study was conducted during spring 2018, as a qualitative research and a case study research strategy. The multiple case research strategy utilized and executed with qualitative methods was suitable for studying complex and context-dependent research topics (Yin 2003). In this research, eight RPA consultants were chosen for the study. The examined RPA consultants represented multiple different sizes of RPA consulting organizations operating in Finland. The inductive approach with semi-structured, thematic interviews, enabled the investigation of the potential of RPA. The interest group was selected based on the results of previous research that focused on BA utilization and data-driven value creation. Among other data-driven approaches, RPA was brought up as a value-adding opportunity to enhance organizational performance in private healthcare. As the opportunities enabled by RPA have not been studied previously in the private healthcare organizations, the research focused on examining the opportunities rather than being an absolute statement of impacts of RPA on organizational performance. This dataset was used in the 'Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare?' publication.

Figure 8. Perspectives and contribution of different actors to research objective.



As Figure 8 also shows, the inductive approach in this research, together with semi-structured, thematic interviews, enabled the investigation of the decision-making and other potentials of BA. This research method was selected upon by others, as it provided broader explanations and a deeper understanding of the research questions, also allowing the adjusted questions and gathering more information flexibly than if a quantitative study was used (Nykänen et al., 2016; Qu and Dumay, 2011). The semi-structured thematic interviews were performed by face-to face interviews, Skype interviews and phone interviews. The interview discussions were recorded and transcribed to be able to systematically organize and analyze gathered data (McLellan et al., 2003). Altogether, 47 semi-structured thematic interviews were conducted as face-to face interviews, Skype interviews and phone interviews between January, 2017 and May, 2018, spanning a total of one year and five months. The data gathered from transcribed interviews was analyzed and classified by the following content analysis methods and by grouping the data under key themes. However, the primary goal of this research was to gain an understanding of BA utilization and its role in the organizational business value creation process.

3.2 Link between research publications and research questions

As shown in the previous Section 3.1., the research activities and collected datasets are connected to each other in several ways. Here, the aim is to show the connection between research activities and the research publications in Table 4. Also, the contribution of the author is specified.

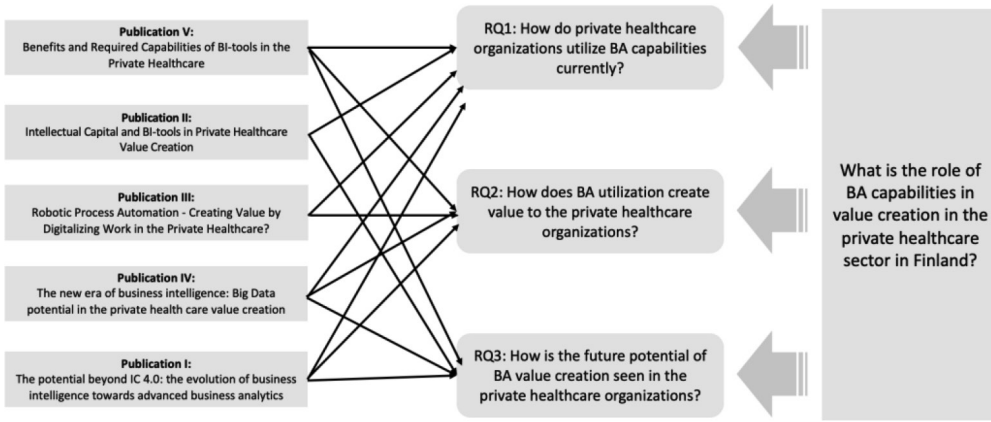
Table 5. Summary of the articles

Article	The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics	Intellectual Capital and BI-tools in Private Healthcare Value Creation	Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare?	The new era of business intelligence: Big Data potential in the private health care value creation	Benefits and Required Capabilities of BI-tools in the Private Healthcare
Authors	Ratia, M., Myllärniemi, J. and Helander, N.	Ratia, M.	Ratia, M., Myllärniemi, J. and Helander, N.	Ratia, M., Myllärniemi, J. and Helander, N.	Ratia, M., Myllärniemi, J. and Helander, N.
Contribution of author	Collecting and analyzing majority of empirical data, 1/3 reporting	Full	Collecting and analyzing majority of empirical data, 1/3 reporting	Collecting and analyzing majority of empirical data, 1/3 reporting	Collecting and analyzing majority of empirical data, 1/3 reporting
Publication channel	Measuring Business Excellence, Vol. 23 No. 4, pp. 396-410	The Electronic Journal of Knowledge Management, Vol 16, Issue 2, pp. 143-154.	Proceedings of the 22nd International Academic Mindtrek Conference. ACM. Tampere, Finland. October 10–11, 2018. Pp. 222-227	Meditari Accountancy Research, Vol. 26 Issue: 3, pp. 531-546	Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland . September 20–21, 2017. Pp. 103-110
Main topic	This publication examines the future potential and opportunities enabled by BA utilization in the private healthcare sector as well as the role of IC in data-driven value creation.	This publication examines the role of IC dimensions, or more specifically, structural (data) and human capital (competences), as well as utilization of BA in data-driven value creation.	This paper looks into the value creating functions of the RPA potential in the private healthcare industry sector.	This publication looks into the potential enabled by Big Data and utilization of BA and BI in creating value in the private healthcare in Finland.	This publication looks into what are the required capabilities as well as how their utilization benefits the decision-makers in private healthcare sector organizations

It was described in Section 3.1.2 how the datasets were gathered and analyzed as well as which publications were published based on them. Thus, the link between the datasets and publications was shown. In addition to summarizing articles and showing the contribution

of the author, the aim of this section is to establish the connections between the publications and research questions, which are shown in Figure 9.

Figure 9. The connection between publications and research questions.



In addition, the connection to the research objective is also shown in Figure 9.

4 Summaries and major findings of each research publication

This chapter contains the summarized contents and major findings of each publication. The contribution of the publications and overall doctoral research, the limitations, and future research are discussed in the following Chapters 5 and 6.

4.1 Publication I: Benefits and Required Capabilities of BI-tools in the Private Healthcare

Ratia, M., Myllärniemi, J. and Helander, N. (2017). "Benefits and Required Capabilities of BI-tools in the Private Healthcare." Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland . September 20–21, 2017, pp. 103-110.

Background and objective

The aim of the research was to gain an understanding of how BA tools were being used and the required capabilities as well as how their utilization benefits decision-makers in private healthcare sector organizations. This study combined the utilization of BA tools and their connection to decision-making in private healthcare organizations. However, having the right selection of technology portfolios is clearly important. By analyzing the capability factors and features of the BA tools in the private healthcare industry sector, the research brings a significant novel value for the private healthcare sector companies, specifying the factors affecting the benefits of utilization. Utilization of various information systems in supporting business processes has created enormous amounts of data that can be used in decision-making and thus enhancing organizational performance. BA can be seen as various methods and processes of turning data into information and further

into knowledge that can be used to enhance organizational decision-making processes. Nevertheless, the roots of most of BA tools lie in the database management, focusing on data collection, extraction, and analysis technologies. After processing mostly structured organizational data, organizations moved toward utilizing these tools in analyzing web-based analytics and social media originated data, to be able to create more knowledge about their customers and establish a conversation between the organization and its market. Also, the next step of technological capabilities is to be able to process large amounts of data originating from sensor and mobile devices. As the requirements towards BA tools are developing and growing, the functionalities and critical capabilities of those tools are also developing to be able to satisfy the demand. In this publication the primarily focus was on the activity and cost data influencing the business decision-making. There are several definitions of capabilities that have been identified for BA tools, required for efficient BA tool utilization. However, even though some of the identified capabilities are valid in a healthcare environment, pointing out specific tool requirements and functional features that are essential for the purpose of health data analysis, and also some of the identified features, is highly relevant in terms of the business-related use of BA tools. In this paper, the IS success model by DeLone and McLean was used as the theoretical lens for identifying the gained benefits and the success of BA tool utilization. The empirical part was based on the information gathered from Finnish private healthcare organizations.

Content and major findings

As the literature shows, there are several required capabilities that enable successful BA utilization in an organization. In this research, the required capabilities and functionalities were identified which were brought up by the examined organizations. The research showed that over half of the identified capabilities and functionalities had also been identified by Chen et al. (2012) and Brandão et al. (2016). When it comes to benefits, in general, the interviewees saw performance excellence and resources optimization as the main benefits of BA tool and technology utilization. In addition, one of the most important approaches was considered to be customer experience, in terms of better customer service and customer knowledge, leading to value creation for both customers and organization. Also, faster reaction time, better forecasting, and enhanced support of decision-making were considered to be significant benefits. However, sharing of "best practices", the creation of new business opportunities and enhancing information flow were also mentioned to be the benefits of BA technology utilization. To summarize, the benefits of utilization in terms of decision-making in the private healthcare sector can be considered quite multidimensional. Thus, by examining direct and indirect BA utilization value functions and their measurement in the private healthcare sector, we can identify the benefits that efficient utilization brings to organizations. This is one of the key factors, also, when supporting decision-making in the private healthcare sector organizations. Nevertheless, the most significant benefits

of BA tool utilization in the private healthcare sector can be considered to be seeking for operational excellence, enhanced customer reporting, and also creating new business opportunities using data on the next level. The research also showed that the BA tools were quite spread, but not intentionally, as true reasons behind were mainly historical, as a result of corporate mergers and other situations of inorganic organizational growth. The responsible organizational functions for BA were IT, finance and business organizations, but there were also cases where BA had no ownership. When it comes to practical utilization, there were several major internal data consumer groups utilizing BA tools, but also external user groups appeared. However, the identification of BA tool requirements and functionalities can help us to understand the benefits of utilizing those data-driven technologies in the private healthcare organizations, also beyond operational excellence, enhancement of customer reporting, and creating potential for new business opportunities.

4.2 Publication II: The new era of business intelligence: Big Data potential in the private health care value creation

Ratia, M., Myllärniemi, J. and Helander, N. (2018) "The new era of business intelligence: Big Data potential in the private health care value creation," Meditari Accountancy Research, Vol. 26 Issue: 3, pp. 531-546.

Background and objective

This publication examined the potential enabled by Big Data and utilization of BA in creating value in private healthcare in Finland. During the past years, the amounts and diversity of generated data have expanded significantly, and as the literature claims, most of the world's data has been generated during the past few years. Also, the amount of data generated in the rapidly changing healthcare sector also requires efficient data-driven decisions at organizational level and in business operations, in addition to the daily work of the clinicians. This requires a different perspective on processing big amounts of data, which is not possible to process manually or within capacities of normal databases. However, in this research, Big Data and certain BA capabilities are seen through the lens of Intellectual Capital (IC), that creates value to organization. The focus of the publication is to identify value creation factors (IC) in terms of data utilization in the private healthcare industry sector now, and also in the future. Therefore, the practical outcome provides an understanding on the existing data sources and BA tools and technologies utilized in the private healthcare in Finland. Besides, it provides insight into the future-oriented Big Data potential that can act as an enabler of creation of new business concepts for private healthcare companies. The conceptual basis includes Big Data, literature related to BA tools, and furthermore Secundo et al.'s (2017) IC model as well the Möller et al.'s (2005)

model of value creation are used as a conceptual framework. The empirical part has been conducted through research among private healthcare organizations.

Content and major findings

The empirical study showed that all of the researched companies had multiple data sources and most of them were using more than one tool to take advantage of BA. The major challenges were considered to be the quality of the data and a rapidly changing organization that did not leave time to adapt to the data requirements nor technology as well as lack of capabilities, such as internal and external competences in utilizing BA efficiently. The future vision was to enable the creation of new products and services out of data. For example, combining various new data sources, not just our own internal operative data, especially, but also to utilize external open-source data with an intent to get deeper analysis of trends, especially Big Data.

Also, data-driven decision-making is a strong goal as well as the data-driven culture that enables value creation. However, capabilities were seen to need significant enhancement, to enable data processing that future requires. Regarding practical data-enabled value creation, the need was not only to combine various new internal and external data sources, but also to create new data, especially for customers. Both for corporations in general and individuals, regarding their personal health. However, moving forward from one value creation level to another adds complexity to the performed operations but also has more potential to bring value, from enhancing operational efficiency and creating new data-based services to new radical business innovation supporting customer's needs. However, to be able to move from one value creation level to another, it is essential to have IC components available, such as human, social and structural capital. Also, each level of value production requires one or several components of IC to achieve success. In addition, when moving from a lower lever to a higher one, the required capital and components also increase, often requiring Big Data, to utilize the whole potential.

4.3 Publication III: Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare?

Ratia, M., Myllärniemi, J. and Helander, N. (2018). "Robotic Process Automation - Creating Value by Digitalizing Work in the Private Healthcare?" Proceedings of the 22nd International Academic Mindtrek Conference. ACM. Tampere, Finland. October 10–11, 2018, pp. 222-227.

Background and objective

Among other organizations, the healthcare sector has recently begun to digitize their organizational processes, to enhance performance, especially in the private healthcare sector. For example, the automatization of certain workflow processes, e.g. utilizing Robotic Process Automation (RPA), in organizations has emerged. The aim of this research was to analyze the value-creating functions of the RPA potential in the private healthcare industry sector. RPA is an automation process that uses software and algorithms to automate an employer's actions and can be used instead of a human resource in performing a specific process. This is reasonable, when using human resources is either too expensive, inefficient, or the amounts of data to be processed are enormous. Here, the focus was especially on finding out what types of organizational work processes can be digitized with RPA in private healthcare. The literature describes RPA as a combination of methods, systems, and tools to automate manual organizational processes.

As a brief description, RPA is seen as a digital enabler, a technology used in an automation process that is based on software and algorithms to automate or copy the employee's manual performance in the digital process and can be used to replace a human resource in performing a digital process. Whether the process is digital, routine, and requires a lot of human resources, utilization of RPA is reasonable or when using human resources is either too expensive, inefficient, or the amounts of data to be processed is too large. Organizations are seeking for effectiveness for example in enhanced digital customer experience. However, enhancing performance should also bring value to the organization. Therefore, the concept of value or value creation is often referred to in business discussions. However, in this case, activities that could be performed by healthcare companies, related to RPA, should be able to create more value not only for themselves but also for their stakeholders. Here, direct and indirect value functions were used to measure the created value in private healthcare.

In this case, value brought by direct functions is easier to measure financially, whereas indirect functions require the input of healthcare organization's outer parties, and the outcomes cannot be directly measured financially. Nevertheless, the direct or monetary functions are known as profit, volume, and safeguard functions. Furthermore, the indirect value creation functions are innovation, market, scout, and access. However, Walter et al.'s (2001) model helps in understanding the measurement examples and functions enabling value creation in the private healthcare sector, rather than being an absolute and exhaustive list of value-creating functions. Here, RPA literature and Walter et al.'s (2001) model were used as a conceptual basis for value creation and introduce the concept of RPA, whereas the empirical setting, introducing the methodology, and empirical material is based on the interviews with RPA consultants responsible for the private healthcare operations.

Content and major findings

The primary objective of this paper was to study whether there was potential for RPA-based organizational performance enhancement and thus, value creation through knowledge work digitalization in the private healthcare business. This research brought up two perspectives of RPA, technological and process. To begin with the technological perspective, the description was very similar to the literature approach and focused on the software opportunities. However, the other approach to RPA utilization is to focus more on the process side, where the technology is not as relevant as the process itself and workflow that RPA is replicating. Also, it is clear that the two approaches are not exclusive but rather complement each other. Therefore, the benefits and value of RPA can also be considered multifaceted. RPA can increase efficiency in the organization by reducing human labor in routine business processes. In addition, the enhancement of work quality, as fewer mistakes are made, and also good scalability can be considered beneficial. Digital outsourcing enables part of the administrative routine and manual work to be outsourced with RPA to a software robot, allowing the clinical staff, doctors, and nurses to concentrate more on interaction with the patient and thus, create value to the customer through the customer experience. Even though a great amount of digitally performed organizational processes can be outsourced to be performed with RPA, there are still major risks and challenges in RPA utilization. If there are errors in a manually performed process, the same defective process will be automated without correcting mistakes in the process, and the RPA technology will continue generating mistakes. Also, as RPA is highly scalable, the significance of flaws grows as RPA performs every step in the process more efficiently than in a manual process. Therefore, the workflow process must be built correctly to avoid mistakes in the automated process. Also, utilizing RPA technologies requires other capabilities within the organization than processes. It also requires the ability to perform tasks not only in IT functions, but also among dedicated business users.

Through function-oriented value analysis, the kind of value that can be co-created in the private healthcare organizations utilizing RPA could be identified. The analysis of value functions revealed that issues related to performance, optimization of workforce, scalability and better quality, were the key factors when creating value through direct value functions. The main focus areas were reducing manual work, optimizing expensive resources, scaling work, and improving the quality of performance. When it comes to value potential, indirect value can be for example refocusing on development and innovations as well as utilizing external sources instead of performing routines and in terms of direct value, it is natural for a business organization to seek better performance and thus profit. Even though the direct value is clear, private healthcare organizations could find new and innovative ways to create value through indirect value functions, such as new digital products and services, both internally and externally. However, here it is more important to understand the activities and functions that can create value in the private healthcare sector with RPA utilization, rather than stating an absolute and exhaustive list of value-creating functions. First, RPA

automates routine business processes, such as administrative routine work, e.g. for HR and finance processes and simple customer service activities. Second, RPA utilization can bring value by enabling clinical staff to focus more on the patient or customer. Third, it can create new products or services that can bring value while requiring that organizations focus on understanding their business processes better.

4.4 Publication IV: Intellectual Capital and BI-tools in Private Healthcare Value Creation

Ratia, M., 2018. "Intellectual Capital and BI-tools in Private Healthcare Value Creation. The Electronic Journal of Knowledge Management," Vol 16, Issue 2, pp. 143-154.

Background and objective

The paper aimed to examine the role of IC dimensions, or more specifically, structural (data) and human capital (competences), as well as the utilization of BA in data-driven value creation. However, various data sources and BA tools can be considered as a part of structural capital, and the ability or competence to utilize BA tools can be considered to be human capital dimensions. Yet, it is unclear what the role of IC dimensions and BA is as a combination of knowledge-enabled value creation potential in the private healthcare sector. Lately, interest in BA and efficient utilization of organizational business data has increased along with the need to identify necessary data sources, not only for supporting organizational decision making but also for combining external data sources, including open data, with organizational data and creating the potential for new business opportunities, and thus value. However, this is not easy to implement on a practical level, as in addition to the utilization of both internal and external data certain capabilities is required to succeed, for example IC dimensions, namely data (structural capital) and competences (human capital), i.e., organizational knowledge prerequisites. Hence, intellectual capital can used to gain competitive advantage.

Organizational business data as well as the ability to utilize different data sources can be considered valuable from an organizational point of view, as it enables a data-driven approach. Also, the concepts of value and value creation and their importance in the context of business decision making can be considered multifaceted. Nevertheless, this research focused mostly on data-driven value creation enabled by the IC dimension, or more specifically, human and structural capital. However, a data-driven business approach seems to be strongly related to the discussion of IC value creation. Knowledge, data, and the ability to use them in business-related decisions are crucial drivers for organizational performance and value creation. Further, organizational innovation capability is also related to IC utilization. Even though IC is a multifaceted topic with no exact definition,

the role of capabilities has been crucial in the IC debate, as has the effect of IC on value creation in organizations. The conceptual basis includes BA- and IC-related literature, and furthermore KM and value creation are used as a conceptual framework. The empirical part was conducted through research among private healthcare organizations and also technology and management consulting companies specializing in BA.

Content and major findings

In this research, most organizations had several data sources from operational and financial systems to be modeled in one data warehouse model and analyzed further using one or several BA technologies. Also, most of the organizations used more than one BA technology, mainly for the historical reasons of corporate mergers. Digital channels were mentioned as one of the data sources and also multiple sources of structural capital included structured data being utilized in creating value. Utilization of both internal and external data sources was considered as an important data asset. However, structural capital itself and also combined data from both internal and external sources, as well as utilization of open data, can be viewed as valuable data assets. Consequently, internal and external capabilities and competences for data and BA utilization have a significant role. However, lack of internal competence can be solved by outsourcing some of the BA operations, but a certain level of in-house competence to secure continuity seems to be important. When it comes to competences within an organization, controllers are the forerunners in BA utilization, but there is a significant lack of competence on the data science and business sides. Also, competences are insufficient in a top management when setting strategic goals for the organization, not only using BA in operative decision-making. It is clear that it is crucial for organizations to understand their data. In the bigger picture, the future of business was seen as becoming increasingly data-based. Consequently, external data sources are not being utilized enough, even though the potential is considered to be significant, especially in combining internal data with open data or other forms of external data sources. Even though the awareness of external sources is expanding, this raises the relevant question of the readiness of data utilization and competences that are available in organizations. However, some organizations do successfully utilize external data sources in addition to their organizational data.

Clearly, BA-enabled value creation requires several IC dimensions. The research showed that, of the IC dimensions, especially human capital and structural capital can have a significant role in data-driven value creation in private health care. Human capital is required to ensure efficient service production and delivery of services, as well as process flexibility and excellence. Also, structural capital has an impact on performance excellence, operational efficiency, and data-driven decision making. When moving further to the next value creation level, human capital can enhance service excellence and enable the development of new solutions and services. Structural capital enables improved

performance and more efficient data utilization. The last level of value creation is highly oriented towards future value, where human capital enables the potential of new business from data and creates new data by combining different data sources. However, structural capital enhances and enables the utilization of external sources, combining them with the organizational data to create value, enabled by efficient utilization of ML and AI. Here, value can be delivered not only through the existing business concept and utilization of existing data sources, but also from proactively seeking new data opportunities to grow the business. However, the existing organizational competences in BA utilization are not enough to fulfill organizational ambitions and, as a result, organizations are required to seek external competences in BA utilization, from deep technological competence to strategic approaches. Clearly, the role of BA competences, to enable BA value creation, will also grow in the future.

4.5 Publication V: The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics

Ratia, M., Myllärniemi, J. and Helander, N. (2019), "The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics," Measuring Business Excellence, Vol. 23 No. 4, pp. 396-410.

Background and objective

The aim of this study was to examine the future potential and opportunities enabled by BA utilization in the private healthcare sector as well as the role of IC in data-driven value creation. The amount of data is growing rapidly, requiring new approaches to utilize it efficiently. However, it is not only the amount of clinical data that is growing, but also organizational administrative processes are generating a vast amount of operative business data that is being used to support managerial decision-making on all organizational levels. Also, the private healthcare sector is naturally seeking to enhance their understanding of business practices and related organizational data as well as their operational environment, for example by automating manual processes such as a physician's written notes and prescriptions, medical imaging, or laboratory results processing, etc., to enable better performance through enhanced and timely decision-making. Moreover, data generated by social media or automatically generated sensor data can be processed more efficiently and enable enhanced decision-making. Further, advanced business analytics can also be applied to proactive preventative care applications, for example health and activity apps. However, value is also created by optimizing administrative and managerial processes, for example more efficient resource allocation and supply chain management or real-time location of assets and human resources. Thus, in decision-making, timely access to relevant information can

be crucial, and this also puts pressure on technology. Therefore, naturally there is increasing interest in BA methods and technologies, as they enable the exploring and exploiting of organizational data that is being siloed in various operational systems, in order to be able to create value through operational and strategic performance improvements. However, it is clear that this requires certain capabilities, in addition to technology, to succeed. As well as BA, KM operations and IC dimensions can also be considered important in terms of better decision making. An organizational knowledge base, i.e., IC is also considered to influence the organizational decision-making capability and implementing it. Also, knowledge-driven value creation is often linked to IC, and as the literature suggests, IC is an important part of organizational value creation. Even though the concept of IC is multifaceted, the literature suggests dividing IC research into four main stages. In this research, the focus was especially on the fourth stage, as the aim was to identify the capabilities required to create value. In the fourth stage of IC evolution, a broader perspective of IC is pointed out, and the focus is on ecosystems where knowledge can be created and developed on a wider scale. Here, networks and ecosystems of different combinations of IC components where human, relational, and structural capital are combined into a new view of IC with a more performative approach, play a central role. However, the emergence of extended BA and related concepts, e.g., Big Data, have also offered new lenses for interpreting IC, where the role of IC is to act as an enabler of continuous development of different capabilities, such as approaches, technologies, and infrastructures enabling data creation in the organizational IC ecosystem. The conceptual basis of the publication includes BA and introduces the Secundo et al. (2017) model of an IC ecosystem. The empirical part was conducted through research among private healthcare organizations and also technology and management consulting companies specializing in BA.

Content and major findings

The primary objective of the study was to examine the future perspectives of BA in the private healthcare sector companies in Finland. The near future of BA was seen to include predictive, prescriptive analytics, and AI to enhance business decisions. Therefore, organizations are mostly turning from historical data towards looking to the future. However, data was considered a valuable asset, especially when organizational data was combined with external data sources. Also, AI was seen to be one of the key factors in mining relevant data from internal and external data sources. Nevertheless, the potential of external data sources and also social data co-creation was pointed out clearly. This kind of collaborative or social co-creation of BA can be beneficial for all members of this data-sharing ecosystem type of interaction, as completely new data can be created out of existing data when combined. In addition to BA, IC was also identified as an upcoming trend. Thus, organizations have an increasing interest in IC and its potential to create value. Also, a minor theme appeared of what will be omitted from BA in the future. It was considered

that the role of traditional reporting and heavy implementations as well as static waterfall projects would be smaller in the future. In addition, there seems to be a need to combine the existing organizational data with external data sources in developing potential for new products and services through social co-creation of BA. Another important approach was seen to be utilizing AI opportunities and operating with predictive and prescriptive analytics in decision-making processes, and consequently, also in this case, creating potential for new business opportunities. As a result, business drivers of change, related IC components, future BA factors and created value were identified. Enhancing production and delivery of services and products, process excellence, and predicting future business can be considered to be the first drivers that require such IC components as human capital (competence of BA utilization) and structural capital (data). The future trends in these areas were identified to be predictive and prescriptive analytics, AI, and as a result, reduction of traditional mass reporting. The second driver reflects organizational innovation, enhancement of business performance, and also creation of new innovations. Here, the IC components are human capital, describing the internal and external capabilities enabling BA utilization, structural capital, more specifically advanced technologies and processes supporting utilization, social capital which means growing customer demands and relational capital, describing the interaction between stakeholders in terms of data sharing, ecosystems, and business networks. The future trends were identified to be utilization of external data sources and combining of internal and external data sources, creating value by mastering customer experience, such as customer reporting and digital service excellence. Finally, as a third business driver, the creation of new radical business innovations and new business concepts outside of core business was identified. Here, the related IC components are structural capital, or more specifically, advanced BA technologies and processes, human capital for internal and external capabilities enabling the BA utilization, social capital for customer experience, relational capital for networks and interaction between stakeholders in terms of data sharing as well as ecosystem acting as combining platform of knowledge sharing between different parties. The future trends were identified to be the advanced utilization of external data sources, and the social co-creation of BA and KM platforms to utilize different data sources. As a result, this creates potential for a new core business from data, the advanced utilization of external sources, social BA co-creation, networks, and social BA ecosystems. By studying the IC ecosystem through the lens of BA and Big Data, three levels of value were suggested in the publication, as the benefits of BA utilization.

5 Discussion

5.1 How do private healthcare organizations utilize Business Analytics capabilities currently?

The purpose of the first research question was to examine how private healthcare organizations utilize BA capabilities currently. The aim was to obtain a general view of utilization of BA capabilities in the Finnish private healthcare sector. Previous researchers have studied BA utilization in either the public healthcare context or in general, in other industries. The results of these previous studies were used as a base for further examination of the current state of BA utilization in the private healthcare sector. This was examined in the following papers: Publication I, Publication III, Publication IV, and Publication V. In the next sections, perspectives on the current utilization of BA tools have been divided into BA tools and capabilities.

5.1.1 Utilization of Business Analytics tools enabling data-driven decision-making and future ecosystems

Regarding the utilization of BA, which was assessed in four publications, the overall finding was that it is strongly related to the BA tools that act as an enabler of data processing, analyzing, and sharing. However, in addition to BA tools, other capabilities are also required to succeed, including process, data, and competences. The literature (e.g., Nykänen et al., 2016; Turban et al., 2008) suggests that tools and methods are one of the main elements in organizational BA utilization. At the end of the day, these tools are crucial in getting the right information to the right people, enabling data-driven decision-making in organizations, which is also a significant part of overall BA utilization (Côrte-Real et al., 2014). As also stated in Publication V, data-driven decision making enabled by BA tools

is strongly the direction that organizations are aiming to move towards, and furthermore a data-driven culture. However, even though modern BA tools are easy to use, not all organizations have enough competence to fully utilize their potential. When it comes to data utilization in the healthcare sector, Kankanhalli et al. (2016) suggest that data can be divided into four primary sources: clinical data, pharmaceutical data, activity and cost data, as well as patient behavior data (sensor devices and social media data). As research showed in Publication V, the focus of BA utilization is mostly on activity and cost data, and still less on analyzing patient behavior data. However, activity and cost data, such as enhancing operational efficiency and data-driven decision-making are clearly the most value-adding in the short term. However, seeking new innovation and enhancing customer experience are beyond the traditional organizational decision making.

Trieu (2017) suggests an expanded role from traditional BA tools towards ML and Big Data tools. Also, this statement is supported by the results of papers of Publication V, Publication II and Publication I, as the future of BA tools is seen to lie mainly in having elements of AI, predictive analytics, ML, and evidence-based decision-making, and being closer to the end-users. Moreover, in Publication I, different KM or data platforms are also mentioned as a tool for utilizing data from different sources. Kankanhalli et al. (2016) mention patient behavior data as one of the primary data sources, as it is rather a pool of different data sources, as described in Publication IV with several different locations in operational and financial systems. However, there are also other sources of data, used for different purposes, as shown in Publication I, in addition to different flexible combinations of data from various sources, data co-creation and different ecosystems will grow. Thus, customer-, situation-, and product-based decision-making will be available and thus, more personalized solutions can be created. Also, as Asrar-ul-Haq and Anwar (2016) state in their research, co-creation is an emerging trend in data sharing.

Wullianallur et al. (2014) highlight the importance of having the right selection of BA tools, as is also shown in Publications IV, III, and I. Therefore, when it comes to tools, many of the case organizations were using more than one tool, mainly for historical reasons, but trying to decrease the amounts of tools used in BA utilization. As there are different data sources utilized for different purposes, several tools have ended up over time in the organizational BA tool portfolios. In addition, serving slightly different purposes, new RPA tools have complemented the set of BA tools of organizations. Aside from the traditional and modern analytics tools, some of the actors brought up modern data platforms that enable combining internal and external data within ecosystems. Tools are also seen as a connector of different siloed organizational data stored in multiple operational systems (Spruit et al., 2014; Grierson et al., 2015). As described in Publication IV, BA tools are mostly used to connect data from different operational and financial systems to enable data-driven decision-making. Brandão et al. (2016) and also Chen et al. (2012) refer to some recognized BA tools, such as QlikView, Tableau, SAP, IBM, Microsoft and Oracle BI tools. Microsoft, IBM, QlikView and Tableau are the most popular BA tools, as listed in Publication V.

When it comes to BA-related RPA capabilities and, further, RPA tools, there are certain matters to be taken into consideration. As Lu et al. (2017) and Kirschmer (2017) mention in their research, RPA tools are often used to outsource digital organizational processes, but there are significant operational risks when it comes to using the tool. Also, as described in Publication III, RPA is highly scalable, so also mistakes in the process are very scalable as well. Thus, whenever the process includes any errors when performed manually, then when the same process will be automated without correcting mistakes in the process, the RPA tool will continue generating the same mistakes, making the flaws even more significant, as RPA performs everything more efficiently. However, as Fernandez and Aman (2018) show and also described in Publication II, if the tool and technological approach is used correctly, it can significantly improve manually performed operational processes and create value.

5.1.2 Functionalities and capabilities enabling Business Analytics utilization

Brandão et al. (2016) in their research identify the requirements and functionalities of successful BA tool utilization, especially in the healthcare environment. Thus, grasping the full potential of BA tools utilization requires understanding the functionalities of the tools and capabilities that enable the actual utilization. Also, as shown in Publications I, II, and III, BA utilization requires certain capabilities. The research suggests that internal and external data, know-how or competences within the organization and partner network, technology or tools, leadership and process capabilities are the overall requirements for BA utilization. Without these capabilities, BA utilization remains incomplete or even impossible. In addition, as described in Publication I, co-creation can be seen as a required capability in some cases. Innovation capability, among others mentioned by Möller et al. (2005), however did not appear in the research results as a capability, but rather as a driver for BA utilization. Also, ecosystems are seen more as being a result or a combination of process and leadership, than a distinct capability. However, it is clear that selection of capabilities may vary between organizations or industries and different interpretations of various schools of thought, being both physical such as technology and data and non-physical, such as leadership and culture. Chen et al. (2012) especially raised capabilities, which are considered critical for BA utilization. As explained in Publication V, over half of those capabilities were also shown as a result of the research.

The research shows that data, whether internal organizational and external, open or purchased, is one of the key elements for BA utilization. As Publication II shows, there are typically several internal and external data sources for their BA utilization. Based on the conducted research, combining data from operational and financial systems, different digital channels, open source and online data are a current state of data capability in BA utilization. Moreover, data capability was seen as a capital. But, as shown in Publication IV, when it comes to data capability, quality and availability are crucial. In addition, to achieve the full potential of different data sources, BA tools play a significant role in connecting

the sources and combining data. As described in Publication II, connecting different data sources using BA tools is also an enabler when it comes to data monetizing. However, to be able to further process and combine internal or external data, a certain selection of BA tools is required, making technology one of key capabilities in enabling BA utilization. Technological requirements are often described as functionalities of BA tools, as also described in Publications V, and III. As the organizational field of technologies is typically built up over time, it is common that there might be several technological solutions for BA utilization. Yet, as it is also shown in Publications II, V, and III, the technology has to include certain functionalities to fulfill the requirements set by BA utilization in organizations. Those functionalities were also suggested by the literature, e.g., Chen et al. (2012) and Brandão et al. (2016).

As Raghupathi and Raghupathi (2014) have shown in their research, utilizing external data and applying advanced analytics in healthcare is beneficial. However, in order to be able to utilize BA successfully and use its all potential, there has to be the ability and proper knowledge on how to utilize them. The ability and knowledge, know-how or competence can be both internal and external. Therefore, as described in Publications II and I, know-how or competences are important both within the organization and in the partner network. However, as the publications show, there is not necessarily enough competence within the organization. Even though many of the researched organizations were using external partner networks in their BA utilization, it was clear that a certain level of internal competence was valued. Moreover, the lack of competence was seen to slow down the overall BA utilization and its development. When it comes to even more non-physical and difficultly measured capabilities, such as leadership or culture, BA utilization seems to be even more fragmented. Even though leadership was seen to be important, as described in Publication V, there was still no clear ownership or one responsible facet for BA utilization process. It seems to be typical that the development of tools and utilization act as separate organizational processes. This division of responsibility might reduce the development of data-driven culture within the organization. However, it is only the combination of BA utilization capabilities that can create value.

5.1.3 Conclusions of results of the first research question

As a conclusion to RQ1, "How do private healthcare organizations utilize BA capabilities currently", the research suggests that successful utilization of BA is strongly related to BA tools. These act as an enabler of data processing, analyzing, and sharing. Yet the utilization of BA tools alone is not enough. In addition, other capabilities are also required to succeed, such as process, data, and competences. This research identifies different purposes for using BA suggested by the literature and brings them to the empirical setting of the private healthcare context. Also, this thesis identifies and presents different BA capabilities that are required for successful BA utilization. However, it is noticeable that different organizations

have different maturity levels of capabilities and thus, value creation can appear on many different levels.

5.2 How does Business Analytics utilization create value for the private healthcare organizations?

The purpose of the second research question was to examine how BA utilization creates value to the private healthcare organizations. The aim was to obtain a general view of BA utilization in the Finnish private healthcare sector organizations in terms of value creation. Previous researchers have studied BA utilization value creation in either the public healthcare context (e.g., Myllärniemi and Helander, 2012) or in general, in other fields of industries (e.g., Walter et al., 2001; Möller et al., 2005; Hugos et al., 2011; Ojala and Helander, 2014; Secundo et al., 2017). The results of these previous studies however were used as a base for further research on the private healthcare sector in BA utilization-based value creation. Value creation enabled by BA was discussed in four publications: I, III, IV, and V, showing that BA, and related concepts such as RPA and AI, can create value in the private healthcare sector. However, value creation, as a concept, is multifaceted and the literature suggests several different models and frameworks to enable and support further research of BA-enabled value creation (e.g., Walter et al., 2001; Möller et al., 2005; Hugos et al., 2011; Ojala and Helander, 2014; Secundo et al., 2017). In the next sections, perspectives on value creation and the utilization of BA are/ will be discussed using several models suggested by the literature.

5.2.1 Creating value on different levels

Myllärniemi and Helander (2012) have suggested that knowledge processes and methods, like BA, should be tightly connected to the healthcare organizations' service provision and value creation (Myllärniemi and Helander 2012). According to Möller et al. (2005), the capabilities that are required in the process of value creation, are also emerging in terms of complexity. However, in business environments too, the primary and less complex capabilities are no less important. Therefore, to be able to proceed to the next and more complex level of value creation, there has to be a solid platform of traditional capabilities of value production, created on the previous level. Additionally, complexity requires more actors to be involved (Möller et al., 2005). As another result of the research reported in Publication IV, the first level of value creation was core value production. More precisely, in the search for basic business value, such as operational efficiency and process excellence along with data-driven decision-making. These value-creating capabilities, however, are not very complex and do not require additional actors in the value creating process, just as Möller et al. (2005) suggest.

