# The Role of IP in a Data-Driven Business Model

A Case Study in a Healthcare Company

Master's Thesis in Entrepreneurship and Business Design

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# Abstract

The digital transformation has impacted healthcare actors to reconsider their value offerings. Traditional hardware products are today connected devices that enable more data to be generated and captured by the healthcare actors. Healthcare companies are facing challenges in utilizing data value in their businesses and developing data-driven products. Generating meaningful data analytics and insights are seen to be critical in competition. Intellectual property (IP) has been well recognized in protecting valuable assets for healthcare actors historically, and along with the trend of digitalization, firms are facing challenges to adapt their IP strategies in innovation and product development to fit their data-driven business models. Thus, this study investigates the role of IP in data-driven business models at a global healthcare company to explore their insights into the topic.

A single case study was chosen to provide an in-depth research of the topic. A qualitative approach with semi-structured interviews was conducted to collect empirical findings with employees at the studied company Philips.

The empirical findings have addressed the evidence that IP's role is central for creating value in a data-driven business model at Philips, where the two most discussed protections are patents and trade secrets. Furthermore, IPs give control points to both hardware and software solutions in the data-driven business model, concerning the acquisition of the raw data as well as the implementation of AI for generating insights. The combination of various IP protections was assessed to provide the key control position against competition.

The conclusion from the research emphasizes that the IP strategy must be aligned to the business strategy to ensure value creation in the data-driven business model. The researchers created a new framework to illustrate the conclusion for contributing to the existing theory by integrating technology assets, value creation, and IP into the data value chain. The developed framework TVID (Technology and IP Based Data-Driven Value Framework) is expected to be an applicable model for healthcare actors like Philips to ensure their IPs correspond with the technology assets and value offering in data-driven business models.

**Keywords**: *Intellectual Property, IP, Value creation, Technology Assets, Data Value Chain, Data-driven Business Models, TVID Framework*

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David Lager & Yuejun Sun, Gothenburg 8th of June 2021

# Abbreviations

AI: Artificial Intelligence
DDBM: Data-Driven Business Model
EPO: European Patent Office
IAM: Intellectual Assets Management
IoT: Internet of Things
IP: Intellectual Property
IPR: Intellectual Property Right
IPs: Intellectual Property in plural
MRQ: Main Research Question
SQ: Sub-Question
TVID: Technology and IP Based Data-Driven Value Framework
WIPO: World Intellectual Property Organization

# Table of Contents

# 1. Introduction

*This chapter covers the introductory parts of the study. The subchapters are divided into five headings to present the background material of the study and the framing of the research purpose and research questions. The following subcategories in chapter one is structured into: Background, Problem Discussion, Research Purpose, Research Questions and Delimitations.*

## 1.1 Background

During the last decades, the major digital transformation impacting society has been a broadly discussed topic. Previously seen as standardised hardware products are today connected devices through the rise of Internet of things (IoT) solutions. This has enabled firms and organizations to gather data from their users. The increasing collection of raw data generated from firms' connected product- and service offerings requires investments in processing the raw data into insights (Senthilkumar et.al, 2018). However, due to the rapid development of connected devices, firms' capacities to handle such volumes of data have been challenged (Senthilkumar et.al, 2018; Vasal et al., 2019). In order to cope with the exponential amount of data that is collected, firms need to develop capabilities within these disciplines. Areas such as advanced data sciences and the integration of AI in daily practices are broadly discussed to handle the data more efficiently (Senthilkumar et.al, 2018).

Firms like Amazon, Google, Facebook and Netflix have been very successful in utilizing data in their business model innovation processes (Sorescu, 2017). In a survey performed by IBM, it was said that firms that applied data-driven elements as big data in their models were more likely to succeed in comparison to their competitors by 36% in terms of operating efficiency and revenue growth (Marshall et al., 2015; Sorescu, 2017). Research has shown that firms' internal capacities to generate value from data varies and therefore a well-functioning data strategy is an essential step to ensure the data gatherings contribution to the firm's bottom line (Vasal et al., 2019). This has led to firms transforming their product- and service-based business models into more data-driven business models that utilize big data analytics to capture more value from their traditional business (Senthilkumar et.al, 2018; Wang & Hajli, 2017).

One industry sector that has been subject to this change and generated a large amount of data is the healthcare industry (Wang & Hajli, 2017). 30 percent of all generated raw data originating from the healthcare sector, however, only 10 percent of the raw data is well deployed, which indicates its value to not be fully captured into useful insights (Wang & Hajli, 2017). This large amount of raw data generated and the fact only a small percentage is turned into valuable insights makes the industry have great potential to adopt data-driven business models. Therefore, data-driven business models are demanded for healthcare companies to deploy (Wang & Hajli, 2017; Gopal et.al, 2019).

Furthermore, handling such great data volumes requires capacity to store and manage it properly, which is a major issue within healthcare. The data collected constitutes usually of various data types, which leads to a big challenge of storing and managing the data properly (Gopal et.al, 2019). This forces healthcare companies to work out how user data can be employed efficiently to improve their value-offering and strengthen the customer relationship. Such developments would lead to an engaging and more profound relationship between the user and the firm due to personalized user-generated data insights and personalized service (Vasal et al., 2019; Senthilkumar et.al, 2018).

A recent example that discloses the development and innovation with data-driven applications in healthcare is the global effort shown during the Covid-19 pandemic (Jazieh & Kozlakidis, 2020). Technology innovation and digitalization has evolved at a fast pace and created a new era of data-driven scenarios. Digital health technologies and new applications have accelerated under the catalysis of the pandemic (Jazieh & Kozlakidis, 2020). The significant utilization of mobile health, wearable devices, and telehealth technologies are identified in the technology area of IoT applications (Attipoe-Dorcoo et al., 2020). IoT provides the necessary connectivity of different devices and sensors with the internet, enables information to be sent and received in real-time, and acquires a large amount of data. The technology has been developed especially in healthcare applications, including innovations on sensors, machine learnings, analysis, and integration of systems. The smart hospital and smart care service are therefore enabled and accelerated. The wireless possibility also increased the scope of connection, allowing technologies in remote-healthcare and telehealth care (Javaid & Khan, 2021).

A data-driven approach has additionally provided remote diagnostic and monitoring with new options by identifying diseases before symptoms arise through remote screening and then alarming the patients. The integration of data from all platforms such as electronic health records and diagnostics can transform healthcare to becoming more patient-centric and provide greater value. Data cooperation platforms also accelerate future innovation that can benefit people in a larger scope. The sharing of data through digital platforms provides opportunities in solving complex problems in a short time instead of facing them one at a time in an isolated manner (Farrugia & Plutowski, 2020). Farrugia & Plutowski (2020) also suggested that the clinical players must seize cross-sector partnerships in science and technology deploy new digital health care solutions together. It is especially important to coordinate the use of data and advanced analytics in collaboration.

Innovation trends have increased substantially, which have speeded up the transition from traditional healthcare to modern digital healthcare. Another typical sign of innovation is the technology patenting trend. According to a report from the European Patent Office (EPO), investments in medical and diagnostic equipment have been intensive for years. There has been an inexorable rise in filings to EPO in the past decades. The EPO patent index 2020 has also indicated that medical technology has been the leading role of patent filings during 2020 compared over all technology clusters. Together with two other healthcare-related sectors, namely biotechnology and pharmaceuticals, these three patent sectors have shown the fastest growth rate in comparison to other technology fields. Inventions relating to digital networks has expanded utilization areas greatly. Healthcare companies compete to capture innovation opportunities, where a greater volume of data can be captured through new technologies (EPO, 2021).