In contrast, the second level of value creation is more complex, as described in Publication IV. Möller et al. (2005) suggest that the second value creation level consists of elements of value-adding relational production, such as innovations and new solutions, customer and partnering capabilities, innovation capabilities and new solutions supporting the customer's business. In this research, regarding the creation of more complex value-adding production, the key capabilities focused more on advancing innovation, enhancing overall performance and mastering efficient data utilization, customer reporting, and service excellence. These identified capabilities clearly create value not only for private healthcare organizations, but also for their networks, including adding value for their customers.

Möller et al. (2005) have defined the third level of value creation as future-oriented value production. Their research suggests that radical innovations opening up new business opportunities require complex capabilities such as network orchestration capabilities, radical innovation capability, network visioning capability, and mastery of the customer's business capability. However, it is clear that the third level of value creation is a complex environment that requires a new level of collaboration and networking. Likewise, the results of Publication IV support the perspective, as here the focus is on creating radical innovations and new business concepts. More specifically, creating new core business out of data and also utilizing efficiently external data sources to create value. Hussinki et al. (2017) suggest that data and knowledge are crucial drivers for performance and value creation in the organization (Hussinki et al., 2017). When it comes especially to the last value creation level, Publications IV, III, and I show that the value in utilizing BA is created by connecting different data types from different sources enabling companies to collect, evaluate, analyze, store, and share timely and relevant data to be used efficiently in different decision-making use-cases. In addition, the literature suggests that the expanding role of external sources has created strategically important opportunities and new potential sources of revenue. (e.g., Foss et al., 2013; Denrell, Fang and Winter, 2003; Zahra and George, 2002). However, BA utilization can be a combination of internal data sources as well as external data sources, which can be used separately or together, creating new data and information and thus, value. Moreover, as described in Publication I and Publication III, value can be created in co-creation, social data co-creation, and data-sharing ecosystems, or in complex environments, as Möller et al. (2005) suggest.

In summary, Publication IV shows that core value production aims for better operational efficiency, performance excellence, and data-driven decision-making. Second, value-adding value production concentrates on excellence in customer reporting and better utilization of data sources. Finally, future-oriented value production enables the development of new business opportunities and creation of new data-driven business concepts and products. One of the enablers of efficient utilization of BA is combining various internal and external data sources. This can be one of the enablers of competitive advantage of BA utilization in the private healthcare sector. In addition, creating new data-driven services and products as well as making new data-based innovations out of data is also a result of the ability to utilize multiple data sources.

5.2.2 Business Analytics creating direct and indirect value

In their research, Walter et al. (2001) introduce a function-oriented model of direct and indirect value functions. Their framework introduces direct and indirect value functions that a.so enable the measurement of created value, among other industries, in private healthcare. Direct value can be measured more specifically in monetary terms, such as profit, volume, and safeguard. However, when it comes to indirect value, there are more clearly non-monetary perspectives involved, such as development, innovation, and scout. Also, as described in Publication III, in the case of the private healthcare sector, value brought by direct functions is easier to measure financially. In contrast, indirect functions require the input of healthcare organization's outer parties, and the outcomes cannot be directly measured financially. As Walter et al. (2001) suggest, direct value creating functions were monetary as described in Publication III, such as the financial value of efficiency, number of tasks performed, and better service levels.

To be more specific, the research in Publication III showed that the financial value of efficiency means less manual administrative work, less workforce required, and enabling an expensive workforce, e.g. doctors, to concentrate on value creation. The amounts of tasks performed reflect the scalability of work, resource optimization, and volume of performed tasks. Better service level equals better quality performance, and better customer service. When it comes to indirect value functions, development functions can be seen as refocusing on development matters, or more specifically focusing on enhancing development processes and developing new ways of work. Innovation is further on creating new products and services, more specifically, by creating new digital solutions and services internally and externally. The scout function brings up external resources and collection of information from external data sources. However, as described in Publication III, BA-related concepts along with RPA and AI capabilities can bring significant benefits and value in automating routine processes, releasing value creating personnel towards value creating work performance and also, enabling the creation of new services and products.

5.2.3 Conclusions of results of the second research question

As a conclusion to RQ2, "How does BA utilization create value for private healthcare organizations?", the research suggests two approaches from the literature: function-oriented direct and indirect value analysis (Walter et al., 2001) and capability-based analysis (Möller et al., 2005). Therefore, the research, supported by the literature, suggests that there is a monetary and non-monetary approach to value creation. In addition, there are different levels of value creation, following each other in terms of complexity. Value creation can be direct or indirect, crossing suggested monetary and non-monetary value functions. Yet, it is clear that value creation is a multifaceted concept, where different approaches complement rather than exclude each other. This thesis identifies and presents the most relevant

approaches, which together with an empirical setting create a broader understanding of the researched phenomenon of BA utilization value creation. This research also identifies the value-creating capabilities for using BA suggested by the literature and brings them into the empirical setting of the private healthcare context. However, the ability to identify the future of BA potential requires a slightly different combination of capabilities.

5.3 How is the future potential of Business Analytics value creation seen in private healthcare organizations?

The purpose of the third research question was to identify the potential of BA value creation in private healthcare organizations. The aim was to obtain an overall perspective of the future potential of BA utilization in the Finnish private healthcare sector. The previous literature has examined BA utilization from different perspectives, for instance, the utilization of BA-related concepts, such as BI, Big Data, ML, AI, RPA, but there is still a lack of understanding of the future potential of BA value creation in private healthcare (e.g., Ylijoki and Porras, 2016; De Mauro et al., 2016; Davenport, 2014; Davenport, 2018; Lu et al., 2017). Even though Brandão et al. (2016) introduce BA in the context of healthcare, there is still a lack of understanding of the potential of BA value creation in private healthcare organizations. However, the future-oriented value production of Möller et al.'s (2005) value production model gives a framework to discuss the question of future BA value creation in the context of private healthcare sector.

Therefore, in four of the publications: IV, V, II, and I, there is a discussion of the future potential of BA value creation, also using previous research as a basis for further discussion. In the next sections, the future potential and limitation of BA value creation capabilities are discussed.

5.3.1 Future insights of Business Analytics utilization

Wamba et al. (2015) suggest that future oriented BA technologies as well as the new generation of BA tools and IT architectures allow significantly big amounts of data from various data sources to be collected, stored and organized, extracted, and analyzed as well as sharing generated data to create value. Also, in that light, Publications IV and II show that in addition to enhancing the ability of better utilization of the existing data sources, the aim is to combine the existing data with external data sources to create insight into future trends, developing potential for new products and services and thus value creation. As shown in Publication IV, in terms of future potential, the value of creating new data out of internal and external data sources, can be seen as twofold. For the organization and thus owners, as well as for the end customer by significantly improving the level of service production.

Moreover, potentially the increasing amount of internal and external data sources provide better insight into data-driven decision making. Our research supported Davenport's (2018) view of embedded analytics, cognitive technologies, and RPA automation of manual tasks. Publication IV also shows that fast data generation and processing enable predictive analytics are more easily to be utilized in the near future. In addition to those, as Publication IV, supported by the literature, (Davenport, 2018; Davenport and Kirby, 2016b; Lu et al., 2017) show that the utilization of ML opportunities, AI, RPA, and predictive analytics can be considered as the future potential for BA utilization. These are seen as future enablers of new business opportunities, in addition to improving the organizational decision-making, and thus, creating value (Kirchmer, 2017; Davenport, 2018; Siegel, 2016).

When it comes to future-oriented value production, Publications IV and II suggest that the future value of BA utilization is created by new radical business innovations and new business concepts. This is supported by research of Möller et al. (2005). In addition, efficient utilization of external data resources could enable a new core business out of data. It is also suggested in Publication II that to achieve them, ML and AI capabilities are required. Moreover, as described in Publication IV, advanced tools and related capabilities are in a significant role for future oriented BA utilization as well as different internal and external data sources, as shown in Publication II, also supported by recent research (e.g., Krishnamoorthi and Mathew, 2018; Fink et al., 2017).

Therefore, creating new services or products and innovations out of newly created data, require multiple different data sources and other new capabilities. Overall, as described in Publication I, AI and ML are seen to be a mirror into the future. In addition, another interesting future perspective is social co-creation of BA, that enables collaboration also in different data networks and data-sharing ecosystems, in order to create new business opportunities within the ecosystem. However, the literature also suggests that data science, predictive analytics, and Big Data can be a valuable asset in future business value creation (e.g., Dong and Yang, 2020; Vidgren et al., 2017; Waller and Fawcett, 2013).

5.3.2 Solid base for unleashing future potential

When it comes to future potential, capabilities play an even more significant role. The literature suggests that as more advanced BA, such as AI, is performed, the same base of basic capabilities and strategy is required, as well as, on the top of it, more advanced and complex capabilities (e.g., Davenport, 2018; Davenport and Kirby, 2016a; Siegel, 2016). Publication IV also shows that the more value can be created, the more complex capabilities are required. Also, Publication III discusses RPA generated value potential, using direct and indirect value functions, where clearly the more there was complexity, the better was potential for value creation. However, as shown in Publication V, and supported by the literature (e.g., Davenport, 2018; Chen et al., 2012; Chaudhuri et al., 2011) operational

capabilities and functionalities also have their significance in creating a base for future and more advanced BA potential.

Yet, capabilities are not acting only as enablers of BA value creation, but they can also be restricting capabilities, such as tight legislation. Also, as shown in Publications IV and II, if certain parts of capabilities are missing, very typically personnel know-how or missing processes, future potential is difficult to achieve. In addition to those supported by the literature (e.g., Brandão et al., 2016; Chen et al., 2012), the literature also suggests (e.g., Davenport, 2018; Rosenbush and Stevens, 2015) leadership and financial capabilities. As Davenport (2018) has pointed out, if the proper base of certain capabilities is missing, advanced BA, Big Data and ML, or AI solutions cannot be implemented in use. As discussed in Publication II, the lack of proper internal and very essential future potential, external data, can limit the future potential of BA utilization. For example, ML and AI require certain amounts and quality of data to be able to create value. In addition, the literature suggests specific combinations of capabilities that are also required, such as analytics capabilities that are affected by management capabilities, technological capabilities, and talent capabilities (e.g., Brinch et al., 2020; Akter et al., 2016).

5.3.3 Conclusions of results of the third research question

As a conclusion to RQ3, "How is the future potential of BA value creation seen in private healthcare organizations?", the study suggests examining the future insights of BA potential and required capabilities enabling these future insights. Therefore, supported by the literature, the study found that the future potential of BA utilization is closely related to AI, ML, and RPA capabilities. To be more specific, there is a potential in creating new business concepts, data-based products and services, especially when combining internal and external data sources. In addition, value creation by collaborative co-creation of BA in data-sharing ecosystems has taken place. Yet it is clear that future-oriented value creation requires more complex and advanced capabilities that are built on top of each other. Moreover, the lack of some of the required capabilities can cause failure in BA future utilization. This thesis has identified and presented the most relevant future BA utilization approaches which, together with an empirical setting, create a broader understanding of the studied phenomenon of future BA utilization. This research identifies future stages and elements of BA suggested by the literature and also discusses them in the empirical setting of the private healthcare context.

6 Conclusions

This doctoral dissertation aimed to achieve a holistic view of the role of BA in value creation in the private healthcare sector in Finland. To be able to answer the research objective, three research questions were posed. The first research question addressed how private healthcare organizations utilize BA capabilities currently. Here especially the aspect of BA tools was crucial. However, other capabilities were also identified. The second research question focused on finding solutions to how BA utilization creates value for private healthcare organizations, i.e., the value creation levels and opportunities. The third research question focused on the future potential of BA value creation in private healthcare organizations and what BA utilization could bring to the organizations in the future.

Concerning the utilization of BA capabilities, the overall finding was that the utilization of BA capabilities may also be strongly related to utilization of BA tools that act as an enabler of data processing, its analysis and also sharing with different stakeholders. Yet, in addition to the technology aspect of BA tools, other capabilities are also required to succeed, for example process, data, and competences or know-how. The literature also suggests (e.g., Nykänen et al., 2016; Turban et al., 2008), that tools and methods are one of the main elements in organizational BA utilization. However, even though modern BA tools are easy to use, not all organizations have enough competence to fully utilize their potential.

When it comes to value creation, capabilities develop depending on the requirements of the value creation process and complexity of the value production (Myllärniemi and Helander, 2012; Moller et al., 2005). Therefore, direct and indirect value also exists/is also created, suggesting that there is a monetary and non-monetary perspective to value creation. Yet, there are also different levels of value creation, following each other in complexity. Further, value creation can be direct or indirect, crossing suggested monetary and non-monetary value functions. However, it is clear that value creation is a very complex concept, where different approaches complement rather than exclude each other.

The purpose here is to give an overall view of the future potential of BA value creation in the Finnish private healthcare sector. The literature has examined BA utilization from

different perspectives, for instance, as utilization of BA related concepts, such as BI, Big Data, ML, AI, RPA, but there is still a lack of understanding of future potential of BA value creation in private healthcare (e.g., Ylijoki and Porras, 2016; De Mauro et al., 2016; Davenport, 2014; Davenport, 2018; Lu et al., 2017).

In addition, there is a significant potential of creating new services or products and innovations out of newly created data sources. However, as shown in Table 6, there is a significant amount of identified data, internal or external, that can be used for different levels of value creation purposes.

Table 6. Data sources summarized

Publication	Identified internal data	Identified external data
Publication I: Benefits and Required Capabilities of BI-tools in the Private Healthcare	Operational systems data, financial data, processes, critical business data, clinical data, pharmaceutical data, activity data, cost data	Market data, web data, customer data, sensor data, mobile device data
Publication II: The new era of business intelligence: Big Data potential in the private health care value creation	Health data, operative data, finance data	Digital channels, open-source data
Publication III: Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare?	Business processes, HR data, financial data, patient record data	Customer service
Publication IV: Intellectual Capital and BI-tools in Private Healthcare Value Creation	Operative data, processes	Social media, emergency care data, newsfeeds, articles in medical journals
Publication V: The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics	Clinical data, business data, operative data, notes and prescriptions, medical imaging, laboratory results	Social and community data, location data, demographic data, market data

In addition, the research shows another interesting future perspective, i.e., the social co-creation of BA that enables collaboration in different data networks and data-sharing ecosystems, so that the creation of new business opportunities is possible within the new ecosystem environment. This research supports previous findings that data science, predictive analytics, and Big Data can be significantly valuable aspects in future business value creation (e.g., Dong and Yang, 2020; Vidgren et al., 2017; Waller and Fawcett, 2013).

6.1 Contribution of the research

At the beginning of this doctoral dissertation, in the introduction section, it was argued that the purpose of this dissertation was to examine the role of BA capabilities in creating business value in the specific context of the private healthcare sector in Finland, from a managerial perspective. Also, the aim was to gain a holistic understanding of the BA concept itself, the required capabilities as well as understanding the evolution of BA-related methods and technologies and different levels of business value creation in the context of private healthcare. In terms of the contribution of this thesis, it relates to the role of BA capabilities in value creation in the private healthcare sector in Finland. This doctoral thesis contributed to this discussion by responding to the three research questions based on the theoretical framework and empirical studies of this research. In particular, it was shown that BA can create significant value (e.g., Secundo et al., 2017; Möller et al., 2005; Walter et al., 2001). In response to the first research question, the capabilities required for BA utilization were identified. Then, in response to the second research question, the research identified the different value creation levels as well as direct and indirect value. Finally, in answer to the third research question, the research showed the future potential of BA value creation.

In summary, the contribution of this doctoral research is to fill the gap in understanding BA utilization in the context of the private healthcare sector in Finland in general. The first part of this research reviewed the discussion in the previous BA literature to establish the research agenda, combining previous research to understand the overall concept of BA as well as its different stages of evolution (e.g., Davenport, 2018; Secundo et al., 2017; Turban et al., 2008; Lönnqvist et. Al, 2006; Côrte-Real et al., 2014). The study used the previous academic research to build a theoretical framework that enables deeper understanding of the value creation potential. Even though as concepts, BA, capabilities, and value creation are well known in the literature, as a combination in the context of Finnish private healthcare they are quite novel. A significant amount of BA research has been conducted during recent decades and the more recent ones include new interpretations of BA, such as RPA, ML, and AI (e.g., Davenport, 2018; Brandão et al., 2016; Davenport and Kirby, 2016b; Lu et al., 2017; Chen et al., 2012; Nykänen et al., 2016). However, even though there is BA research focusing on the healthcare sector (e.g., Brandão et al., 2016), the research has mainly focused on BA tools, and not so much on the holistic perspective of BA capabilities.

Also, the Finnish hybrid healthcare system creates an interesting context; for several decades, the Finnish Ministry of Social Affairs and Health has advanced their data-driven vision and the first Finnish national strategy for applying information technology to healthcare and social welfare, where patients and citizens were described as informed and active participants in the healthcare delivery process (Vehko et al., 2019). Also, it was hoped that the successful combination of digital capabilities would be able to create potential for new service innovations (Vehko et al., 2019; Ministry of Social Affairs and Health, 2015). However, this very ambitious national goal affects the generalizability of the research

conducted in other countries. Moreover, the Finnish healthcare sector includes services that are provided by both the public and private sector, which are also both under pressure to enhance the productivity of healthcare services (Myllärniemi et al., 2012; Kujala et al., 2006). Overall, the whole healthcare system is about to face major reform and requires new ways of operating (Kaihlanen et al., 2018).

Based on previous academic research and conducted empirical research, this doctoral dissertation suggests the required capabilities for BA utilization in the private healthcare sector in Finland. Thus, this research contributes to the discussion on required capabilities and functionalities by showing the key capabilities that can be leveraged to create a competitive advantage. This research also supports the finding that value can be generated on different value creation levels, as identified in the literature (e.g., Möller et al., 2005) as well as direct and indirect value functions (e.g., Walter et al., 2001). These frameworks have been previously applied to the public healthcare sector (e.g., Myllärniemi and Helander, 2012), but not to private healthcare organizations. After all, the nature of public and private healthcare organizations is very different, so the results of public healthcare research cannot be directly applied to the private sector. Moreover, this dissertation opens the debate about the future potential of BA value creation in private healthcare, creating new services or products and innovations out of newly created data, although this requires multiple different data sources and other new capabilities. The research shows another interesting future perspective, i.e., the social co-creation of BA, enabling collaboration in different data networks and data-sharing ecosystems, in order to create new business opportunities within the ecosystem. This dissertation supports previous findings that data science, predictive analytics, and Big Data can be a valuable asset in future business value creation (e.g., Dong and Yang, 2020; Vidgren et al., 2017; Waller and Fawcett, 2013).

6.2 Managerial implications

This doctoral research also has clear managerial implications: First, increased understanding of how private healthcare organizations currently utilize BA capabilities. Also, utilization of BA tools is one of the main focus areas. As a result of the first research question, it became clear what kind of BA tools were utilized and for what kinds of purposes. Moreover, the result shows the direction and trend of BA tools in the private healthcare sector and why they are used. Also, the reasons for the decisions made in terms of BA tools are also discussed. When it comes to actual BA tools, in the context of the private healthcare sector, it is a good starting point for practitioners planning implementation of new sets of tools to be familiar with the ones already in use, as seeking the best practices in BA tools could benefit an organization targeting a BA transformation project. Moreover, it gives an idea of what kind of tools have brought value to similar organizations.

The second result of this research has a very clear managerial value, as understanding the BA capabilities required is the key to successful BA utilization. The research identifies

the required capabilities and functionalities that enable BA utilization. Understanding the full potential of BA tools utilization requires understanding of the enabling functionalities of tools and capabilities. The study suggests that internal and external data, know-how or competences within the organization and partner network, technology or tools, leadership and process capabilities are all, in combination, required for successful BA utilization. If those capabilities are not available, BA utilization remains incomplete or even impossible. In addition, innovation capability, for instance, was also mentioned also in the literature (e.g., Möller et al., 2005), but however did not appear as a capability in the results of this research. It was seen more as a driver for BA utilization. Nevertheless, ecosystems were also seen more as being a result or a combination of process and leadership than a distinct capability. However, it is clear that understanding the combination of required capabilities, both physical such as technology and data, and non-physical such as leadership and culture, are the key blocks in building a successful BA utilization. Also, the business analytics success model or BASM framework, consisting of twenty concepts, can be used as a tool to evaluate the competitive advantage brought about by BA utilization, and thus increase overall understanding of BA (Seddon et al., 2017; Ratia and Myllärniemi, 2019).

The third practical managerial result of this research is that value can be created on different levels. Therefore, even on the first level and at the beginning of the BA journey, a significant amount of value can be created. During the first level of value creation, the organization seeks basic business value enhancement, such as operational efficiency and process excellence along with data-driven decision-making. Regarding the second value creation level, some elements are present of value-adding relational production, such as innovations and new solutions, customer and partnering capabilities, innovation capabilities and new solutions supporting the customer's business. On the other hand, future-oriented value production enables the developing of new business opportunities and creating new data-driven business concepts and products. The more value creating the capabilities are, the more complex they become; they also require additional actors in the value creating process. Also, it is an important observation that value can be direct and monetary or indirect and non-monetary.

The fourth practical implication of this study is to identify the future potential of BA value creation in the Finnish private healthcare sector. This can bring significant benefit to organizations when planning further steps in terms of BA utilization. The research suggests that, in addition to enhancing the ability of better utilization of the existing data sources, there is potential in combining the existing data with external data sources to create insight into future trends, developing potential for new products and services, and thus value creation. In addition, the future value of BA utilization can be identified as creating new radical business innovations and new business concepts.

However, the managerial implications of this research are closely connected to the value creation level framework and some practical guidelines can also be applied.

Guideline 1: The result of the research shows that BA tools can create value on different levels. Thus, the significance of proper BA tools should be acknowledged. Current tools should be evaluated and, depending on the value level targeted, reinforcements made.

According to the empirical findings, this is not always properly understood. Also, it can be difficult to evaluate if BA operations are not implemented systematically.

Guideline 2: BA utilization requires certain capabilities. Understanding and identifying these capabilities brings an organization closer to building a functional BA capability environment. The organization should evaluate which capabilities are required on a specific value creation level.

If these capabilities are not identified or available when needed, BA utilization remains incomplete or even impossible and thus, value cannot be generated.

Guideline 3: The research shows that value varies on different value creating levels. Also, it requires more complex combinations of capabilities. The organization should estimate the availability of capabilities and target a realistic value creation level.

Regarding the availability of capabilities, it must be evaluated how and when they might be available, to act as enablers to move to the next level. In addition, the organization should decide whether to acquire capabilities by growing or buying them, or as a part of an ecosystem.

Guideline 4: The research shows that BA utilization also has significant future potential. To be able to reach full potential, the organization should have a clear understanding of its capabilities and also the available resources outside its organization.

Only combining internal and external capabilities and resources will bring the organization to the next level of value creation.

6.3 Evaluation of the research

The purpose of this dissertation was to examine the role of BA capabilities in creating business value in the specific context of the private healthcare sector in Finland, from a managerial perspective. Qualitative methods were used to conduct this research. As the aim of the research was to research a phenomenon, quantification was not applied. Qualitative research, especially the case study approach is often criticized, in that the results of this kind of research cannot be directly generalized (e.g., Guba and Lincoln, 1994: Gomm et al., 2009). However, generalization within the case can be applied (Gomm et al., 2009).

In addition, Yin (2010) suggests that analytic generalization can be applied when logical argument or theory is made clear at the beginning of the case study. Therefore, if

the findings of the research support the theory, a logical argument can be made to show how the findings of that research can be generalized to similar situations (Yin, 2010). In this doctoral research, the purpose was not to create a general theory that could be applied to several industries and contexts. Instead, the purpose was to identify the value creation levels and required BA capabilities within the private healthcare business sector. Therefore, as the research adds new business value perspectives to the debate on the different levels of value creation in the literature and in the context of the private healthcare sector, analytic generalization can be made. There are, however, a few noticeable matters related to this research. Choosing the private healthcare sector for the empirical part of the study enabled the phenomenon of BA value creation to be researched widely, as the industrial context is multifaceted and complex. Even though, unlike the public healthcare sector, the private healthcare sector seeks new business opportunities, there are still points of contact, such as operational excellence, enhanced decision-making, and the pursuit of efficiency. Nevertheless, evaluating qualitative research is multifaceted. More precisely, the evaluation criterion of qualitative research is trustworthiness, whereas the corresponding criteria for evaluation are credibility, transferability, dependability, and confirmability (Guba, 1990; Lincoln and Guba, 1986).

Credibility describes the value of the truth in the research, in other words, showing whether the research findings are congruent with the collected data (Guba, 1990). Also, credibility is affected by the adequacy of the information available about the actual research process. Therefore, as detailed as possible a description of the researched phenomena in its context enhances credibility (Miles and Huberman, 1994; Shenton, 2004). In this doctoral dissertation, descriptions of the cases and interviewees, as detailed as possible while preserving the anonymity of the interviewees, are summarized and provided in each of the research articles. However, to enhance the credibility of the research, a survey could have been conducted after interviews for instance, but on a practical level this was difficult to arrange due to a lack of research resources.

Transferability reflects general applicability. The role of researcher is to provide as detailed a description of the participants and the research process itself as possible, to enable evaluation on whether the findings made in that research are transferable to another setting. This judgement is usually made by the reader who is not usually aware of the research settings, but through different simulations the reader can be helped to make this judgement. (Crozier, Denzin, and Y. Lincoln, 1994). Hence, the publications provide as much detailed information as possible about the organizations and interviewees. However, the number of private healthcare organizations in Finland is quite limited, especially due to recent mergers and acquisitions, so the results do cover the Finnish private healthcare sector at the time of conducting the research quite well. The investigated organizations were of a certain size, as smaller organizations did not have the possibility to develop their BA capability. The smallest ones were not included in the study, so the results cannot be applied to those organizations.

Dependability can be evaluated in two steps, first with overlapping methods, where two or more methods are put together in such a manner that the weaknesses of one are compensated by the strengths of the other; and second with replication or an audit trail, in which two separate research teams act as separate data collectors (Guba, 1990). Regarding the first step, only one method, the semi-structured thematic interview was used here, as the aim of the research was to research a phenomenon, thus quantification was not applied. In addition, regarding the second step, even though publications provided criteria on the selection of the cases and interviewees, the interviews were performed by only one researcher.

Confirmability refers to the extent to which the results of research can be confirmed by others. Therefore, the primary objective of confirmability is to produce findings that are free from investigator bias (Guba, 1990). In this research, triangulation was not very strong, as the research method, the case study approach, was applied. However, even though there was no triangulation of the method, there was a triangulation of data. Even though, the possibilities of describing the methodological approach were limited due to the word or length limitations of the publication, the methodological details have been described sufficiently.

However, as summarized above, this study formed the result of the research agenda and answered the research questions step by step. However, in every study it is essential to evaluate the process and results of the research. When interpreting the results of this research, some limiting factors should also be considered. Moreover, the limitations also create a base and need for further research. The study was conducted during 2017-2019, in several larger parts and a few smaller ones. The research focused on the theoretical background of BA and value creation. Different opportunities for empirical data collection offered a good chance to examine different cases of BA utilization. After each set of data was collected, it was analyzed, and conference and journal publications were written. First, it is significant to point out that the research was conducted in Finland and in the context of the private healthcare sector. Therefore, even if the results work here and can be applied to Finnish private healthcare organizations, they are not applicable to another cultural context. To be able to apply to different cultural and geographical environments, more research is required. However, as the amount of qualitative data is thick, transferability may be applied (e.g., Lincoln and Guba, 1986).

The research process proceeded mainly as planned, at some stage even slightly faster, as some publications were more straightforward than expected. Second, the research strongly leans on the results of interviews held in the process of researching available interviewees and organizations. This research covers the large and mid-size organizations that had already developed their BA capabilities to some level. The smallest ones were not included in the study, so the results cannot be extended to those organizations. As the empirical part of the research was conducted as thematic semi-structured interviews, there is some triangulation of data that enables the cross-checking of information (Eriksson and Kovalainen, 2008).

This study consists of three research questions and their results: how private healthcare organizations utilize BA capabilities currently, how BA utilization creates value for private healthcare organizations, and how the future potential of BA value creation is seen in private healthcare organizations. The current utilization of BA has a solid connection to the timeline of the empirical study. Technology and applications are developing very fast and also in terms of use cases, as the maturity of BA utilization grows, business use cases will also develop further. Also, value creation develops over time. Organizations had a specific level of BA-enabled value level at the time that the research was conducted, but it is only natural if many of them have already moved to the next level of value creation. However, as the literature (Möller et al., 2005) and conducted research suggest, the previous levels of value creation have to be achieved and solid before moving to the next level of value creation. When it comes to future potential, it grows as the maturity of the organization grows and capabilities develop. It is clear that the technological and methodological future of BA looks different viewed from 2017 and 2021 perspectives. Even though the study had respondents from different organizational levels and functions, such as private healthcare organizations, technology and methodology consultants, and technology vendors, an even more diverse pool of respondents, such as doctors, might be beneficial for further research.

In addition, it is also a limiting factor that the literature base or theoretical framework was built on the basis of mainly knowledge management and information systems aspects of BA and value creation, without deep insights from other multidisciplinary fields of research. However, the suggested results give examples and establish a research agenda, rather than giving absolute and exact validated results. To summarize the evaluation of the research, the publications included in this doctoral dissertation answered the research questions and were also published in respected journals and conference publications in the KM and IS fields. These publications responded to the research questions and covered all the areas of this doctoral dissertation, which is a consistent summary of the published research publications.

6.4 Further research approaches

This research has offered an interesting overview of the literature related to BA and value creation from different perspectives. However, due to the limitations of this study, there are many further research opportunities that can be pursued. One avenue for research is to continue studying Finnish private healthcare organizations in terms of BA-enabled value creation. This study offers an introduction and some examples of the research topic, but as the market of private healthcare organizations is changing due to mergers and acquisitions, more studies are required to confirm and extend the results of this research. Moreover, the empirical part of this doctoral thesis was a cross-sectional research. In order to further validate the results and gain a deeper insight into BA utilization and value creation as well as to see how the value develops, it might be a good perspective to use a longitudinal study

in future research. Also, now that the discussion and research agenda have been established, other methods, such as surveys, could be performed.

In addition, this research could be extended and replicated in other geographical areas that are economically similar in order to further validate the research and to create knowledge about how BA-enabled value creation differs in other country contexts, for example, the Nordic and Baltic countries. As this study shows, BA can create value in the private healthcare sector in Finland, so the results are encouraging for further research. Also, increased interest in advanced analytics such as ML and AI among many private healthcare organizations offers a good ground for further research. Nevertheless, more research is required to examine the connection between BA and value creation, specifically to confirm what the capabilities are that create value and how to grow those capabilities in the organization. In this doctoral research, BA utilization and value creation were studied in the context of the Finnish private healthcare sector. Due to the scope of the research as well as practical time and financial limitations, this research was not able to provide information about BA value creation the private healthcare sector in different geographical contexts. In addition, more detailed utilization of the BASM model, as a practical framework and including analysis of about 100 cases, could be an opportunity for further research (Seddon et al., 2017).

Another research direction is to target BA-enabled value creation in general, not only in private healthcare organizations. More information is needed about the BA-enabled value creation on different value creation levels. In particular, what is the role of advanced analytics such as ML and AI in business value creation in other fields? Further research in other types of organizations, for example, the public sector or in other fields of business or industry, would enrich the overall understanding of BA potential in value creation. Moreover, as BA utilization clearly generates value for organizations, enhances current operations, and creates potential for new business opportunities, further multidisciplinary research is required to specify the key capabilities and create a solid base to enable their growth in organizations.

References

Aalto, A-M., Elovainio, M., Tynkkynen, L-K., Reissell, E., Vehko, T., Chydenius, M. and Sinervo, T. (2017). What patients think about choice in healthcare? A study on primary care services in Finland. Scandinavian Journal of Public Health. Vol. 46, Issue 4, pp. 463–470.

Abbasi, A., Sarker, S. and Chiang, R. H. L. (2016). Big Data Research in Information Systems: Toward an Inclusive Research Agenda. Journal of the Association for Information Systems. Vol. 17. Issue 2.

Abidi, S. S. R. and Abidi, S. R. (2019). Intelligent health data analytics: A convergence of artificial intelligence and big data. Healthcare Management Forum. 2019. Vol. 32. Issue 4. pp. 178–182.

Acharya, A., Singh, S. K., Pereira, V., and Singh, P. (2018). Big data, knowledge co-creation and decision making in fashion industry. International Journal of Information Management. Vol. 42, pp. 90–101.

Acito, F. and Khatri, V. (2014). Business analytics: Why now and what next? Business Horizons. Vol. 57, Issue 5, pp. 565–570.

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R. and Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? International Journal of Production Economics. Vol. 182, December 2016, pp. 113–131.

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? International Journal of Production Economics. Vol. 182. pp. 113–131.

Alshammari, H., Abd El-Ghany, S. and Shehab, A. (2020). Big IoT Healthcare Data Analytics Framework Based on Fog and Cloud Computing. Journal of Information Processing Systems. Volume 16. Issue 6, pp. 1238–1249.

Amit, R. and Schoemaker, P. J. (1993). Strategic assets and organizational rent. Strategic Management Journal. Vol. 14, Issue 1, pp. 33–46

Amit, R. and Zott, C. (2001). Value creation in e-business. Strategic Management Journal. Vol. 22. pp. 493–520.

Ashrafi, A., Ravasan, A. Z., Trkman, P. and Afshari, S. (2019). The role of business analytics capabilities in bolstering firms' agility and performance. International Journal of Information Management. Vol. 47. pp. 1–15.

Appelbaum, D., Kogan, A., Vasarhelyi, M. and Yan, Z. (2017). Impact of business analytics and enterprise systems on managerial accounting. International Journal of Accounting Information Systems. Vol. 25, May 2017, pp. 29–44.

Attaran, M. and Attaran, S. (2019). Opportunities and Challenges of Implementing Predictive Analytics for Competitive Advantage. Proceedings of the 52nd Hawaii International Conference on System Sciences. 2019.

Aydiner, A. S., Tatoglu, E., Bayraktar, E., Zaim, S. and Delen, D. (2019). Business analytics and firm performance: The mediating role of business process performance. Journal of Business Research. Vol 96, March 2019, pp. 228–237.

Barnes, S. J. (2002). The Mobile Commerce Value Chain: Analysis and Future Developments. International Journal of Information Management. Vol 22, pp. 91–108.

Barton, D. and Court, D. (2012). Making Advanced Analytics Work for You. Harvard Business Review. Vol. 90, pp. 79–83.

Bates, D., Saria, S., Ohno-Machado, L., Shah, A., Escobar, G. (2014). Big Data In Health Care: Using Analytics To Identify And Manage High-Risk And High-Cost Patients. Health Affairs 33.7, July 2014, pp. 1123–31.

Bayrak, T. (2015). A review of business analytics: A business enabler or another passing fad. Procedia – Social and Behavioral Sciences. Vol 195. pp. 230–239.

Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation. MIS Q. 24 (1) (2000), pp. 169–196.

Bolloju, N., Khalifa, M. and Turban, E. (2002). Integrating knowledge management into enterprise environments for the next generation decision support. Decision Support Systems 33, 2002, pp. 163–176.

Bolton, R. N., McColl-Kennedy, J. R., Cheung, L., Gallan, A., Orsinher, C., Witell, L. and Zaki, M. (2018). Customer experience challenges: bringing together digital, physical and social realms. Journal of Service Management, Vol. 29 No. 5, pp. 776–808.

Bordeleau, F., Mosconi, E. and Santa-Eulalia, L. A. (2018). Business Intelligence in Industry 4.0: State of the art and research opportunities. Proceedings of the 51st Hawaii International Conference on System Sciences. 2018. pp. 3944–3953.

Bose, R. (2003). Knowledge management-enabled health care management systems: capabilities, infrastructure, and decision-support. Expert Systems with Applications 24, 2003, pp. 59–71.

Božič, K. and Dimovski, V. (2019). Business intelligence and analytics for value creation: The role of absorptive capacity. International Journal of Information Management. Vol. 46, June 2019, pp. 93–103.

Brandão, A., Pereira, E., Esteves, M., Portela, F., Santos, M. F., Abelha, A. and Machado, J. (2016). A Benchmarking Analysis of Open-Source Business Intelligence Tools in Healthcare Environments. Information, 7(4), p. 57.

Brandenburger, A., and Stuart, H. W. (1996). Value-Based Business Strategy. Journal of Economics and Management Strategy Vol. 5, pp. 5–24.

Breidbach, C. F., Choi, S., Ellway, B. E., Keating, B. W., Kormusheva, K., Kowalkowski, C., Lim, C. and Maglio, P. (2018). Operating Without Operations: How is Technology Changing the Role of the Firm? Journal of Service Management, Vol. 29, No. 5, pp. 809–833.

Brinch, M., Gunasekaran, A. and Wamba, S. F. (2020). Firm-level capabilities towards big data value creation. Journal of Business Research. Available online 10 August 2020. In Press, Corrected Proof.

Bowman, C. and Ambrosini, V. (2000). Value Creation Versus Value Capture: Towards a Coherent Definition of Value in Strategy. British Journal of Management vol. 11, Issue 1, pp. 1–15.

Buhasho, E., Wausi, A. and Njihia, J. (2020). Business Intelligence Capability, Complementary Resources and Performance among Public Listed Firms in Kenya. International Journal of Business and Management. Vol. 15, No. 9, pp. 66–74.

Cao, G., Duan, Y. and Li, G. (2015). Linking Business Analytics to Decision Making Effectiveness: A Path Model Analysis. Transactions on Engineering. Volume 62, Issue 3, pp. 1–36.

Carlsson, C. (2018). Decision analytics – Key to digitalisation. Information Sciences. pp. 424–438.

Cases, M., Furlong, L., Albanell, J., Altman, R. B., Bellazzi, R., Boyer, S., Brand, A., Brookes, A. J., Brunak, S., Clark, T. W., Gea, J., Ghazal, P., Graf, Guigó, R., Klein, T. E., López-Bigas, Maojo, Mons, B., Musen, M. and Oliveira, J. L. (2013). Improving data and knowledge management to better integrate health care and research. Journal of Internal Medicine. Oct 2013, Vol. 274 Issue 4, pp. 321–328.

Chae, B., Yang, C., Olson, D. and Sheu, C. (2014). The impact of advanced analytics and data accuracy on operational performance: A contingent resource based theory (RBT), perspective. Decision Support Systems, Vol. 59, Issue 1, pp. 119–126.

Chang, V., Xu, X., Wong, B. and Mendez, V. (2019). Ethical problems of smart wearable devices. COMPLEXIS 2019 – Proceedings of the 4th International Conference on Complexity, Future Information Systems and Risk. Published 2 May 2019. Greece. pp. 121–129.

Chaudhuri, S., Dayal, U. and Narasayya, V. (2011). An Overview of Business Intelligence Technology. Communications of the ACM. Vol. 54, pp. 88–98.

Chen, H., Chiang, R. H. L., and Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. MIS Quarterly, Vol. 36. Issue 4, pp. 1165–1188.

Côrte-Real, N., Ruivo, P. and Oliveira, T. (2014). The diffusion stages of business intelligence & analytics (BI&A): A systematic mapping study. Procedia Technology. Vol.16, pp.172–179.

Côrte-Real, N., Oliveira T. and Ruivo, P. (2017). Assessing business value of Big Data Analytics in European firms. Journal of Business Research. Vol. 70, January 2017, pp. 379–390.

Cosic, R., Shanks, G. and Maynard, S. (2015). A business analytics capability framework. Australasian Journal of Information Systems. 2015, vol. 19, pp. 5–19.

Cox, M. and Ellsworth, D. (1997). Application-controlled demand paging for out-of-core visualization. Proceedings of the 8th conference on Visualization '97.

Crozier, G., Denzin, N. and Lincoln, Y. (1994). Handbook of Qualitative Research. Vol. 42. 4. Sage Thousand Oaks, CA, 409.

Davenport, T. H. and Harris, J. G. (2007). Competing on Analytics: The New Science of Winning. Boston, MA, USA: Harvard Business School Review Press, 2007.

Davenport, T. H. & Patil, D. J. (2012, October). Data scientist: The sexiest job of the 21st century. Harvard Business Review. Retrieved from https://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century

Davenport, T. (2014). Big data at work: dispelling the myths, uncovering the opportunities. Harvard Business Review Press.

Davenport, T. H. and Kirby, J. (2016a). Only humans need apply: Winners and losers in the age of smart machines. New York: Harper Business.

Davenport, T.H. and Kirby, J. (2016b). Just How Smart Are Smart Machines? MIT Sloan Management Review, Vol 57, No. 3. pp. 21–25.

Davenport, T. H. (2018). From analytics to artificial intelligence. Journal of Business Analytics. Volume 1, 2018 – Issue 2. pp. 73–80.

Dehning, B., Richardson, V.J. and Zmud, R.W. (2003). The value relevance of announcements of transformational information technology investments. MisQuarterly 27, pp. 637–656.

De Mauro, A., Greco, M. and Grimaldi, M. (2016). A Formal Definition of Big Data Based on its Essential Features. Library Review, Vol. 65, Issue 3, pp. 122–135.

Demirkan H. (2013). A Smart Healthcare Systems Framework. IT Professional. Sept/Oct 2013. Vol.15, Issue 5, pp. 38–45.

Dragland, A. (2013). Big Data – for better or worse. [Online] Available from: https://www.sciencedaily.com/releases/2013/05/130522085217.htm

Dong, J.Q. and Yang, C-H. (2020). Business value of big data analytics: A systems-theoretic approach and empirical test. Information and Management. Vol. 57. pp. 103–124.

Easton, G. (1992). Industrial networks: a review, in Axelsson, B. and Easton, G. (Eds.) Industrial Networks: A New View of Reality, Routledge, London, pp. 3–34.

Easterby-Smith, M., Lyles, M. A. and Tsang, E. W. (2008). Inter-organizational knowledge transfer: Current themes and future prospects. Journal of Management Studies, Vol. 45, No. 4, pp. 677–690.

Elbashir, M. Z., Collier, P. A. and Davern, M. J. (2008). Measuring the effects of business intelligence systems: The relationship between business process and organizational performance. International Journal of Accounting Information Systems. Vol. 9. Issue 3, pp. 135–153.

Elbashir, M., Collier, P., Sutton, S., Davern, M. and Leech, S. (2013). Enhancing the Business Value of Business Intelligence: The Role of Shared Knowledge and Assimilation. Journal of Information Systems. Vol. 27, No. 2. Fall 2013, pp. 87–105.

Elia, G., Polimeno, G., Solazzo, G. and Passiante, G. (2020). A multi-dimension framework for value creation through big data. Industrial Marketing Management. Vol. 90, pp. 508–522.

Elia, G. (2020). et al. Industrial Marketing Management 90 (2020) 508–522 519 alignment? International Journal of Production Economics, 182, pp. 113–131.

Elkjaer, B. and Simpson, B. (2011). Pragmatism: A lived and living philosophy. What can it offer to contemporary organization theory? Research in the Sociology of Organizations Special Volume on Philosophy and Organization Theory, 2011. Vol. 32, pp. 55–84.

Eriksson, P. and Kovalainen, A. (2008). Qualitative Methods in Business Research. Sage Research Methods.

Fink, L., Yogev, N. and Even, A. (2017). Business intelligence and organizational learning: an empirical investigation of value creation processes, Information Management. Vol. 54. 2017, pp. 38–56.

Finne-Soveri, H., Mäkelä, M, Noro, A. & Tepponen, M. (2014). Kotihoitoon on panostettava, jotta huonokuntoinenkin voi voida hyvin ja kuntoutua omassa kodissaan – Case Eksote. Terveyden ja hyvinvoinnin laitos. Tutkimuksesta tiiviisti 25.https://www.julkari.fi/bitstream/hadle/10024/120382/THL_TUTI_25_2014korjattu%2019%2012%202014.pdf?sequence=3. Hallituksen esitys sote- ja maakuntauudistuksesta 2.3.2017. http://alueuudistus.fi/lakiluonnokset-12-2016 (6.4.2017)

Foshay, N. and Kuziemsky, C. (2014). Towards an implementation framework for business intelligence in healthcare. International Journal of Information Management. Vol 34, Issue 1, February 2014. pp. 20–27.

Fosso Wamba, S., Akter, S., Edwards, A., Chopin, G. and Gnanzou, D. (2015). How 'Big Data' Can Make Big Impact: Findings from a Systematic Review and a Longitudinal Case Study. International Journal of Production Economics. Vol. 165, pp. 234–246.

Gandomi, A. and Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. International Journal of Information Management 35 (2015) pp. 137–144.

Gilad, B. and Gilad T. (1985). A systems Approach to Business Intelligence. Business Horizons. Vol.28, No. 5, pp. 65–70.

Gomm, R., Hammersley, M. and Foster, P. (2009). Case Study Method. Chapter 5: Case Study and Generalization. https://dx.doi.org/10.4135/9780857024367

Gold, A. H., Malhotra, A. and Segars, A. H. (2001). Knowledge Management: An Organizational Capabilities Perspective. Journal of Management Information Systems. Vol. 18, Issue 1, pp. 185–214.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. Organization Science. Vol. 7, Issue 4. pp. 375–387.

Gregor S., Martin, M., Fernandez, W., Stern, S. and Vitale, M. (2006). The transformational dimension in the realization of business value from information technology. Journal of Strategic Information Systems. Vol 15. 2006. pp. 249–270.

Grierson, H.J., Corney, J.R. and Hathcher, G.D. (2015). Using visual representations for the searching and browsing of large, complex, multimedia data sets. International Journal of Information Management. Vol. 35. pp. 244–252.

Grover, V., Chiang, R. H. L., Liang, T-P. and Zhang, D. (2018). Creating Strategic Business Value from Big Data Analytics: A Research Framework. Journal of Management Information Systems. Vol. 35, Issue 2. pp. 388–423.

Guba, E. G. (1990). The alternative paradigm dialog. The paradigm dialog, pp. 17–30.

Guba, E.G. and Lincoln, Y.S. (1994). Competing paradigms in qualitative research. Handbook of qualitative research 1994. pp. 105–117.

Gulati, R., Nohria, N. and Zaheer, A. (2000), 'Strategic networks, Strategic Management Journal, Vol. 21 No. 3, pp. 203–15.

Hannula, M. and Pirttimäki, V. (2003). Business Intelligence Empirical Study on the top 50 Finnish Companies. Journal of American Academy of Business, Cambridge; Mar. 2003. pp. 593–599.

Hawking, P. and Sellitto, C. (2020). Business Intelligence (BI) Critical Success Factors. 21st Australasian Conference on Information Systems Business Intelligence (BI) Critical Success Factors. 1–3 Dec 2010, Brisbane.

Heilig, L., Stahlbock, R. and Voß, S. (2019). From Digitalization to Data-Driven Decision Making in Container Terminals. Computer Science. ArXiv. April 2019.

Hennala, L., Koistinen, P., Kyrki, V., Kämäräinen, J-K., Laitinen, A., Lanne, M., Lehtinen, H., Leminen, S., Melkas, H., Niemelä, M., Parviainen, J., Pekkarinen, S., Pieters, R., Pirhonen, J., Ruohomäki, I., Särkikoski, T., Tuisku, O., Tuominen, K., Turja, T. and Van Aeschot, L. (2017). Robotics in Care Services: A Finnish Roadmap. University of Tampere. 2017.

Holbrook, M. B. (1999). Consumer value. A framework for analysis and research. Routledge: London.

Holsapple, C., Lee-Post, A. and Pakath, R. (2014). A unified foundation for business analytics. Decision Support Systems. Vol. 64, August 2014, pp. 130–141.

Hugos, M.H. and Hulitzky, D. (2011). Business in the Cloud: What Every Business Needs to Know About Cloud Computing. John Wiley & Sons, Inc.

Håkansson, H. and Snehota, I. (1989), No Business is an Island. The Network Concept of Business Strategy, Scandinavian Journal of Management, Vol. 4 No. 3, pp. 187–200.

Jinpon P., Jaroensutasinee, M. and Jaroensutasinee, K. (2011). Business Intelligence and its Applications in the Public Healthcare System. Walailak Journal of Science and Technology (WJST). 2011. Vol. 8, Issue 2, pp. 97–110.

Johnson, P. and Duberley, J. (2000). Understanding Management Research. 2000. Sage Research Methods.

Jormanainen, K., Niemi, A., Erhola, M., Keskimäki, I. and Kaila, M. (2019). Half of the Finnish population accessed their own data: comprehensive access to personal health information online is a corner-stone of digital revolution in Finnish health and social care. Finnish Journal of eHealth and eWelfare, Issue 11, No. 4, pp. 298–310.

Kaihlanen, A-M., Laulainen, S., Hietapakka, L., Niiranen, V., Lehtoaro, S. and Sinervo, T. (2018). Working in the change of Finnish health and social care system- Perceptions of the employees. European Journal of Public Health, Volume 28, Issue 4, November 2018, pp. 213–228.

Kakhki, M. D. and Palvia, P. (2016). Effect of Business Intelligence and Analytics on Business Performance. Business Intelligence and Analytics and Performance. Twenty-second Americas Conference on Information Systems, San Diego, 2016.

Kankanhalli, A., Hahn, J., Tan, S. and Gao, G. (2016). Big data and analytics in healthcare: Introduction to the special section. Information Systems Frontiers. April 2016, Volume 18, Issue 2, pp. 233–235.

Kaufman, B. E. (2015). The RBV theory foundation of strategic HRM: critical flaws, problems for research and practice, and an alternative economics paradigm. Human Resource Management Journal. Vol. 25 Issue 4. pp. 516–540.

Katal, A., Wazid, M. and Goudar, R.H. (2013). Big data: Issues, challenges, tools and Good practices. Proceedings of Sixth International Conference on Contemporary Computing (IC3) 2013. pp. 404–409.

Katsaliaki, K. and Mustafee, N. (2011). Applications of simulation within the healthcare context. Journal of the Operational Research Society. Aug. 2011, Vol.62, Issue 8, pp. 1431–1451.

Keeling, D. I., Keeling, K., Ruyter, K. and Laing, A. (2021). How value co-creation and co-destruction unfolds: a longitudinal perspective on dialogic engagement in health services interactions. Journal of the Academy of Marketing Science. 2021 Vol. 49. pp. 236–257.

Kilpeläinen, K., Parikka, S., Koponen, P., Koskinen, S., Rotko, T., Koskela, T. and Gissler, M. (2016). Finnish experiences of health monitoring: local, regional, and national data sources for policy evaluation. Journal Global Health Action. Vol. 9, Issue 1, 2016. Special Issue: Monitoring Health Determinants with an Equity Focus. pp. 1–9.

Kinnunen, M., Mian, S. Q., Oinas-Kukkonen H., Riekki, J., Jutila, M., Ervasti, M., Ahokangas, P. and Alasaarela, E. (2016). Wearable and mobile sensors connected to social media in human well-being applications, Telematics and Informatics, Volume 33, Issue 1, 2016, pp. 92–101.

Kirchmer, M. (2017). Robotic Process Automation – Pragmatic Solution or Dangerous Illusion? Business Transformation & Operational Excellence World Summit (BTOES). 2017.

Krishnamoorthi, S. and Mathew, S. K. (2018). Business analytics and business value: A comparative case study. Information & Management. Vol. 55 (2018). pp. 643–666.

Krumholz, H.M. (2014). Big Data And New Knowledge In Medicine: The Thinking, Training And Tools Needed For A Learning Health System. Health Affairs 33.7. July 2014, pp. 1163–70.

Kujala, J., Lillrank, P., Kronström, V. and Peltokorpi, A. (2006). Time-based management of patient processes. Journal of Health, Organisation and Management, Vol. 20, pp. 512–524.

Kulkarni, U. R., Robles-Flores, J.A. and Popovič, A. (2017). Business Intelligence Capability: The Effect of Top Management and the Mediating Roles of User Participation and Analytical Decision Making Orientation. Journal of the Association for Information Systems. Vol. 18. Issue 7. pp. 516–541.

Kwon, O., Lee, N. & Shin, B. (2014). Data quality management, data usage experience and acquisition intention of big data analytics. International Journal of Information Management, 34(3), pp. 387–394.

Laihonen, H. and Kokko, P. (2020). Knowledge management and hybridity of institutional logics in public sector. Knowledge Management Research & Practice. DOI: 10.1080/14778238.2020.1788429.

Lakomaa, E. (2018). Digitalization, Collective Intelligence, and Entrepreneurship in the Care Sector. Managing Digital Transformation. Stockholm School of Economics Institute for Research (SIR). 2018. Edited, Andersson, P., Movin, S., Mähring, M., Teigland, R. and Wennber, K. pp. 265–279.

Laney, D. (2001). 3D data management: Controlling data volume, velocity and variety. META Group Research Note 6, p. 70.

Lapierre, J. (2000). Customer-perceived value in industrial contexts, Journal of Business & Industrial Marketing 2/3, pp. 122–145.

Larson, D. and Chung, V. (2016). A review and future direction of agile, business intelligence, analytics and data science. International Journal of Information Management. Vol. 36, Issue 5, October 2016, pp. 700–710.

Laursen, M. and Svejvig, P. (2016). Taking stock of project value creation: A structured literature review with future directions for research and practice. International Journal of Project Management, 34(4), 736–747.

Lin, Y. and Wu, L.-Y. (2014). Exploring the role of dynamic capabilities in firm performance under the resource-based view framework. Journal of Business Research. Vol. 67. Issue 3., pp. 407–413.

Lincoln, Y. S. and Guba, E. G. (1986). But Is It Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation. New Directions for Program Evaluation. No. 30. June 1986.

Lindgreen, A., Hingley, M. K., Grant, D. B. and Morgan, R. E. (2012). Value in business and industrial marketing: Past, present, and future. Industrial Marketing Management. Vol. 41, Issue 1, January 2012, pp. 207–214.

Lu, H., Li Y., Chen, M., Kim, H. and Serikawa, S. (2017). Brain Intelligence: Go Beyond Artificial Intelligence. Mobile Networks and Applications 2017. pp. 1–8.

Luhn, H. P. (1958). A Business Intelligence System. IBM Journal of Research and Development. Vol 2. Issue 4.

Lönnqvist, A. and Pirttimäki, V. (2006). The measurement of business intelligence. Information Systems Management, Vol.23, 2006. Issue 1, pp. 32–40.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A.H. (2011). Big data: The next frontier for innovation, competition, and productivity. McKinsey Global Institute.

Marjanovic, O. (2010). Business Value Creation through Business Processes Management and Operational Business Intelligence Integration. Proceedings of the 43rd Hawaii International Conference on System Sciences – 2010.

McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D. and Barton, D. (2012). Big data: The Management Revolution. Harvard Business Review 90, pp. 61–67.

Mehta, N. and Pandit, A. (2018). Concurrence of big data analytics and healthcare: A systematic review. International Journal of Medical Informatics Vol. 114. 2018. pp. 57–65.

Mikalef, P., Pappas, I. O., Krogstie, J. and Giannakos, M. (2018). Big data analytics capabilities: a systematic literature review and research agenda. Information Systems and e-Business Management. August 2018, Vol. 16, Issue 3, pp. 547–578.

Mikalef, P., Krogstie, J., Pappas, I. O. and Pavlou, P. (2019). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. Information & Management. Available online 29 May 2019, 103169. In Press, Corrected Proof.

Miles, M.B. and Huberman, A.M. (1994). Qualitative Data Analysis, Second edition, 1994. Sage Publication Inc., Thousand Oaks.

Ministry of Social Affairs and Health (Sosiaali- ja terveysministeriö) (2015). Information to support well-being and service renewal. eHealth and eSocial Strategy 2020. Edita Prima, Helsinki. http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/74459/URN_ISBN_978-952-00-3575-4.pdf?sequence=1&isAllowed=y

Myllärniemi, J., Okkonen, J., Paavilainen, J. & Vuori, V. (2012). Negative competition steering patient flow in a public-private healthcare co-opetition setting–a Finnish case. World Review of Entrepreneurship, Management and Sustainable Development, 8(2), pp. 208–220.

Myllärniemi, J. and Helander, N. (2012). Healthcare System as a Value Network. World Review of Entrepreneurship, Management and Sustainable Development. 2012, Vol.8, Issue 2.

Möller, K., Rajala, A. and Svahn, S. (2005). Strategic business nets—their type and management. Journal of Business Research. Vol. 58, Issue 9, Sep 2005, pp. 1274–1284.

Nalchigar, S. and Yu, E. (2018). Business-driven data analytics: A conceptual modeling framework. Data & Knowledge Engineering. Vol. 117 (2018), pp. 359–372.

Nevo, S. and Wade, M.R. (2011). Firm-level benefits of IT-enabled resources: a conceptual extension and an empirical assessment. Journal of Strategic Information Systems. Vol 20. Issue 4, pp. 403–418.

Njie, B. and Asimiran, S. (2014). Case Study as a Choice in Qualitative Methodology. Journal of Research and Method in Education. Vol. 4. Issue 3, pp. 35–40.

Nordgren, L. (2009). Value creation in health care services – developing service productivity. Experiences from Sweden. International Journal of Public Sector Management Vol. 22, No. 2, 2009, pp.114–127 .

Normann, R. and Ramirez, R. (1993). From value chain to value constellation: designing interactive strategy. Harvard Business Review, Jul-Aug 1993, pp. 65–77.

Nykänen, E., Järvenpää, M. and Teittinen, H. (2016). Business intelligence in decision making in Finnish enterprises. Nordic Journal of Business, 65 (2), pp. 24–44.

Ojala, A. and Helander, N. (2014). Value Creation and Evolution of a Value Network: A Longitudinal Case Study on a Platform-as-a-Service Provider. System Sciences (HICSS), 2014 47th Hawaii International Conference, Issue Date: 6–9 Jan. 2014.

Pagani, M. (2013). Digital Business Strategy and Value Creation: Framing the Dynamic Cycle of Control Points. MIS Quarterly Vol. 37 No. 2, June 2013. pp. 617–632.

Ramanathan, R., Philpott, E. Duan, Y. and Cao, G. (2017). Adoption of business analytics and impact on performance: A qualitative study in retail. Production Planning and Control Special Issue. Mar 2017. Vol. 28. Issue 11–12, pp. 985–998.

Parolini, C. (1999). The Value Net. A Tool for Competitive Strategy, John Wiley & Sons Ltd: Great Britain.

Peters, M. D., Wieder, B., Sutton, S. G. and Wakefield, J. (2016). Business intelligence systems use in performance measurement capabilities: Implications for enhanced competitive advantage. International Journal of Accounting Information Systems. Vol. 21 (2016). pp. 1–17.

Pirttimäki, V. (2006). Business Intelligence as a Managerial Tool in Large Finnish Companies. Tampere University of Technology. Publication 646. Doctoral thesis. Tampere, Finland.

Popovič, A. (2017). If we implement it, will they come? User resistance in post-acceptance usage behaviour within a business intelligence systems context. Economic Research-Ekonomska Istraživanja, 2017. VOL. 30, NO. 1, pp. 911–921.

Porter, M. E. (1985). Competitive advantage: creating and sustaining superior performance. The Free Press. New York.

Porter, M. E. and Kramer, M. R. (2019). Creating Shared Value. In: Lenssen G., Smith N. (eds) Managing Sustainable Business. Springer, Dordrecht.

Power, D. J. (2008). Understanding Data-Driven Decision Support Systems. Information Systems Management. Vol. 25. Issue 2. pp. 149–154.

Provost, F. and Fawcett, T. (2013). Data Science and Its Relationship To Big Data and Data-driven Decision Making. Big Data. February 2013, 1(1): pp. 51–59.

Raghupathi, W. and Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. Health information science and systems, 2:3.

Raitoharju, R. (2007). Comparing the acceptance of information technology among public and private healthcare sector employees in Finland. International Journal of Healthcare Technology and Management. 2007. Vol. 8, No. 1/2, 2007. Published online 20.1.2007.

Ratia, M. and Myllärniemi, J. (2017). Business Intelligence Tools for Private Healthcare Data-Driven Value Creation. Proceedings IFKAD 2017. St. Petersburg, Russia, 7–9 June 2017. pp. 408–419.

Ratia, M. and Myllärniemi, J. (2018). Beyond IC 4.0: The Future Potential of BI in the Private Healthcare. Proceedings IFKAD 2018. Delft, Netherlands, 4-6 July 2018. pp. 1652–1667.

Ratia, M. and Myllärniemi, J. (2019). Business Analytics Enabling Future Insights in the Private Healthcare. Proceedings of International Forum on Knowledge Asset Dynamics 2019: 5–7 June 2019, Matera, Italy.

Rissanen, P., Parhiala, K., Hetemaa, T. Kekkonen, R., Knape, N., Ridanpää, H., Rintala, E., Sihvo, S., Suomela, T. and Kannisto, R. (2018). Sosiaali- ja terveyspalvelut Suomessa 2018. Asiantuntija-arvio. Päätösten tueksi 2/2020. Tiedosta arviointiin – Tavoitteena paremmat

palvelut. Terveyden ja hyvinvoinnin laitos. 2020. http://www.julkari.fi/bitstream/handle/10024/139289/URN_ISBN_978-952-343-474-5.pdf?sequence=4&isAllowed=y

Rosenbush, S. and Stevens, L. (2015). At UPS, the algorithm is the driver. The Wall Street Journal. Journal of Business Analytics. Vol. 79.

Sabat, H. K. (2002). The Evolving Mobile Wireless Value Chain and Market Structure. Telecommunications Policy. Vol. 26, pp. 505–535.

Saunders, M. N. K., Lewis, P. and Thornhill, A. (2009). Research Methods for Business Studies. Pearson Education.

Saunders, M. N. K., Lewis, P. and Thornhill, A. (2019). Research Methods for Business Studies. Pearson Education.

Schmarzo, B. (2013). Big Data: Understanding how data powers big business. John Wiley & Sons.

Sharda, R., Delen, D., and Turban, E. (2016). Business Intelligence, analytics and data science: a managerial perspective (4th edition). Saddle River, NJ: Pearson-Prentice Hall.

Sharma, R., Mithas, S. and Kankanhalli, A. (2014) Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organisations. European Journal of Information Systems. Vol 23, Issue 4. pp. 433–44.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. Education for Information. Vol. 22. pp. 63–75.

Siegel, E. (2016). Predictive analytics. New York: Wiley.

Smith, C. J. and Rauhut, D. (2019). Still 'skiing their own race' on New Public Management implementation? Patient choice and policy change in the Finnish and Swedish health-care systems. International Review of Administrative Sciences. Volume: 85, Issue: 1, pp. 62–79.

Seddon, P. B., Constantinidis, D., Tamm, T. and Dod, H. (2017). How does business analytics contribute to business value? Information Systems Journal. May 2017, Vol. 27, Issue 3, pp. 237–269.

Spruit, M., Vroon, R. and Batenburg, R. (2014). Towards healthcare business intelligence in long-term care. An explorative case study in the Netherlands. Computers in Human Behavior, 2014. Vol. 30, pp. 698–707.

Starman, A. B. (2013). The case study as a type of qualitative research. Journal of Contemporary Educational Studies. 1/2013. pp. 28–43.

Stewart, R. and Davis, K. (2016). 'Big data' in mental health research: current status and emerging possibilities. Social Psychiatry and Psychiatric Epidemiology. Aug 2016, Vol. 51, Issue 8, pp. 1055–1072.

Story, V. M., O'Malley, L. and Hart, S. (2011). Roles, role performance and radical innovation competences. Industrial Marketing Management. Vol. 40. pp. 952–966.

Story, V.M., Raddats, C., Burton, J., Zolkiewski, J. and Baines, T. (2017). Capabilities for advanced services: A multi-actor perspective. Industrial Marketing Management. Vol. 60. pp. 54–68.

Sun, Z., Strang, K. and Firmin, S. (2016). Business Analytics-Based Enterprise Information Systems. Journal of Computer Information Systems. Vol 57, Issue 2, pp. 169–178.

Sun, Z., Strang, K. and Firmin, S. (2017). Business Analytics-Based Enterprise Information Systems. Journal of Computer Information Systems. Volume 57, 2017 – Issue 2. pp. 169–178.

Suomi, R. and Tähkäpää, J. (2002). The Strategic Role of ICT in the Competition Between Public and Private Health Care Sectors in the Nordic Welfare Societies – Case Finland. Proceedings of the 35th Hawaii International Conference on System Sciences – 2002.

Tanriverdi, H. (2005). Information technology relatedness, knowledge management capability, and performance of multibusiness firms, MIS Q. Vol 29. Issue 2. pp. 311–334.

Teece, D. J., Pisano, G. and Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal. Vol. 18, Issue 7, pp. 509–533.

Teperi, J., Porter, M.E., Vuorenkoski, L. and Baron, J.F. (2009). The Finnish Health Care System: A Value-Based Perspective, Sitra Reports 82, Helsinki, Finland.

Tresp, V., Overhage, M., Bundschus, M., Rabizadeh, S., Fasching P. A. and Shipeng, Y. (2016). Going digital: A Survey on Digitalization and Large-Scale Data Analytics in Healthcare. Proceedings of the IEEE. Vol. 104. No. 11, November 2016. pp. 2080–2206.

Trieu, V. (2017). Getting value from Business Intelligence systems: A review and research agenda. Decision Support Systems. Vol. 93, January 2017, pp. 111–124.

Torres, R., Sidorova, A. and Jones, M.C. (2018). Enabling firm performance through business intelligence and analytics: A dynamic capabilities perspective. Information & Management. Vol. 55 (2018). pp. 822–839.

Turban, E., Aronson, J. E., Liang, T-P. and Sharda, R. (2008). Business intelligence: a managerial approach. Pearson Prentice Hall, New Jersey.

Tynkkynen, L-K., Alexandersen, N., Kaarbøe, O., Anell, A., Lehto, J. and Vrangbæk, K. (2018). Development of voluntary private health insurance in Nordic countries – An exploratory study on country-specific contextual factors. Health Policy. Vol 122, Issue 5, May 2018, pp. 485–492.

VanWynsberghe, R. and Khan, S. (2007). Redefining Case Study. International Journal of Qualitative Methods. Vol. 6. Issue 2. pp. 80–94.

Vehko, T., Ruotsalainen, S. and Hyppönen, H. (2019). E-health and e-welfare of Finland. Check Point 2018. Report 7/2019. National Institute for Health and Welfare. http://www.julkari.fi/bitstream/handle/10024/138244/RAP2019_7_e-health_and_e-welfare_web_4.pdf?sequence=4&isAllowed=y

Vidgren, R., Shaw, S. and Grant, D. (2017). Management challenges in creating value from business analytics. European Journal of Operational Research. Volume 261, Issue 2, 1 September 2017, pp. 626–639.

Visinescu, L. L., Jones, M.C. and Sidorova, A. (2016). Improving Decision Quality: The Role of Business Intelligence. The Journal of Computer Information Systems. Vol. 57. Issue 1. Fall 2016, pp. 58–66.

Vitari, C. and Raguseo, E. (2019). Big data analytics business value and firm performance: Linking with environmental context. International Journal of Production Research, Taylor & Francis, 2019. pp. 1–21.

Waller, M. A. and Fawcett, S. F. (2013). Click here for a data scientist: Big data, predictive analytics, and theory development in the era of a maker movement supply chain. Journal of Business Logistics, Vol. 34(4). pp. 249–252.

Wamba, S. F., Akter, S., Edwards, A., Chopin, G. and Gnanzou, D. (2015). How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study. International Journal of Production Economics. Vol. 165, July 2015, pp. 234–246.

Wamba, S.F., Gunasekaran, A., Akter, S., Ren, S.J., Dubey, R., Childe, S.J., (2017). Big data analytics and firm performance: Effects of dynamic capabilities. Journal of Business Research. Vol. 70, January 2017, pp. 356–365.

Wang, H. and Wang, S. (2008). A knowledge management approach to data mining process for business intelligence. Industrial Management & Data Systems Vol. 108 No. 5, 2008, pp. 622–634.

Wang, Y., Kung, LA., Ting, C. and Byrd, T.A. (2015). Beyond a technical perspective: understanding big data capabilities in health care. System Sciences (HICSS), 2015 48th Hawaii International Conference, pp. 3044–3053.

Wang, Y., Kung, LA., Byrd., T. A. (2016). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. Technological Forecasting and Social Change Vol. 126, January 2018, pp. 3–13.

Ward, M. J., Marsolo, K. A. and Froehle, C. M. (2014). Applications of Business Analytics in Healthcare. Business horizons, Vol. 57. Issue 5, pp. 571–582.

Watson, H. J. and Wixom, B. H. (2007). The current state of business intelligence. Computer. Vol. 40. Issue 9. pp. 96–99.

Watson, H. J. (2009). Tutorial: Business intelligence-Past, present, and future. Communications of the Association for Information Systems. Vol. 25. Issue 1. 39. pp. 487–510.

Westerlund, M., Leminen, S. and Rajahonka, M. (2014). Technology Innovation Management Review. pp. 5–14.

Wieder, B. and Ossimitz, M-L. (2015). The impact of Business Intelligence on the quality of decision making – a mediation model. Conference on ENTERprise Information Systems / CENTERIS 2015 October 7–9, 2015. pp. 1163–1171.

Winter, S. G. (2003). Understanding dynamic capabilities. Strategic Management Journal. Vol. 24, Issue 10. pp. 991–995.

Winter, M. and Szczepanek, T. (2008). Projects and programmes as value creation processes: A new perspective and some practical implications. International Journal of Project Management, 26(1), pp. 95–103.

Wullianallur, R. and Viju, R., (2014). Big data analytics in healthcare: promise and potential. Health Information Science and Systems. 2014, Vol. 2, Issue 3.

Ye, S., Feng, S., Huang, L. and Bian, S. (2020). Recent Progress in Wearable Biosensors: From Healthcare Monitoring to Sports Analytics.Biosensors 10, no. 12: 205.

Yeoh, W. and Koronios, A. (2010). Critical success factors for business intelligence systems, Journal of computer information systems. Vol. 50. No. 3. Spring, pp. 23–32.

Yeoh, W. and Popovič, A. (2015). Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems. Journal of Association for Information Science and Technology. Vol. 67, Issue 1, January 2016, pp. 134–147.

Yin, R. (2010). Analytic Generalization. In Albert J. Mills, G. Durepos, & E. Wiebe (Eds.), Encyclopedia of Case Study Research. pp. 21–23. Thousand Oaks, CA: SAGE Publications, Inc.

Ylijoki, O. and Porras, J. (2016). Perspectives to Definition of Big Data: A Mapping Study and Discussion. Journal of Innovation Management JIM 4, 1 (2016). pp. 69–91.

Publications

Publication I Ratia, M., Myllärniemi, J. and Helander, N. (2017). Benefits and Required Capabilities of BI-tools in the Private Healthcare. Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland. September 20–21, 2017. pp. 103-110.

Publication II Ratia, M., Myllärniemi, J. and Helander, N. (2018) "The new era of business intelligence: Big Data potential in the private health care value creation", Meditari Accountancy Research, Vol. 26 Issue: 3, pp. 531-546.

Publication III Ratia, M., Myllärniemi, J. and Helander, N. (2018). Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare? Proceedings of the 22nd International Academic Mindtrek Conference. ACM. Tampere, Finland. October 10–11, 2018. pp. 222-227.

Publication IV Ratia, M., 2018. Intellectual Capital and BI-tools in Private Healthcare Value Creation. The Electronic Journal of Knowledge Management, Vol 16, Issue 2, pp. 143-154.

Publication V Ratia, M., Myllärniemi, J. and Helander, N. (2019), The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics, Measuring Business Excellence, Vol. 23 No. 4, pp. 396-410.

PUBLICATION I

Benefits and Required Capabilities of BI-tools in the Private Healthcare

Ratia, M., Myllärniemi, J. and Helander, N.

Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland. September 20–21, 2017. pp. 103-110.

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ABSTRACT

Increasing amount of data in the healthcare sector requires specific tools that enable to process data in the rapidly changing environment. Especially in the private healthcare sector there is a clear need for appropriate tools to support decision-making process and thus, enhance profit making. Based on an empirical investigation of eight private healthcare sector organizations, we gain understanding on use of BI-tools in the private healthcare sector and utilization of them in decision-making. We analyse the capability factors and features of the BI-tools in the private healthcare industry sector, using the information systems (IS) success model by DeLone and McLean [1] as our theoretical lenses for identifying the gained benefits and the success of BI-tool utilization.

AcademicMindtrek'17, September 20–21, 2017, Tampere, Finland

ACM ISBN 978-1-4503-5426-4/17/09…$15.00
https://doi.org/10.1145/3131085.3131128

KEYWORDS

Business Intelligence, BI-tools, private healthcare sector, benefits

1 INTRODUCTION

The healthcare sector is changing rapidly, putting forward a growing need for developing ways for data-driven decisions not only in the daily work of the clinicians, but also at the organizational level [2, 3, 4, 5]. Especially in the private healthcare sector there is a clear need for appropriate tools that can support not only the clinical work, but also the business decisions and thus, enhance profit making [6, 7]. This paper focuses on the Business Intelligence (BI) -tools utilization and benefits in the private healthcare sector in Finland. The purpose of the research is to gain understanding of how BI-tools are being used, what are the required capabilities of BI-tools and how utilization of BI-tools benefits the decision-makers in the private healthcare sector organizations.

The amount of health data, that is been captured in the healthcare organizations is growing, but in addition to that, there is also enormous amounts of operative business data to support the decision-making [8]. The private healthcare sector is looking for better ways to understand their business practices to be able to seek for better performance [9]. Therefore management and executives have been showing an increasing interest in BI-tools that enable explore and exploit organizational data siloed in different operational systems, to be able to achieve operational and strategic performance improvements by utilizing BI-tools to support their decision-making process [10].

This study is putting together the utilization of BI-tools and its connection to decision-making in the private healthcare organizations. Having the right selection of BI-tools is an important aspect in the field of private healthcare, but there are not many

previous studies looking into this issue [11, 11]. By analysing the capability factors and features of the BI-tools in the private healthcare industry sector, the research brings a significant novel value for the private healthcare sector companies, specifying the factors affecting the benefits of BI-tool utilization.