Sebastian et al., (2020) discussed the digital transformation for traditional big companies regarding the adaption of new digital business models. They disclose that in most industries, the majority of the big companies will have their revenues relied on traditional products and services before they could find a clear way towards data-, cloud- or analytical- driven approach. The value propositions are the growing accessibility in data to enrich product, services and customer relationships. They further suggest that a digital strategy will be needed to be based on the business strategy, which leads to decisions of technology-enabled assets as an operational backbone together with a digital service platform. Data-driven business models in healthcare are well included in the discussion as Sebastian et al., (2020) draw the discussion across industries. The trends and activities in establish new data-driven business models are found to be relevant, such as aiming at building patient-centric and information-rich and -integrated care systems (Thompson & Brailer, 2004; Rantala & Karjaluoto, 2016). Concerning the technology backbone to be found for the healthcare industry, the discussion again relates to the medical technology patent trends identified in the previous paragraph. The phenomenon discloses the importance of capturing both technology and business in a data-driven era for a company to achieve the transformation. In addition to contributing to the development of the firm's product and service offerings, the valuable insights of users' routines, usage and interaction could be monetized by selling data to third parties (Trabucchi et al, 2017).

A lot of the healthcare technology innovations developed today are data-driven functions based intensively on AI. Bader & Stummeyer (2019) have studied the topic and explained that AI applications are relying greatly on data. The purpose of integrating AI in data-driven business models are due to finding, extracting, and summarizing data accurately to enable forecasts based on the analysed data (Bader & Stummeyer, 2019). IP's role in protecting AI-related inventions and thereby their business models are important to further investigate.

In order to succeed with the transformation from product-and service-based business models to data-driven ones in healthcare, issues around how to protect and capture value-generating activities must be assessed. Intellectual properties as patents, trademarks, design rights, copyright and trade secrets are in various regularity assumed to be applied to secure important assets to the data-driven business models, which the researchers found as an interesting research topic to investigate.

## 1.2 Problem Discussion

Existing research found within the healthcare industry in relation to data-driven business models is focused upon discussing the challenges of generating valuable insights from the gathered raw data (Senthilkumar et.al, 2018; Wang & Hajli, 2017). IoT and big data analytics are said to be broadly adopted in healthcare innovation (Bhatt et al, 2017). Such value creation activities serve an important purpose to drive growth and develop new technology applications to strengthen firms' business models. Patenting and other IPs have been presented as important strategies for creating value to technology innovations in a healthcare company (WIPO, 2020). However, IP's applicability and impact to protect such new technology innovations to data-driven business models for healthcare companies have not been clearly discussed in previous research.

A lot of questions addressed by the data-driven business model are still left unanswered in research around the healthcare setting (Wang & Hajli, 2017). The authors of this study have identified a research gap regarding IP's role in creating value to data-driven business models for healthcare companies. Since IP plays a central role when it comes to protecting technology inventions in healthcare and that data-driven business models are an increasing topic of interest, the identified gap requires exploration and explanation. The area is by the researchers viewed as important to understand for healthcare companies to create more value and enhance their IP strategies in relation to data-driven business models.

## 1.3 Research Purpose

Data-driven business models are enhancing in importance due to the rise of data acquisition in the healthcare industry. The advantages of incorporating data-driven business models inside the healthcare company are potentially higher customer satisfaction and profitability through value creation activities (Senthilkumar et.al, 2018). Since IP has been playing an essential role in healthcare companies' innovation activities, it's interesting to study how IP could contribute to data-driven business model. Therefore, this study will investigate how the incorporation of intellectual properties in data-driven business models impact the firm's value creation activities and strategies. By conducting a study at a healthcare company, the dissertation aims to explore how IPs are perceived and utilized in relation to data-driven business models and how IP strategy is developed within the analysed company. Moreover, the research aims to discuss how IP could be utilized in data-driven business models by comparing empirical findings with theoretical frameworks in order to provide a recommendation for healthcare companies. In addition to the above motivation of research purpose, this research also intends to provide an overview of how intellectual properties are utilized in data-driven business models within a healthcare company.

## 1.4 Research Questions

In order to fulfil the purpose of this study, the specific research question that will be explored in this dissertation is framed as follows*:*

**MRQ:**

- *How is IP applied into data-driven business models and creating value within a Healthcare company?*

To accomplish the aim of answering the main research question, sub-questions are designed as stated:

**SQ1:**

- *How are technology assets developed according to data-driven business models in a healthcare company?*

**SQ2:**

- *What are the most applicable IPs in controlling such technologies to data-driven business models?*

**SQ3*:***

- *How could healthcare actors create value through IP strategy in data-driven business models?*

## 1.5 Delimitations

The research purpose of investigating how IP is incorporated in data-driven business models and impacting a healthcare company's value creation activities and strategies forms several topics to explore. One possibility is to take a legal standpoint and study regulatory frameworks impact on the research topic. However, this point of view is excluded due to making the study more manageable for the researchers. The researchers have also ignored the possibility of making a deep dive into data strategies and data policies in the studied healthcare company. Instead, the focus has been on understanding the data gathered from connected devices and how IP is impacting the value creation concerning data-driven business models.

Another delimitation of the study is the absence of examining geographical differences and preferences to the research topic. Aspects about potential cultural variations in how IP is applied into data-driven business models around the globe are not researched. Therefore, the study makes no intention of distinguishing or evaluating geographical perceptions in relation to the topic. Furthermore, possible differences in opinions due to age and gender are not discussed either.

Moreover, the research scope is directed towards a healthcare company's view on IPs role in data-driven business models. This delimits the study scope of potentially researching the healthcare system in general. Such a perspective would have been interesting to analyse as well, however that would have aggravated the intention of providing an in-depth study since combining a public and private perspective on the research topic would have been too extensive.

A final delimitation of the study is the approach of only looking into one large healthcare company with great resources and capacities inside the IP field instead for healthcare companies of various sizes. This delimitation was made due to encompass the study with detailed knowledge in relation to the research scope. However, such a decision makes the analysis and conclusions uncertain to correspond with the perceptions of other healthcare companies. The delimitation is specifically clear towards smaller healthcare companies, where similar research in that category could have differentiated findings substantially.

# 2. Theoretical Frameworks

*This chapter encompasses and displays the theoretical frameworks selected in relation to support the study. The following subchapters are framed to cover the content of this dissertation and lay the foundation for framing answers to the research questions. The chapter is structured into five sub-categories as the following: Definition of Technology Assets, Intellectual Property in Healthcare Innovation, Value Creation in Healthcare, Data-driven Business Model in Healthcare and Technology and IP Based Data-Driven Value Framework.*

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The selection of the theoretical frameworks is based on the research topic and the purpose of this study: aiming at discovering and researching the phenomenon of value creation through data-driven business models and its interplay with IP in a healthcare company. To ensure the empirical findings align with the research purpose, the study design uses a conceptual theoretical framework to guide the research findings. In each section, the basic concepts and definition will be presented, as well as the intentional utilization of the theory in the study.

## 2.1 Technology Assets

### 2.1.1 Definition of Technology Assets

The concept of technology has been explored in many types of research, but still not reached a universal definition. As Smith & Sharif, (2007: p.1) described:
*"Technology has become an integral part of nearly every business and social endeavour. However, despite this, each profession has different definitions for what technology is. A universally shared definition has not emerged— which indicates that the transformation of these professions by technology is still occurring faster than it can be codified".*

Earlier research has defined technology as knowledge, skills, process driving, product development and information utilization for greater value, collective learning in the organization as well as creating new industries (Burgelman et al.,2004; Christensen & Raynor, 2003; Prahalad & Hamel, 1990; Porter, 1985). Especially, Prahalad & Hamel (1990) emphasize the importance of skills in integrating multiple streams of technologies. (Sharif, 1995; 1999) further suggests that the streams of technology fall into four categories as technological assets, which are essential for the company to manage for capturing the competitive advantage. The four categories defined by Sharif (1995;1999) are "humanware, technoware, inforware, and orgaware.", which means the capabilities in technology, information, organization, and human resources. In some other researches, the definition of technology assets is kept on an intellectual level which means it may be a combination of intellectual assets and property that exploited by a company and has a scope defined as Intellectual Capital. (Roos et al., 1997; Utunen, 2003).

### 2.1.2 IAM Framework for Identifying Technology Assets

Another useful theory discussing technology assets is the Intellectual Asset Management (IAM) framework developed by Petrusson (2016), which can be used to identify the technology assets. Petrusson (2016) directs the IAM framework as a useful tool in promoting the utilization of academic research results to innovative business practice. The researchers of this study recognize that the IAM theory is applicable in the healthcare innovation setting. The framework by Petrusson (2016), introduces a model of *claiming, positioning, deciding,* and *organizing* the intellectual assets, which is beneficial for an innovation project to be commercialized. In the first part of the IAM framework, the claiming phase is explained as identifying and capturing intellectual assets (IA) from technology development. The technology development includes various technical solutions, methods and documents that generally being recognized as the technology assets for a firm (Petrusson, 2016).