Lönnqvist and Pirttimäki [13] have said that few organizations have means to measure the value of BI, but it would be important to measure what are the BI benefits (i.e. is it worth of the investment), and further, to ensure the quality of BI products [13]. In our study we present the results of our empirical study to point out the benefits Finnish healthcare organizations have gained by using BI tools. We use the information systems (IS) success model by DeLone and McLean as our theoretical lenses for identifying the gained benefits and the success of BI-tool utilization [1]. The practical outcome of this research will provide valuable information as well as deep understanding on the existing BI-tool capabilities requirements and the benefits of BI-tool utilization in the Finnish private healthcare sector companies, as advanced BI-tool features would increase their ability of enhanced decision-making.

In the second section of the paper the conceptual basis of BI and BI-tools and the key characteristics and capabilities of them are discussed along with presenting the IS success model. Section three presents empirical setting, introducing the methodology and empirical data. Section four is of showing the empirical results of BI-tools benefits in the Finnish private healthcare sector. Finally, in section five, the conclusions and discussion conclude the paper.

2 THE CONCEPT OF BUSINESS INTELLIGENCE

2.1 Business Intelligence tools as decision-making enablers

Utilization of various information systems in supporting business processes has created enormous amounts of data that can be used in decision-making and thus enhancing organizational performance [14]. Business Intelligence (BI) can be seen as various methods and processes of turning data into information and further on into knowledge, that can be used to enhance organizational decision-making process [15]. The concept of BI is quite diverse with several definitions. It can be considered as an umbrella-like phrase or term under which one combines different tools, applications and methods [16]. Brandão et al. [30] and Chen et al. [24] refer to some well-known tools, such as QlikView, Tableau, SAP, IBM, Microsoft and Oracle BI-tools, enabling Ad hoc queries and searches, reporting, dashboards, online analytical processing, interactive visualization as well as predictive modeling and data mining.. Nykänen et al. [17] is expressing, that the literature is showing two main approaches to the BI, the technological and the process one. However, it is notable that BI has many similar concepts such as competitive intelligence, market intelligence, customer intelligence, competitor intelligence, strategic intelligence, technical intelligence and data analytics [13].

BI could be defined as management philosophy or a strategic milestone, summarizing the functionalities of BI, collecting raw data, evaluating the validity and reliability of data, analysing and storing data, as well as to sharing the processed information to support the decision makers [18 19, 17]. Besides a process-oriented approach, BI can be also identified as a selection of techniques, technologies, tools, practices, methodologies, and applications that are able to analyse critical business data to enable better understanding for enterprise of its business and market and make appropriate business decisions [20, 17]. BI-tools are an essential part in getting the right information to the right people, enabling the data-driven decision-making in organizations. The tools themselves, such as data warehouses and data mining tools, support the different stages of BI as efficiently as possible. Fast information access to support decision-making is critical and the amount of information in organizations is growing rapidly. Data processing requires specific tools to enable knowledge and value creation to the organization [21]. The value of BI is created by connecting different data types from different sources enabling to collect, evaluate, analyse, store and share up-to-date data to be used efficiently in decision making. This requires efficient BI-tools as well as internal and external capabilities to utilize them. BI-tools and BI-transformations have been dominating projects on the priority lists of CIOs to be able to provide 360 degrees view to their business [22, 23].

2.2 Key characteristics and capabilities of BI-tools

The roots of the most of BI-tools are lying in the database management, focusing on data collection, extraction, and analysis technologies [24, 25, 16, 26]. After processing mostly structured organizational data, organizations moved towards utilizing BI-tools in analyzing web-based analytics and social media -originated data, to be able to create more knowledge about their customers and establish a conversation between the organization and its market [24, 27, 28]. The next step of BI-tool capabilities, is to be able to process also big amounts of sensor- and mobile device -originated data [24]. As the requirements towards BI-tools are developing and growing, also the functionalities and critical capabilities of BI-tools are developing to be able to satisfy the demand. Kankanhalli et al.[29] is dividing data that is formed in the healthcare sector into four primary sources, clinical data, pharmaceutical data, activity

and cost data as well as patient behavior data (sensor devices and social media data).

In this study, we mainly concentrate on the activity and cost data influencing the decision-making in the private healthcare sector in Finland. There are several definitions of capabilities that have been identified for BI-tools, required for efficient BI-tool utilization. Chen et al. [24] refer to Gartner reports, where they have identified 13 critical capabilities for BI-tools. Brandão et al. [30] is identifying the requirements for BI-tool in the healthcare environments, pointing out specific tool requirements and functional features that are essential for the purpose of health data analysis. Some of the identified features though are also being relevant in terms of business-related use of BI tools. When focusing on the efficiency and value creation for the healthcare business-related operational and financial business data, the capabilities presented by Chen et al. [24] are critical to take into account, too.

However, these critical capabilities identified by Chen et al.[24] are not industry specific, therefore in this research we also consider BI-tool requirements by Brandão et al. [30] to gain understanding in BI-tool capabilities and requirements specifically from the perspective of healthcare sector. Brandão et al. [30] are referring in their analysis of BI-tool requirements in healthcare environments to several critical requirements that are essential in the healthcare sector. In Table 1. we present the required capabilities of BI-tools based on both the work of Brandão et al. [30] and Chen et al. [24]. We have identified those requirements, that are identified both in Chen et al.'s. [24] and Brandão et al.'s [30] researches by bolding them in Table 1.

Table 1. Required capabilities for BI-tools in healthcare context [30, 24].

Required capability	**Description**
Performance	Good performance in query processing with a high volume of data
Online Analytical Processing ad hoc queries	Tool allows the user to have the freedom to define queries, which he considers appropriate in a given context. OLAP allows the users to perform ad hoc analyses on the data, considering multiple dimensions and providing the necessary information for an even more efficient decision-making process. This technique allows the analysis of the document's history, and the use of operations such as the roll-up, drill-down, slice and dice, and pivot.
Architecture	Implementation with a Data Warehouse (DW) and OLAP architectures with high scalability, i.e., capable of processing information evenly, even if the load is increasing.
Display of Key Performance Indicators (KPIs)	Whether or not the tool provides visualization of the KPIs of the organization. These indicators can be clinical or management ones.
Plug-ins	Development and use of plug-ins that add functionality to it.
Interactive visualization of data	Interactivity between the user and dashboards, reports, and graphs. This is a very important characteristic since interactivity is appealing to the user, and also facilitates the understanding of the information demonstrated.
Documentation	Quality of the documentation given by the tool.
Dashboards	Supporting the development of dashboards, enabling the integration of graphics, tables, and other analyses such as OLAP and DM.
Navigation Features	Enabling the creation of reports, using roll-up, drill-down, slice and dice, and pivot operations
Extract, Transform, and Load (ETL)	Possibility of extraction, transformation, and loading of data by creating procedures incorporated into the tool.
Connection to the database	Establishing the connection to different databases and several at a time, to integrate information from different data sources.
Integration of dimensional model	Integration of a DW dimensional model.
Open-source	Tool having a development model for which, besides being free, the source code is completely available for users to visualize, modify, and redistribute without restrictions placed by the owner of the product.
Export	Export to other formats such as PDF, HTML, spreadsheets, and others.
Pervasive	The free version of the tool provides a server that allows the development of a web application, which can be opened in a browser, or a mobile application that can be installed on different mobile devices and send alerts, and other pervasive data or healthcare

	characteristics. If the tool has this feature, it is not necessary to install the application on all the computers in the organization, but only on a server, with all computers connected to the organization network able to access the web application.
Online Help	Online help resources.
Support for mobile devices	Supporting the use of mobile devices.
Data Mining	Providing the ability to use data to predict chosen outcomes as clinical situations or behavior patterns.
Ease of Use	Enabling a non-experienced user to be able to identify and to find the tools' features, as well as how easy it is to perform them.
Attractiveness	Interface attractiveness
Customization of the interface	Customization of the interface by the administrator.
User Profile	Allowing the administrator to set hierarchies by assigning different permissions to different system users.
Real-time	Allowing users to access the application and the information in real time, including real-time data processing (ETL) and dashboard updates.

By combining several interpretations of critical BI-tool requirements, we gain understanding of the beneficial factors influencing the decision-making process in the private healthcare sector in Finland, influenced by BI-tool utilization.

2.3 Information systems success model

The literature is showing several IS success models and studies. To point out the importance of BI-tool capabilities and BI-tool value potential, we use one of the most influential IS success model, that can be considered being DeLone and McLean updated IS success model. The model is suggesting to choose several relevant measures based on the research objectives and the IS context and to consider possible relationships among the dimensions [1, 31]. The following Figure 1. illustrates the DeLone and McLean updated IS success model [1].

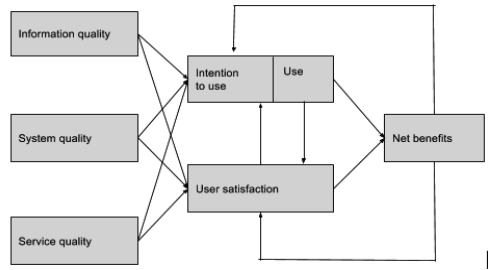

Figure 1: DeLone and McLean updated IS success model [1]

The DeLone and McLean IS success model is identifying and describing the relationships between six critical dimensions of IS success, information quality, system quality, service quality, system use/intention to use, user satisfaction and net system benefits. All these six dimensions of success are suggested to be interrelated rather than independent [1].

According to DeLone and McLean [1] information quality refers to the quality of the information that the system is able to store, deliver, or produce and is having an influence on user satisfaction. System quality is measuring the desired characteristics of the IS that are valued by users. Another critical dimension influencing customer satisfaction is service quality, where the support provider can be either internal or external service provider. System use or intention to use is being influenced by information, system, and service quality of IS. In addition, user satisfaction is measurable for the whole lifecycle of IS. Finally, the net benefits, being the most important measured metric, but not measurable without system and information quality measurements [1].

3 METHODS

The aim of this study is to describe the utilization of BI-tools and how it benefits decision-makers in the private healthcare sector in Finland. This has been conducted by focusing on the interest group, the private healthcare industry that is utilizing the BI-tools.

The method for studying the demand for BI-tools in the private healthcare sector is conducted by using qualitative research methods. Eight private healthcare sector companies have been chosen for the study. The inductive approach with semi-structured, thematic interviews, allow investigating the required capabilities and the value enabled by BI-tools. The research method is chosen upon other research methods, as it provides better explanations and deeper understanding on the research questions as well as enables the adjusted questions and gather more information, which might have been lost, if used quantitative study [31]. For example a

quantitative survey is insufficient to give deep enough understanding of the utilization of BI-tools and value creation impact in the private healthcare sector [17]. Discussions have been recorded and transcribed to enable systematically organize and analyse data sets by content analysis technique [1].

From the private healthcare sector the interviewees were top managers and directors, representing mainly ICT or financial organizational functions, chosen to be involved in the research based on their area of responsibility for Business Intelligence within their organization. The private healthcare companies with turnover over 40 million euros per year (2015) were chosen for the study. The list of interviewees is presented in Table 2.

Table 2. The list of interviewees, their titles and main work activities.

Title of interviewee	Main work activity
Director, ICT	Head ICT functions
Director, Digital Services	Head of Digitalization
Head of IT	Head of ICT functions
Development Manager	Responsible for BI and development
CIO	Head of ICT functions
Head of Accounting and Reporting	Head of Controlling and BI
Director, Digitalization	Head of ICT and Digitalization
ICT Manager	Head of ICT

The interviews were carried out during the period between January and March 2017. The interviews were conducted with the following interview themes:

- what kinds of BI-tools they have been utilizing,
- who is responsible for BI,
- who are the consumers of BI-tools ,
- how they are consuming BI-tools and
- what are the benefits from BI-tools.

In chapter 4.1. we discuss the use of BI-tools and their required capabilities in the private healthcare sector based on the empirical data. In chapter 4.2. we analyse the benefits gained by BI-tools through the framework of Delone and McLean [1].

4 RESULTS AND IMPLICATIONS

4.1 BI-tool use in the private healthcare sector

Most of the companies involved in the research are using more than one BI-tool for various reasons, from one to four tools each, but all of them have an objective to streamline their BI-processes to be performed by only one BI-tool. Cognos has been used in four companies, Tableau, Power BI and other tools (not specified) in three cases. Qlik Sense and Excel were mentioned to be in very active use in two cases both. Excel is in use basically in all companies, but as an actual BI-tool, in only in two of them. Almost all companies had BI either on strategic roadmap or as a separate ongoing BI-project within a year.

An interesting question in regard to BI use is that who is responsible for BI in the organization. There was no clear named function in the researched organizations for BI. As one of the interviewee brought up: “When we started our BI-project, we actually noticed, that there is no owner for BI-functions in our company, who would lead the big picture”. The work distribution was mainly twofold, as BI-tools are mainly provided and supported by ICT and in over than half of the cases, the process owner for BI was finance function. There were a few cases, where the ownership was in business functions as well. In some of the cases, the owner was directly ICT and there was also a case of shared ownership between ICT and finance functions.

Another interesting question in regard to BI utilization is that who are the consumers for BI-tools. As BI-tool output, the data consumption in turns of data-driven decision making, has more variety. There can be identified several larger groups of data consumers in the private healthcare sector companies, but also smaller groups, that do not appear in all companies involved in the study. The largest groups consuming data are business managers, customers and authorities. In addition, also executives, members of the board, owners, partners, finance, investors and marketing functions use data to support their decision-making.

The consumption channels varied not only between the researched organizations but also inside those organizations. Some of the variations in the consuming of BI was caused by different user groups. In this research, we identified the required capabilities and functionalities, that are pointed out by the examined organizations. The required capabilities and functionalities that were presented in Table 1, are marked with *. Over half of the identified capabilities were identified also by Chen et al. [24] and Brandão et al. [30].

- Dashboards that enable to follow KPI’s*
- Drilling down into the costs and activities*
- Different views for different user groups, user-role restrictions*
- Embedded reports in intra- and extranet -portals
- Embedding to PowerPoint -presentations
- Mobile device utilization*
- Numerical data reports
- E-mail distribution of static reports

- Self-service analytics*
- Integration of several data sources*
- Internal and external capabilities to utilize BI-tools
- Visual and interactive*

Implementation of new BI-tool was seen as one of main goals for the nearest future as well as better utilization of current data sources. “We do have a brand new BI-tool, but we have not yet started to use it”, annotates one of the interviewees. Another interviewee is bringing up better utilization: “In the future we have to learn how to utilize better our existing data”. Next, aim is to combine the existing data with external data sources, developing potential for new products and services and thus value creation. Another important approach to future needs was seen to be utilizing machine learning opportunities and operating with predictive analytics. Consequently creating new business opportunities and as a result, also creating value. Data-driven decision-making is the direction organizations are strongly heading towards to, leading to the culture of data-driven value creation.

4.2 Benefits of using BI-tools in the private healthcare sector

Generally the interviewees saw performance excellence and resources optimization as the main benefits from BI-tool utilization. “It can decreases the amount of manual work and enables resource optimization” one of the interviewees is stating. Another important approach was seen to be customer satisfaction, in terms of better customer service and customer knowledge, enabling value creation. Also enhanced reaction time, forecasting and support of decision-making were considered being significant benefits. As one interviewee stated: “Of course the benefit is, that we are being able to make better operative decisions and strategic business decisions”. Another interviewee is bringing up the reaction time: “When be build it correctly, it will enhance our reaction time and structure the data”. In addition, sharing of “Best Practices”, creation of new business opportunities and enhancing information flow were mentioned to be the benefits of BI-tool utilization. “By identifying, implementing and utilizing the “Best Practices”, our business is getting direct financial benefits” notices one of the interviewees.

The following Table 3 illustrates the DeLone and McLean updated IS success model [1], with the BI-tools success metrics in the private healthcare sector. Systems quality is representing required characteristic such as mobile use, visualization possibility, reliability of the system, dashboards and integrations to several operative systems to be able to combine data from different sources. Information quality is referring to relevant, secured, personalized, good quality data, enabling user to drill down to the root-causes. The internal or external support for BI-tool is part of service quality, as well as self-service possibilities and embedding reporting into intra- or extranet portals. Primary metrics in usage are decision-making, data-driven management and forecasting.

Table 3. BI-tools in the private healthcare sector success metrics (based on DeLone and McLean [1])

Systems quality	Information quality	Service quality	Use	User satisfaction	Net benefits
Mobile use	Relevance of data to user	Self-service	Decision-making	Demand for new	Cost savings
Visualization	Security/user groups	Internal/external support	Data-driven management	Contracts / tendering	Expanded markets
Reliability	Personalization	Embedding of reports	Forecasting		Competitive advantage
Dashboards	Drilling down				Operational excellence
Integrations	Quality of data				Time savings

As a summary, the benefits of utilizing BI-tools in terms of decision-making in the private healthcare sector, can be considered multidimensional. By studying the direct and indirect BI-tool utilization value functions and their measurement in the private healthcare sector, we can identify the benefits that utilization of BI-tools brings to organizations [34]. The benefits generated by efficient utilization of BI-tools is one of the key factors, when supporting the decision-making in the private healthcare sector. The most remarkable benefits of BI-tool utilization in the private healthcare sector can be considered to be operational excellence, enhancing customer reporting and creating new business opportunities through data utilization. The success metrics for BI-tools in the private healthcare sector, based on DeLone and McLean [1] updated IS success model, are showing the metrics that are influencing the success of BI-tools in the private healthcare in

Finland and thus, having an impact on enhanced decision-making [1].

5 CONCLUSIONS AND DISCUSSION

This paper introduces empirically focused approach to discussion of the use of BI-tools and benefits of utilization of BI-tools in the private healthcare sector in Finland. Healthcare is facing changes and challenges all over the world and pressure for improvements is remarkable [35]. Utilization of BI-tools in terms of decision-making can be seen as one of the "efficient-choice" rationales [17, 36]. We analyzed the BI-tool benefits and success metrics through the IS success model [1], to gain better understanding of the benefits gained by utilizing BI-tools.

The research showed, that the BI-tools options were spread into several tools available on the market, using more than one BI-tool. The reasons behind were mainly historical, as a result of inorganic organizational growth. The responsible organizational functions for BI were ICT, Finance and Business organizations. There were several major consumer groups utilizing BI-tools, internal as if external user groups. The identification of BI-tool requirements can help us to understand the benefits of utilizing BI-tools in the private healthcare organizations. Utilization of BI-tools bring operational excellence, enhance customer reporting and creates new business opportunities.

The practical outcome of this research will provide valuable information as well as understanding on the existing BI-tools used in the Finnish private healthcare sector companies, what are the required capabilities of those BI-tools as well as how is their utilization benefits the decision-makers. Advanced BI-tools would increase the ability of data-driven decision-making in the private healthcare sector companies. Thus utilizing BI-tools, not only in the decision-making, but also in creating new business opportunities. However, the limitation of our study is in generalizability. In order to get more specific view on this issue, we need to gather more empirical data from the private healthcare organizations as well as the supplying side, the consulting companies providing BI-tools such as Microsoft Power BI, IBM Cognos, QlikView and Tableau. In addition, we need to study the public healthcare sector, to be able to point out specific tool requirements and functional features that are essential for the healthcare sector as whole, to gain deeper understanding of factors having impact on BI-tools utilization.

REFERENCES

[1] DeLone, W., and McLean, E. 2003. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems / Spring 2003, Vol. 19, No. 4, pp. 9–30.

[2] Bates, D., Saria, S., Ohno-Machado, L., Shah, A., Escobar, G. (2014). Big Data In Health Care: Using Analytics To Identify And Manage High-Risk And High-Cost Patients. Health Affairs 33.7, Jul2014, pp.1123-31

[3] Cases, M., Furlong, L., Albanell, J., Altman, R. B., Bellazzi, R., Boyer, S., Brand, A., Brookes, A. J., Brunak, S., Clark, T. W., Gea, J., Ghazal, P., Graf, Guigó, R., Klein, T. E., López-Bigas, Maojo, Mons, B., Musen, M. and Oliveira, J. L. (2013). Improving data and knowledge management to better integrate health care and research. Journal of Internal Medicine. Oct 2013, Vol.274 Issue 4, pp.321-328

[4] Katsaliaki K. and Mustafee N. (2011). Applications of simulation within the healthcare context. Journal of the Operational Research Society. Aug2011, Vol.62, Issue 8, pp.1431–1451

[5] Stewart, R. and Davis K. (2016). 'Big data' in mental health research: current status and emerging possibilities. Social Psychiatry and Psychiatric Epidemiology. Aug2016, Vol.51, Issue 8, pp.1055–1072

[6] Krumholz, H.M. (2014). Big Data And New Knowledge In Medicine: The Thinking, Training And Tools Needed For A Learning Health System. Health Affairs 33.7. Jul2014. pp.1163-70

[7] Swanson, R. C., Cattaneo, A., Bradley, E., Chunharas, S., Atun, R., Abbas, K. M., Katsaliaki, K., Mustafee, N., Meier, B. M. and Best, A. (2012). Rethinking health systems strengthening: key systems thinking tools and strategies for transformational change. Oxford Journals. Medicine & Health. Health Policy and Planning Vol.27, 2012. Issue supply 4. pp. iv54-iv61.

[8] Spruit, M., Vroon, R. and Batenburg, R. (2014). Towards healthcare business intelligence in long-term care. An explorative case study in the Netherlands. Computers in Human Behavior, 2014. Vol.30 pp.698–707.

[9] Demirkan, H. 2013. A Smart Healthcare Systems Framework. IT Professional. Sept/Oct 2013. Vol.15, Issue 5, pp.38-45

[10] Elbashir M., Collier P., Sutton S., Davern M. and Leech S. (2013). Enhancing the Business Value of Business Intelligence: The Role of Shared Knowledge and Assimilation. Journal of Information Systems. Vol.27, No. 2. Fall 2013, pp.87–105

[11] Wullianallur R. and Viju R., (2014). Big data analytics in healthcare: promise and potential. Health Information Science and Systems. 2014, 2:3.

[12] Suomi, R. and Tähkäpää, J. (2002). The Strategic Role of ICT in the Competition Between Public and Private Health Care Sectors in the Nordic Welfare Societies - Case Finland. Proceedings of the 35th Hawaii International Conference on System Sciences - 2002

[13] Lönnqvist A. and Pirttimäki V. (2006). The measurement of business intelligence. Information Systems Management , Vol.23, 2006. Issue 1, pp.32-40

[14] Hawking, P. and Sellitto, C. (2010). Business Intelligence (BI) Critical Success Factors. 21st Australasian Conference on Information Systems. 1-3 Dec 2010, Brisbane.

[15] Popovič, A., Hackney R., Coelho P.S. and Jaklič J. (2012). Towards business intelligence systems success: effects of maturity and culture on analytical decision making. Decision Support Systems. Vol.54, pp.729–739

[16] Turban, E., Aronson, J. E., Liang, T-P. and Sharda, R. (2008): Business intelligence: a managerial approach. Pearson Prentice Hall, New Jersey.

[17] Nykänen, E., Järvenpää, M., and Teittinen, H. (2016). Business intelligence in decision making in Finnish enterprises. Nordic Journal of Business, 65 (2), pp.24-44.

[18] Pirttimäki, V. (2006). Business Intelligence as a Managerial Tool in Large Finnish Companies. Tampere University of Technology. Publication 646. Doctoral thesis. Tampere, Finland.

[19] Gilad B. and Gilad T. (1985). A systems Approach to Business Intelligence. Business Horizons. Vol.28, No. 5, pp.65-70

[20] Côrte-Real, N., Ruivo, P. and Oliveira, T. (2014). The diffusion stages of business intelligence & analytics (BI&A): A systematic mapping study. Procedia Technology. Vol.16, pp.172–179

[21] Jinpon, P., Jaroensutasinee M. and Jaroensutasinee K. (2011). Business Intelligence and its Applications in the Public Healthcare System. Walailak Journal of Science and Technology (WJST). 2011. Vol8, Issue 2, pp.97-110

[22] Yeoh, W. and Koronios, A. (2010). Critical success factors for business intelligence systems. Journal of computer information systems, Spring 2010, pp.23-32

[23] Wang, H. & Wang S. "A Knowledge Management Approach to Data Mining Process for Business Intelligence," Industrial Management & Data Systems, 108(5), 2008, 622-634.

[24] Chen H., Chiang R. and Storey V. 2012. Business Intelligence and Analytics: From Big Data To Big Impact. MIS Quarterly Vol. 36 No. 4, pp. 1165-

1188/December 2012.

[25] Chaudhuri, S., Dayal, U. and Narasayya, V. (2011). An Overview of Business Intelligence Technology. Communications of the ACM. Vol.54, pp.88-98

[26] Watson, H. J., and Wixom, B. H. 2007. "The Current State of Business Intelligence," IEEE Computer (40:9), pp. 96-99.

[27] Doan, A., Ramakrishnan, R., and Halevy, A. Y. (2011). "Crowdsourcing Systems on the World-Wide Web," Communications of the ACM (54:4), pp. 86-96.

[28] O'Reilly, T. 2005. "What Is Web 2.0? Design Patterns and Business Models for the Next Generation of Software," September 30, (http://www.oreillynet.com/pub/a/oreilly/tim/ news/2005/09/30/what-is-web-20.html).

[29] Kankanhalli, A., Hahn J., Tan, S., and Gao, G. (2016). Big data and analytics in healthcare: Introduction to the special section. Information Systems Frontiers. April 2016, Volume 18, Issue 2, pp 233–235.

[30] Brandão, A., Pereira, E., Esteves, M., Portela, F., Santos, M. F., Abelha, A. and Machado, J. (2016). A Benchmarking Analysis of Open-Source Business Intelligence Tools in Healthcare Environments. Information, 7(4), pp.57

[31] Yeoh, W. and Popovič, A. (2015). Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems. Journal of the Association for Information Science and Technology.. Volume 67, Issue 1. January 2016. Pages 134–147

[32] McLellan, E., MacQueen, K. M. and Neidig, J L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. Sage Journals, Feb2003, pp.63-84

[33] Walter, A., Ritter, T. and Gemünden, H.G. (2001). Value creation in buyer-seller relationships. Industrial Marketing Management 30(4), pp.365-377.

[34] Ratia, M. and Myllärniemi, J. (2017). Business Intelligence Tools for Private Healthcare Data-Driven Value Creation. Proceedings IFKAD 2017. St. Petersburg, Russia, 7-9 June 2017. pp. 408-419.

[35] Myllärniemi, J. (2013). Knowledge processes in healthcare network - a case study. 8th International Forum on Knowledge Asset Dynamics, IFKAD 2013, 12.-14.6.2013, Zagreb, Croatia. Zagreb, Croatia: Institute of Knowledge Asset Management, pp.1223-1236

[36] Malmi, T. (1999). Activity-based costing diffusion across organizations: an exploratory empirical analysis of Finnish firms. Accounting, Organizations and Society. Vol.24, pp.649–672

PUBLICATION II

The new era of business intelligence: Big Data potential in the private healthcare value creation

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Meditari Accountancy Research, Vol. 26 Issue: 3, pp.531-546.

The New Era Of Business Intelligence: Big Data Potential in the Private Healthcare Value Creation

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Structured Abstract

Purpose – As the healthcare sector is changing rapidly, it is putting forward a growing need for developing new ways for data-driven decisions, especially at the organizational level. Data utilization, like business intelligence activities, bring benefits to healthcare organisations. The purpose of this paper is to study the Big Data potential and utilization of Business Intelligence (BI) -tools in creating value in the private healthcare in Finland.

Design/methodology/approach – Intellectual Capital (IC) components and Möller et al.'s (2005) work on value capabilities is used as a framework to point out the data utilization and BI-tools' role in value creation. Our study includes private healthcare organizations in Finland. The empirical data was collected during 2017. Thematic interviews of key-personnel responsible for BI were conducted, to gain understanding of the value creation based on Big Data potential and utilization of BI-tools in the Finnish private healthcare industry.

Originality/value – Data-driven value creation is currently one of the most discussed topics in the private healthcare sector organizations. By analysing the current data source utilization, their challenges in data utilization and use of BI-tools, future vision in terms of data utilization and development roadmaps, we gain better understanding of the IC

components and value creation capabilities in the private healthcare organizations. This helps us to understand the potential of data-based value creation. The suggested approach has novelty value in the context of the Finnish private healthcare sector.

Practical implications – In this study, the outcome will provide understanding on the existing data sources and BI-tools utilized in the private healthcare in Finland. In addition, it provides insight into the future-oriented Big Data potential, that can create new business concepts for the private healthcare companies. Advanced capability of data and Big Data potential utilization would increase the ability of value creation in the private healthcare sector companies. The approach provides valuable insights for value identifying the future needs of data utilization and creates understanding on the current state within the private healthcare sector.

Keywords – Healthcare, Big Data, Business Intelligence tools, Intellectual Capital, value creation

Paper type – Academic Research Paper

Introduction

Rapidly changing healthcare sector is demanding data-driven decisions not only in the daily work of the clinicians, but also at the organizational level (Bates et al. 2014; Cases et al. 2013; Katsaliaki et al. 2011; Stewart et al. 2016). The need to enhance the decision-making is a current topic especially in the private healthcare sector, where is a clear need for appropriate tools that can support not only the clinical work, but also the business decisions and thus, enhance value creation (Krumholz 2014; Swanson 2012).

Utilization of business intelligence tools in healthcare sector has shown significant benefits in terms of enhancing decision-making process. (Ratia et al. 2017). However, the amount of generated and captured data in the private healthcare is expanding phenomenally, both in the means of health data and operative business data, the latter one processed and stored to support the organisational decision-making (Spruit et al. 2014; Grierson et al. 2015). The private healthcare sector is looking for better ways to understand their business practices to be able to seek for better performance (Demirkan 2013). The key is to be able to identify business critical data sources, that are key Intellectual Capital and enhance the value creation of the organization. Therefore management and executives have been showing an increasing interest in data utilization and in the BI-tools, that enable explore and exploit organizational data siloed in different operational systems, and in this way to create value through operational and strategic performance improvements (Elbashir et al. 2013). Also in Finland, the private healthcare management is showing an increasing interest towards data-driven decision-making, even though the organizational culture is not there yet in all of the cases (Ratia and Myllärniemi 2017). The future demand in terms of value creation can be secured, once the factors affecting it, can be identified.

The purpose of this paper is to identify the Big Data potential in value creation, when utilizing Business Intelligence (BI) -tools in the private healthcare sector in Finland. Big Data and use of BI-tools are in this paper seen as future oriented components of Intellectual Capital (IC), which rationale is to create value (see e.g. Secundo et al 2017). This study is putting together the Intellectual Capital used in value creation, now and in the future, in the context of Big Data potential and utilization of data by using BI-tools in the private healthcare organizations. Also having the right selection of BI-tools is an important aspect in the field of private healthcare, but there are not many previous studies looking into this issue (Wullianallur et al. 2014; Suomi et al. 2002). By analysing the value creation factors in terms of data utilization in the private healthcare industry sector, the research brings novel

value for the private healthcare sector companies, specifying the factors affecting the value creation now and in the future. The practical outcome of this research will provide valuable information as well as understanding on the existing data sources and BI-tools utilized in the private healthcare in Finland. In addition, it provides insight into the future-oriented Big Data potential, that can create new business concepts for the private healthcare companies. The paper focuses on the potential of data and utilization of BI-tools in the business decisions of the private healthcare sector companies, leaving out the data based decisions in the clinicians daily work, i.e. the actual care and diagnosis questions.

In the second chapter the aim is to show a conceptual basis for Big Data, BI and BI-tools, and furthermore the Secundo et al's (2017) IC model as well the Möller et al's (2005) model of value creation along with a theoretical discussion on inter-organizational networks opening the complexity of value creation in the private healthcare setting, too. Chapter 3 presents empirical setting, introducing the methodology and empirical material. Chapter 4 is of showing the results of Big Data potential and data-driven value creation in the Finnish private healthcare sector. Finally, in chapter 5, the conclusions and discussion conclude the paper.

2 Big Data and utilization of BI-tools to create value at the private healthcare sector

2.1. The concept of Big Data

The amount of generated data is expanding phenomenally, as the literature is saying, that the most of the world's data has been generated during the past few years (Grierson et al. 2015; Dragland 2013). Thus, there was formed a clear need to be able to process big amounts of generated data, which is not possible to process, using manual analysis or within capacities of conventional databases (Provost and Fawcett 2013). As a term, Big Data is not new, it was used to visualize big datasets already back in 1997 (Ylijoki and Porras 2016; Cox and Ellsworth, 1997). However, at the beginning of 2000's the term achieved its current meaning when Laney (2001) used the three V's to describe the meaning of Big Data (Laney 2001; Ylijoki and Porras 2016). Also later on, the literature has mostly described the dimensions as three V's, volume, variety and velocity (Chen et al. 2012; Katal et al. 2013; Kwon et al. 2014; Gandomi and Haider 2015; De Mauro et al. 2016). In addition,

there are also other dimensions mentioned in the literature, veracity, visualization, variability and value. The last two have especially been brought up by the tech industry (Gandomi and Haider 2015).

Another approach to the concept of Big Data is to consider it is a technology, that has a significant influence on industries and enterprises, bringing remarkable benefits to its organization such as competitive advantage (Ylijoki and Porras 2016; Manyika et al., 2011; Schmarzo, 2013; Davenport, 2014; McAfee et al., 2012; Dehning et al., 2003). Therefore, the role of new generation ICT-tools and architectures is to allow collecting significantly big amounts of data from various data sources, store and organize it, extract and analyze it as well as share generated data to create value (Fosso Wamba et al. 2015). As per Ylijoki and Porras' (2016) resent analysis, the perspective of Big Data has changed the direction into the discussion of business value creation during the past few years (Ylijoki and Porras 2016). Consequently, value creation in the context of Big Data, has become the focus for multiple academic and corporate research, due to its high operational and strategic potential to business value creation (Fosso Wamba et al. 2015).

2.2. Business Intelligence and BI-tools

The concept of Business Intelligence is multilateral with several definitions to BI. It can be seen as an umbrella-like phrase or term under which one combines different tools, applications and methods (Turban et al. 2008) or to consider it having two main approaches to the BI, the technological and the process one (Nykänen et al. 2016). Nevertheless, it is considered, that BI has many similar concepts such as competitive intelligence, market intelligence, customer intelligence, competitor intelligence, strategic intelligence, technical intelligence and data analytics (Lönnqvist et. al 2006). Besides, BI could be defined as management philosophy or a strategic milestone, summarizing the functionalities of BI, collecting raw data, evaluating the validity and reliability of data, analysing and storing data, as well as to sharing the processed information to support the decision makers and thus, create value. (Pirttimäki 2006; Gilad et al. 1985; Nykänen et al. 2016).

In addition, to a process or management approach, BI can be also identified as a selection of techniques, technologies, tools, practices, methodologies, and applications that are able

to analyse critical business data to enable better understanding for organization of its business and market as well as enable data-driven decision-making (Côrte-Real et al. 2014; Nykänen et al. 2016). BI-tools, such as data warehouses and data mining tools, support the different stages of data-driven decision making as efficiently as possible, simultaneously bringing the value to the organization. Fast information access to support decision making is critical and the amount of information in organizations is growing rapidly and thus, putting challenges towards data processing, which requires specific tools to enable knowledge and value creation to the organization (Jinpon et al. 2011). The value of utilization of BI-tools is created by connecting different data types from different sources enabling to collect, evaluate, analyse, store and share up-to-date data to be used efficiently in decision making.

2.3. Intellectual Capital and Big Data - the rationale to create value

Concepts of value, value creation, and value capture, that are often being utilized in business discussions as well as the importance of understanding the elements included in the concept of value are the keys, according to Ojala and Helander (2014). An extended perspective is describing, that the concept of value can be considered in terms of a trade-off between benefits and sacrifices (Hugos et al. 2011; Lapierre 2000; Parolini 1999; Ojala and Helander 2014). These trade-offs between benefits and sacrifices can be seen in monetary terms, such as productivity and resource utilizations, but also including non-monetary rewards, such as competence, market position, social rewards, time, effort and energy (Ojala and Helander 2014; Myllärniemi and Helander 2012; Hagen et. al 2006; Nordgren 2009). In this research we mostly focus on the monetary aspect of value creation. In addition, value creation requires capabilities, that in different levels of value production are getting more complex, when moving towards the next level of value creation and involving a greater amount of different kinds of network actors in the value creation process.

In fact, value creation can be seen as a key driver for building networks. The statement “No business is an island”, presented already in the seminal work of Håkansson and Snehota, (1989) on industrial networks, describes well the important role of inter-organizational relationships and networks in complex business environment. A business network can be defined as an intentional cooperative arrangement composed of more than two actors, which is connected by inter-organizational relationships (Möller et al. 2005). These kinds of networks are usually considered strategically significant for its members.

Thus it is not a surprise that already for decades networks have been widely discussed, particularly in the marketing and management literature (Easton, 1992; Gulati et al., 2000; Easterby-Smith et al., 2008), as for companies the ability to act in networks and create value by combining at best possible way the capabilities and resources of different actors in the inter-organizational networks is a matter of survival.

Capabilities required in the process of value creation, are in ascending order in terms of complexity. Nevertheless, the first capabilities are not less important, but rather less complex (Möller et al. 2005). Being able to produce the next level of value creation, there has to be a solid platform of value production build on the previous level. The Figure 1 is describing in a simplified manner, how the capabilities are considered to be linked to value creation in the network context. As shown in Figure 1, the lower level of capabilities is representing more traditional competencies and the upper row is representing more of the capabilities required in managing strategic relationships and business nets. The capabilities that are being required for the value production are being presented in an approximate order of ascending complexity, but not meaning that the capabilities on the left side are less important. The more complex the value system becomes, the more actors are being involved, the more intensive is the relationship between the actors, the more complex the set of required capabilities becomes. Nevertheless, to be able to move to the next level, it is required to be able to manage one business relationship well, is being a learning step towards moving to the complex relationships (Möller et al. 2005).