Considering the benefits of applying such a categorization of the technology assets, this research will identify and link such terms in the studied case, aiming to build a connection with the other theoretical frameworks in the analysis chapter. Through the utilization of the IAM framework, the researchers aim to identify and claim control mechanisms that enable commercialization activities associated with such technology assets.

Petrusson (2016: p,337) emphasizes the categorization of knowledge assets is to "claiming intellectual assets to capture their unique character as knowledge phenomena." This definition is assessed by the authors of this study to be relevant for technology assets according to multiple external theories (Burgelman et al., 2004; Christensen & Raynor, 2003; Prahalad & Hamel, 1990; Porter, 1985; Roos et al., 1997; Smith & Sharif, 2007; Utunen, 2003). The categorization of knowledge assets recommended by Petrusson (2016) is presented into ten categories. According to the purpose of the study in the phenomenon of data-driven business models, the researchers find the following six categories of technology assets to be relevant:

*Data* – Collection of information in the form of raw data. This knowledge asset encompasses value in form of results from for example measurements, clinical tests, and interviews.

*Database* – Differentiating from data by being captured in an organized structure. A database is valuable since it provides an infrastructure within the healthcare company and establishes the development of insights from the raw data.

*Instruction* – Refers to how certain actions are directly linked to instructions. For example, a typical instruction for a technical solution is the algorithms.

*Software* – In addition to instruction, *Software* is determined as a unique category in the framework due to its performance of specific tasks. Platforms, systems, and applications are some parts where software creates great value.

*Solution* – This asset category suggests the engineered solution to a problem. This can be seen as a technical element that can vary in the overall importance of the functioning of the offering.

*Visualization* – In many aspects, it is similar to the technical solution category. However, the element of design such as drawings, models, prototypes etc. are highlighted in this category. The visualization category is applicable when the design adds extra value to a technical solution.

The chosen categories above give a brief and clear explanation about what type of technology assets are most relevant in data-driven business models according to the researchers' assessment. These categories are used as guidance and references for the researchers to identify the technology assets for the studied case found in empirical data. Additional categories to the above presented in the IAM framework are *observation*, *theoretical framework*, *narrative* and *creation* (Petrusson, 2016). These will however not be discussed in this report as commonly identified technology assets.

## 2.2 Intellectual Property in Healthcare Innovation

### 2.2.1 Intellectual Property definition

"Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce" (WIPO, 2020, p.1). By acquiring Intellectual property rights (IPR), which refers to the legal protection of the IPs (Spence, 2007), the innovators or business entities can receive protection by law for their IPs, normally in the forms of patents, copyrights, trademarks, and trade secrets. The protection gives exclusive rights to the IPR owners and enables them to gain benefits for the efforts they have made for creating innovation. The IPR provides a balance between the benefits of innovators and the public interest. Therefore, IP has been recognized as important aspects in promoting creativity and innovation (WIPO, 2020).

When considering promoting innovation, patents are often seen as an important protection method for technologies across industries (EPO, 2021). Patents are official agreements between the inventors and government or agency that designated on the innovations of its rights to exclude others (WIPO, 2020). Typically, the patent owners will rely on the IPR to commercialize a product and generate revenues. The patent can be analysed for determining novelty in technologies and even forecasting innovation developments in a specified domain. Therefore, patent management is often seen as an organizational strategy in relation to technology innovation and R&D activities and are broadly adopted in different industries (Chang et al., 2009).

### 2.2.2 IAM Framework for Capturing Intellectual Property Assets

The IAM Framework provides in addition to the categorization of knowledge assets, a second level of a method focusing on claiming research results as intellectual property assets (IP Assets). In this research, the IAM framework's definition of IP assets will be evaluated in relation to the empirical findings regarding intellectual properties. The researchers of this study perceive the model to correlate well by applying the intellectual property categorizations in relation to technology asset categorization explained in 2.1.2. The purpose of applying the second level of categorization is to distinguish and establish which knowledge assets that could also been captured as IP assets and further claimed as IP rights. The interaction between the knowledge asset and IP asset classifications is said to be crucial for developing organizational capability and encouraging utilization activities (Petrusson, 2016). Therefore, the interaction of technology assets and IP in this research is perceived to be essential for promoting innovation activities in a company.

The categorization of IP assets recommended by Petrusson (2016) are divided into eight categories. To fulfil the purpose of the study, the researches consider the following six IP assets categories to be relevant to explore:

*Invention* – Patents, patent applications and patentable inventions are covered in the invention category as IP assets that must be managed. This intellectual property asset category requires application for protection and enables value through the exclusivity a patent entails in regard to its claims.

*Designs* – Protectable designs, protected designs, applications for design protection and registering design protection are mentioned as definitions in the design category. This IP asset is valuable because it excludes others from using similar designs since a design must be new and have an individual character to be protectable.

*Artistic and literary work* – In the IAM framework, copyright protected works of art and literature are highlighted as IP assets within this category. In contrary to the above-mentioned IP assets, inventions and designs, artistic and literary work does not require registration to award protection since its given upon creation.

*Database* – Protected databases and database rights are distinguished as a separate category in the framework and is protected primarily through copyright. The Swedish legislation system states protection to a person that have made a significant investment or complied a large amount of information the exclusive right to produce copies.

*Trademark* – Registerable trademarks, established trademarks, trademark registration applications and trademark rights are defined as intellectual property assets in the trademark category. A trademark is a controllable symbol and is granted due to registration or establishment.

*Trade Secrets* – Protectable information, both documented and undocumented are the description of content in the Trade Secrets category. In contrary to the other presented intellectual assets categories above, trade secret protection does not result in an exclusive right. Instead, trade secrets are viewed as protected objects as long as they are kept secret. Therefore, certain action must be taken to fulfil the criteria of secrecy, so that a disclosure of the trade secrets would damage the information holder's position in competition.

The selected categories of IP assets are described in the theoretical framework to serve as a basis for identifying IPs in the empirical data. Furthermore, the researchers of this study perceive the categorization of IP assets to structure and simplify the understanding of IPs role in regards of the research topic. The two categories from the IAM-framework, topography, and plant variety, were ignored due they were seen as less relevant, thus they will not be applied or analysed in this report as intellectual property assets.

### 2.2.3 The Role of IP in Healthcare and AI-based Innovation

In the healthcare industry, trademarks are a well-established IP for protecting business contents, such as logotypes, product names, slogans, and other elements. These IPs are significant in the work with brand management, which signifies the healthcare companies' identities, market positions and reputations (WIPO, 2020). Copyright is usually used to protect original creative work, which is most suitable for published content, software or interface designs the healthcare applications. These IPs are less used in protecting important technology innovation because of the weak legal protection and easily imitated character (Cockburn & Long, 2015). In comparison, applications or software are more mentioned to be protected through trade secrets in innovation, which require structured organizational restrictions and rules to ensure the validity of the secrets (Lutz, 2020).

The "2007–08 LES survey" has differentiated patent's importance in multiple sectors, wherein the recognition of patent significance is highest within Healthcare. The survey discloses that 89% of innovative firms in Healthcare, including Biotechnology, Pharmaceuticals, and Medical technology characterize patents as an "extremely important" role in achieving competitiveness. In comparison, results from other industries, for example, Energy and Chemicals are 79% and in Electronics and Software are 73%. Other responded sectors in the survey reach 47% on average, which are substantially lower than the healthcare sector. The survey also indicates that the differences between the importance of patents versus other forms of IP, such as trade secrets, trademarks, and copyrights, were the greatest in the healthcare sector. For example, in the Pharmaceutical industry, patent protection is the most used intellectual property right (Cockburn, I., & Long, G., 2015). In another study, Arora et al. (2007) has also estimated returns to patent protection and their impact on firm-specific R&D investment across industries, and the return is seen as highest in the healthcare industry of their study.