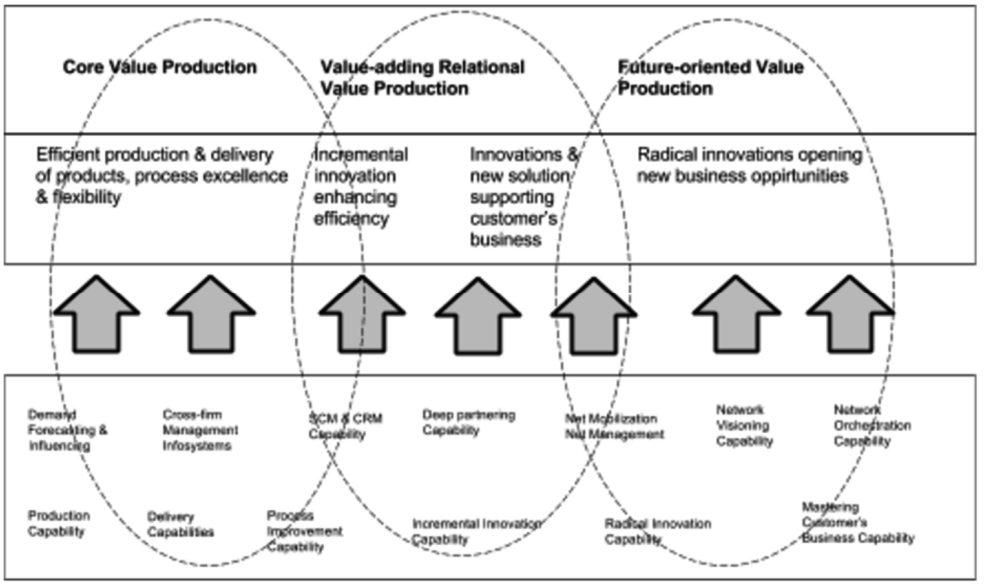

Figure 1. Value production and network capability base (Möller et al. 2005).

Also within IC discussion, the role of capabilities have been in central role, and the impact of IC to value creation in organizations has been brought up, even though otherwise IC is such a multifaceted topic that there is no exact agreement on its definition (Secundo et al. 2017; Moustaghfir and Schiuma, 2013). Generally the literature is mainly dividing the IC research into two interpretations: the conceptual and passive, categorizable and measurable assets as well as dynamic one, that is interpreting IC from process or capability perspective (Kianto et al. 2014; Edvinsson and Malone, 1997; Sullivan, 1998; Bontis, 2001; Guthrie, 2001). So, IC can also be seen rather as a managed value creation resource than just a static stock of resources (Secundo et al. 2017; Andriessen, 2005). Gaining competitive advantage requires IC management actions such as identifying, measuring, disclosing and reporting knowledge assets effectively (Secundo et al. 2017; Edvinsson 2013; Lerro et al. 2014; Lerro and Schiuma 2013; Marr et al. 2004; Secundo and Elia 2014). Furthermore, organizational IC include immaterial resources, such as human capital, social capital and structural capital (Kujansivu and Lönnqvist 2005; Secundo et al. 2017). These three are the basis for value creation in the context of Big Data (Secundo et al. 2017).

As Big Data can be identified as big amounts of structured and unstructured data in-coming and out-going of the organizational ecosystem, where the dimensions of Big

Data, volume, velocity and variety are being the backbone of IC model shown on the Figure 2. In this model, the role of IC is to enable continuous development of approaches, technologies and infrastructures to enable data creation in the organizational ecosystem. Thus, this requires innovative management of the IC components within the ecosystem, such as human, social and structural capital. (Secundo et al. 2017)

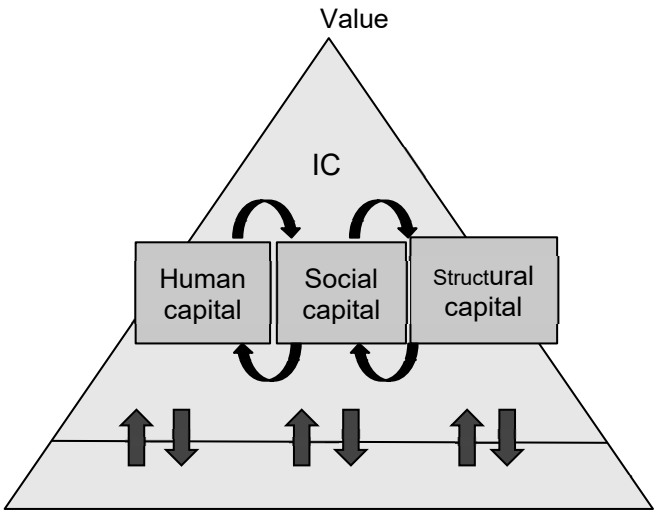

Figure 2. IC ecosystem definition through the lens of Big Data (Secundo et al. 2017).

However, creating value, is the most important aspect of IC in the context of Big Data within the organization (Secundo et al. 2017). In addition, it should clearly be part of the organizational strategy, as if are data, approaches and tools.

2.4. Value creation in the private healthcare sector

Basically there are two parallel systems in Finland for providing healthcare, the public healthcare sector and the private healthcare sector. Generally the Finnish healthcare system is strongly alike in other Nordic countries, offering range of health services delivered primarily by publicly owned and operated providers funded mainly through general taxation (Teperi et al. 2009). The healthcare sector consists of services, that are jointly provided by public and private sector, both having a pressure for intensifying healthcare services (Myllärniemi et al. 2012; Kujala et al. 2006). This has lead to the fact that the healthcare managers and clinical operational personnel, who previously have concentrated on the

clinical healthcare, have to also intensify the overall management practices for cost effectiveness (Kujala et al 2006). One of the value creation factors in many other industries, information technology, has been slow to penetrate healthcare sector (Teperi et al. 2009).

The healthcare sector is struggling to enhance its operational efficiency as well as seeking new ways to ensure efficient resource utilization while simultaneously ensuring high quality patient care, while it is widely acknowledged that BI can provide significant benefits to healthcare organizations, such as improved clinical performance, effective utilization of human resources, improved process and cost efficiency (Foshay and Kuziemsky 2014). Even though the amounts of generated data is growing, there is a potential to improve the quality of clinical performance and reduce costs. These increasing quantities of data (known as Big Data), hold the promise of supporting not only a wide range of clinical functions but also decision support (Raghupathi and Raghupathi 2014). Despite there are various ways of defining IC in the literature on healthcare, the most common definitions describe IC as a stock of knowledge that is being utilized for value creation and gaining competitive advantage (Evans et al. 2015; Bontis 2002; Subramanian and Youndt 2005).

According to Myllärniemi and Helander (2012) knowledge processes and methods, like BI, should be tightly connected to healthcare organisations' service provision and value creation. To point out the BI-tools' meaning in value creation and pointing out the Big Data potential, we use Möller et al.'s (2005) network-capability-base framework as bases of our analysis, as it is suitable also for the private healthcare sector, when modified accordingly. In the next chapters with Möller et al's framework we show, how BI-tools and their capabilities are linked to Big Data potential in value creation and show the linkage of IC in it. Through the following empirical examination we could understand the potential of data-based value creation.

3 Methods

This study was conducted by using qualitative research methods and a case study research strategy. Multiple case research strategy carried out with qualitative methods was chosen due to its suitability for studying research topics that are complex and context-dependent (Yin, 2003). Eight private healthcare sector companies were chosen for the study. These eight companies were chosen for the study to represent different sizes of

private healthcare companies operating in Finland to achieve potentially different viewpoints on BI and Big Data utilization. Usually the bigger healthcare companies are more advanced in novel approaches, such as Big Data and BI are in the Finnish healthcare sector. The inductive approach with semi-structured, thematic interviews, allowed investigating the value creation potential enabled by Big Data and BI-tools now and in the future. The qualitative research method was chosen upon others, as it provides better explanations and deeper understanding on the research topic as well as enables the adjusted questions and gather more information, which may not have been achieved, if used quantitative study (Yeoh et al. 2010; Nykänen et al. 2016). The interview questions are showing the connection of different data sources to the decision-making process.

The case companies involved in the research were having business activities in the dentalcare, socialcare and healthcare parts of the healthcare industry. Also, the locations of those companies were positioned all over the Finland. In addition, the organizations included Finnish as well as international companies, that had office in Finland. To be able to identify the relevant organizations in terms of this research, it was required to gather multiple open source documentation about the companies' background and analyzed the suitability for the research.

The research proceeded by conducting the semi-structured thematic interviews, being time intensive face-to face interviews and skype-interviews, as the interviewees were executives and high-level managers with a very tight schedule. The interviews were recorded and transcribed to enable systematically organize and analyse gathered data (McLellan et al. 2003). From the private healthcare sector the interviewees were top managers and directors, representing mainly ICT or financial organizational functions, selected to be involved in the research based on their area of responsibility for Business Intelligence within their organization. The private healthcare companies with turnover over 40 million euros per year (2015) were chosen for the study. The list of interviewees as well as their position in the organization and main responsibilities is presented in Table

1.

Table 1. The list of interviewees, their organizational position and area of responsibility

Position in the organization	**Area of responsibility**
Director, ICT	Head ICT functions
Director, Digital Services	Head of Digitalization
Head of IT	Head of ICT functions
Development Manager	Responsible for BI and development
CIO	Head of ICT functions
Head of Accounting and Reporting	Head of Controlling and BI
Director, Digitalization	Head of ICT and Digitalization
ICT Manager	Head of ICT

The interviews were performed during the period between January and March 2017. Altogether eight thematic semi-structured interviews were conducted among the private healthcare sector companies. The interview were carried out in discursive atmosphere, addressing the key themes identified from the literature concerning Big Data and BI-tools. Thus, the interviews included discussion on issues e.g. what kinds of data sources are currently being utilized, what are the challenges in utilizing current data and BI and what kinds of future visions there are for data utilization.

The transcribed interview data was analysed and classified by following content analysis method and by grouping the data under key themes. In chapter 4.1. we present our results through the identified themes. Further, in chapter 4.2. we present the key results by using Möller et al.'s (2005) framework to highlight the Big Data potential for healthcare value creation.

4 Results and implications

4.1 Current utilization of data in the private healthcare sector

All of the companies involved in this research are using more than one data source in their BI-tool or tools. The most popular scenario is to have several data sources from

operational and financial systems to be modelled in one data warehouse model and analyzed further on in several BI-tools. In addition, most of the companies were using more than one BI-tool, from one to four BI-tools each, for various reasons (Ratia and Myllärniemi 2017). Also, digital channels were mentioned as one of the data sources. Multiple sources of structural capital include structured data that is being utilized in creating value.

The second question was related, to the challenges they have had in terms of data utilization and BI. The most remarkable challenges and risks are considered to be quality of the data and rapidly changing organization, not leaving time to adapt the data requirements nor BI-tools to the organizational changes. As one of the interviewees is stating: "Definitely the biggest challenge is the quality of the data". As the operational systems are not all structured, there applies the principle of "garbage in, garbage out". As interviewee stated: "We are trying to influence on the input side, by instructing our personnel". Whenever the input data is inserted into the operational system incorrectly or insufficiently, the same also appears on the output, on the end-report or -analysis. Especially, when several different data sources are being used, data quality has a significant effect in the total quality of reporting. Some of the organizations studied, have grown through multiple takeovers, so, that there are multiple operational and financial systems to be integrated and taken into consideration in the reporting. In addition, some other challenges were mentioned as well, such as internal and external capabilities. Lack of human capital is a relevant problem, that is weakening the efficient utilization of data. Having not enough of internal capabilities is slowing down the development and progressing. Also interpretation of data is seeing as one challenge: "We have so many data sources, where the same term is meaning totally different in another system". This is causing additional inconvenience.

The third question was what kinds of future vision they have for utilizing data sources. Implementation of new BI-tool was seen as one of main goals for the nearest future to be able to utilize better the existing data sources. Next, aim is to combine the existing data with external data sources, developing potential for new products and services and thus value creation. The increasing amount of data sources provides also significantly better insight to the data-driven decision making. Another important approach to future needs was seen to be utilizing machine learning opportunities and operating with predictive analytics. Consequently, creating new business opportunities, enhance the decision-making, and as a

result, also creating value. Data-driven decision-making is the direction organizations are strongly heading towards to, leading to the culture of data-driven value creation (Ratia and Myllärniemi 2017). In addition, the aim is to create internal capabilities, or enhance human capital, to enable efficient future data processing.

4.2 Big Data potential in future data utilization

The requirements towards private healthcare data processing are growing rapidly. Thus, also the amounts of data or volume is growing, setting challenges also to the speed of generating and processing the data, or the velocity of the data. Veracity, or importance of quality of data is one of the key factors, as only clean data can bring value to the organization. Fast data generation and processing also enables proactive and predictive business management, or as one of the interviewees is stating: "Our next step in this development, is proactivity!" Collecting data from various internal and external sources is seeing to be the key of Big Data potential: "Without doubt we are in a need to combine various new data sources, not just our own internal operative data, but also to utilize external open source data with an intend to get deeper analysis of trends. The aim is not only to serve our internal needs, from production management point of view, but also to create new data for our customers. Both, to the corporations in general and to individuals, regarding their personal health." This kind of utilization of Big Data potential is creating value both to the organization, creating new business opportunities, enhancing performance and bringing value also to its owners, but also to a single customer, enhancing customer service to the next level: "We want to give a single individual, an opportunity, to follow the correlations, for example, between his or her physical activity and our patient records".

The Big Data potential has been clearly identified, but it is yet unclear, where are the limitations in terms of legislation in data processing: "We have lots of future development ideas in terms of data. The private healthcare as an industry is very favourable in the knowledge management discussion, as everything we do, is generated, processed and stored in the systems. As almost all ends up in systems, we can process everything and anything into something". "The legislation is a bit tight, on how we are allowed to mix and process data". Machine learning is one of the perspectives to the Big Data potential: "We are starting to consider utilization of Machine Learning, as it might have a huge potential in

it". Also the faith in data-driven value creation and data-centric organizations is strong: "I strongly believe, that it is becoming the center of the business. Advanced data processing and its potential will be opening new business opportunities, that have been impossible before". The core business is believed to move more and more towards data and its processing: "There will be new data-driven business concepts, around which the whole business will be built up". This is showing that Big Data related value creation will be the future trend and the direction, that the private healthcare companies are heading towards.

4.3 IC and value creation in the private healthcare sector in Finland

The three levels of value creation in the private healthcare sector in Finland are being illustrated in the following Figure 3. The very first level requires efficient service production and delivery of services and products as well as process excellence and flexibility. In the conducted study, it appears, that operational efficiency, performance excellence and data-driven decision-making are the drivers in utilization of BI-tools and creating value. The BI-tools are not seen valuable as such, but a tool helping to reducing costs and improving performance as well as when moving to the next level of value creation, enabling the Big Data potential. Therefore, meaning better operational and strategic decisions, improving data availability for further consumption and validating the decision-making.

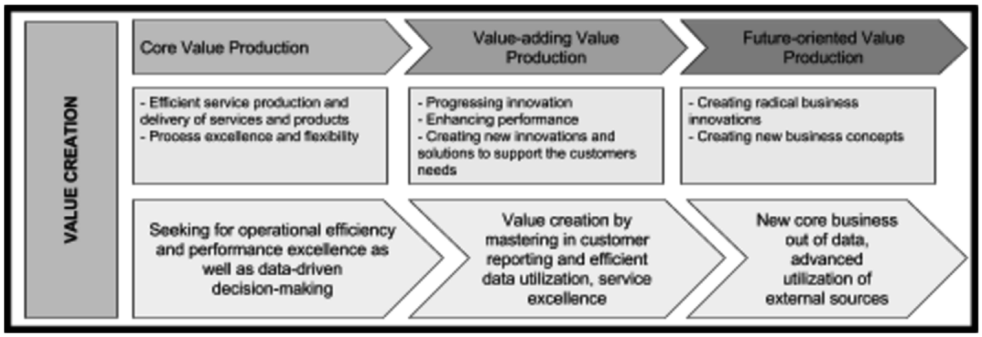

Figure 3. Data based value creation (based on Möller et al. 2005; Ratia and Myllärinemi 2017)

The next level is to move towards value-adding value production. In the context of private healthcare, its characteristics are progressing innovation, enhancing performance as

well as creating new innovations and solutions supporting the customer needs, utilizing data processing. In this research, the majority of the companies were mastering in customer reporting and half of the companies strongly felt, that the significance of customer reporting will be growing, believing to become a competitive advantage in the nearest future. As the competition is increasing in the private healthcare sector in Finland, there is also pressure to be able to perform better customer service and enhance customer satisfaction. IC, i.e. social capital, is playing a major role in the value creation.

The third level of value creation is highly future-oriented, creating the Big Data potential and value creation. This level is including creation of radical innovations and new business concept opportunities enabled by utilization of Big Data potential. Thus, creating completely new core business out of data and analytics as well as utilize multiple external sources for new data creation. In addition, achieve good capabilities of utilizing Machine Learning and Artificial Intelligence. Ability to explore and exploit also the possibilities of predictive analytics utilizing multiple external sources combined. Creating value not only through the original business concept and utilizing the existing data sources, but also proactively seeking for new opportunities to grow their business with Big Data potential. IC is the value creating factor on that level of value creation.

Also, components of IC ecosystem model can be seen as as a part of value creation levels. As shown in table 2., the value creation level and capital utilized in value creation are being tightly connected to the drivers and components used in the process to achieve the goal of the value creation level (Ratia and Myllärniemi 2017; Secundo et al. 2017). All three value creation levels require capital resources as well as the drivers and components to achieve the goal.

Table 2. Value creation levels in IC ecosystem (modified Ratia and Myllärniemi 2017; Secundo et al. 2017).

Value Level	**Capital**	**Driver**	**Components**	**Goal**
Core Value Production	Human capital - Capability of BI-tool utilization in	- Enhanced service production and delivery of services and products to internal use	BI-tool utilization	Operational efficiency and performance excellence as well as data-driven

	decision-making	- Process excellence and flexibility		decision-making
Value-Adding Value Production	Human capital - BI-tool capabilities with the organization - combining different data sources Social capital - Ascended customer demands	- Progressing innovation - Enhancing performance - Creating new innovations and solutions to support the customers needs	BI-tool utilization	Value creation by mastering in customer reporting and efficient data utilization, service excellence
Future-oriented Value Production	Structural capital -Advanced BI-tools and processes for Big Data processing Human capital - Internal and external capabilities enabling the Big Data utilization	- Creating new radical business innovations - Creating new business concepts	BI-tool utilization Big Data utilization	New core business out of data, advanced utilization of external sources

Each level of value production is requiring one or several capitals and components to achieve the goal. When moving from lower lever to the upper, the required capitals and components are also increasing.

As a summary, the value creation, utilizing data and Big Data potential in the private healthcare sector, can be considered multidimensional. By studying the value creation concept, we can identify the three levels of value creation, as a result of utilizing different data sources, using BI-tools and utilizing Big Data potential (Möller et al. 2005; Ratia and Myllärniemi 2017). In this study, the core value production represents seeking for better operational efficiency, performance excellence as well as data-driven decision-making. When moving to the next level, value-adding value production explains mastering

in customer reporting and better utilization of data sources as value creating components. Thus, IC model components are being partially involved. Furthermore, future-oriented value production consists of developing new businesses by creating new data-driven business concepts and products. The value creation is being generated by efficient utilization of various internal and external data sources, thus, being one of the key factors, when building competitive advantage on the private healthcare sector. The most significant elements in value creation in the private healthcare sector can be considered to be the utilization of Big Data potential. Consequently, creating new services and products as well as making new innovations out of newly created data, that has been generated from multiple data sources. In addition, the last value creation level is heavily consisting of IC model components.

5 Conclusions and discussion

This paper introduces a fairly novel empirically focused approach to discussion of the utilization of different data sources in value creation in the private healthcare sector in Finland. Healthcare is facing changes and challenges all over the world and pressure for improvements is significant, both on the private and public sector (Myllärniemi 2013; Ratia and Myllärniemi 2017). Utilization of BI-tools in terms of data-driven value creation can be seen as one of the "efficient-choice" rationales (Nykänen et al. 2016; Malmi 1999). We analyzed the value creation activities and processes, through the concept model of value creation, to achieve better understanding of the key factors in each level of value creation and the to be able to identify the elements of Big Data potential. (Myllärniemi and Helander 2012; Möller et al. 2005). We also utilized the IC ecosystem framework to identify the IC components on the value creation levels (Secundo et al. 2017).

The research showed, that the primary existing data sources were spread into several locations in operational and financial systems. In addition, most of the private healthcare organizations used more than one BI-tool (Ratia and Myllärniemi 2017). The most significant challenges in data utilization and using BI-tools were considered to be, quality of data and inability to adapt data sources and BI-tools quickly to rapid organizational changes and lack of internal and external capabilities. The future vision for data sources and utilization was, to implement new unified BI-tool to be able to utilize existing data more

efficiently, to combine the existing data with external data sources and developing potential for new products and services and thus value creation. The identification of levels of value creation in data-driven value creation process can help us to identify the crucial factors in the context of data and Big Data potential utilization in the private healthcare sector. Also, we are better able to identify the IC related components from the value creation levels.

Based on the conducted analyses, some managerial implications for the private healthcare organizations can be drawn. First, more advanced utilization of existing data sources can be a driver towards enhancing performance and new innovations. Second, the utilization of Big Data potential could bring additional value to the private healthcare by opening new business opportunities. Third, to ensure the role of IC in the value creation process of the private healthcare sector, organizations should focus on better utilization of BI tools.

The practical outcome of this research will provide insight into the future-oriented Big Data potential, that can create new business concepts for the private healthcare companies. Advanced capability of data and Big Data potential utilization would increase the ability of value creation in the private healthcare sector companies. However, in order to get more specific view on this issue, we need to gather more empirical data from the private healthcare organizations, the supplying side, the information technology companies providing BI-tools as well as the consulting companies helping in the concepting of data utilization. In addition, we need to study the criteria for BI-tool selection, to be able to point out specific tool requirements and functional features that are essential for the private healthcare sector, to gain deeper understanding of those IC components that are having the biggest impact on value creation (Brandão et al. 2016; Chen et al. 2012). Another interesting future research avenue would be the use of Big Data and sophisticated analysis tools in supporting the daily work of the clinicians. This research topic would, however, call a true interdisciplinary research cooperation in order to be successful.

References

Andriessen, D. (2005). Implementing the KPMG value explorer: critical success factors for applying IC measurement tools. Journal of Intellectual Capital, Vol. 6 No. 4, pp. 474-488.

Bates, D., Saria, S., Ohno-Machado, L., Shah, A., Escobar, G. (2014). Big Data In Health Care: Using Analytics To Identify And Manage High-Risk And High-Cost Patients. Health Affairs 33.7, Jul 2014, pp.1123-31

Bontis N. (2002). Managing organizational knowledge by diagnosing intellectual capital: Framing and advancing the state of the field. The Strategic Management of Intellectual Capital & Organizational Knowledge. NY: Oxford: University Press; 2002.

Brandão, A., Pereira, E., Esteves, M., Portela, F., Santos, M. F., Abelha, A. and Machado, J. (2016). A Benchmarking Analysis of Open-Source Business Intelligence Tools in Healthcare Environments. Information, 7(4), pp.57

Bontis, N. (2001). Assessing knowledge assets: a review of the models used to measure intellectual capital. International Journal of Management Reviews, Vol. 3 No. 1. pp. 63-76.

Cases, M., Furlong, L., Albanell, J., Altman, R. B., Bellazzi, R., Boyer, S., Brand, A., Brookes, A. J., Brunak, S., Clark, T. W., Gea, J., Ghazal, P., Graf, Guigó, R., Klein, T. E., López-Bigas, Maojo, Mons, B., Musen, M. and Oliveira, J. L. (2013). Improving data and knowledge management to better integrate health care and research. Journal of Internal Medicine. Oct 2013, Vol.274 Issue 4, pp.321-328

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. MIS Quarterly, 36(4), pp. 1165–1188.

Côrte-Real, N., Ruivo, P. and Oliveira, T. (2014). The diffusion stages of business intelligence & analytics (BI&A): A systematic mapping study. Procedia Technology. Vol.16, pp.172–179

Cox, M., Ellsworth, D. (1997). Application-controlled demand paging for out-of-core visualization. Proceedings of the 8th conference on Visualization '97 pp. 235–ff

Davenport, T. (2014). Big data at work: dispelling the myths, uncovering the opportunities. Harvard Business Review Press.

Dehning, B., Richardson, V.J. and Zmud, R.W. (2003). The value relevance of announcements of transformational information technology investments. MisQuarterly 27, pp. 637–656.

De Mauro, A., Greco, M. and Grimaldi, M. (2016). A Formal Definition of Big Data Based on its Essential Features. Library Review, Vol. 65 Iss: 3, pp.122 – 135

Demirkan H. 2013. A Smart Healthcare Systems Framework. IT Professional. Sept/Oct 2013. Vol.15, Issue 5, pp.38-45

Dragland, A. (2013). Big Data - for better or worse. [Online] Available from: https://www.sciencedaily.com/releases/2013/05/130522085217.htm [Accessed: 10th August 2017]

Easterby-Smith, M., Lyles, M. A., and Tsang, E. W. (2008). Inter-organizational knowledge transfer: Current themes and future prospects. Journal of Management Studies, Vol. 45 No. 4, pp. 677-690.

Easton, G. (1992), Industrial networks: a review, in Axelsson, B. and Easton, G. (Eds.) Industrial Networks: A New View of Reality, Routledge, London, pp. 3-34.

Edvinsson, L. (2013). IC 21: reflections from 21 years of IC practice and theory. Journal of Intellectual Capital, Vol. 14 No. 1. pp. 163-172.

Edvinsson, L. and Malone, M. (1997). Intellectual Capital: Realising Your Company's True Value by Finding its Hidden Brainpower, Harper Collins, New York, NY.

Elbashir M., Collier P., Sutton S., Davern M. and Leech S. (2013). Enhancing the Business Value of Business Intelligence: The Role of Shared Knowledge and Assimilation. Journal of Information Systems. Vol.27, No. 2. Fall 2013, pp.87–105

Fosso Wamba, S., Akter, S., Edwards, A., Chopin, G., and Gnanzou, D. (2015). How 'Big Data' Can Make Big Impact: Findings from a Systematic Review and a Longitudinal Case Study. International Journal of Production Economics.

Gandomi, A. and Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics.

International Journal of Information Management 35 (2015) pp. 137–144

Gilad, B. and Gilad T. (1985). A systems Approach to Business Intelligence. Business Horizons. Vol.28, No. 5, pp.65-70

Grierson, H.J., Corney, J.R. and Hathcher, G.D. (2015). Using visual representations for the searching and browsing of large, complex, multimedia data sets. International Journal of Information Management 35 (2015) pp. 244–252

Gulati, R., Nohria, N. and Zaheer, A. (2000), 'Strategic networks, Strategic Management Journal, Vol. 21 No. 3, pp. 203-15.

Guthrie, J. (2001). The management, measurement and the reporting of intellectual capital. Journal of Intellectual Capital, Vol. 2 No. 1. pp. 27-41.

Hagen, H.-O. and Hagsten, E. (2006), "Därför behöver produktiviteten i den offentliga sektorn mätas". Rapport till Expertgruppen för Studier i Samhällsekonomi 2006:2, Fritzes, Stockholm.

Hugos, M.H. and Hulitzky, D. (2011). Business in the Cloud: What Every Business Needs to Know About Cloud Computing. John Wiley & Sons, Inc.

Håkansson, H. and Snehota, I. (1989), No Business is an Island. The Network Concept of Business Strategy, Scandinavian Journal of Management, Vol. 4 No. 3, pp. 187-200.

Jinpon P., Jaroensutasinee M. and Jaroensutasinee K. (2011). Business Intelligence and its Applications in the Public Healthcare System. Walailak Journal of Science and Technology (WJST). 2011. Vol 8, Issue 2, pp.97-110

Katal, A., Wazid, M. and Goudar, R.H. (2013). Big data: Issues, challenges, tools and Good practices. Proceedings of Sixth International Conference on Contemporary Computing (IC3) 2013. pp. 404-409

Katsaliaki, K. and Mustafee N. (2011). Applications of simulation within the healthcare context. Journal of the Operational Research Society. Aug 2011, Vol.62, Issue 8, pp.1431–1451

Kianto, A., Ritala, P., Spender, J-C. and Vanhala M. (2014). The interaction of intellectual capital assets and knowledge management practices in organizational value creation. Journal of Intellectual Capital, Vol. 15 Issue: 3, pp.362-375

Krumholz, H.M. (2014). Big Data And New Knowledge In Medicine: The Thinking, Training And Tools Needed For A Learning Health System. Health Affairs 33.7. Jul 2014. pp.1163-70

Kujala, J., Lillrank, P., Kronström, V. and Peltokorpi, A. (2006) Time-based management of patient processes. Journal of Health, Organisation and Management, Vol. 20, pp.512-524.

Kujansuu, P. and Lönnqvist, A. (2005). How Do Investments in Intellectual Capital Create Profits? FeBR 2005 Frontiers of e-Business Research 2005. pp. 304-319.

Kwon, O., Lee, N., & Shin, B. (2014). Data quality management, data usage experience and acquisition intention of big data analytics. International Journal of Information Management, 34(3), pp. 387–394.

Laney, D. (2001). 3D data management: Controlling data volume, velocity and variety. META Group Research Note 6, pp. 70.

Lapierre, J. (2000). Customer-perceived value in industrial contexts, Journal of Business & Industrial Marketing 2/3, pp.122-145.

Lerro, A. and Schiuma, G. (2013). Intellectual capital assessment practices: overview and managerial implications. Journal of Intellectual Capital, Vol. 14 No. 3. pp. 352-359.

Lerro, A., Linzalone, R. and Schiuma, G. (2014), Managing intellectual capital dimensions for organizational value creation. Journal of Intellectual Capital, Vol. 15 No. 3. pp. 350-361.

Lönnqvist, A. and Pirttimäki, V. (2006). The measurement of business intelligence. Information Systems Management , Vol.23, 2006. Issue 1, pp.32-40

Malmi, T. (1999). Activity-based costing diffusion across organizations: an exploratory empirical analysis of Finnish firms. Accounting, Organizations and Society. Vol.24, pp.649–672

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A.H. (2011). Big

data: The next frontier for innovation, competition, and productivity. McKinsey Global Institute.

Marr, B., Schiuma, G. and Neely, A. (2004). The dynamics of value creation: mapping your intellectual performance drivers. Journal of Intellectual Capital, Vol. 5 No. 2. pp. 312-325.

McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D. and Barton, D. (2012). Big data: The Management Revolution. Harvard Business Review 90, pp. 61–67.

McLellan, E., MacQueen, K. M. and Neidig, J L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. Sage Journals, Feb 2003, pp.63-84

Moustaghfir, K. and Schiuma, G. (2013). Knowledge, learning and innovation: research and perspectives. Journal of Knowledge Management, Vol. 17 No. 4. pp. 495-510.

Myllärniemi, J. and Helander, N. (2012). Healthcare System as a Value Network. World Review of Entrepreneurship, Management and Sustainable Development. 2012, Vol.8, Issue 2.

Myllärniemi, J., Okkonen, J., Paavilainen, J., & Vuori, V. (2012). Negative competition steering patient flow in a public-private healthcare co-opetition setting–a Finnish case. World Review of Entrepreneurship, Management and Sustainable Development, 8(2), pp. 208-220.

Myllärniemi, J. (2013). Knowledge processes in healthcare network - a case study. 8th International Forum on Knowledge Asset Dynamics, IFKAD 2013, 12.-14.6.2013, Zagreb, Croatia. Zagreb, Croatia: Institute of Knowledge Asset Management, pp.1223-1236

Möller, K., Rajala, A. and Svahn, S., (2005). Strategic business nets—their type and management. Journal of Business Research. Vol.58, Issue 9, Sep 2005, pp.1274–1284

Nordgren, L. (2009). Value creation in health care services – developing service productivity. Experiences from Sweden. International Journal of Public Sector Management Vol.22 No. 2, 2009 pp.114-127

Nykänen, E., Järvenpää, M., and Teittinen, H. (2016). Business intelligence in decision making in Finnish enterprises. Nordic Journal of Business, 65 (2), pp.24-44.

Ojala, A. and Helander, N. (2014). Value Creation and Evolution of a Value Network: A Longitudinal Case Study on a Platform-as-a-Service Provider. System Sciences (HICSS), 2014 47th Hawaii International Conference on, Issue Date: 6-9 Jan. 2014.

Parolini, C. (1999). The Value Net. A Tool for Competitive Strategy, John Wiley & Sons Ltd: Great Britain.

Pirttimäki, V. (2006). Business Intelligence as a Managerial Tool in Large Finnish Companies. Tampere University of Technology. Publication 646. Doctoral thesis. Tampere, Finland.

Raghupathi, W. and Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. Health information science and systems, 2:3.

Provost, F. and Fawcett T. (2013). Data Science and Its Relationship To Big Data and Data-driven Decision Making. Big Data. February 2013, 1(1): pp. 51-59.

Ratia, M. and Myllärniemi, J. (2017). Business Intelligence Tools for Private Healthcare Data-Driven Value Creation. Proceedings IFKAD 2017. St. Petersburg, Russia, 7-9 June 2017. pp. 408-419.

Schmarzo, B. (2013). Big Data: Understanding how data powers big business. John Wiley & Sons.

Secundo, G. and Elia, G. (2014). A performance measurement systems for academic entrepreneurship. Measuring Business Excellence, Vol. 18 No. 3. pp. 23-37.

Secundo, G., Del Vecchio, P., Dumay, J. and Passiante, G. (2017). Intellectual capital in the age of Big Data: establishing a research agenda. Journal of Intellectual Capital, Vol. 18 Issue: 2. pp. 242-261.

Spruit, M., Vroon, R. and Batenburg, R. (2014). Towards healthcare business intelligence in long-term care. An explorative case study in the Netherlands. Computers in Human Behavior, 2014. Vol.30 pp.698–707.

Subramanian, M. and Youndt, M. (2005). The influence of intellectual capital on the types of innovative capabilities. Acad Manage J. 2005;48 (3) : pp. 450–463.

Sullivan, P. (1998). Profiting from Intellectual Capital: Extracting Value from Innovation, Wiley, New

York, NY.

Suomi, R. and Tähkäpää, J. (2002). The Strategic Role of ICT in the Competition Between Public and Private Health Care Sectors in the Nordic Welfare Societies - Case Finland. Proceedings of the 35th Hawaii International Conference on System Sciences - 2002

Stewart, R. and Davis K. (2016). 'Big data' in mental health research: current status and emerging possibilities. Social Psychiatry and Psychiatric Epidemiology. Aug2016, Vol.51, Issue 8, pp.1055–1072

Swanson, R. C., Cattaneo, A., Bradley, E., Chunharas, S., Atun, R., Abbas, K. M., Katsaliaki, K., Mustafee, N., Meier, B. M. and Best, A. (2012). Rethinking health systems strengthening: key systems thinking tools and strategies for transformational change. Oxford Journals. Medicine & Health. Health Policy and Planning Vol.27, 2012. Issue supply 4. pp. iv54-iv61.

Teperi, J., Porter, M.E., Vuorenkoski, L. and Baron, J.F. (2009) The Finnish Health Care System: A Value-Based Perspective, Sitra Reports 82, Helsinki, Finland.

Turban, E., Aronson, J. E., Liang, T-P. and Sharda, R. (2008): Business intelligence: a managerial approach. Pearson Prentice Hall, New Jersey.

Wullianallur, R. and Viju R., (2014). Big data analytics in healthcare: promise and potential. Health Information Science and Systems. 2014, 2:3.

Yeoh, W. and Koronios A. (2010). Critical success factors for business intelligence systems. Journal of computer information systems, Spring 2010, pp.23-32

Yin, R.K. (2003). Case Study Research: Design and Methods. 3rd ed., Sage, Thousand Oaks.

Ylijoki, O. and Porras, J. (2016). Perspectives to Definition of Big Data: A Mapping Study and Discussion. Journal of Innovation Management JIM 4, 1 (2016). pp. 69-91

PUBLICATION III

Robotic Process Automation – Creating Value by Digitalizing Work in the Private Healthcare

Ratia, M., Myllärniemi, J. and Helander, N.

Proceedings of the 22nd International Academic Mindtrek Conference. ACM. Tampere, Finland. October 10–11, 2018. pp. 222-227.

Robotic Process Automation - Creating Value by Digitalizing Work in the Private Healthcare?

Full Paper

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ABSTRACT

Organizations are applying digitalization to the constantly increasing amounts of different organizational processes [2]. The healthcare sector is also changing and actively seeking better ways to enhance performance, especially in the private healthcare sector [7]. Automation of workflow processes, e.g., Robotic Process Automation (RPA), in organizations has been emerging as a solution to this demand [3, 4]. To meet this clear demand, automation of workflow processes in organizations has been a rising trend during the past few years [3]. We analyze the value creating functions of the RPA potential in the private healthcare industry sector, using modified Walter et al.'s function-oriented value analysis as our theoretical lens for identifying the potential of RPA.

KEYWORDS

Healthcare, digitalization of knowledge work, Robotic Process Automation, value creation

 ACM ISBN 978-1-4503-6589-5/18/10…$15.00
https://doi.org/10.1145/3275116.3275129

1 INTRODUCTION

The growing amount of organizational data has posed a challenge to its processing recently, also requiring increasing organizational resources to be able to perform the required processes efficiently [1]. Organizations are applying digitalization to constantly growing amounts of different organizational processes [2]. The automation of workflow processes, e.g., Robotic Process Automation (RPA), has been emerging in organizations as a solution to this demand [3, 4]. Robotic Process Automation (RPA) is an automation process that uses software and algorithms to automate the employer's operations and can be used instead of a human resource in performing a specific process [4, 5, 6, 2, 28]. Utilization of RPA is justifiable, when using human resources is either too expensive, inefficient, or when the amounts of data to be processed are enormous [4]. The healthcare sector is also changing and actively seeking better ways to enhance performance, especially in the private healthcare sector [7].

The aim of this paper is to study the potential of RPA-based organizational performance enhancement and thus, value creation through knowledge work digitalization in the private healthcare business industry. We are especially interested in analyzing what are the types of organizational work processes that can be digitalized with RPA in the private healthcare.

This study gathers together the potential of RPA-based organizational performance enhancement and thus, value creation through knowledge work digitalization in the private healthcare business industry. The potential of RPA in enhancing operational excellence can be a very important aspect of the digitalization of knowledge work in the private healthcare, but there are few previous studies that have looked at this issue. By analyzing the opportunities enabled by RPA in the private healthcare industry sector, the research brings a significant novel value for private healthcare sector companies, specifying the opportunities enabled by RPA. There are two practical outcomes of this research. The first outcome of this

study will provide valuable information on the potential of RPA in work digitalization in the private healthcare sector. Digitalization of work would increase the ability to create value in private healthcare sector companies. As a result, the second outcome of this study will provide the ability of the private healthcare companies to adopt the potential of RPA enhanced processes to improve organizational performance. In addition, this will show the RPA-enabled potential of the digitalization of knowledge work processes in the private healthcare sector, and consequently aim for performance excellence.

In the second chapter the aim is to show the conceptual basis for value creation and introduce the concept of RPA. Chapter 3 presents the empirical setting, introducing the methodology and empirical material. Chapter 4 deals with the potential of RPA within the Finnish private healthcare sector. Finally, in chapter 5, the paper ends with conclusions and discussion.

2 CAN BUSINESS PROCESS AUTOMATION CREATE VALUE?

2.1 Robotic process automation - buzzword or digital opportunity?

The software-based business and workflow process automation in organizations have been an emerging trend during the past few years [3]. The existing literature describes RPA as a combination of method, system, and tool, including computer software, to automate manual organizational processes [16, 17]. Robotic Process Automation (RPA) is a technology used in an automation process, which is based on software and algorithms to automate or copy employees' actions in the digital process and can be used instead of a human resource in performing a specific digital process. Software robots, robots, or digital workers are also being used to underline the purpose of digitalizing the automation process [4, 5, 6, 28].

When the process is digital, routine, and requires a lot of human resources, utilization of RPA is justifiable and also when using human resources is either too expensive, inefficient, or the amounts of data to be processed are enormous [4]. Organizations are seeking effective solutions that can improve the quality of deliverables, enhance efficiency, help them to meet compliance requirements, make them more agile, and improve customer experience. RPA can be seen as a potential digital enabler [18]. As there is still a lot of routine work in organizations, it is clear that, as a technology, RPA is found very interesting by executives, especially in industries with a lot of manual work and expensive labor, such as the private healthcare sector in Finland.

The suggested value of RPA is mainly created by increasing efficiency in the organization, by reducing human labor in routine business processes, and also by increasing the quality of the work, e.g., fewer mistakes and good scalability [18]. Increasing the productivity and reducing costs seem to be the driver for RPA utilization [16]. To sum up, RPA clearly impacts on the work carried out in organizations. The promised increase in work productivity by RPA [18] does not, however, have only a positive impact within organizations, as this kind of digital transformation is always a socio-technical phenomenon that affects the personnel in many ways. It is necessary for organizations applying RPA to provide support for their employees who face technology disruption [16]. Furthermore, it is as yet unclear what the value of RPA will be in the long term. In addition, it is necessary to gather more knowledge about RPA practices and activities in general and also in particular about those that healthcare organizations could utilize, to be able to create value for the companies and their stakeholders.

2.2 The concept of value creation

The concepts of value, value creation, and value capture, are often referred to in business discussions. Moreover, it is important to understand the elements included in the concept of value [8]. However, if the concept is taken with a broad enough perspective, value can be considered in terms of a trade-off between benefits and sacrifices [9, 10, 11, 8]. These trade-offs can be seen in monetary terms, such as productivity and resource utilization, but also include non-monetary, or secondary functions, such as competence, market position, social rewards, time, effort, and energy [12, 8, 13, 14, 15].

To highlight the potential of RPA in value creation, we use Walter et al.'s [12] function-oriented value analysis, modified by Myllärniemi and Helander's approach [13] as the basis of our analysis. However, Walter et al.'s [12] model offers us a view on the types of activities that could be performed by healthcare companies, in relation to RPA, to be able to create more value not only for themselves but also for their stakeholders. The model introduces direct and indirect value functions that enable measurement of the created value in private healthcare. In this case, value brought by direct functions is easier to measure financially, whereas indirect functions require the input of the healthcare organization's external sources, and the outcomes cannot be directly measured financially. Nevertheless, the direct or monetary functions are known as profit, volume, and safeguard functions. Furthermore, the indirect value creation functions are innovation, market, scout, and access. However, this model helps us to understand the measurement examples and functions that create value in the private healthcare sector, rather than being an absolute and exhaustive list of value-creating functions.

3 METHODS

The aim of this paper is to study the potential of RPA-based organizational performance enhancement and thus, value

creation through knowledge work digitalization in the private healthcare business industry. The research has been conducted by focusing on an interest group, the RPA consulting companies, more specifically on RPA consultants.

The interest group was selected based on the results of previous research, which focused on business intelligence (BI) utilization and data-driven value creation. Among other data-driven approaches, RPA was raised as a value-adding opportunity for enhancing organizational performance in private healthcare. As the opportunities enabled by RPA have not been studied previously in private healthcare organizations, the research focuses on examining the opportunities rather than being an absolute statement of the impacts of RPA on organizational performance. By studying the interest group of RPA consultants, we reveal the discourse on RPA-enabled potential in enhancing performance in private healthcare organizations.

However, in terms of research design, there were several decisions to be carefully considered, such as e.g., who to interview, how many consultants to interview, and how many interviews to conduct [29, 30]. The study was conducted as qualitative research with a case study research strategy. The multiple case research strategy we used, executed with qualitative methods, is suitable for studying complex and context-dependent research topics [20]. In this research, eight RPA consultants were chosen for the study. The RPA consultants under study represented multiple different sizes of RPA consulting organizations operating in Finland. The inductive approach with semi-structured, thematic interviews, allowed us to investigate the potential enabled by RPA. The qualitative research method was chosen over other research methods, as it provides better explanations and deeper understanding on the research questions, also enabling adjusted questions and gathering of more information, than if a quantitative study were used [21, 22].

In addition, the semi-structured interview approach is flexible and allows information gathering to be conducted effectively and conveniently [23]. The semi-structured interview involved questions prepared in advance and was guided systematically by identified themes, enabling the conversation to be directed toward the researched topics and issues, also enabling the disclosure of important and sometimes hidden facets of human and organizational behavior [29]. In addition, it is flexible and the most effective and convenient means of gathering information [29, 31].

The case organizations from the technology consulting sector, were located all over Finland, and had business operations at least in RPA, with some also in BI. Moreover, the organizations involved in the study included both Finnish and international companies with an office in Finland. The semi-structured thematic interviews were conducted as Skype interviews and phone interviews. The interview discussions were recorded and transcribed to be able to systematically organize and analyze gathered data [24]. The interviewees were technology consultants, mostly representing the RPA functions of their organizations, and were chosen as their area of responsibility within their organization was RPA. The list of interviewees, as well as their role, is given in Table 1.

Table 1. The list of interviewees and their roles within the organization

Interviewee	Role
1	Consultant
2	Consultant
3	Consultant
4	Manager
5	Consultant
6	Consultant
7	Director
8	Consultant

The interviews with representatives of private healthcare organizations were conducted during spring 2018. The types of questions included introducing questions, follow-up and probing questions, as well as specific direct and indirect questions [29]. However, background-related questions were not specified, to ensure the anonymity of the interviewees. The interviews were carried out in a discursive atmosphere, including discussion on issues such as what RPA is, what benefits and value it brings to private healthcare, what kinds of organizational processes can be automated, and what the biggest challenges of RPA consist of.

In chapter 4.1. we present our results by answering the interview themes, based on the first round of analysis. In chapter 4.2. we analyze the result with Walter et al.'s [12] framework, based on the second round of analysis.

4 RESULTS AND IMPLICATIONS

4.1 RPA enabling focus on value creation

The primary objective of this paper is to study the potential of RPA-based organizational performance enhancement and thus value creation through knowledge work digitalization in the private healthcare business industry. The RPA consultants raised two RPA perspectives, the technological and the process perspectives. From the technological perspective, the description was quite similar to the literature's approach and focused on the software side [e.g., 4, 5, 6, 28]. In addition, there was another perspective, focusing more on the process side, where the technology was not as relevant as the process and the workflow that RPA was copying. However, the descriptions were not exclusive but rather complementary. Nevertheless, the benefits and value of RPA were considered multilateral. Also here, the majority of the interviewees pointed out the same as is stated in the literature: RPA increases efficiency in the organization by reducing human labor in routine business processes. Also, the quality of the work, such as fewer mistakes and good scalability, were mentioned. Another interesting approach was that when the administrative routine and manual work can be outsourced by means of RPA to a software robot, the clinical staff, doctors, and nurses can concentrate more on the interaction with the patient and thus create value for the customer. RPA is also a highly scalable system and easy to implement in technical terms, as it does not require integration etc., but operates on top of existing software.

All of the interviewees agreed unanimously that almost any of the digitally performed organizational processes could be outsourced for implementation with RPA. The interviewees could not think of a single process that could not be enhanced by RPA. However, there are still risks and challenges in RPA utilization. If the process has errors when performed manually and the same process is automated without correcting the mistakes in the process, the RPA technology will continue generating the mistakes. Furthermore, the flaws may be even more significant, as RPA performs everything more efficiently. Therefore, the workflow process must be built correctly to avoid mistakes in the automated process. As RPA is very scalable, the mistakes are also very scalable. Therefore it is crucial that the automation process is built in cooperation with those who know the process properly. Utilization of RPA also requires capabilities within the organization, not only in ICT functions, but also dedicated business users.

4.2 Potential of RPA in value creation in private healthcare

However, we need more knowledge about RPA practices and activities that healthcare organizations could utilize, in order to create value for them and their stakeholders. In the next table we represent what value could be achieved by using RPA. The modifications to the measurements have been made based on earlier research on the healthcare sector [26, 19].

Table 2. Direct and indirect RPA utilization value functions and their measurement in the private healthcare sector (based on 12, 19, 26)

Value function	Description of the function	Measurement examples for private healthcare sector
DIRECT		
Profit	The financial value of efficiency	- Less manual administrative work - Less workforce needed - Expensive workforce, e.g. doctors can concentrate on value creation
Volume	Amount of tasks performed	- Scalability of work - Resource optimization between workforce and RPA - Volume of performed tasks
Safeguard	Better service level	- Better quality performance - Better customer service
INDIRECT		
Development	Refocusing to development	- Allowing to focus on development of process -Developing new ways of work
Innovation	Creating new products and services	- Creating new digital solutions and services internally and externally
Scout	External sources	- Utilization of RPA to collect information from external data sources

The kind of value that can be co-created in the private healthcare organizations utilizing RPA could be identified through function-oriented value analysis. The analysis of the value functions revealed that issues related to performance, optimization of workforce, scalability, and better quality were key when creating value through direct value functions. The main focus areas were reducing manual work, optimizing expensive resources, scaling work, and improving quality of performance.

In terms of indirect value creation, the main examples were refocusing on development and innovations as well as utilizing external sources. Nevertheless, direct value function analysis did not bring any significant novelty to the debate on process automation, as it is likely that a business organization will seek better performance and thus profit. However, through indirect value functions, private healthcare organizations could find new and innovative ways to create value. For example, the innovation function enables creation of new digital products and services, both internally and externally, creating value

through RPA utilization. This model helps us to understand the activities and functions that can create value in the private healthcare sector through RPA utilization, rather than being an absolute and exhaustive list of value-creating functions.

Some managerial implications can also be drawn based on the conducted study. First, RPA can bring significant benefits in the automation of routine business processes, such as administrative routine work, e.g., HR and finance processes and simple customer service activities. Second, the utilization of RPA can bring value by enabling clinical staff to focus more on the patient or customer, e.g., in visit records management, where inputting multiple records is outsourced to be performed using RPA and doctors and nurses have more time for the patient or customer. Third, it can create new products or services that can bring value. In addition, to ensure the role of RPA in the value creation process of the private healthcare sector, organizations should focus on understanding their business processes better. This can bring significant benefits to the organizations when properly built organizational processes are automated. As a summary, value creation utilizing RPA in the private healthcare sector can be considered multidimensional, with reservations, as it also includes risks and challenges.

5 CONCLUSIONS AND DISCUSSION

This paper introduces a fairly novel approach to the discussion of the potential of RPA-based organizational performance enhancement and thus value creation through knowledge work digitalization in the private healthcare business industry in Finland. Healthcare organizations, especially private healthcare companies, are facing changes and challenges all over the world, and are also undergoing significant pressure to improve performance and enhance their processes [26, 27]. The utilization of RPA technologies could be considered as one of the ways to improve efficiency in the organization, by reducing human labor in routine business processes, improving the quality of the work, enhancing scalability, increasing productivity, and reducing costs [18, 16]. We analyzed the potential value of RPA through Walter et al.'s (2001) framework to gain better understanding of the direct and indirect value functions in the context of private healthcare in Finland [12, 19, 26].

This research has gathered together the potential of RPA-based organizational performance enhancement and thus value creation through knowledge work digitalization in the private healthcare business industry in Finland. The potential of RPA in enhancing operational excellence can be considered an interesting opportunity in the digitalization of knowledge work in the private healthcare, e.g., by reducing cost and enhancing the financial performance of the organization [16, 18]. By analyzing the RPA-enabled opportunities in the private healthcare industry, the research brings a significant novel value for private healthcare sector companies, specifying the opportunities enabled by RPA. The literature review and empirical research both showed that there were several benefits of RPA utilization in private healthcare. In terms of direct value, the primary examples were the financial value of efficiency, such as reduction of manual administrative work and allowing medical staff to concentrate more on patient work and thus, value creation [e.g., 16, 18]. In addition to directly measurable financial value, indirect value also emerged in the empirical study. In terms of indirect value, the main examples were refocusing on development and innovations as well as utilizing external sources. Nevertheless, through indirect value functions, private healthcare organizations could find new and innovative ways to create value. For example, the innovation function enables creation of new digital products and services, both internally and externally, creating value through RPA utilization.

There are two practical outcomes of this research. The first outcome of this study is to provide valuable information as well as deep understanding of the potential of RPA in work digitalization in the private healthcare sector. Digitalization of work would increase the ability of creating value by automating repetitive and routine tasks [32]. Healthcare providers are seeking to increase the quality of their operations and reduce their costs to maximize value [33]. As a result, the second outcome of this study will provide the capability of the private healthcare companies to adopt the potential of RPA enhanced processes to improve organizational performance. In addition, this shows the RPA-enabled potential of the digitalization of knowledge work processes in the private healthcare sector, constantly seeking performance excellence.

As of evaluation of qualitative study, terms like reliability and validity do not fit, as they do in terms of quantitative study [34]. Guba [35] is suggesting a model of assessing the trustworthiness of qualitative data. This model is relying on the identification of four aspects of trustworthiness: truth value, applicability, consistency, and neutrality [35]. Truth value can be also termed as credibility, which is suggested to appear when it presents accurate descriptions or interpretation of

human experience that people who also share that experience

would immediately recognize the descriptions. When a qualitative research is presenting an accurate description or interpretation of experience that people who also share that experience would immediately recognize the descriptions [35]. Whereas applicability is referring to whether the findings can be applied to other contexts. One perspective is, that in qualitative study approach, it is not relevant to generalize the study to other research issues, but rather having a unique setting [35]. Also, in terms of consistency, where the finding are evaluated based on their replication inquiry in a similar context, in case of qualitative study, more important is to learn from the interviewees [35]. The neutrality is referring to freedom from bias in the research and interviewees as well as scientific distance of the researcher and interviewees, to be not able to influence the study [35].

However, in order to obtain a more specific view on this issue, we need to gather more empirical data from the RPA consulting organizations. In addition, further study of the private healthcare organizations' perspective is required, on different organizational levels, to be able to point out the relevance of RPA utilization in value creation process.

REFERENCES

[1] Saari, E., Käpykangas. S. and Hasu, M. (2016). The Cinderella Story - A Skilled Worker's New Chance in the Digitalization of Services. Proceedings of 26th Annual RESER Conference 2016.

[2] Lacity, M., Willcocks, L. and Craif, A. (2015a). Robotic Process Automation: Mature Capabilities in the Energy Sector. The Outsourcing Unit Working Research Paper Series. October 2015. Paper 15/06, pp. 1-19.

[3] Davenport, T.H. and Kirby, J. (2016). Just How Smart Are Smart Machines? MIT Sloan Management Review, Vol 57, No. 3., pp. 21-25.

[4] Lu, H., Li. Y., Chen, M., Kim, H. and Serikawa, S. (2017) Brain Intelligence: Go Beyond Artificial Intelligence. Mobile Networks and Applications 2017, pp 1–8.

[5] Willcocks, L., Lacity, M. and Craig, A. (2015a). The IT Function and Robotic Process Automation. The Outsourcing Unit Working Research Paper Series. October 2015. Paper 15/05 pp. 1-39.

[6] Willcocks, L., Lacity, M. and Craig, A. (2015b). Robotic Automation at Xchanging. The Outsourcing Unit Working Research Paper Series. June 2015. Paper 15/03 pp. 1-26.

[7] Ratia, M. and Myllärniemi, J. (2018). Beyond IC 4.0: The Future Potential of BI in the Private Healthcare. Proceedings IFKAD 2018. Delft, Netherlands, 4-6 July 2018, pp. 1652-1667.

[8] Ojala, A. and Helander, N. (2014). Value Creation and Evolution of a Value Network: A Longitudinal Case Study on a Platform-as-a-Service Provider. System Sciences (HICSS), 2014 47th Hawaii International Conference on, Issue Date: 6-9 Jan. 2014.

[9] Hugos, M.H. and Hulitzky, D. (2011). Business in the Cloud: What Every Business Needs to Know About Cloud Computing. John Wiley & Sons, Inc.

[10] Lapierre J. (2000). Customer-perceived value in industrial contexts, Journal of Business & Industrial Marketing 2/3, pp.122-145.

[11] Parolini, C. (1999). The Value Net. A Tool for Competitive Strategy, John Wiley & Sons Ltd: Great Britain.

[12] Walter, A., Ritter, T. and Gemünden, H.G. (2001). Value creation in buyer-seller relationships. Industrial Marketing Management 30(4), pp.365-377.

[13] Myllärniemi, J. and Helander, N. (2012). Healthcare System as a Value Network. World Review of Entrepreneurship, Management and Sustainable Development. 2012, Vol.8, Issue 2.

[14] Hagen, H.-O. and Hagsten, E. (2006), "Därför behöver produktiviteten i den offentliga sektorn mätas". Rapport till Expertgruppen för Studier i Samhällsekonomi 2006:2, Fritzes, Stockholm.

[15] Nordgren, L. (2009). Value creation in health care services – developing service productivity. Experiences from Sweden. International Journal of Public Sector Management Vol.22 No. 2, 2009, pp.114-127.

[16] Fernandez, D. and Aman, A. (2018). Impacts of Robotic Process Automation on Global Accounting Services. Asian Journal of Accounting and Governance 9, pp. 127-140.

[17] Bataller, C., Jacquot, A. & Torres S. R. 2017. Robotic Process Automation. US 9555544 B2. Retrieved from https://www.google.com/patents/US9555544

[18] Kirchmer, M. (2017). Robotic Process Automation - Pragmatic Solution or Dangerous Illusion? Business Transformation & Operational Excellence World Summit (BTOES). 2017.

[19] Myllärniemi, J., Okkonen, J., Paavilainen, J., & Vuori, V. (2012). Negative competition steering patient flow in a public-private healthcare co-opetition setting–a Finnish case. World Review of Entrepreneurship, Management and Sustainable Development, 8(2), pp. 208-220.

[20] Yin, R.K. (2003). Case Study Research: Design and Methods. 3rd ed., Sage, Thousand Oaks.

[21] Yeoh W. and Koronios A. (2010). Critical success factors for business intelligence systems. Journal of computer information systems, Spring 2010, pp. 23-32.

[22] Nykänen, E., Järvenpää, M., and Teittinen, H. (2016). Business intelligence in decision making in Finnish enterprises. Nordic Journal of Business, 65 (2),, pp. 24-44.

[23] Qu, S.Q. and Dumay, J., (2011). The qualitative research interview. Qualitative Research in Accounting & Management, 8(3), pp. 238-264.

[24] McLellan, E., MacQueen, K. M. and Neidig, J L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. Sage Journals, Feb 2003, pp. 63-84.

[26] Ratia, M. and Myllärniemi, J. (2017). Business Intelligence Tools for Private Healthcare Data-Driven Value Creation. Proceedings IFKAD 2017. St. Petersburg, Russia, 7-9 June 2017, pp. 408-419.

[27] Myllärniemi, J. (2013). Knowledge processes in healthcare network - a case study. 8th International Forum on Knowledge Asset Dynamics, IFKAD 2013, 12.-14.6.2013, Zagreb, Croatia. Zagreb, Croatia: Institute of Knowledge Asset Management, pp.1223-1236.

[28] Lacity, M., Willcocks, L. and Craif, A. (2015b). Robotic Process Automation at Telefónica O2. The Outsourcing Unit Working Research Paper Series. April 2015. Paper 15/02,, pp. 1-19.

[29] Qu, S. Q. and Dumay, J.. (2011). The qualitative research interview, Qualitative Research in Accounting & Management, Vol. 8 Issue 3, pp.238-264.

[30] Doyle, J.K. (2004). Introduction to interviewing techniques. In Wood, D.W. (Ed.), Handbook for IQP Advisors and Students, Worcester Polytechnic Institute, Worcester, MA.

[31] Kvale, S. and Brinkmann, S. (2009). Inter Views: Learning the Craft of Qualitative Research Interviewing, Sage, Los Angeles, CA.

[32] Leopold, H., van der Aa, H. and Reijers, H. A. (2018). Identifying Candidate Tasks for Robotic Process Automation in Textual Process Descriptions. Business-Process and Information Systems Modeling. 2018, pp. 67-81.

[33] Laurenza, E., Quintano, M., Schiavone, F. and Vrontis, D. (2018). The effect of digital technologies adoption in healthcare industry: a case based analysis. Business Process Management Journal, Vol. 24 Issue 5, pp.1124-1144.

[34] Krefting, L. (1991). Rigor in Qualitative Research: The Assessment of Trustworthiness. American Journal of Occupational Therapy. March 1991, Vol. 45, Number 3, pp. 214-222.

[35] Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. Educational Resources Information Center Annual Review Paper, 29, pp. 75-91.

PUBLICATION IV

Intellectual Capital and BI-tools in Private Healthcare Value Creation

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The Electronic Journal of Knowledge Management, Vol 16, Issue 2, pp. 143-154.

Intellectual Capital and BI-tools in Private Healthcare Value Creation

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Abstract: The demand for data-driven decision making in the healthcare sector has increased, not only on the clinical side, but also from the managerial perspective; this is especially true in the private healthcare sector. Utilisation of internal and external data requires certain capabilities, such as intellectual capital (IC), as different data sources (structural capital) and organisational competences (human capital) can become organisational value. We study the utilisation of business intelligence (BI) tools and IC dimensions in creating value in the Finnish private healthcare sector.

IC components and a modified value creation capabilities model are used as a framework for considering data utilisation and BI tools' role in value creation. Our study includes private healthcare organisations in Finland and management and BI technology consulting representatives. Thematic interviews of key personnel responsible for BI were conducted to elucidate the value creation capabilities, IC components and BI tool utilisation in the Finnish private healthcare industry.

Data-driven decision making is currently one of the most discussed topics in private healthcare sector organisations. By analysing the current data source utilisation and organisational competences in data utilisation, we gain a better understanding of IC and BI tool–enabled value creation in private healthcare organisations.

The study's outcomes will provide valuable information and a deep understanding concerning the influence of BI tools and IC dimensions on value creation in private health care in Finland. In addition, it will provide insight into future-oriented value creation factors that can enable new business concepts for private healthcare companies. Advanced capability of data utilisation will increase the value creation ability in private healthcare sector companies. However, in addition to the technology and data, human capital or capability of BI tool utilisation and data-driven decision making are crucial.

Keywords: Private healthcare, business intelligence, intellectual capital, value creation, external data sources

1. Introduction

The amount of data in the healthcare that are being generated, captured, processed and analysed is expanding significantly. It has been widely recognised that not only are the amounts of clinical data growing, but operative business data are also being used to support organisational decision making (Raghupathi, 2010; Raghupathi and Raghupathi, 2014; Spruit, Vroon and Batenburg, 2014; Grierson, Corney and Hathcher, 2015). The same demand has been identified in the private healthcare, where organisations are seeking to enhance their understanding of business practices and related organisational data, as well as their operational environment, to enable better performance via enhanced decision making (Demirkan, 2013; Ratia and Myllärniemi, 2017; Ratia, et al., 2017).

In private health care, the interest in efficient data utilisation and the business intelligence (BI) tools enabling exploration and utilisation of organisational data has increased (Elbashir, et al., 2013). In addition, there has been a growing interest in identifying necessary data sources, not only for supporting organisational decision making but also combining external data sources, open data among others, with the organisational data, and creating the potential for new business opportunities, and thus, value (Ratia and Myllärnemi, 2017). In contrast, utilisation of both internal and external data requires certain capabilities, such as intellectual capital (IC) dimensions, namely data (structural capital) and competences (human capital), to succeed. The significance of data utilisation has been growing and creating the need to transform the data-related IC dimensions into organisational value; this has brought up a managerial approach of IC dimensions, related to

Reference this paper: Ratia, M., 2018. Intellectual Capital and BI-tools in Private Healthcare Value Creation. *The Electronic Journal of Knowledge Management,* 16(2), pp. 143-154, available online at www.ejkm.com

human and structural capital, on how to utilise IC in the management of the organisation (Dumay and Garanina, 2013; Lerro, Linzalone and Schiuma, 2014).

The paper aims to examine the role of IC dimensions, and more specifically, structural (data) and human capital (competences), as well as utilisation of BI tools in data-driven value creation in the private healthcare sector in Finland. In this paper, various data sources and BI tools are considered as a part of structural capital, and BI tool utilisation and competence are viewed as human capital dimensions. This study brings together qualitative empirical data on competences available for BI tool use and data source utilisation, combined with a theoretical framework, for exploring the potential of external data sources' value-creating rationale.

The applicable selection of BI tools and capabilities is an important aspect in the field of private healthcare, but there are not many previous studies that have examined this issue (Suomi and Tähkäpää, 2002; Wullianallur and Viju, 2014; Ratia and Myllärniemi, 2017). In addition, the role of IC dimensions in the value creation potential in the private healthcare sector remains unclear. By exploring the IC dimensions and BI utilisation in the context of private healthcare, the research brings novel value for private healthcare sector companies, as well as consulting organisations providing competence, for the value-creation potential. The practical outcome of this research will provide valuable information and a deep understanding concerning the role of BI tool utilisation competences and data sources in private healthcare in Finland. In addition, it will provide insights into the value creation potential that those IC dimensions can create for private healthcare companies.

In the second section of the paper, the aim is to show a conceptual basis for IC and BI, as well as a modified model of value creation capabilities (Möller, Rajala and Svahn, 2005; Ratia and Myllärniemi, 2017). Section 3 presents the empirical setting, introducing the methodology and empirical material. Section 4 shows the results of data-driven value creation in the Finnish private healthcare sector. Finally, in section 5, the conclusions and discussion complete the paper.

2. BI tools creating value by IC in the private healthcare

2.1 The concept of IC

The connection between organisational knowledge and intellectual capital has been considered in several previous studies. The first one to introduce IC was Galbaraith (1969), who considered it a form of knowledge, intellect and brainpower activity to create value utilising knowledge (Galbaraith, 1969; Shih, Chang and Lin, 2010). In addition, intellectual capital can be the sum of all the knowledge organisations use to gain a competitive advantage (Nahapiet and Ghoshal, 1998; Youndt, Subramaniam and Snell, 2004; Subramaniam and Youndt, 2005; Wang, Wang and Liang 2014). However, there can still be defined the two different focusses between them. IC can be seen focussing on intangible resources and knowledge management (KM) concerning knowledge-related processes and management activities (Edvinsson and Malone, 1997; Sullivan, 1998; Gold, Malhotra and Segard, 2001; Lee and Choi, 2003; Heisig, 2010; Spender, et al., 2013; Kianto, et al., 2014). The literature has introduced several IC definitions; one of the most typical, which is also used in this research, is dividing the intangible resources into three dimensions – human, structural and relational capital (e.g. Bontis, 2001; Guthrie, 2001; Ling, 2013; Kianto, et al., 2014).

Human capital refers to employee competences or capabilities, such as skills, training, education, experience and professional know-how (Dzinkowski, 2000; Shih, Chang and Lin, 2010; Ling, 2013; Kianto, et al., 2014). Structural capital can be viewed as organisational processes and flows, supply chains, systems and databases (Shih, Chang and Lin, 2010; Kianto, et al., 2014). Relational capital refers to the relationship networks and interactions between all related parties and stakeholders (Roos, Bainbridge and Jacobsen, 2001; Shih, Chang and Lin, 2010; Kianto, et al., 2014). Therefore, normatively, IC can be conceptualised into three separate elements that accumulate and distribute knowledge differently (Subramaniam and Youndt, 2005). In addition, the literature presents people (human capital), systems and procedures (structural capital) as a requirement for everyday organisational activities, along with organisational interactions between internal and external stakeholders (relational capital; Rossi and Magni, 2017). The evolution of IC research has moved from understanding IC's potential in creating and managing a competitive advantage, profit-driven IC and accountingisation, toward a more strategic managerial approach (Petty and Guthrie, 2000; Dumay, 2009; Chiucchi and Dumay, 2015).

The discussion of organisational knowledge and IC also refers to a List of Operational Knowledge Assets (LOKA), which identifies several areas of contribution into organisational data, information and knowledge, namely market capital, human capital, decision effectiveness, organisational capital and innovation and customer capital (Andreou, Green and Stankosky, 2007; Erickson and Rothberg, 2014). The approach clearly illustrates that information and data are a solid part of the discussion. In addition, BI and BI tool utilisation are naturally part of both organisational knowledge and IC discussions (Erickson and Rothberg, 2014). Edvinsson and Sullivan (1996) describe organisational knowledge as knowledge that can be converted into value. This can include knowledge, systems and data processes (Edvinsson and Sullivan, 1996).

2.2 BI and utilisation of external data sources

The notion of BI has several definitions that supplement each other, enabling overall understanding of the BI concept. It can be viewed as a combination of different tools, applications and methods (Turban, et al., 2008). Nykänen, Järvenpää and Teittinen (2016) is separating BI into two main streams: technological and process. In addition, from a broader perspective, BI can include many concepts that are relatively close to each other, such as competitive intelligence, market intelligence, customer intelligence, competitor intelligence, strategic intelligence, technical intelligence and data analytics (Hannula and Pirttimäki, 2003; Lönnqvist and Pirttimäki, 2006; Kimble and Milolidakis, 2015). In addition, BI can be a managerial activity and have a strategic goal in terms of collecting raw data, evaluating the validity and reliability of data, analysing and storing data and sharing the processed information to support the organisational decision makers, thereby affecting the value creation (Gilad and Gilad, 1985; Pirttimäki, 2006; Nykänen, Järvenpää and Teittinen, 2016).

In addition to a process or management approach, in the literature, BI has been described as a selection of techniques, such as statistical methods and data mining, technologies, tools, practices, methodologies and applications, enabling the business data analysis required for a better understanding of the business and market. As a result, it leads to data-driven decision making by providing comprehensive, timely information (Hannula and Pirttimäki, 2003; Chen, Chiang and Storey, 2012; Côrte-Real, Ruivo and Oliveira, 2014; Nykänen, Järvenpää and Teittinen, 2016; Ratia and Myllärniemi, 2017). Simply, BI is business' ability to utilise the available data and employ it (Kimble and Milolidakis, 2015). To benefit from BI utilisation, organisations need proper tools to enable data analysis. BI tools, such as data warehouses and data mining tools, support the different stages of data-driven decision making as efficiently as possible, simultaneously bringing value to the organisation. Real-time, flawless information access to support decision making is critical, and the amount of information in organisations is growing rapidly, thereby creating challenges for data processing, which requires specific tools to enable knowledge and value creation to the organisation (Hannula and Pirttimäki, 2003; Jinpon, Jaroensutasinee and Jaroensutasinee, 2011; Ratia, et al., 2017). Overall, BI includes people, processes and technology, as well as the knowledge and end product (Hannula and Pirttimäki, 2003; Shollo and Galliers, 2016).

Like BI, KM has multiple definitions; one is that it is a set of practices concerning the creation, development and application of knowledge in terms of organisational performance. Both KM and BI improve the utilisation of available information and knowledge, as well as processing unstructured information, along with tacit knowledge (Wang and Wang, 2008). However, the concepts of BI and KM are not identical. The purpose of BI tools is supporting the decision-making process, whereas KM technologies can be viewed as knowledge and content management for storing, distributing and analysing structured and unstructured information (Herschel and Jones, 2005). Although KM has many different definitions in the literature, one clear aspect can be identified that differentiates it from BI: It contains subjective human knowledge that is not data for objective information (Davenport and Seely, 2006; Wang and Wang, 2008). However, BI and KM are deeply influenced by each other (Wang and Wang 2008).

IC dimensions – more specifically, structural capital, such as data – can be a valuable asset for organisations. In contrast, the value of BI tool utilisation is created by connecting different data types from different sources, allowing businesses to collect, evaluate, analyse, store and share up-to-date data to be used efficiently in decision making. The role of external sources in creating strategic opportunities and new potential sources of revenue has grown significantly (Zahra and George, 2002; Denrell, Fang and Winter, 2003; Foss, Lyngsie and Zahra, 2013). In the context of healthcare, external data can comprise social media posts, including Twitter feeds, blogs, status updates on Facebook and other platforms and webpages; or less patient-specific information, including emergency care data, newsfeeds and articles in medical journals. For example, utilising external data and applying advanced analytics to patient profiles would benefit from proactive care to

preventive care (Raghupathi and Raghupathi, 2014). Consequently, BI utilisation can include both internal and external data sources, where they can be used separately or together, creating new data and information, and thus, value.

2.3 IC creating value in private health care

Data and the ability to connect different data sources can be considered valuable from an organisational point of view, as it enables a data-driven approach. However, the concepts of value and value creation and their importance in the context of business decision making can be considered multilateral. When considering an extended perspective, the concept of value can be described in terms of a trade-off between benefits and sacrifices (Parolini, 1999; Lapierre, 2000; Hugos and Hulitzky, 2011; Ojala and Helander, 2014; Ratia and Myllärniemi, 2017). These trade-offs between benefits and sacrifices can be divided into monetary terms, such as productivity and efficient resource utilisation, as well as non-monetary terms, such as competence, market position, social rewards, time, effort and energy (Hagen and Hagsten, 2006; Nordgren, 2009; Myllärniemi and Helander, 2012; Ojala and Helander, 2014). In this research, we mostly focus on data-driven value creation enabled by IC dimensions, more specifically, human and structural capital.

The data-driven approach is strongly related to the discussion of IC value creation. In addition, data and knowledge are crucial drivers for an organisation's performance and value creation (Hussinki, et al., 2017). In addition, an organisation's capability to innovate has a close relation to its IC and ability to utilise it (Subramaniam and Youndt, 2005; Pirozzi and Ferulano, 2016). The role of capabilities has been central in the IC discussion, as has the effect of IC on value creation in organisations, although IC is a multilateral topic with no exact definition (Moustaghfir and Schiuma, 2013; Secundo, et al., 2017). Mostly, the literature divides the IC research into two interpretations: the conceptual, passive and categorisable, measurable assets and the dynamic, interpreting IC from a process or capability perspective (Edvinsson and Malone, 1997; Sullivan, 1998; Bontis, 2001; Guthrie, 2001; Kianto, et al., 2014; Pirozzi and Ferulano, 2016). Overall, IC can be defined as a sum of the intangible and knowledge-related resources that organisations can use to create value (Kianto, et al., 2014). Organisational IC consists of immaterial resources, such as human capital, structural capital and relational capital, creating value for the organisation (Kujansivu and Lönnqvist, 2005; Secundo, et al., 2017). Out of these, human capital and structural capital are the focus and basis for value creation in this paper. Moreover, the organisational competence of BI tool utilisation, as well as the utilisation of external data sources and its combination with the organisational data to create value.