Additionally, due to the increasing involvement of big data in healthcare companies, technology innovation and development is shifting from traditional innovation to a more data-driven innovation era. The database protection as the sue genius rights are more and more mentioned as an IP right. The sui generis Database Right operates under EU law and encompass that the right in a database is not subject to the originality requirement but the effort in organizing and structuring the data to obtain the right of protection (Gervais, 2019; Sappa, 2019).

The new patient-oriented value offering is pushing healthcare companies to develop more personalized care and treatment, where data science and AI play essential roles to improve diagnosis and analytical capabilities (Weiner & Weisbecker, 2011; Kühne & Böhmann, 2019). The industrial sectors such as data mining and data analytics are interplaying with healthcare to collect and generate insights through data (Senthilkumar et al, 2018; Wang & Hajli, 2017; Vasal et al., 2019). To capture competitive advantages in healthcare applications, the companies intend to rely more and more on trade secrets for their innovations, especially in software development (Weider et al, 2016). However, Wiebe & Schur (2019) lifted the discussion of the difficulty in protecting trade secrets in a data-driven business context. For instance, in the context of IoT or Industry 4.0, there are growing challenges in the means of protecting technology by trade secrets. When physical parts get connected and the manufacturing process and data acquisition take place autonomously, the sensors can freely record or exchange data through the network. Combined with big data algorithms, large data volumes can be analysed in real-time, and decisions are made or suggested by the systems. Consequently, it needs to give authentication to these machines, and sometimes to third parties to analyse data to generate insights, which may break the rules of secrecy. At the same time, the sensor-generated data in a networked environment also impacts the allocation of trade secrets. Due to such challenges, the adoption of trade secrets in healthcare innovation, especially to the inventions relating to IoT and connected medical devices, can be constrained, and challenged (Wiebe & Schur, 2019).

WIPO's Director General, Francis Gurry, has addressed the challenges laying in the data-driven business world regarding IP considerations in an interview with WIPO (WIPO, 2019). He suggests that data-driven technology is undoubtedly the growing force that dominates business opportunities, and the traditional way of adopting IP policy is challenged by any means. In the digital economy, applying trade secrets for protecting unpublished data and business values is growing in importance but still faces inefficiency. More questions are also raised about data utilization in AI-based algorithms when it comes to copyrights as ambiguous and unclear pathways of data aggregating processes standing in the way. Privacy, security, and market-related policies such as the competition policy are all challenged by the means of data-driven business.

In an article, Gervais (2019) discusses the challenges of applying for patents in the digital field. With the involvement of AI, competitive advantages protected by patents may become more difficult to capture in future innovations. AI can be used to expand patent applications by big healthcare players and even used to guess the competitors' incremental innovation and strategically disclose them. The AI also can generate insights that are not invented by human and increase business achievements, thus such inventions will be difficult to protect by patents. The interfaces between data and IP are on the track to adapt proper parameters for adapting the IP rights.

IP's role in business models impacted by AI is described by Bader & Stummeyer (2019) in two various forms, namely formal IP, and informal IP. Formal IP refers to IP rights such as patents, copyrights, trademarks, and design rights. Informal IP on the other hand implies trade secrets, manufacturing advances and lead-time advantages difficult to imitate. IP strategies designed for protecting AI could include patenting according to the legal requirements while generating copyright through AI code. AI-generated data insights could also be protected as trade secrets and databases through copyright. The different IP approaches are adopted by innovation actors to monetize upon their R&D investments (Bader, 2007; Gassmann & Bader, 2017).

## 2.3 Value Creation in Healthcare

### 2.3.1 Healthcare Value Models

Value as a general term represents the benefits achieved through certain situations. In healthcare, value is often perceived as the outcome that the patient health could get improved through a certain cost (Porter, 2010). Since the concept of value is abstract when connecting to cost, Porter (2010) suggested defining a framework for measuring the improvement of value through a rigorous and disciplined way due to value in healthcare often being unmeasured and misinterpreted. Porter argues that value needs to count not only for the patient but in a more systematic scope, including improvement for the healthcare payers, providers, suppliers, and other stakeholders in healthcare's economic chain. The value should be the overarching goal for all stakeholders to embrace for quality, safety, patient-centeredness, and cost containment as important elements (Porter, 2010; 2016). As the traditional healthcare model has been based on "fee-for-service", a shift towards the "fee-for-value" is predicted to be challenging because of the non-standardized measurements for value created for the patients. The transition is considered difficult and time-consuming. But in the long-term, it is argued to be both financially and qualitatively beneficial for multiple stakeholders (NEJM Catalyst, January 1, 2017).

Healthcare value innovation is taking place through business models. Healthcare business models are shifting rapidly and are proactively driven by industrial leaders to reimagine how patient care is perceived and delivered. The usage of data and advanced analytics, better integration of care and a greater alignment of incentives entailing risk-bearing are mentioned elements in newer healthcare business models (Clark et al., 2021). Larger traditional players within the healthcare industry are engaging in the creation of new technologies to adopt their value offerings and tweak their business models. At the same time, new players are entering the scene with innovative solutions and disruptive business models across various sub-fields to intensify the competition (Clark et al., 2021).

Birch & Shea (2019) argue in their article how consumers today demand anytime services enabled through technology innovation. When other industries have transformed rapidly through on-demand platforms like Netflix, Uber and Airbnb, the healthcare industry has delayed due to regulatory issues and its complexity. This is expected to change through the entrance of new care delivery business models as "virtual first" and consumer-centric delivery models. Through such offerings, standardized business to business (B2B) and business to consumer (B2C) healthcare models is said to be replaced with a consumer to business (C2B) on-demand platform. Such a platform would then integrate services from several healthcare providers making the care alternative in the hands of the consumer. By presenting such a healthcare business model, Birch and Shea (2019) claim that the C2B platform will threaten larger healthcare companies proprietary value propositions and their brand position. The patient benefit with such a transition would be decreasing costs, easier access, and an enhanced quality of care with a more patient-centric and virtual care model. Examples of integrating features in a “healthcare anywhere” business model are telehealth, telepresence, and remote monitoring.

In an article published by *McKinsey*, successful healthcare business models have been identified to include certain characteristics to enhance the quality of patient care. Such characteristics include the integration of new technologies and analytics in the standardization of clinical and operational processes. Furthermore, connected care devices that continuously monitoring and alerting the patient and clinician due to drastic changes in combination with telehealth applications are good examples of how new technologies and analytics are integrated with the cluster of remote monitoring and patient self-management. The integration of such value offerings would liberate the time of the health professionals for performing more highly skilled tasks, while the patient will participate more actively in monitoring their health conditions and thus enabling a greater opportunity to adopt the services concerning patient need (Bartlett et al., 2017).

Additionally, such new out-of-hospital delivery methods as remote patient monitoring through connected devices is an increasing field that concentrates on preventive measures to manage patients in their home (Bartlett et al., 2017). In the research paper, *Design Research on Business Models in-home healthcare*, the authors perform telemonitoring pilots to investigate its impact in supporting patients and staff remotely. The research indicates the importance of introducing new innovative business models to telemonitoring to reduce healthcare costs in respective country and healthcare system (Simonse et al., 2011). In another report, Fjeldstad et.al (2020), emphasize that utilizing network architecture to mobilize and integrate health care professionals, patients, family members and other stakeholders into the care delivery would lead to improvement of the value offering. Such integration could also add more value to research and development activities of new knowledge in healthcare.

Onwards, a shift in the value-offering is expected and new business models will emerge. New technologies that contribute to delivering quality care for everyone is anticipated, where healthcare players providing efficient solutions through an ecosystem model to simplify patient care is assumed (Clark, Singhal & Weber, 2021). This will lead to healthcare businesses and organizations apply IoT solutions consistently and through big data and advanced analytics to drive the innovation forward. The application of AI will have a substantial effect here and embedding such technologies will be crucial to future success (Gopal et al., 2019).