Knowledge processes and methods, like BI, should be tightly connected to healthcare organisations' service provision and value creation (Myllärniemi and Helander, 2012). To clarify the BI tools' meaning in value creation and the link to IC, we use a network-capability-base framework as the foundation our analysis, as modified for the private healthcare sector (Möller, Rajala and Svahn, 2005; Ratia and Myllärinemi, 2017). However, the conducted analysis was based on qualitative research, which was supported by the analysis. In addition, it shows how IC dimensions are connected to data-driven value creation and the linkage to utilisation of external data sources and organisational capabilities or competences in BI tool utilisation.

3. Methods

This research was carried out using qualitative research methods and a case study research strategy. The research strategy, multiple case studies performed with qualitative research methods, was chosen for its suitability for studying complex and context-dependent research topics (Yin, 2003). In total, 26 thematic interviews were conducted for the study between January and October 2017. The companies were chosen to represent different sizes of private healthcare organisation, management consulting companies and technology consulting companies operating in Finland to accomplish potentially different viewpoints of data and BI utilisation. The research proceeded by conducting semi-structured thematic interviews, which were time-intensive, face-to-face interviews and Skype interviews, as the interviewees were executives and high-level managers and consultants on a tight schedule. The questions in the thematic interviews related to the connection of different data sources and organisational competence to value creation. The interviews were recorded and transcribed to enable systematic organisation and analysis of the gathered data (McLellan, MacQueen and Neidig, 2003). The qualitative approach provides better explanations and understanding of the research topic, also enabling adjusted questions, and as a result, more information, than if a quantitative study had been conducted (Yeoh and Koronios, 2010; Nykänen, Järvenpää and Teittinen, 2016). The flexible

approach to semi-structured interviews allows information to be gathered effectively and conveniently (Qu and Dumay, 2011).

Private healthcare companies involved in the case study were engaged in business activities in the healthcare, social care and dentalcare parts of the healthcare industry. The consulting case companies involved in the research were engaged in management consulting and technology consulting. Furthermore, the companies were located all over Finland. In addition, Finnish companies and international companies with offices in Finland were included. To identify the relevant private healthcare and consulting organisations for this research, it was necessary to gather multiple open-source documents about the companies' backgrounds and analyse whether they would be suitable for the research.

From the private healthcare sector, the interviewees were top managers and directors, representing mostly information and communication technology (ICT) or financial organisational functions; they were selected to be involved in the research based on their area of responsibility for BI in their organisations. Private healthcare companies with a turnover of over 40 million euros per year (as of 2015) were chosen for the study. The list of interviewees, their position in the organisation and their primary areas of responsibility are presented in Table 1.

Table 1: List of Interviewees, Organisational Positions and Areas of Responsibility

Interviewee	Position in the organisation	Area of responsibility
1	Director, Information and Communication Technology (IC)T	Head ICT functions
2	Director, Digital Services	Head of Digitalization
3	Head of Information Technology (IT)	Head of ICT functions
4	Development Manager	Responsible for business intelligence (BI) and development
5	Chief information officer (CIO)	Head of ICT functions
6	Head of Accounting and Reporting	Head of Controlling and BI
7	Director, Digitalization	Head of ICT and Digitalization
8	ICT Manager	Head of ICT
9	Head of Controlling	Head of Controlling and BI

The interviews were conducted in January–May 2017. Altogether, nine thematic semi-structured interviews were conducted among private healthcare sector companies. The interviews were carried out in a discursive atmosphere, addressing the key themes identified from the literature concerning IC and BI tools. Thus, the interviews included discussion on specific issues, for example, what kinds of data sources are currently being utilised and whether the companies have enough organisational capabilities for BI utilisation.

Seventeen consultants were interviewed for the study. The approach was inductive, with semi-structured, thematic interviews. The interviewees from the consulting industry were management consultants and BI technology consultants; they were selected to be involved in the research based on their area of responsibility in BI-related consulting in their organisations. In total, 52 consultants were contacted via the professional social networking platform LinkedIn. The list of interviewees and their organisational positions and main responsibilities is presented in Table 2.

Table 2: List of interviewees, Organisational Positions, and Company Types

Interviewee	Position in the organisation	Type of consulting
1	Director	Technology
2	Consultant	Technology
3	Director	Technology
4	Consultant	Technology
5	Director	Technology

Interviewee	Position in the organisation	Type of consulting
6	Consultant	Technology
7	Director	Management consulting
8	Consultant	Technology
9	Manager	Management consulting
10	Manager	Management consulting
11	Manager	Management consulting
12	Manager	Technology
13	Director	Technology
14	Director	Technology
15	Director	Technology
16	Director	Management consulting
17	Consultant	Technology

The interviews were performed in April–October 2017. There were 12 interviews in the field of technology consulting and 5 interviews in management consulting. Altogether, 17 semi-structured thematic interviews were conducted among the consulting companies. The discursive interviews included discussions on issues like whether there were external data sources utilised in the customers' organisations and customers' organisations had enough capabilities for BI utilisation.

The interview data were transcribed and classified following the content analysis method, and the data were grouped by their key themes. In section 4.1, we present our results according to the interview themes. In section 4.3, we analyse the results using the modified value creation capabilities framework (Möller, Rajala and Svahn, 2005; Ratia and Myllärniemi, 2017), utilising it to point out the importance of IC in data-driven value creation in private health care.

4. Results and implications

4.1 Utilisation of data in the private healthcare sector

The private healthcare companies participating in this research utilised several data sources in their BI tool(s). Most had several data sources from operational and financial systems to be modelled in one data warehouse model and analysed further using one or several BI tools. In addition, most of the companies used more than one BI tool, from one to four BI tools each, for various – mainly historical – reasons (Ratia and Myllärniemi, 2017). Furthermore, digital channels were mentioned as one of the data sources. The multiple sources of structural capital included structured data being utilised in creating value. Utilisation of both internal and external data sources was considered crucial: As interviewee no. 2 stated, 'Without a doubt, we have a need to combine various new data sources, not just our own internal operative data, but also external, open-source data, with the intention of doing deeper trend analysis. The aim is not only to serve our internal needs, from a production management point of view, but also to create new data for our customers – both corporations in general and individuals – regarding their personal health'. Thus, structural capital and combining data from both internal and external sources, as well as utilising open data, can be viewed as valuable assets. In addition, structural capital was viewed as a valuable factor for the future: 'I strongly believe that it is becoming the centre of the business. Advanced data processing and its potential will open new business opportunities that were impossible before' (interviewee no. 7). In addition, the core business was perceived to be moving more toward data-based business: 'There will be new data-driven business concepts, around which the whole business will be built up' (interviewee no. 7).

The second theme was related to the internal and external capabilities of the organisation. Internal and external capabilities and competences for data and BI tool utilisation have a significant role. All eight private healthcare organisations were using external capabilities to some extent. Some companies clearly had internal capabilities, and they were only utilising external capabilities in special cases. As interviewee no. 3 noted, 'We do the majority ourselves, but in special cases, we use consulting services – I would say about 10% of all the BI work'. Moreover, as another interviewee commented, 'We are trying to gain internal capabilities, but for deeper things we use consulting' (interviewee no. 9). However, there were also some organisations that outsourced some BI-related work on purpose: 'We have internal capabilities to some extent, but we have made a conscious decision to use consultants for some technical issues' (interviewee no. 4). Nevertheless, most of the companies exhibited a balance between internal and external capabilities, although many interviewees considered that the current internal capabilities were not as strong as they could have been. Some interviewees strongly felt that there must be a certain level of in-house capabilities to secure continuity. A lack of human capital is a relevant problem that is weakening the efficient utilisation of data: 'I don't have enough in-house capabilities right now, but such capabilities are on a recruiting list. This is slowing the progress and development of our BI' (interviewee no. 1). In addition, the creation of internal capabilities, or enhancing human capital, to enable efficient future data processing was considered important: 'If I think about future recruiting, and hiring more people, then one person is not going to be enough. Capabilities can become our bottleneck in terms of BI' (interviewee no. 5). Thus, having insufficient internal capabilities is slowing down the development and progress of BI.

4.2 External data utilisation and organisational capabilities as a part of IC

The interviewees from the consulting industry had opinions that meshed with those of private healthcare organisation decision makers, to the effect that external data sources were not being utilised enough. However, the potential was viewed as significant, and most BI tools allow combining internal data with open data or other forms of external data sources: 'This is going to grow, this is the direction we are heading' (interviewee no. 7). However, disagreement in the interviewees' opinions emerged in discussing whether the organisations were ready for utilising external data sources: As interviewee no. 4 argued, 'Even the internal data sources are not yet being utilised efficiently, not to mention external data sources'. Some of the interviewees had more faith in the monetisation of data: 'Linking it to the organisational data and process further on – This is actually something you want to pay money for!' (interviewee no. 16). The utilisation of external data sources is clearly growing; as one interviewee mentioned, 'No doubt we are going in this direction' (interviewee no. 12), and another stated, 'It is being done more and more' (interviewee no. 9). Nevertheless, although the awareness of possibilities concerning external data utilisation has grown significantly, it seems that it is still in its inception. The overall impression of most consultants was that, although some of the organisations are already doing this successfully, the others are just heading there.

The consultants also shared their opinions concerning capabilities. There were several views on the sufficiency of capabilities. Some of the interviewees strongly felt that there were not enough capabilities to fulfil developing organisations' needs: 'They use our services so much, and in such things, there is no way they would have enough capabilities of their own' (interviewee no. 11). As one interviewee argued, 'If they had internal competence in BI, they wouldn't be needing us so much' (interviewee no. 2). Another approach was that the controlling type of resources was sufficient, but there was a significant lack of resources on the data science and business sides: 'I can tell you where they lack competence, as we are always asked for data scientists and business strategists' (interviewee no. 16). In addition, one of the perspectives, especially on the management consulting side, was that the capability discussion is not only about operational capability, but also about the capabilities throughout the organisation, especially concerning the top management and strategic goals. However, it was obvious that the capability discussion is beyond the scope of operational performance; instead, it is part of the management strategy.

The discussion of future BI was strongly directed toward predictive analytics and evidence-based decision making. Historically, BI has been static and backward looking; now and for the future, it is becoming proactive and predicting. In addition, the processing is increasingly transferred from the ICT functions to the end user. In addition, one of the trends is the capacity to conduct predictive analytics. Online analytics enabling reactive interaction could enable evidence-based results in the decision making. Another future trend is collecting and combining external data sources to elucidate how the market functions.

4.3 IC enhancing value creation in the private healthcare sector in Finland

The three levels of value creation identified in the Finnish private healthcare sector are illustrated in Figure 1. IC dimensions, human capital and structural capital play a major role in the value production enabled by BI utilisation. The first level, core value production, requires human capital in efficient service production and delivery of services, as well as in process flexibility and excellence. In addition, structural capital affects performance excellence, operational efficiency and data-driven decision making. This value creation process requires both BI tools and data, as well as the capacity to use them properly.

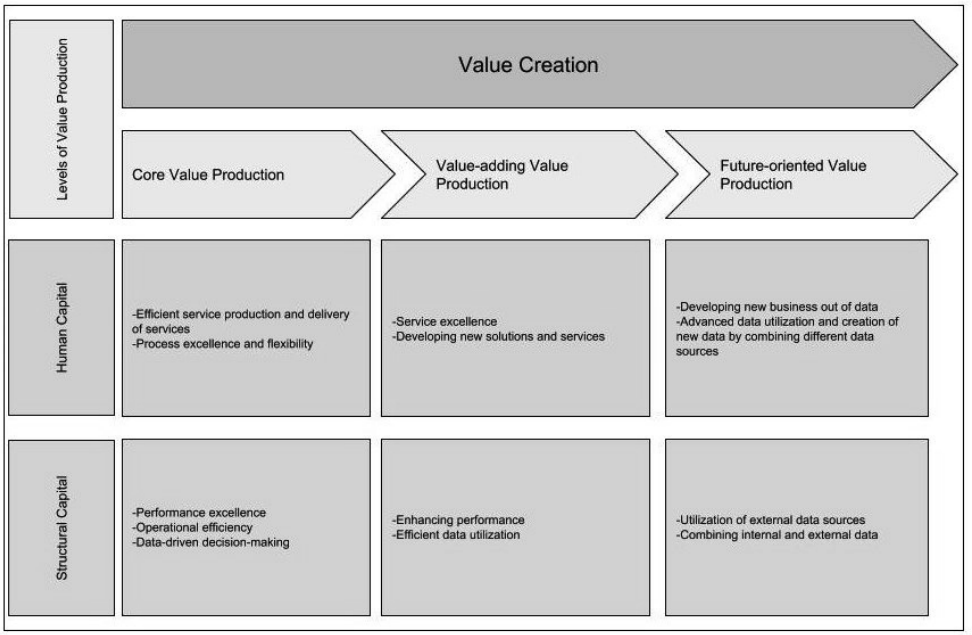

Figure 1: Data-based value creation (based on Möller, Rajala and Svahn, 2005; Ratia and Myllärinemi, 2017).

The second level is moving toward value-adding value production. In the context of private healthcare, human capital can enhance service excellence and enable the development of new solutions and services. In contrast, structural capital enables enhancing performance and efficient data utilisation. Already, data sources create a potential in terms of value creation. In this research, most of the company representatives thought that the external data sources would turn into a competitive advantage in the near future. As the competition is increasing in the private healthcare sector in Finland, there is also pressure to provide better customer service and enhance customer satisfaction, as well as taking the data value-adding practices further. However, it is clear that IC dimensions, namely human and structural capital, play a major role in value creation.

The third and last level of value creation is highly future oriented. Here, human capital contributes to the development of new business from data and creates new data by combining different data sources. In addition, structural capital enhances and enables the utilisation of external sources, combining them with the organisational data to create value. In addition, when achieving this level of value, utilising machine learning and artificial intelligence was viewed as a potential part of structural capital. Creating value was also viewed as a goal, not only via the original business concept and utilising the existing data sources, but also from proactively seeking new opportunities to grow the business by utilising external data sources.

As a summary, value creation, utilising external data sources and capabilities in the private healthcare sector, can be considered multidimensional. Human capital and structural capital play a significant role in the value-creation process. By studying the value creation concept, we can identify the three levels of value creation from utilising different data sources (Möller, Rajala and Svahn, 2005; Ratia and Myllärniemi, 2017). The IC dimensions of human and structural capital are strongly involved in each level of value production.

5. Conclusions and discussion

This paper introduced a fairly novel, empirically focussed approach to discussing the role of IC in data-driven value creation in the Finnish private healthcare sector. The healthcare sector is changing rapidly and seeking new, better ways of improving performance; especially in the private sector, there is a clear need for better decision-making procedures (Ratia and Myllärniemi, 2017). It is essential to identify the factors affecting data-driven decision making. In addition, this paper illustrated the importance of different data source utilisations, especially combining internal and external data sources, along with their potential to create value. We analysed the value-creation factors through the concept model of value creation, seeking to achieve a better understanding of the key factors in each level of data-driven value production and the ability to identify the different dimensions of IC to create value (Möller, Rajala and Svahn, 2005; Myllärniemi and Helander, 2012). In addition, having private healthcare companies, as well as the consulting industry's perspective on the discussion of external data source utilisation and organisational capabilities, can help us to understand the role of IC dimensions in BI tool utilisation.

The research showed that, out of the IC dimensions, human capital and structural capital can have a significant role in data-driven value creation in private health care. However, existing organisational capabilities or competences in BI utilisation were considered insufficient for fulfilling organisational ambitions. Clearly, all the private healthcare companies were required to seek external capabilities or competences in BI utilisation to some extent. The requirements for external resources varied, from deep technological know-how to strategic approaches. In addition, it was clear that the need for capabilities will grow in the future. Structural capital can also be a valuable asset in terms of data-driven value creation. Nevertheless, utilisation of different data sources was seen as extremely important, now and in the future. After all, combining organisational data with external data can create new data, and thus, new business opportunities, which could turn into value. However, it is clear that the journey toward external data utilisation has begun, with some of the organisations being at the beginning of the journey and some already taking their second steps.

Based on the conducted research, some managerial implications can be drawn for private health care. First, external data combined with organisational data can potentially create new business concepts. Advanced utilisation of different data sources, internal and external, can enable the creation of new data and enhance organisational decision making. Second, focussing on the organisational capabilities or competence in BI tool utilisation can support data-driven value creation. Furthermore, human capital or capabilities are required not only in terms of BI-tool utilisation, but also on a strategic level, to improve data-driven decision making in the organisation. Third, the significance of external data utilisation will also grow in the future. Again, the potential of organisational value creation will be the driver for using more external data sources. In addition, the search for completely new business concepts and opportunities is an essential driver. However, IC dimensions can have a significant role in the development of data-driven decision making, as data have no value per se if there are no capabilities to use it. As there can be internal and external capabilities involved, knowledge sharing has a key role. There is a clear need to develop internal capabilities that enable BI tool utilisation and data-driven decision making. To some extent, external consultants can provide support to both. However, the development of capabilities can appear only when there is true knowledge sharing between the organisation and consultants, enabling the organisation to learn on a strategic and BI tool–utilisation level. Although some of the practical tasks and strategic development can be outsourced to external consultants, there must be a certain level of capabilities inside the organisation, especially in terms of data-driven decision making.

The practical outcome of this research will provide insight into the role of human capital and structural capital in data-driven value creation. In addition, it introduces a future-oriented data-driven approach that can create new business concepts for private healthcare companies. Sufficient capabilities or competence in BI tool utilisation, along with external data source utilisation, would increase the value creation ability among private healthcare sector companies. However, to uncover a deeper view on this issue, we need to gather more empirical data from private health care, at different organisational levels. Furthermore, it will be necessary to study the role of networks and relational capital in accessing different external data sources. In addition, we need to investigate the required capabilities of BI tool selection, so that we can point out specific tool requirements and functional features that are essential for the private healthcare sector, and we need to look at the consulting industry perspective for gaining a deeper understanding of data-driven value creation (Chen, Chiang and Storey, 2012; Brandão, et al., 2016; Ratia, et al., 2017).

References

Andreou, A.N., Green, A. and Stankosky, M., 2007. A framework of intangible valuation areas and antecedents. *Journal of Intellectual Capital*, 8(1), pp.52-75.

Bates, D., Saria, S., Ohno-Machado, L., Shah, A. and Escobar, G., 2014. Big data in health care: using analytics to identify and manage high-risk and high-cost patients. *Health Affairs*, 33(7), pp.1123-31

Brandão, A., Pereira, E., Esteves, M., Portela, F., Santos, M.F., Abelha, A. and Machado, J., 2016. A benchmarking analysis of open-source business intelligence tools in healthcare environments. *Information*, 7(4), p.57.

Bontis, N., 2001. Assessing knowledge assets: a review of the models used to measure intellectual capital. *International Journal of Management Reviews*, 3(1), pp.63-76.

Cases, M., Furlong, L., Albanell, J., Altman, R.B., Bellazzi, R., Boyer, S., Brand, A., Brookes, A.J., Brunak, S., Clark, T.W., Gea, J., Ghazal, P., Graf, Guigó, R., Klein, T.E., López-Bigas, Maojo, Mons, B., Musen, M. and Oliveira, J.L., 2013. Improving data and knowledge management to better integrate health care and research. *Journal of Internal Medicine*, 274(4), pp.321-28.

Chen, H., Chiang, R.H.L. and Storey, V.C., 2012. Business intelligence and analytics: from big data to big impact. *MIS Quarterly*, 36(4), pp.1165-88.

Chiucchi, M.S. and Dumay, J., 2015. Unlocking intellectual capital. *Journal of Intellectual Capital*, 16(2), pp.305-30.

Côrte-Real, N., Ruivo, P. and Oliveira, T., 2014. The diffusion stages of business intelligence & analytics (BI&A): a systematic mapping study. *Procedia Technology*, 16, pp.172-79.

Demirkan, H. 2013. A smart healthcare systems framework. *IT Professional*, 15(5), pp.38-45

Denrell, J., Fang, C. and Winter, S.G., 2003. The economics of strategic opportunity. *Strategic Management Journal*, 24, pp.977-90.

Dumay, J. (2009). Intellectual capital measurement: a critical approach. *Journal of Intellectual Capital*, 10(2), pp.190-210.

Dumay, J. and Garanina, T., 2013. Intellectual capital research: a critical examination of the third stage. *Journal of Intellectual Capital*, 14(1), pp.10-25.

Dzinkowski, R., 2000. The measurement and management of intellectual capital: an introduction. *Management Accounting*, 78, pp.32-36.

Edvinsson, L. and Malone, M., 1997. *Intellectual capital: realising your company's true value by finding its hidden brainpower.* New York: Harper Collins.

Edvinsson, L. and Sullivan, P., 1996. Developing a model for managing intellectual capital. *European Management Journal*, 14(4) pp.356-64.

Elbashir, M., Collier, P., Sutton, S., Davern, M. and Leech, S., 2013. Enhancing the business value of business intelligence: the role of shared knowledge and assimilation. *Journal of Information Systems*, 27(2), pp.87-105.

Foss, N.J., Lyngsie, J. and Zahra, S.A., 2013. The role of external knowledge sources and organizational design in the process of opportunity exploitation. *Strategic Management Journal*, 34(12), pp.1453-71.

Galbraith, J.K., 1969. *The new industrial state*. Harmondsworth: Penguin.

Gilad, B. and Gilad, T., 1985. A systems approach to business intelligence. *Business Horizons*, 28(5), pp.65-70.

Gold, A., Malhotra, A. and Segard, A., 2001. Knowledge management: an organizational capabilities perspective. *Journal of Management Information Systems*, 18(1), pp.185-214.

Grierson, H.J., Corney, J.R. and Hathcher, G.D., 2015. Using visual representations for the searching and browsing of large, complex, multimedia data sets. *International Journal of Information Management*, 35, pp.244-52.

Guthrie, J., 2001. The management, measurement and the reporting of intellectual capital. *Journal of Intellectual Capital*, 2(1), pp.27-41.

Hagen, H.-O. and Hagsten, E., 2006, *Därför behöver produktiviteten i den offentliga sektorn mätas*. Rapport till Expertgruppen för Studier i Samhällsekonomi 2006:2. Stockholm: Fritzes.

Hannula, M. and Pirttimäki, V., 2003. Business intelligence Empirical Study on the top 50 Finnish companies. *Journal of American Academy of Business*, Mar, pp.593-99.

Heisig, P., 2010. Harmonisation of knowledge management – comparing 160 KM frameworks around the globe. *Journal of Knowledge Management*, 18(4), pp.4-31.

Herschel, R.T. and Jones, N.E., 2005. Knowledge management and business intelligence: the importance of integration. *Journal of Knowledge Management*, 9(4), pp.45-55.

Hugos, M.H. and Hulitzky, D., 2011. *Business in the cloud: what every business needs to know about cloud computing*. John Wiley & Sons.

Hussinki, H., Ritala, P., Vanhala, M. and Kianto, A., 2017. Intellectual capital, knowledge management practices and firm performance. *Journal of Intellectual Capital*, 18(4), pp.904-22.

Jinpon, P., Jaroensutasinee, M. and Jaroensutasinee, K., 2011. Business intelligence and its applications in the public healthcare system. *Walailak Journal of Science and Technology (WJST)*, 8(2), pp.97-110.

Katsaliaki, K. and Mustafee, N., 2011. Applications of simulation within the healthcare context. *Journal of the Operational Research Society*, 62(8), pp.1431-51.

Kianto, A., Ritala, P., Spender, J-C. and Vanhala, M., 2014. The interaction of intellectual capital assets and knowledge management practices in organizational value creation. *Journal of Intellectual Capital*, 15(3), pp.362-75.

Kimble, C. and Milolidakis, G., 2015. Big data and business intelligence: debunking the myths. *Global Business and Organizational Excellence*, 35(1), pp.23-34.

Krumholz, H.M., 2014. Big data and new knowledge in medicine: the thinking, training and tools needed for a learning health system. *Health Affairs*, 33(7), pp.1163-70.

Kujansuu, P. and Lönnqvist, A., 2005. How do investments in intellectual capital create profits? *Frontiers of e-Business Research (FeBR)*, 2005, pp.304-19.

Lapierre, J., 2000. Customer-perceived value in industrial contexts. *Journal of Business & Industrial Marketing*, 2/3, pp.122-45.

Lee, H. and Choi, B., 2003, Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination. *Journal of Management Information Systems*, 20(1), pp.179-228.

Lerro, A., Linzalone, A. and Schiuma, G., 2014. Managing intellectual capital dimensions for organizational value creation. *Journal of Intellectual Capital*, 15(3), pp.350-61.

Ling, Y.H., 2013. The influence of intellectual capital on organizational performance – knowledge management as moderator. *Asia Pacific Journal of Management*, 30(3), pp.937-64.

Lönnqvist, A. and Pirttimäki, V., 2006. The measurement of business intelligence. *Information Systems Management*, 23(1), pp.32-40.

Malmi, T., 1999. Activity-based costing diffusion across organizations: an exploratory empirical analysis of Finnish firms. *Accounting, Organizations and Society*, 24, pp.649-72.

McLellan, E., MacQueen, K.M. and Neidig, J.L., 2003. Beyond the qualitative interview: data preparation and transcription. *Sage Journals*, Feb., pp.63-84.

Möller, K., Rajala, A. and Svahn, S., 2005. Strategic business nets – their type and management. *Journal of Business Research,* 58(9), pp.1274-84.

Moustaghfir, K. and Schiuma, G., 2013. Knowledge, learning and innovation: research and perspectives. *Journal of Knowledge Management*, 17(4), pp.495-510.

Myllärniemi, J., 2013. Knowledge processes in healthcare network – a case study. *8th International Forum on Knowledge Asset Dynamics, IFKAD 2013, 12.-14.6.2013, Zagreb, Croatia*. Zagreb: Institute of Knowledge Asset Management. pp.1223-36.

Myllärniemi, J. and Helander, N., 2012. Healthcare system as a value network. world review of entrepreneurship. *Management and Sustainable Development*, 8(2).

Nahapiet, J. and Ghoshal, S., 1998. Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review*, 23, pp.242-66.

Nordgren, L., 2009. Value creation in health care services – developing service productivity. Experiences from Sweden. *International Journal of Public Sector Management*, 22(2), pp.114-27.

Nykänen, E., Järvenpää, M. and Teittinen, H., 2016. Business intelligence in decision making in Finnish enterprises. *Nordic Journal of Business*, 65(2), pp.24-44.

Ojala, A. and Helander, N., 2014. value creation and evolution of a value network: a longitudinal case study on a platform-as-a-service provider. *47th Hawaii International Conference on System Sciences (HICSS), 6-9 Jan. 2014*.

Parolini, C., 1999. The value net. a tool for competitive strategy. John Wiley & Sons.

Petty, R. and Guthrie, J., 2000. Intellectual capital literature review: measurement, reporting and management. *Journal of Intellectual Capital*, 1(2), pp.155-76.

Pirozzi, M.G. and Ferulano, G.P., 2016. Intellectual capital and performance measurement in healthcare organizations: an integrated new model. *Journal of Intellectual Capital*, 17(2), pp.320-50.

Pirttimäki, V. (2006). *Business intelligence as a managerial tool in large Finnish companies*. Ph. D. Tampere University of Technology.

Qu, S.Q. and Dumay, J., 2011. The qualitative research interview. *Qualitative Research in Accounting & Management*, 8(3), pp.238-64.

Raghupathi, W., 2010. Data mining in health care. In: S. Kudyba, ed. *Healthcare informatics: improving efficiency and productivity*. Taylor & Francis. pp.211-23.

Raghupathi, W. and Raghupathi, V., 2014. Big data analytics in healthcare: promise and potential. *Health Information Science and Systems*, 2, p.3.

Ratia, M. and Myllärniemi, J., 2017. Business intelligence tools for private healthcare data-driven value creation. *Proceedings of IFKAD 2017, St. Petersburg, Russia, 7-9 June 2017*. pp.408-19.

Ratia, M., Myllärniemi, J. and Helander, N. (2017). Benefits and Required Capabilities of BI-tools in the Private Healthcare. *Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland . September 20 - 21, 2017.* pp. 103-110

Rossi, M. V. and Magni, D. (2017). Intellectual capital and value co-creation: an empirical analysis from a marketing perspective. *The Electronic Journal of Knowledge Management*, 15(3), pp.147-58.

Roos, G., Bainbridge, A. and Jacobsen, K., 2001. Intellectual capital analysis as a strategic tool. *Strategy & Leadership*, 29, pp.21-28.

Secundo, G., Del Vecchio, P., Dumay, J. and Passiante, G., 2017. Intellectual capital in the age of Big Data: establishing a research agenda. *Journal of Intellectual Capital*, 18(2), pp.242-61.

Shih, K.-H., Chang, C.-J. and Lin, B., 2010. Assessing knowledge creation and intellectual capital in banking industry. *Journal of Intellectual Capital*, 11(1), pp.74-89.

Shollo, A. and Galliers, R., 2016. Towards an understanding of the role of business intelligence systems in organisational knowing. *Information Systems Journal*, 26(4), pp.339-67.

Spender, J.-C., Bernardz-Luczewska, P., Bordianu, A. and Rohaert, S., 2013. Intangibles: theory, categories, and the Kozminski matrix. *Knowledge Management Research & Practice*, 11(2), pp.101-11.

Spruit, M., Vroon, R. and Batenburg, R., 2014. Towards healthcare business intelligence in long-term care. An explorative case study in the Netherlands. *Computers in Human Behavior*, 30, pp.698-707.

Subramaniam, M. and Youndt, M.A., 2005. The influence of intellectual capital on the types of innovative capabilities. *Academy of Management Journal*, 48(3), pp.450-63.

Sullivan, P., 1998. Profiting from intellectual capital: extracting value from innovation. New York: Wiley.

Suomi, R. and Tähkäpää, J., 2002. The strategic role of ICT in the competition between public and private health care sectors in the Nordic welfare societies – case Finland. *Proceedings of the 35th Hawaii International Conference on System Sciences*.

Stewart, R. and Davis K., 2016. 'Big data' in mental health research: current status and emerging possibilities. *Social Psychiatry and Psychiatric Epidemiology*, 51(8), pp.1055-72.

Swanson, R.C., Cattaneo, A., Bradley, E., Chunharas, S., Atun, R., Abbas, K.M., Katsaliaki, K., Mustafee, N., Meier, B.M. and Best, A., 2012. Rethinking health systems strengthening: key systems thinking tools and strategies for transformational change. Oxford Journals. Medicine & Health. *Health Policy and Planning*, 27(Suppl 4), pp.iv54-61.

Turban, E., Aronson, J.E., Liang, T.-P. and Sharda, R., 2008. *Business intelligence: a managerial approach*. New Jersey: Pearson Prentice Hall.

Wang, H. and Wang, S., 2008. A knowledge management approach to data mining process for business intelligence. *Industrial Management & Data Systems*, 108(5), pp.622-34.

Wang, Z., Wang, N. and Liang, H., 2014. Knowledge sharing, intellectual capital and firm performance. *Management Decision*, 52(2), pp.230-58.

Wullianallur, R. and Viju, R., 2014. Big data analytics in healthcare: promise and potential. *Health Information Science and Systems*, 2(3).

Yeoh, W. and Koronios, A., 2010. Critical success factors for business intelligence systems. *Journal of Computer Information Systems*, Spring, pp.23-32.

Yin, R.K., 2003. Case study research: design and methods. 3rd ed. Thousand Oaks: Sage.

Youndt, M.A., Subramaniam, M., and Snell, S.A., 2004. Intellectual capital profiles: an examination of investments and returns. *Journal of Management Studies*, 41, pp.335-62.

Zahra, S. and George, G., 2002. Absorptive capacity: a review, reconceptualization, and extension. *Academy of Management Review*, 27, pp.185-203.

PUBLICATION V

The potential beyond IC 4.0: the evolution of business intelligence towards advanced business analytics

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Measuring Business Excellence, Vol. 23 No. 4, pp. 396-410.

The Potential Beyond IC 4.0 : The Evolution of Business Intelligence towards Advanced Business Analytics

Structured Abstract

Purpose – The private healthcare sector is seeking to improve their understanding of business processes to be able to improve their performance. The aim of this paper is to understand the future needs of the private healthcare sector organizations in terms of business intelligence (BI) and business analytics (BA) to ensure value-creation.

Design/methodology/approach – The four evolution stages of IC enriched by managerial data-driven approach are used as a framework to point out the future of BI or BA in the private healthcare sector. The research includes private healthcare organizations, BI-vendors and management consultants in Finland.

Findings – Based on our findings, the private healthcare is stepping towards a new phase of data-driven decision-making, requiring to change the whole set of mind towards data utilization and required capabilities. Also showing, that the future factors of BI varied from practical tools and methods, such as predictive and prescriptive analytics along with AI, to more conceptual factors, such as social BI co-creation and platforms.

Originality/value – Data-driven decision-making and seeking for new business opportunities are currently one of the most discussed topics in the private healthcare sector. By identifying the future opportunities of BI and BA, we gain better understanding on the role of IC components and BI in creating potential for new business for the private healthcare.

Practical implications – As an outcome, we will provide understanding on role of IC components in the future BI and BA utilization as well as valuable insight into the future

potential of BI in the private healthcare sector.

Keywords – Private healthcare, business intelligence, business analytics decision-making, intellectual capital, future potential

Paper type – Research Paper

1 Introduction

As the amount of data in the healthcare that being generated, captured, processed and analyzed, is expanding significantly, the healthcare sector is demanding enhanced decisions not only in the daily work of the clinicians, but also at the organizational level (Ratia and Myllärniemi 2017; Bates et al. 2014; Cases et al. 2013; Katsaliaki et al. 2011; Stewart et al. 2016). So, not only clinical data amounts are expanding phenomenally, but also business processes are generating large amounts of operative business data, that is being used to support the managerial decision-making on all organizational levels (e.g. Ratia and Myllärniemi 2018; Raghupathi and Raghupathi 2014; Raghupathi 2010). This also concerns processes in the private healthcare sector, where organizations are actively searching to improve their business practices and understand the related organizational data and as a result, enhance the performance of the organization through better decision-making. For example automating manual processes such as physician's written notes and prescriptions, medical imaging or laboratory results processing etc. Also data generated by social media or machine generated sensor data can be processed more efficiently and enable enhanced decision-making (Ratia and Myllärniemi 2017; Ratia et al. 2017; Demirkan 2013). Another successful example of business analytic use case is to identify the most clinically and cost effective treatments. Moreover, advanced business analytics can be applied also to proactive preventative care (Raghupathi and Raghupathi 2014). However, also optimizing administrative and managerial process is required, for example more efficient resource allocation and supply chain management or real-time locating for assets and human resources (Ward et al. 2014).

Consequently, the significance of Business Intelligence (BI) and related concepts, such as Business Analytics (BA) and Big Data, has grown also in managerial decision-making process, also having a positive impact the organizational performance (e.g. Ratia and Myllärniemi 2018, Trieu 2017, Wang 2016). In addition to BI and BA, also Knowledge Management (KM) can be considered to be a driver for better decision-making (Pauleen 2017). Organizational knowledge-base, i.e. intellectual capital (IC) is also considered to have influence on organizational decision-making capability (Secundo et al. 2016; Kujansivu, 2009; Lönnqvist et al., 2009). So, all of these three are required to make better

decisions and implement them as actions (Pauleen 2017). However, the importance of people or human capital is significant in decision-making and personnel capability is the key to successful BA and BI utilization (Ward et al. 2014).

Among many other industries, also the private healthcare management and executives have been showing an increasing interest in BI and BA (Elbashir et al. 2013). Yet, is seems that there is not enough awareness of knowledge-base, i.e. IC being a solution for enhanced decision-making (Pauleen 2017). This paper focuses on the impact of IC and utilization of BI and BA in the future in the private healthcare sector in Finland. The purpose of the research is to understand the future needs of the private healthcare sector organizations in terms of BI and BA to ensure value-creation.

This study is putting together the future potential of BI and BA as well as the role of IC dimensions in the decision-making and value creation of the private healthcare organizations. By analysing the future potential of the BI and BA, as well as impact of IC dimensions in the private healthcare industry sector, the research brings novel value for the private healthcare sector companies, also specifying the future factors of BI and BA opportunities. The practical outcome of this research will provide valuable understanding on the future potential enabled by BI, BA and the role of IC dimensions in the Finnish private healthcare sector companies. However, as the majority of the studies have been limited to investigate the public healthcare sector, the research concerning the private healthcare sector has not been to the same extent (e.g. Ratia and Myllärniemi 2018; Wullianallur et al. 2014; Elbashir et al. 2013).

In the second chapter the aim is to show a conceptual basis for BI and BA and introduce the Secundo et al's (2017) model of IC ecosystem in the context of BI and BA. Chapter 3 presents empirical setting, introducing the methodology and empirical material. Chapter 4 is of showing the results of future BI and BA within the Finnish private healthcare sector. Finally, in chapter 5, the conclusions and discussion conclude the paper.