### 2.3.2 Value Creation Model

Considering the general relationships between value creation to business and IP concepts, a model addressed by CIP (2019) illustrates a good foundation for this research topic. The model interprets the content of knowledge-based value creation to be an interacting process concerning the interplay between IP, Business Strategy and Technology Innovation. Technology Innovation is utilized to create value aligned with the business strategy, which requires it to be protected and controlled through intellectual property to fulfil its purpose of establishing sustainable competitiveness. Therefore, the model designed by CIP (2019) places the target in the interlinkage of all three circles to display the significance of their involvement in knowledge-based business management. The following Figure 2.1 shows the cited image about the mentioned model.

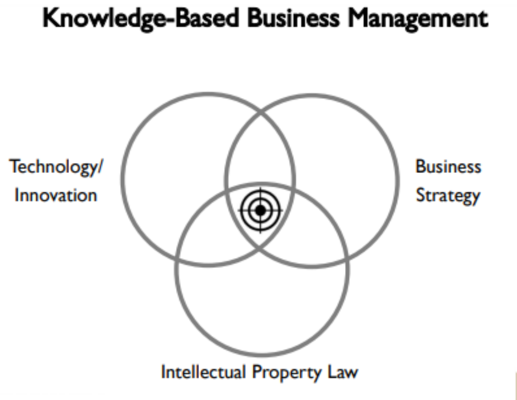


*Figure 2.1, CIP (Innovation & Patent, 2019, slide 3)*

The model's main elements correlate well with the concepts this study highlights. IP Law represents the IP control position; business strategy is the process of how value is extracted and realised; the technology innovation discloses the technology assets that developed through innovation.

To develop the model further in alignment with this study's concentration, the researchers have renamed the circle elements with the concepts of this study. The developed framework is displayed below in Figure 2.2. The model functions as guidance in finding the interplay between the three concepts. It illustrates the role of IP, technology assets, and value creation in relation to the research.-

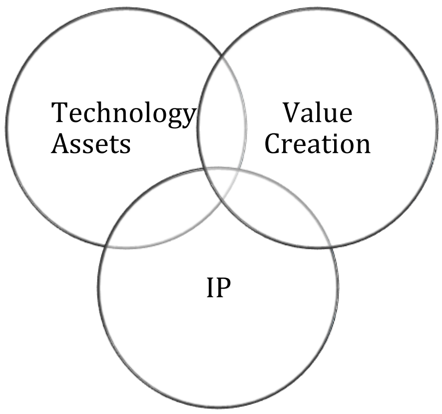


*Figure 2.2, Value Creation Model developed by the authors with the inspiration of CIP (2019, slide 3)*

## 2.4 Data-driven Business Models in Healthcare

### 2.4.1 Data-driven Business Models

Along with the digital transformation, organizations are embracing energy and resources into new data-driven business models, where the data is a key asset for converting value. (Kühne & Böhmann, 2019). The digital transformation has led many organizations to turn from product-based offerings to more flexible service-oriented business models (Weiner & Weisbecker, 2011; Kühne & Böhmann, 2019). At the same time, data is increasingly collected and leveraged through data-driven business model innovations. These innovations and transformation are crucial activities to keep the competitive advantage for organizations (Hunke et al. 2017; Brownlow et al. 2015; Bulger et al. 2014; Muhtaroglu et al., 2013).

Various ways of monetizing upon data-driven business models have been elaborated in research (Vasal et al., 2019; Trabucchi et al., 2017). For example, in the article *Give away your digital services*, the authors discuss how raw data is converted into data insights for exploiting value-added activities in advertising, product- and service development as well as selling data/insights directly to third parties (Trabucchi et al., 2017). More explicitly, an example is how Fitbit's business essence lies in its capacity of collecting, processing, and presenting feedback to the users. This is aligned with that how a data-driven business model utilizes gathered data from the user and turns it into value that they can monetize upon (Sorescu, 2017).

The rise of smartphones and fitness trackers have opened the possibility of continuously monitoring health conditions during the last decade. This has led to a greater interest for individuals to keep track of their well-being, which has generated new business opportunities for healthcare organizations in the market of remote monitoring devices (Gopal et al., 2019; Reddy, 2021). These devices collect for instance data as vital signs, which assists the healthcare provider in predicting the likelihood of a major health event occurring for the patient. Such data insights are valuable and enable monetizing opportunities in several ways, for example by providing insurance companies with the insights to rate a patient's risks for getting certain diseases more accurately (Reddy, 2021).

The impact of AI in data-driven business models are crucial. In the paper, *Digital transformation in healthcare - architectures of present and future information technologies*, the authors describe "A Gutenberg moment taking place" in healthcare referring to how AI and big data enable efficient handling of how to store, organize and generate value from data (Gopal et.al, 2019, p.1). In addition, the usage of AI and big data is having the potential to reduce treatment costs, prevent illness and enhance the everyday life of human being (Durcevic, 2020). Healthcare professionals want to understand a patient's health and condition in an early phase to discover warning signs and treat diseases before they strike. Technology enhancements in addition to the inclusion of AI and big data in healthcare data analytics are central for guaranteeing qualitative preventive care (Durcevic, 2020). The impact of AI and big data is seen in healthcare applications when it comes to real-time alerting, which implies when user data is compared with general public data to determine if medical actions must be initiated to treat the user. Other applications where AI and big data is constantly present is image reconstruction and within data management, for example, the Electronic health records (EHR) and Staff protocols (Durcevic, 2020). These factors have made global healthcare companies accelerating their development of updated business models from the more traditional ones to data-driven ones (Birch & Shea, 2019; Trabucchi et al., 2017; Vasal et al., 2019).

Healthcare applications where the impact of AI and Big data is especially emphasized in data management and analytics. This is seen as another potential of data-driven business models in how organizations could supply the infrastructure around data-based services. The application of cloud-based software as a Service (SaaS) in the healthcare domain is a possible solution to handle a large set of data on the cloud (Weider et.al, 2016) The available security measures help handle the data on the cloud in a secured manner. Having a great service on the cloud that helps users to analyze the data from a remote location will be helpful for both patients and the healthcare industry. This can reduce the costs for people travelling to hospitals for every medical check-up. Many firms are today gathering large amounts of raw data from their business offering, but do not have the capacity to utilize that data for profit, which have furnished platforms like Amazon Web Services and Salesforce within this category (Sorescu, 2017).

Birch & Shea (2019) argues that data-driven business models require investments from the large healthcare firms in new technology to enable interaction with health consumers and the ability to generate insightful data. The impact of integrating connected devices to acquire data through hardware offerings and then develop algorithms to process the data cannot be ignored and therefore motivates investments in IoT and AI. In addition, cloud technology and next-generation computing are of interest as future technology adoptions within healthcare. Other enhancing technologies adding value as training tools and patient-staff interaction. The common denominator of all these examples is the significance of data, which motivates the importance of data-driven healthcare business models (Birch & Shea, 2019).

### 2.4.2 Data-driven Value Chain in Healthcare

As previously mentioned in the introduction chapter, the amount of data that is generated within the healthcare industry is immense. The fact that only a small percentage of the collected data is estimated to be transformed into valuable insights indicates the importance of better functioning data management in healthcare (Wang & Hajli, 2017). In a report from Deloitte published in 2019, the lack of trust encompassing data usage, the incompetency of structuring and integrating data practices as well as non-existing firm strategies to data management were mentioned as the most frequent pitfalls in organizations across various industries (Vasal et al., 2019). Furthermore, the article demonstrates the importance of constructing a profound data foundation to enable analytics measures, for example through AI solutions. This includes data management from the start of the data acquisition phase to the end by providing useful insights. Such insights would lead to potentially re-imaginations of the value offerings and optimization of the user experience to stimulate growth and business value (Vasal et al., 2019).

Healthcare management has altered due to data during the 21st century from being disease-centred to patient-centred as well as shifting from volume-based to value-based. This has led to a growing demand for the implementation of big data in healthcare settings. In order to manage the vast amount of health data collected, innovative solutions such as big data tools are needed to be integrated (Senthilkumar et al., 2018). To simplify such a process, healthcare big data analytics could be seen in the figure below, is divided into five processes, demonstrating the data value chain from data acquisition to data visualization and reporting (Senthilkumar et al., 2018).