2 A step from Business Intelligence towards Business Analytics

2.1. A concept of Business Intelligence redefined

Traditionally, the concept of Business Intelligence has been described as a complex combination of several and various definitions. The literature is identifying several approaches, that are rather complementary among each other, than being exclusive. Turban et al. (2008) is proposing BI as a unifying phrase or term, combining different tools, applications and methods. Another description is defining BI, is that it is a combination of technology and process (Nykänen et al. 2016). Moreover, there are several BI alike concepts, that can be also debatable, whether they are part of BI, such as competitive intelligence, market intelligence, customer intelligence, competitor intelligence, strategic intelligence, technical intelligence and data analytics (Lönnqvist et. al 2006). Furthermore, BI can be considered to operate as a process that is producing information and knowledge for the management and decision-makers in the organization (Pirttimäki 2006; Gilad et al. 1985; Nykänen et al. 2016). However, lately BI has been seen as a selection of techniques, technologies, tools, practices and methods enabling analysis of business data to create deep understanding of business and market for organizations and support appropriate business decisions (Côrte-Real et al. 2014; Nykänen et al. 2016). The updated concept of BI has enabled new methods and BI related and derived concepts, e.g. BA, Big Data and machine learning (Trieu 2017). Moreover, recently the concepts of BI, BA and even Big Data have been used alternatively or interchangeably (Trieu 2017; Wang et al. 2016). However, it is certain, that BI, BA and other related concepts have a positive influence on organizational performance (Kakhki and Palvia 2016).

Especially now, when the amount of data and information generated, processed and stored in organizations is growing rapidly, a timely access to relevant information for decision-making support is crucial. To be efficient, data and information processing require specific approaches and methodologies to enable knowledge and value creation to the organization (Jinpon et al. 2011). Among others, one of the values created of BI and BA is by connecting several data types from different sources and enabling to collect, evaluate, analyse, store and share up-to-date data to be used efficiently in decision making. There are several studies, that are looking into the capabilities of BI, BA and Big Data, but however, their primary focus is the clinical side and not managerial view (Ratia and Myllärniemi

2017; Wang et al. 2016; Wang et al. 2015; Jiang et al. 2014; Murdoch and Detsky 2013).

2.2. The evolution of Intellectual Capital

Intellectual Capital (IC) is multi-faced topic and its definition is rather not clear. However, the literature suggests several approaches to it, as well as value creation should be connected to the discussion of IC (Secundo et al. 2017; Moustaghfir and Schiuma 2013). However, even though there is no unified definition, there appears general certainty, that IC is essential for organizational value creation (Secundo et al. 2017; Moustaghfir and Schiuma 2013; Dumay 2016). Nevertheless, organizational value creation requires effectively managed IC, or to be more exact, identifying, measuring, disclosing and reporting knowledge assets effectively. This is also stating IC as a rather manageable than a stock of resources (Secundo et al. 2017; Andriessen 2005). IC research can be divided into four main stages of evolution. The first stage of IC evolution, when modern approach of IC was grounded in the 1980s and 1990s in the work of practitioners, the primary focus was on the awareness of IC and its potential in creating competitive advantage in organizations (Secundo et al. 2017; Petty and Guthrie 2000; Borin and Donato 2015). The second stage was focusing on the purposes of organizational strategic management and also measurement of its efficiency to point out potential for value creation (Secundo et al. 2017; Petty and Guthrie 2000).

In the third stage, IC is considered as a dynamic system of intangible resources, focusing on the interactions between IC components and practical managerial activities of the organization (Secundo et al. 2017; Guthrie et al. 2012; Silvestri and Veltri 2011). Also, for the third stage, it is more typical to be practically oriented, and research IC practices empirically inside organizations (Secundo et al. 2017; Guthrie et al. 2012). Nevertheless, the fourth stage of IC evolution shows a broader perspective of IC, with a focus on ecosystems, allowing the knowledge to be created and developed on a wider scale (Secundo et al. 2017; Dumay and Garanina 2013). In this case, the focus is on the connection between internal knowledge or human capital and external knowledge or relational capital (Secundo et al 2017; Borin and Donato 2015). Moreover, also the new social aspects, where human, relational and structural capital can be combined into a new view of IC with a more performative approach (Secundo et al. 2017; Guthrie et al. 2012; Dumay and Garanina 2013). When knowledge flow goes beyond traditional boundaries of relational capital and

flows between networks with interdisciplinary perspective, there can also be created new value in those networks, (Borin and Donato 2015; Edvinsson and Lin 2012; Edvinsson and Lin 2009).

This fourth stage of IC seems to question the boundaries between organizations and ecosystems and the knowledge flow between them. Furthermore, emerging of new BI and BA related concepts e.g. Big Data have offered new interpretation lens also for IC (Secundo et al. 2017). The main critical elements of Big Data can be defined as volume, velocity and variety (Secundo et al. 2017). Secundo et al. (2017) is introducing a conceptual framework, IC ecosystem definition through the lens of Big Data. The modified model is presented in Figure 1.

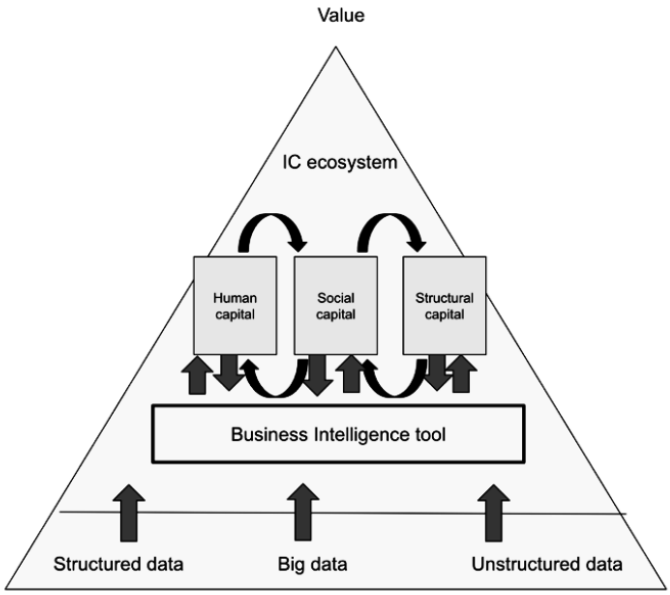

Figure 1. Adapted model of IC ecosystem definition through the lens of Big Data (modif. Secundo et al. 2017)

In this model of IC ecosystem, Big Data is referred to be as a part of BI and BA concept, being able to describe the diversity and complexity of the data. Secundo et al. (2017) is also suggesting, that value creation is the main objective for incorporating BI and BA related concept of Big Data approach into organisational IC strategy. In the presented model, the

role of IC is to act as enabler of continuous development of approaches, technologies and infrastructures enabling data creation in the organizational IC ecosystem. Thus, requiring management of IC components, such as human, social and structural capital, within this ecosystem (Ratia and Myllärniemi 2018; Secundo et al. 2017). However, even though information sharing and co-creation are emerging trends, also knowledge and information hiding can be the case, when human capital is related (Asrar-ul-Haq and Anwar 2016).

3 Methods

This research was conducted with qualitative research methods and a case study research strategy. The research strategy, more specifically a multiple case study, performed with qualitative research methods, was chosen for its suitability for studying complex and context-dependent research topics (Yin, 2003). The qualitative research was conducted by focusing on the interest group, the private healthcare organizations and consulting companies, more specifically of both, technology and management consultants. When studying both sides, we got a wider picture perspective of potential of BI and BA, as well as the role of IC components, in the Finnish private healthcare organizations. In this research ten managers representing private healthcare organizations were chosen as interviewees. The examined companies were representing multiple different sizes of private healthcare organizations operating in Finland. As there are limited amount of private healthcare companies in Finland of that size, having BI and analytics activities, the majority of them was covered.

Also, twenty consultants were interviewed for the study. They were representing both, the technology and management consulting organizations. The inductive approach with semi-structured, thematic interviews, allowed to investigate the future potential enabled by BI and BI-tools. The qualitative research method was chosen upon other research methods, as providing better explanations and deeper understanding on the research questions, also enabling the adjusted questions and gather more information, than if used quantitative study (Yeoh et al. 2010; Nykänen et al. 2016). In addition, semi-structured interview approach is flexible and is allowing information gathering to be conducted effectively and conveniently (Qu and Dumay 2011). However, qualitative study approach enables to research the phenomena from different perspectives, that would not

been the possible if quantitative methods were applied.

The interviewed organizations from the private healthcare sector, located all over Finland, were having business operations in the dentalcare, socialcare and healthcare businesses of the healthcare industry. Moreover, among organizations involved in the study were Finnish and international companies having office in Finland. The semi-structured thematic interviews were conducted face-to face interviews, skype-interviews and phone interviews. The interview discussions were recorded and transcribed to be able to systematically organize and analyse gathered data (McLellan et al. 2003). The interviewees were top managers and executives, mostly representing ICT or financial functions, and they were chosen as of their area of responsibility for BI within their organization. The study included private healthcare organizations with turnover over 40 million euros per year (2015). The list of interviewees as well as their role is described in Table 1.

Table 1. The list of interviewees, their role and area of responsibility in organization

viewee		**nsibility**
1	tor, ICT	ICT functions
2	tor, Digital Services	of Digitalization
3	of IT	of ICT functions
4	opment Manager	nsible for BI and development
5		of ICT functions
6	of Accounting and Reporting	of Controlling and BI
7	tor, Digitalization	of ICT and Digitalization
8	Manager	of ICT
9	of Controlling	of Controlling and BI
10	of Controlling	of Controlling and BI

The interviews of private healthcare organizations were conducted during the period between January and May 2017. They were carried out in discursive atmosphere, including discussion on issues e.g. what is the future perspectives, ideas and needs in terms

of BI.

Furthermore, twenty consultants were interviewed for the study. The approach was also inductive with semi-structured, thematic interviews. The interviewees chosen for the study were technology and management consultants, focusing on BI related consulting within their organization. Below, in table 2 is presented a list of interviewees, their position in the organization and main responsibilities.

Table 2. The list of interviewees, their position and type of the consulting company

Interviewee	**Position**	**Type of consulting**
11	Director	Technology
12	Consultant	Technology
13	Director	Technology
14	Consultant	Technology
15	Director	Technology
16	Consultant	Technology
17	Director	Management consulting
18	Consultant	Technology
19	Manager	Management consulting
20	Manager	Management consulting
21	Manager	Management consulting
22	Manager	Technology

23	Director	Technology
24	Director	Technology
25	Director	Technology
26	Director	Management consulting
27	Consultant	Technology
28	Director	Management consulting
29	Director	Management consulting
30	Director	Technology

The interviews were carried out between April and October 2017. Altogether twenty thematic semi-structured interviews were conducted. The discursive interviews included discussions on issues e.g. what is the future of BI and what will be left behind in terms of BI.

Moreover, one private healthcare company was chosen for deeper case study. The interviewees were business and finance directors as well as representative of controlling function. The list of interviewees among with their position in the organization and main responsibilities is presented in Table 3.

Table 3. The list of interviewees of the healthcare case company.

Interviewee		**work activities**
31	Director	Business
32	Director	Business

33	Director	Finance
34	Controller	Business Control

In the final set of interviews, one major BI tool provider, an international technology company, was also chosen for deeper case study. The list of interviewees among with their position in the organization and main responsibilities is presented in Table 4.

Table 4. The list of interviewees of the technology case company.

Interviewee		**work activities**
35	Consultant	AI, ML and Advanced Analytics
36	Architect	Analytics
37	Consultant	Analytics
38	Architect	Analytics
39	Architect	AI, ML and Advanced Analytics

In chapter 4.1. we present our results by answering to the interview themes, based on the first round of analysis. In chapter 4.2. we analyse the result with Secundo et al.'s (2017) modified IC ecosystem frameworks, based on second round of the analysis.

4 Results and implications

4.1 Reinventing Intelligent Business?

The primary objective of the study is to examine, what are the future perspectives of BI and BA and the role of IC components in the private healthcare sector companies in Finland. Firstly, the future of BI utilization is seen to include predictive, prescriptive analytics and artificial intelligence (AI) to enhance business decisions. A common view is that from looking into historical data, the focus will be more towards the future, for example, interviewee 23 is stating: *"Until now we have been looking into rear-view mirror,*

into the history. With new methods we could be able to predict business, here I mean predictive and prescriptive analytics". Also, interviewee 14 says: *"Historically BI has been quite static and looking backwards, that what traditional BI has been. From now on it will be going towards reactive and predictive analytics and reporting. Moving also towards end-users"*. Consequently, AI is seen to be one of the key-factors in mining relevant data, for example interviewee 16 says: *"When enormous amounts of data will be collected, we will just collecting it and putting it into lake to see what business AI can get out of it"* and interviewee 2 says: *"Well, the direction now, when we have collected and combined different data sources is predictive analytics and machine learning, there is a huge potential in it".*

Secondly, data was considered a valuable asset. Especially, in the case of big data, when combining organizational data with external data sources. In addition, intellectual capital was named to be an upcoming trend, for example interviewee 28 says: *"Before going into technological details, the most important is that data and knowledge is treated as capital. If we look at the most successful companies in the world, they are handling quite well their intellectual capital. We have many examples of companies doing that successfully, but still too many executives are considering it to be ICT related thing"*. Organizations will be emergently focusing on their IC and its value.

Thirdly, also the potential of external data sources and social data co-creation was pointed out clearly, for example interviewee 17 is saying: *"Considering online external data in decision-making process, so that the data model changes based on new data. Customer, situation and product-based decision-making. I believe that it will be expanding and affecting business. Also marketing and advertising will be more personal and tied to situation"* and also interviewee 12 says: *"Enriching organizational data with external data sources, will be the trend"*. Data-driven decision-making is essential also in managing external data sources, for example interviewee 28 says: *"Evidence based decision-making also in creating business with external data. Not accepting any decisions without proven with data. But this is not a technological issue, it is a mindset thing"*.

Fourthly, one of the most interesting openings was social co-creation of BI, for example interviewee 16 says: *"The use of external data will be certainly growing. There*

will be social sharing or communities. We have a lot of external open data, that anyone can use, also in terms of social interaction. That kind of things give great ideas to companies, how they can use external data and combine it with internal one. There is a huge potential, for example in connecting location or demographic data to operational data" and interviewee 26 says: *"More of going towards knowledge management platforms, where we will be able flexibly combine data from many different data sources and for different purposes".* This social co-creation of BI can be beneficial for all members of this data-sharing ecosystem -type of interaction, as completely new data can be created out of the existing ones when combined.

In addition, fifthly, the minor theme was what will be left behind in terms of BI. One of the descending trends was considered to be traditional reporting. Interviewee 23 is saying: *"I think that in the long run, all kinds of data warehousing will be left behind. The data lakes are the ones to be instead. No more routine reporting"*. Interviewee 14 is saying: *" I am not saying that they will totally disappear, but at least the role of standard reporting will be much smaller. There is still certain demand, but they will be done more flexibly avoiding the massive reporting"*. Interviewee 28 says: *"There will be less of traditional BI reporting, its role will become smaller"*.

However, the goal is to combine the existing organizational data with external data, and to develop potential for new products and services through social co-creation of BI. Another important aspect of BI was seen to be utilizing AI opportunities and operating with predictive and prescriptive analytics in decision-making process. Consequently also in this case, creating potential for new business opportunities.

4.2 The future opportunities of BI and BA

The drivers, IC components, future BI and BA factors and the value creation is being illustrated in below Table 5. The first driver reflects enhancing service and products production and delivery. Also, process excellence and predicting business are also being a part of the first driver. Here, the related IC components are human capital, describing the capability of BI and BA utilization in decision-making process as well as structural capital, providing the timely and relevant data for decision-making. The future trends were identified to be predictive and prescriptive analytics, AI and as a result, reduction of

traditional mass-reporting.

Table 5. Future BI factors in IC ecosystem: empirical results analysed based on Secundo et al. (2017) framework..

Driver	**IC component**	**Future BI factor**	**Value**
- Enhanced service production and delivery of services and products - Process excellence and flexibility - Predicting business	Human capital - Capability of BI and BA utilization in decision-making Structural capital - Timely data to enhance decision-making	- Predictive and prescriptive analytics - Artificial Intelligence - Leaving behind traditional mass-reporting	- Operational efficiency and performance excellence - Data-driven evidence-based decision-making
- Progressing innovation - Enhancing performance - Creating new innovations and solutions to support the customers needs	Human capital - BI and BA capabilities with the organization - combining different data sources Structural capital -Advanced BA and processes for BI processing Social capital - Ascended customer demands Relational capital - Interaction between stakeholders in terms of data sharing	- Utilization of external data sources - Combining internal and external data, i.e. big data	Value creation by mastering in customer reporting and efficient data utilization, service excellence
- Creating new radical business innovations - Creating new business concepts	Structural capital -Advanced BA and processes for BI processing Human capital - Internal and external capabilities enabling the BI utilization Social capital - Ascended customer	- Advanced utilization of external data, i.e. big data - Social co-creation of BI and BA - KM platforms to utilize different data sources	New core business out of data, advanced utilization of external sources, social BI and BA co-creation, BI ecosystems

	demands Relational capital - Interaction between stakeholders in terms of data sharing IC ecosystem		

The second driver is to progress innovation and enhance performance. Also, to create new innovations. Nevertheless, the related IC components are human capital, describing the internal and external capabilities enabling the BI utilization, structural capital, more specifically advanced BI-tools and processes for BI processing, social capital, ascended customer demands and relational capital, describing interaction between stakeholders in terms of data sharing. The future trends were identified to be utilization of external data sources and combining internal and external data sources. As a result, value creation by mastering in customer reporting and efficient data utilization, service excellence.

The third driver is to create new radical business innovations and new business concepts. However, the related IC components are structural capital for more specifically advanced BI-tools and processes for BI processing, human capital for internal and external capabilities enabling the BI utilization, social capital for ascended customer demands, relational capital for interaction between stakeholders in terms of data sharing and IC ecosystem as a combining platform of knowledge sharing. The future trends were identified to be advanced utilization of external data sources, social co-creation of BI and KM platforms to utilize different data sources. As a result, creating the potential for new core business out of data, advanced utilization of external sources, social BI co-creation and social BI ecosystems.

As a summary, the future factors as well as their drivers can be considered multidimensional. By studying the IC ecosystem through the lens of BI related concept of Big Data, we can identify the three levels of value, as a benefit of BI utilization. In this study, the IC component is describing the components of intellectual capital, that are being exploited in each of the driver level. Next, future BI factor is describing the future potential of BI utilization in the private healthcare. In addition, the value creating factors are

describing the value created by IC components and BI factors in the private healthcare.

5 Conclusions

The healthcare, especially the private sector, is facing changes and challenges all over the world, also having a pressure for improving performance (Ratia and Myllärniemi 2017; Myllärniemi 2013). The utilization of BI and BA could be considered as one of the ways to enhance efficiency in the organization (Ratia and Myllärniemi 2017; Nykänen et al. 2016; Malmi 1999). We analyzed the future BI and BA factors in IC ecosystem model to gain better understanding of the drivers, IC components, future BI and BA factors and created value in the context of the private healthcare in Finland (Secundo et al. 2017; Ratia and Myllärniemi 2017).

Traditionally BI has been seen as a combination of technology and process. BI has also been described as a complex combination of several and various definitions, such as being as a unifying phrase or term, combining different tools, applications and methods (e.g. Nykänen et al. 2016; Turban et al. 2008). However, recently the focus of BI has been more on enabling analysis of business data to create deep understanding of business and market for organizations and support appropriate business decisions (Côrte-Real et al. 2014; Nykänen et al. 2016). Thus, the updated concept of BI has enabled new methods and BI related and derived concepts, e.g. BA, Big Data and machine learning, that have been used alternatively or even interchangeably (Trieu 2017; Wang et al. 2016). Nevertheless, the value that is being generated of updated concepts of BI and BA is created not only by the methods and processes, but also requiring capabilities, such as IC components, i.e. human capital (Secundo et al. 2017; Borin and Donaro 2015).

Based on our findings, the private healthcare sector is stepping towards a new phase of data-driven decision-making, where it is required to change the whole set of mind towards data utilization and required capabilities. From looking backwards, into historical data, the focus will be more towards predictive analytics, and the future. The nearest future of BA is about organizational data utilization capability, i. e. operational data sources, towards combining multiple data sources, i.e. external data, and more systematic data analytics. These require several IC components to succeed. If the goal is to predict future,

the most efficient way is through social co-creation. Thus, data is the key asset, it must be treated as a capital.

Our study establishes a link between IC components and future factors BI/BA. However, our research showed, that there can be several drivers for BI and BA. The actual drivers varied from enhanced product and service production, performance excellence to innovation potential and new business opportunities. Also, the more complex drivers were involved, also the more IC components were involved in value production. However, the more complex value expectations were required, the more significant was the role of IC dimensions. The future needs are being presented as future BI factors, acting together with IC components. The findings of the research were, that the future factors of BI varied from practical tools and methods, such as predictive and prescriptive analytics along with AI, to more conceptual factors, such as social BI co-creation and BI co-creation platforms. In addition, the future factors of BI were quite similar in the private healthcare organizations and consulting companies. As a result of combining different IC components and future BI factors was value, created to the organizations in the private healthcare.

The practical outcome of this research will provide valuable understanding on the future of BI and BA in the Finnish private healthcare sector companies. In addition, this paper is in its own part establishing a discussion of potential role of IC components in future data-driven value creation in the private healthcare. Furthermore, advanced BI practices also in the future would increase the ability of value creation in the private healthcare sector companies. Thus utilizing of BI or BA methods, not only in the decision-making, but also in creating the potential for new business opportunities.

Nevertheless, there are several limitations of the study. First, even though the amount of private healthcare organizations in the research is covering the most of certain sized companies of the private healthcare sector in Finland, not all of the organizations are covered. Second, the companies have been studied at a certain organizational level and a business perspective, covering mainly managerial, financial, ICT and executive levels, however not researching for example medical or support personnel. Finally, the exact processes, methods and practices in organizations remain unclear yet.

Also, in order to get more specific perspective on this issue, we need to gather more empirical data from the private healthcare organizations, especially from different organizational levels to accomplish a broader view on the benefits of BI and BA utilization and also, to achieve even more deep understanding of factors having impact on enhanced decision-making in the private healthcare sector (Ratia et al. 2017; Brandão et al. 2016). Moreover, we need to study more of data analytic methods and processes, i.e. BI-tools, to be able to point out requirements and features that are essential for the private healthcare sector to gain deeper understanding of factors having impact on value creation (Ratia et al. 2017; Brandão et al. 2016; Gartner 2017). In addition, human capital and information hiding is an interesting an emerging theme in the context of IC and KM discussion (Asrar-ul-Haq and Anwar 2016).

References

Andriessen, D. (2005). Implementing the KPMG value explorer: critical success factors for applying IC measurement tools. Journal of Intellectual Capital, Vol. 6 No. 4, pp. 474-488.

Asrar-ul-Haq, M., & Anwar, S. (2016). A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges. Cogent Business & Management, 3(1),

Bates, D., Saria, S., Ohno-Machado, L., Shah, A., Escobar, G. (2014). Big Data In Health Care: Using Analytics To Identify And Manage High-Risk And High-Cost Patients. Health Affairs 33.7, Jul2014, pp.1123-31

Borin, E. and Donato, F. (2015). Unlocking the potential of IC in Italian cultural ecosystems. Journal of Intellectual Capital, Vol. 16 No. 2, pp. 285-304

Brandão, A., Pereira, E., Esteves, M., Portela, F., Santos, M. F., Abelha, A. and Machado, J. (2016). A Benchmarking Analysis of Open-Source Business Intelligence Tools in Healthcare Environments. Information, 7(4), pp.57

Brody, R. (2008) Issues in defining competitive intelligence: An exploration. Journal of Competitive Intelligence and Management, 4(3), 2008, pp.3–16

Cases, M., Furlong, L., Albanell, J., Altman, R. B., Bellazzi, R., Boyer, S., Brand, A., Brookes, A. J., Brunak, S., Clark, T. W., Gea, J., Ghazal, P., Graf, Guigó, R., Klein, T. E., López-Bigas, Maojo, Mons, B., Musen, M. and Oliveira, J. L. (2013). Improving data and knowledge management to better integrate health care and research. Journal of Internal Medicine. Oct 2013, Vol.274 Issue 4, pp.321-328

Chaudhuri, S., Dayal, U. and Narasayya, V. (2011). An Overview of Business Intelligence Technology. Communications of the ACM. Vol.54, pp.88-98

Côrte-Real, N., Ruivo, P. and Oliveira, T. (2014). The diffusion stages of business intelligence & analytics (BI&A): A systematic mapping study. Procedia Technology. Vol.16, pp.172–179

Demirkan H. 2013. A Smart Healthcare Systems Framework. IT Professional. Sept/Oct 2013. Vol.15, Issue 5, pp.38-45

Dumay, J. and Garanina, T. (2013). Intellectual capital research: a critical examination of the third
stage. Journal of Intellectual Capital, Vol. 14 No. 1, pp. 10-25

Dumay, J. (2016). A critical reflection on the future of intellectual capital: from reporting to disclosure. Journal of Intellectual Capital, Vol. 17 No. 1, pp. 168-184.

Edvinsson, L. and Lin, C.Y.-Y. (2009). National Intellectual Capital: A Comparison of 40 Countries,
Springer, New York, NY.

Edvinsson, L. and Lin, C.Y.Y. (2012). National intellectual capital model and measurement. International Journal of Knowledge-Based Development, Vol. 3 No. 1, pp. 58-82

Elbashir, M., Collier, P. and Davern, M. (2008). Measuring the effects of business intelligence systems: The relationship between business process and organizational performance. International Journal of Accounting Information Systems. Vol.9, pp.135–153

Elbashir M., Collier P., Sutton S., Davern M. and Leech S. (2013). Enhancing the Business Value of Business Intelligence: The Role of Shared Knowledge and Assimilation. Journal of Information Systems. Vol.27, No. 2. Fall 2013, pp.87–105

Fleisher, C. S. and Bensoussan, B. E. (2007). Business and competitive analysis. Effective application of new and classic methods, Pearson Education, New York.

Gilad B. and Gilad T. (1985). A systems Approach to Business Intelligence. Business Horizons. Vol.28, No. 5, pp.65-70

Grierson, H.J., Corney, J.R. and Hathcher, G.D. (2015). Using visual representations for the searching and browsing of large, complex, multimedia data sets. International Journal of Information Management 35 (2015) pp. 244–252

Guthrie, J., Ricceri, F. and Dumay, J. (2012). Reflections and projections: a decade of intellectual capital accounting research. British Accounting Review, Vol. 44 No. 2, pp. 68-92

Hagen, H.-O. and Hagsten, E. (2006), "Dărför behöver produktiviteten i den offentliga sektorn mătas". Rapport till Expertgruppen för Studier i Samhällsekonomi 2006:2, Fritzes, Stockholm.

Hugos, M.H. and Hulitzky, D. (2011). Business in the Cloud: What Every Business Needs to Know About Cloud Computing. John Wiley & Sons, Inc.

Jiang, P., Winkley, J., Zhao, C., Munnoch, R., Min, G. and Yang, L.T., (2014). An intelligent information forwarder for healthcare big data systems with distributed wearable sensors. Syst. J. IEEE 1–9 pp. 99

Jinpon P., Jaroensutasinee M. and Jaroensutasinee K. (2011). Business Intelligence and its Applications in the Public Healthcare System. Walailak Journal of Science and Technology (WJST). 2011. Vol8, Issue 2, pp.97-110

Katsaliaki K. and Mustafee N. (2011). Applications of simulation within the healthcare context. Journal of the Operational Research Society. Aug2011, Vol.62, Issue 8, pp.1431–1451

Kakhki, M. D. and Palvia, P. (2016). Effect of Business Intelligence and Analytics on Business Performance. Business Intelligence and Analytics and Performance. Twenty-second Americas Conference on Information Systems, San Diego, 2016.

Krumholz, H.M. (2014). Big Data And New Knowledge In Medicine: The Thinking, Training And Tools Needed For A Learning Health System. Health Affairs 33.7. Jul2014. pp.1163-70

Kujala, J., Lillrank, P., Kronström, V. and Peltokorpi, A. (2006) Time-based management of patient processes. Journal of Health, Organisation and Management, Vol. 20, pp.512-524.

Kujansivu, P. (2009). Is something wrong with intellectual capital management models? Knowledge Management Research & Practice, Vol. 7 No. 4, pp. 300-307.

Lapierre J. (2000). Customer-perceived value in industrial contexts, Journal of Business & Industrial Marketing 2/3, pp.122-145.

Lönnqvist A. and Pirttimäki V. (2006). The measurement of business intelligence. Information Systems Management , Vol.23, 2006. Issue 1, pp.32-40

Lönnqvist, A., Sillanpää, V. and Carlucci, D. (2009). Intellectual capital management in practice:
assessment of implementation and outcomes. Knowledge Management Research & Practice,

Vol. 7 No. 4, pp. 308-316.

Malmi, T. (1999). Activity-based costing diffusion across organizations: an exploratory empirical analysis of Finnish firms. Accounting, Organizations and Society. Vol.24, pp.649–672

McLellan, E., MacQueen, K. M. and Neidig, J L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. Sage Journals, Feb2003, pp.63-84

Moustaghfir, K. and Schiuma, G. (2013). Knowledge, learning and innovation: research and perspectives. Journal of Knowledge Management, Vol. 17 No. 4, pp. 495-510

Murdoch, T.B. and Detsky, A.S. (2013). The inevitable application of big data to health care. J. Am. Med. Assoc. 309 (13), pp. 1351–1352

Myllärniemi, J. and Helander, N. (2012). Healthcare System as a Value Network. World Review of Entrepreneurship, Management and Sustainable Development. 2012, Vol.8, Issue 2.

Myllärniemi, J., Okkonen, J., Paavilainen, J., & Vuori, V. (2012). Negative competition steering patient flow in a public-private healthcare co-opetition setting–a Finnish case. World Review of Entrepreneurship, Management and Sustainable Development, 8(2), pp. 208-220.

Myllärniemi, J. (2013). Knowledge processes in healthcare network - a case study. 8th International Forum on Knowledge Asset Dynamics, IFKAD 2013, 12.-14.6.2013, Zagreb, Croatia. Zagreb, Croatia: Institute of Knowledge Asset Management, pp.1223-1236

Möller, K., Rajala, A. and Svahn, S., (2005). Strategic business nets—their type and management. Journal of Business Research. Vol.58, Issue 9, Sep2005, pp.1274–1284

Nordgren, L. (2009). Value creation in health care services – developing service productivity. Experiences from Sweden. International Journal of Public Sector Management Vol.22 No. 2, 2009 pp.114-127

Nykänen, E., Järvenpää, M., and Teittinen, H. (2016). Business intelligence in decision making in Finnish enterprises. Nordic Journal of Business, 65 (2), pp.24-44.

Ojala, A. and Helander, N. (2014). Value Creation and Evolution of a Value Network: A Longitudinal Case Study on a Platform-as-a-Service Provider. System Sciences (HICSS), 2014 47th Hawaii International Conference on, Issue Date: 6-9 Jan. 2014.

Parolini, C. (1999). The Value Net. A Tool for Competitive Strategy, John Wiley & Sons Ltd: Great Britain.

David J. Pauleen, (2017). Davenport and Prusak on KM and big data/analytics: interview with David J. Pauleen. Journal of Knowledge Management, Vol. 21 Issue: 1, pp.7-11.

Petty, R. and Guthrie, J. (2000). Intellectual capital literature review: measurement, reporting and
management. Journal of Intellectual Capital, Vol. 1 No. 2, pp. 155-176

Pike, S. and Roos, G. (2007). Recent advances in the measurement of intellectual capital: a critical
survey. The 8th European Conference on Knowledge Management, Barcelona, September 2007, pp. 6-7

Pirttimäki, V. (2006). Business Intelligence as a Managerial Tool in Large Finnish Companies. Tampere University of Technology. Publication 646. Doctoral thesis. Tampere, Finland.

Popovič, A., Hackney R., Coelho P.S. and Jaklič J. (2012). Towards business intelligence systems success: effects of maturity and culture on analytical decision making. Decision Support Systems. Vol.54, pp.729–739

Popovič, A. (2017). If we implement it, will they come? User resistance in post-acceptance usage behaviour within a business intelligence systems context. Economic Research-Ekonomska Istraživanja, 2017. VOL. 30, NO. 1, pp. 911–921

Qu, S.Q. and Dumay, J., (2011). The qualitative research interview. Qualitative Research in Accounting & Management, 8(3), pp. 238-264.

Raghupathi W (2010): Data Mining in Health Care. In Healthcare Informatics: Improving

Efficiency and Productivity. Edited by Kudyba S. Taylor & Francis; 2010: pp. 211–223.

Raghupathi, W. and Raghupathi, V. 2014. Big data analytics in healthcare: promise and potential. Health Information Science and Systems. 2014 2:3.

Ratia, M. and Myllärniemi, J., 2017. Business intelligence tools for private healthcare data-driven value creation. Proceedings of IFKAD 2017, St. Petersburg, Russia, 7-9 June 2017. pp.408-19.

Ratia, M., Myllärniemi, J. and Helander, N. (2017). Benefits and Required Capabilities of BI-tools in the Private Healthcare. Proceedings of the 21st International Academic Mindtrek Conference. ACM. Tampere, Finland . September 20 - 21, 2017. pp. 103-110

Ratia, M. (2018). Intellectual Capital and BI-tools in Private Healthcare Value Creation. The Electronic Journal of Knowledge Management, Vol 16, Issue 2, pp. 143-154

Ratia, M. and Myllärniemi, J. (2018). Beyond IC 4.0: The Future Potential of BI in the Private Healthcare. Proceedings IFKAD 2018. Delft, Netherlands, 4-6 July 2018. pp. 1652-1667

Sallam, R. L., Howson, C., Idoine, C. J., Oestreich, T.W., Richardson, J. L. and Tapadinhas J., (2017). Magic Quadrant for Business Intelligence and Analytics Platforms. Gartner 2017.

Secundo, G., Dumay, J., Schiuma, G. and Passiante G. (2016). Managing intellectual capital through a collective intelligence approach. An integrated framework for universities. Journal of Intellectual Capital. Vol. 17 No. 2, 2016. pp. 298-319

Secundo, G., Del Vecchio, P., Dumay, J. and Passiante, G. (2017). Intellectual capital in the age of Big Data: establishing a research agenda. Journal of Intellectual Capital, Vol. 18 Issue: 2. pp. 242-261

Silvestri, A. and Veltri, S. (2011). The intellectual capital report within universities: comparing experiences. Economic Science Series, Vol. 20 No. 2, pp. 618-624

Spruit, M., Vroon, R. and Batenburg, R. (2014). Towards healthcare business intelligence in long-term care. An explorative case study in the Netherlands. Computers in Human Behavior, 2014. Vol.30 pp.698–707.

Suomi, R. and Tähkäpää, J. (2002). The Strategic Role of ICT in the Competition Between Public and Private Health Care Sectors in the Nordic Welfare Societies - Case Finland. Proceedings of the 35th Hawaii International Conference on System Sciences - 2002

Stewart, R. and Davis K. (2016). 'Big data' in mental health research: current status and emerging possibilities. Social Psychiatry and Psychiatric Epidemiology. Aug2016, Vol.51, Issue 8, pp.1055–1072

Swanson, R. C., Cattaneo, A., Bradley, E., Chunharas, S., Atun, R., Abbas, K. M., Katsaliaki, K., Mustafee, N., Meier, B. M. and Best, A. (2012). Rethinking health systems strengthening: key systems thinking tools and strategies for transformational change. Oxford Journals. Medicine & Health. Health Policy and Planning Vol.27, 2012. Issue supply 4. pp. iv54-iv61.

Teperi, J., Porter, M.E., Vuorenkoski, L. and Baron, J.F. (2009) The Finnish Health Care System: A
Value-Based Perspective, Sitra Reports 82, Helsinki, Finland.

Trieu, V. (2017). Getting value from Business Intelligence systems: A review and research agenda. Decision Support Systems. Vol. 93, January 2017, pp. 111-124

Turban, E., Aronson, J. E., Liang, T-P. and Sharda, R. (2008): Business intelligence: a managerial approach. Pearson Prentice Hall, New Jersey.

Visinescu, L. L., Jones, M.C. and Sidorova A. (2016). Improving Decision Quality: The Role of Business Intelligence. The Journal of Computer Information Systems. Vol. 57. Issue 1. Fall 2016, pp. 58-66

Walter, A., Ritter, T. and Gemünden, H.G. (2001). Value creation in buyer-seller relationships. Industrial Marketing Management 30(4), pp.365-377.

Wang, Y., Kung, LA., Ting, C. and Byrd, T.A. (2015). Beyond a technical perspective:

understanding
big data capabilities in health care. System Sciences (HICSS), 2015 48th Hawaii International Conference, pp. 3044–3053

Wang, Y., Kung, LA., Byrd., T. A. (2016). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. Technological Forecasting and Social Change Vol. 126, January 2018, pp. 3-13

Ward, M. J., Marsolo, K. A., and Froehle, C. M. (2014). Applications of Business Analytics in Healthcare. Business horizons, 57(5), 571–582.

Wullianallur R. and Viju R., (2014). Big data analytics in healthcare: promise and potential. Health Information Science and Systems. 2014, 2:3.

Yeoh W. and Koronios A. (2010). Critical success factors for business intelligence systems. Journal of computer information systems, Spring 2010, pp.23-32

Yeoh, W. and Popovič, A. (2015). Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems. Journal of Association for Information Science and Technology. Vol. 67, Issue1, January 2016, pp. 134-147

Yin, R.K., 2003. Case study research: design and methods. 3rd ed. Thousand Oaks: Sage.