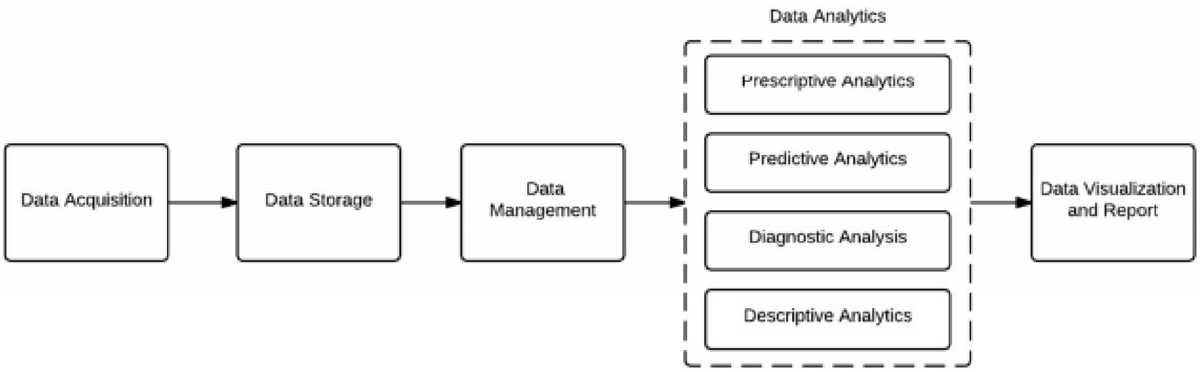


*Figure 2.3, Cited from Big Data in Healthcare Management (Senthilkumar et al., 2018, p.61).*

In this figure, the big data analysis process is illustrated in the data-driven value chain through the steps of acquisition, storage, management to analytics and visualization and reporting, which intends to increase the awareness around big data process in healthcare (Senthilkumar et al., 2018). For this study, the data value chain functioning as a logical theoretical framework to the importance of data for the healthcare company concerning its processing.

*Data Acquisition* refers to the way the data is acquired by the healthcare company. It can be through sensors in a hardware product, through electronic medical records as well as social media platforms and other applications. The acquired data is then captured through step two in the data value chain, namely data storage (Wang & Hajli, 2017; Senthilkumar et al., 2018).

*Data Storage* implies how the data is stored within the healthcare company through a large cloud. This part is crucial for the value chain since it provides elasticity and the capability to create awareness around the data to later apply analytics solutions that drive value (Wang & Hajli, 2017; Senthilkumar et al., 2018).

*Data management* aims to organize, clean, and govern stored data in the healthcare company to simplify data analytics. The validating of potential scrap data or missing values also occur within the data management step to remove such information before the analysis step (Wang & Hajli, 2017; Senthilkumar et al., 2018).

*Data analytics* is the step of the value chain where raw data is turned into insights. The analytical power of data enables healthcare companies to identify patterns of care between patients directly as well as discover linkage in the larger arena. Data analytics can provide recommendations through examining real-time data with medical records simultaneously, which captures previously very difficult patterns to identify and therefore improve the care situation. Data analytics in healthcare is divided into four types of analytics, namely prescriptive analytics, predictive analytics, diagnostics analysis and descriptive analytics, which differs in the way they utilize acquired data and prognosis the future (Wang & Hajli, 2017; Senthilkumar et al., 2018).

*Data Visualization and report* is the final step of the data value chain and highlights the displaying of healthcare data into a perceivable framing for the user. The intention with the final step is to make the analytics of the raw data understandable and incentivize better decision making from the user (Wang & Hajli, 2017: Senthilkumar et al., 2018).

Other authors have as well pointed out the importance of integrating big data processes in the healthcare business. For example, it is said that many organizations focus on solving technical issues by adopting big data. With such an approach, the organizations will be able to leverage big data analytics as long as they address the management challenges regarding big data (Wang & Hajli, 2017). This emphasizes the significance of making efforts at a strategic level to organize resources to improve big data analytics and thereby generate business value.

More articles discuss how data processing in healthcare aims to distinguish various types of data to produce appropriate analyses for generating insights (Ward et al., 2014). This transformation from patient data into meaningful insights through analytics are commonly referred to as descriptive, predictive, and prescriptive analytics by researchers, which differentiates the purpose of the big data analysis (Ward et al., 2014; Senthilkumar et al, 2018). Big data analytics comprises an integrated array of aggregation, analytics, and interpretation techniques, which allow users to transform data into evidence-based decisions and informed actions. By doing so, data analytics aims to process all kinds of data and perform appropriate analyses for harvesting insights (Wang et.al, 2018).

The future trend in adopting big data analytics is to reduce resistance and ineffective use of analytics. The healthcare transformation using big data analytics is a broadly discussed topic also in the areas of computer science, information systems and healthcare informatics (Wang & Hajli, 2017). By integrating big data analytics in healthcare, the possibility to predict diseases and severe conditions before they occur is enabled through the integration of medical records (Senthilkumar et.al, 2018). This integration makes the healthcare industry transforming from reporting facts to concentrating on the discovery of insights and thereby becoming data-driven healthcare organizations (Eswari et.al, 2015).

## 2.5 Technology and IP Based Data-Driven Value Framework

In order to understand the interlinkage between technology assets, IP, and value creation to data-driven business models in a healthcare company, the researchers designed a theoretical framework, the TVID framework, presented below in Figure 2.4. The framework originates from the value creation model (Figure 2.2) and the data value chain (Figure 2.3) in combination and was developed to better fit the scope of this research. The model attempts to guide the readers about the relationships between these concepts by explaining the role of technology assets, value creation and IP in data-driven business models within a healthcare company. The utilization of this model serves as a framework to organize and evaluate the empirical findings in the analysis chapter.

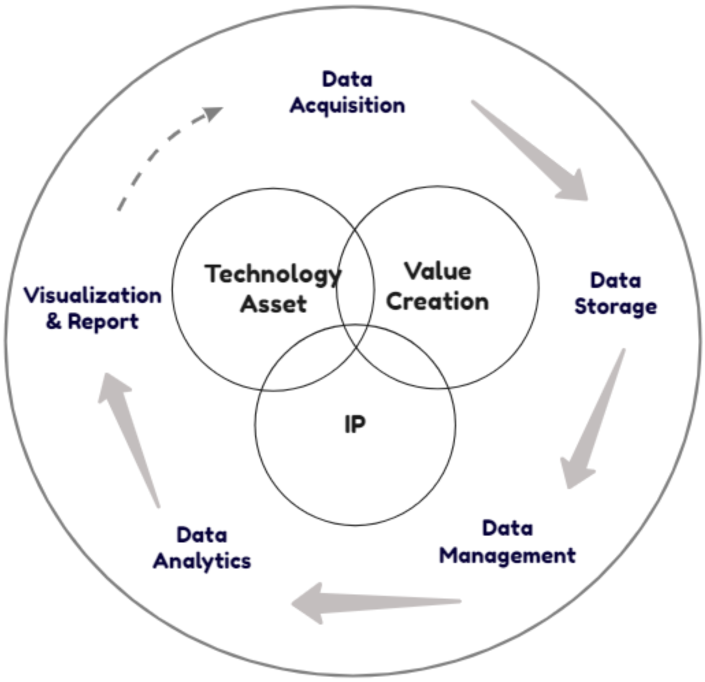


*Figure 2.4, **TVID framework**, developed by the authors based on CIP (2019, slide 3) and Senthilkumar et al. (2018, p. 61)*

The developed framework, TVID, intends to present the relations between the data-driven value model and the value creation model. As seen in the model, the three inner circles are designed following the value creation model and interplays technology asset, value creation and IP. The outer layer is surrounded by the data-driven value chain, where the data flow is seen as central to transform companies' business models into data-driven ones. By combining the value creation model with the data-driven value model, the researchers have developed a theoretical framework matching the scope of the study by interpreting its connections.

More specifically, the TVID framework intends to point out which Technology assets, IP and Value creations can be distinguished in the different parts of the data value chain, for example, what technology assets, IP and value creation elements can be distinguished in the data acquisition phase. By examining this, the researchers strive to identify and explore which technology assets and IPs being in focus and utilized more essentially in particular parts of the data-driven value chain. By testing the developed theoretical framework in a healthcare company, the researchers aim to fulfil the study's purpose of exploring how intellectual properties are perceived and utilized in a healthcare company for data-driven business models.

# 3. Methodology

*This chapter will discuss the methodology of the research. The following subchapters are presented in an extensive manner to support the findings and validity of the study. The methodology chapter is structured into the seven sections as follow: Research Strategy, Research Design, Data Collection, Data Analysis Method, Quality of the Study, Limitations, and Ethical Considerations.*

## 3.1 Research Strategy

To fulfil the purpose of this study, which is to understand IP's role in a data-driven business model, the researchers have put the focus on gathering information to understand the relations between IP and data-driven business models. The research is designed to be a qualitative study by searching for answers through empirical data. A qualitative study is aiming to understand the studied topic and explain the behaviours and experiences of individuals or a group in-depth (Whiting & Sines, 2012). The research will use a case study at a single organization to investigate the research topic. The study aims to provide knowledge of how large healthcare companies perceive and select IP strategy to improve the data value processes for a data-driven business.

The study will investigate IP and data-driven business models to understand the relation between the two. From an ontological standpoint, both IP and business models are socially constructed by human, which means they are not objective entities independent of human factors. Therefore, the ontological position for this study will be constructionism (Bryman & Bell, 2015).

The concepts of IP and business model are existing elements in this study; therefore, the researchers will use them as starting points to find the relations between the concepts and the empirical findings. This process requires to fit the empirical data into the framework of concepts and the researchers intend to understand the studied context through comparing existing theoretical frameworks to the participants perspective from the interviews, which indicates a deductive approach (Bryman & Bell, 2015). From this aspect, the epistemological position of the study will be positivism (Bryman & Bell, 2015; Easterby-Smith et al., 2018). However, an inductive approach will be applied to summarize the relationship between the empirical findings and the studied frameworks and draw conclusions to form some sort of new theory (Bryman & Bell, 2015). As Bryman (2016) argued that in a social study, the deductive and inductive approach can be both needed to find the research answer. An inductive approach means that concepts and themes are generated from extracted data that are identified, examined, and discussed further by the researchers (Bryman & Bell, 2015).

By combining the deductive and inductive research approaches, an abductive method is said to be applied (Bryant & Charmaz, 2019). An abductive approach is said to be a way of reasoning through relating unexpected observations or findings to determine the relationships of the studied objects and generate a conclusion to solve the puzzle of the relationships (Timmermans & Tavory, 2012). It is also said to be a rule-guided way to new knowledge (Bryant & Charmaz, 2019). Therefore, the abductive approach fits this research by first identifying and relating to existing concepts and then generating new theory out of the relationship between empirical findings and the concepts. The inclusion of both testing hypotheses to already established theories and performing inductive reasoning makes the epistemological position including both positivism and interpretivism. This makes the research to be a shift of epistemologies since it is altering between positivism and interpretivism (Dubois & Gadde,1999; Bryman & Bell, 2015; Easterby-Smith et al., 2018). In summary, the researchers have adopted the

deductive process and inductive process in different phases to generate the results of this study and help revealing how IP may contribute to the data-driven business models.
A research strategy chart is illustrated in Figure 3.1.

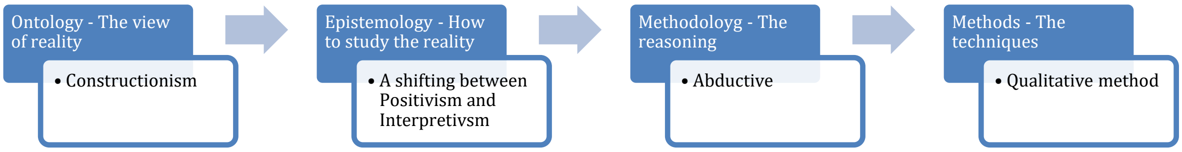


*Figure 3.1, Research strategy, developed by the researchers.*

## 3.2 Research Design

This study will use a qualitative method applying an abductive approach to analyse the collected data. Since the data collection will be focused on the healthcare context and an in-depth understanding of the discussed topic, a case study is chosen to disclose more detail. The case was said to preferable be to a global healthcare company utilizing both traditional business models and digitalized data-driven business models. The empirical data for the qualitative study will be collected through qualitative interviews, conducted with relevant employees who are involved with the data-driven business practices at the case company.

The intention of the research is to study a single organization that operates with various data-driven business models and at the same time, has a strong IP management tradition. Bryman & Bell (2015) have suggested that multiple-case studies will hinder the researchers from going in-depth and may lead to a focus on the contrasts between the cases. Since the study purpose is to understand the concepts and relations between the concepts and the findings, the focus of the research is not to compare and draw differences between multiple cases. The study is more concerned about collecting in-depth information, therefore, a single case study from a single company will fit better the research purpose. But as Bryman & Bell, (2015) and many other researchers may argue, the potential drawback of a single-case study is to generalize the empirical findings. It's important for the researchers of the study to have a clear definition of the scope of the research and keep aware of contexts potential generalizations can be made. A summary of the research design is shown in Figure 3.2.

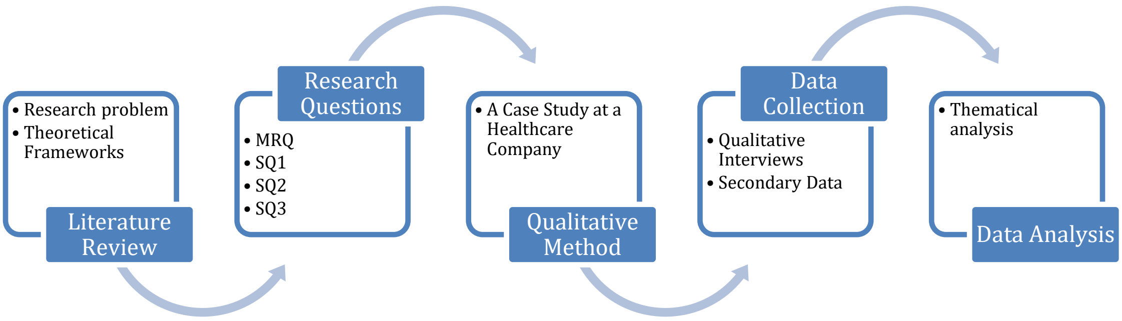


*Figure 3.2. Summary of the qualitative research design using a case study.*

### 3.2.1 A single Case Study

The case study is said to be a popular and widely used research design in business research (Eisenhardt & Graebner 2007; Bryman & Bell, 2015). A case can be a single organization, a single location, a person, or a single event (Bryman & Bell, 2015). The motivation for a case study is that a case can create a detailed description than other research designs, and it can explore the complexity of an event or situation (Bryman & Bell, 2015). Yin (2009) defines a case study as an empirical inquiry to investigate the context in a phenomenon, including ambiguous and complex boundaries. Stake (2005) suggests that the selection of cases should be based on the opportunity to learn, and where the expectation of learning is great. According to his suggestion, the case selected for this study is most likely an instrumental case that focuses on understanding a broader issue and allowing challenging generalizations (Stake, 2005; Bryman & Bell, 2015).

This study is focusing on exploring the phenomenon of a data-driven business model in the healthcare context, and the research will investigate how a large worldwide known healthcare company utilizes its IP to cooperate and improve its data-driven business models. The selection of the case is based on theoretical comments that confirming the validity of a case study.

### 3.2.2 Selecting the case study

The selection of the case for a single case study is an important step to ensure the logic linking between the research questions and the study quality being achieved through the collected data (Yin, 2009). There is a need to select the case according to the research propositions and criteria, and then design the method for acquiring relevant information (Baskarade, 2014). Seawright & Gerring (2008) suggest that case selection is the fundamental task of the case study researcher, as well as the research plan for studying the case. The case selection and analysis are normally intertwined during the research process. The aim of case studies is not to support statistical generalisation but to support analytical generalisation according to Yin (2009), and therefore the case study tent to be in-depth.

Gerring (2004) advocates that it is critical to clearly define relevant terms in a case study. But to identify the suitable terms of analysis requiring careful considerations, which makes the process challenging. According to Yin (2009), the cases can be classified into five types, namely the critical case, the unique case, the revelatory case, the representative case or typical case and the longitudinal case. According to the discussion above, in this study, the researchers have conducted a careful selection of a company to fit in the healthcare context, which ensures capturing the necessary characteristics for the study to be valid in quality. The researchers, therefore, have chosen the international recognized Healthcare company, Philips, to be the studied case.

#### 3.2.2.1 Philips

Philips is one of the largest healthcare companies globally with more than 80 000 employees divided upon 120 plus nationalities (Koninklijke Philips N.V., 2020). Philips business strategy is driven by the purpose to “improve people’s health and well-being through meaningful innovation” (Koninklijke Philips N.V., 2020, p.9) This purpose is accomplished by positioning themselves as a leading health technology company and making their value-offering accessible and affordable. By doing so, Philips aims to achieve their vision in 2030 of improving the lives of 2.5 billion people (Koninklijke Philips N.V., 2020).

In order to succeed with realizing their vision, the new innovative solutions will integrate and connect systems, smart devices, informatics and services and apply big data. This makes the Philips organization an excellent single case to study due to the firm's large IP portfolio and the work of developing novel business models (Koninklijke Philips N.V., 2020). Since Philips is embedding data science and AI in their value propositions, the interlinkage between data-driven business models and IP is expected to be found and discussed which makes the selection of case study suitable.

The organization of Philips is operating with four main business clusters according to the official structure of the annual report. These four business clusters are Personal Health businesses, Connected Care Businesses, Precision Diagnosis Businesses and Other. Within the different business clusters, several subsegments can be found to indicate the scope of industries. For example, in the Personal Health Segment, the following segments are mentioned: Oral Healthcare, Mother and Child Care, Personal Care (Male Grooming and Beauty) and Domestic Appliances[1] (Koninklijke Philips N.V., 2020). Together with the other business clusters and subsegments, the Philips healthcare business scope covers the whole healthcare value chain from Healthy living, prevention, diagnosis, treatment, and homecare. (Koninklijke Philips N.V., 2020).

In this report, the empirical findings are gathered from conducting interviews with employees across all business clusters to ensure that the capture of interview data will contain a broad perspective of opinions on the research topic. To ensure the relevancy of the data, the interviews are selected in the department that focusing on IP-related activities and carrying knowledge and tasks with a data-driven business model. This scope of selection of interviewees can make assurance of the quality of respondents' answers.

## 3.3 Data Collection

A clear data collecting strategy and method should be designed before collecting the data Yin (2009). Since this research is aiming to find in-depth empirical findings through a qualitative method, the data collection method has been a qualitative semi-structured interview for the primary data. The secondary data has also been used to enrich the finding. Published documents, the company's annual reports, research articles, media reports were the sources used for secondary data. Secondary data has interacted with the primary data for the empirical analysis.

### 3.3.1 Primary Data Collection

Qualitative interviews are methods that use direct conversations with relevant questions to collect answers about a certain topic (Lofland & Lofland, 1984). Easterby-Smith et al. (2018, p.179) suggest that "Interviews, therefore, enable researchers to access information in context, and to learn about phenomena that are otherwise difficult or impossible to observe" and "the researcher will need to be sensitive enough and skilled enough to understand the other person's views". For qualitative research, it is important to get face-to-face interaction with the interviewees and capture the mind of the participants (Bryman & Bell, 2015).

The often-mentioned qualitative interviews include unstructured interviews and semi-structured interview approach. The unstructured interview is similar to a conversation, which intends to have

[1] Domestic Appliances was sold to the global investment firm, Hillhouse Capital, in Q1 2021 for a total deal value of 4.4 Billion EUR and is from the first quarter 2021 presented as a discontinued operation in Philips financial statements.

reflective interaction with the interviewees and ask questions accordingly. The interview normally starts with one question and develops according to the researcher's interests along the way. In contrast, a semi-structured interview needs the researchers to have a list of questions with specific topics. Like the unstructured interview, the semi-structured interview also allows the interviewees to reply and reflect in their way which leaves certain freedom to the answers. The interviewer for the semi-structured interview can also add extra questions according to the situation, which is flexible (Bryman & Bell, 2015). There is also one type of interview named structured interview, using highly standardized questions, aiming at getting standardized answers. The structured interview, therefore, is used more often in a quantitative study to exam hypotheses (Bryman & Bell, 2015). Highly structured interviews hinder flexibility and prevent the researchers to discover unknown factors, while unstructured interviews can generate un-relevant data which leads to poor data quality (Easterby-Smith, 2018). Considering this research, the topic of the research provided a general concept about what should be found in the answers, therefore, a semi-structured interview that follows a guideline of different concepts were the best fit for this study. Through a semi-structured interview setting, in-depth conversations with the interviewees have been performed. The process allowed for detailed information from specific aspects to be asked, and to give the interviewer flexibility, contributing to complete pictures (Bryman & Bell, 2015).

One potential drawback of a qualitative interview is that the subjectivity for the interpretation depends mainly on the researcher's view, which could lead to an unsystematic view on significance. Besides, the replicability, transparency and generalizability of the findings can be problematic in a qualitative data collection (Bryman & Bell, 2015). Since this study mainly aimed at finding answers to discover certain phenomenon within the certain context of a healthcare company, the proposition of the study is quite fixed. The selection of case was also considered to be representative and typical, which contributes to the context in its way. Therefore, the qualitative interviews' findings were suitable in this research within the scope of the study.

#### 3.3.1.1 Sampling strategy

It is important to design a sampling strategy before any data being collected for qualitative studies (Yin, 2009; Easterby-Smith et al., 2018). In a qualitative study, the sampling strategy plans the method to find reasonable examples within the studied phenomenon. An appropriate method is non-probabilistic sampling which is seeking a purposeful sample to enable the data collection to fulfil the purpose of the research (Easterby-Smith et al., 2018). There are some different types of purposive sampling such as random sampling, snowball sampling, ad-hoc sampling, typical-case sampling and theory-guided sampling, and the most discussed ones are snowball sampling and theoretical sampling (Bryman & Bell, 2015; Easterby-Smith et al., 2018).

In this study, the purposive sampling strategy was utilized. This implies that the participants were selected according to certain criteria, such as their business cluster and position within Philips. Since the study's topic concerning IP and data-driven business model, the suitable interviewees need to have a deeper understanding either in the IP field or in the business field, and preferably in both fields. Such criteria defined the scope of selection of the interviewees. A significant challenge in selecting the interviewees have been that the company was huge by both the number of employees and its geographical representation. Therefore, it has not been possible to cover all departments for representing their business clusters. Since the study was an in-depth qualitative study, their replies were supposed to be in-depth instead of being broad. The suitable interviewees, therefore, were those who know IP and business, which enable the research to find concise findings. The selected interviewees were defined to be business managers in the IP field, IP counsels and IP analysts. The business managers in the IP field had an overall understanding of the company business strategy including data-driven business, as well as IP positions and strategies. IP counsels were those who created new IP for instance drafting patents, and defending patents, who had good knowledge about IP in relation to their business technology areas. The IP analysts had overall views about the business clusters' IP strength, therefore were suitable candidates as well. The selection of the interviewees also followed a random method but with the limiting of the business clusters. The researchers have reached out to suitable interviewees and conducted the interview with those who had agreed to attend. Some interview invitations were not responded to.

The number of interview samples in a qualitative study is said to reach a saturation level of information (Easterby-Smith et al., 2018). But due to the time constraints, the numbers of selected interviewees were limited to keep the interviews within a reasonable level to be able to answer the research questions. More interviews could have been conducted to reach saturation, but since the purpose of the study was to answer the research questions, which in this case to discover the relations between IP and data-driven business models and not for generating new theories, the selected samples were expected to fulfil the purpose.

#### 3.3.1.2 Interviewees

As discussed in the previous section, the interviewees were chosen by considering employees' positions and the business clusters. Significant points might be found due to the different experiences of the interviewees. In summary, the empirical findings were collected through 9 interviews, and each interviewee was interviewed for between 30 to 60 minutes. Table 3.1 shows the summary of information about the interviewees.

| The Interviewee | The Position | The Business Cluster | Interview Date | Time conducted |
|---|---|---|---|---|
| **A** | IP& Business | Personal Health | 2021-03-26 | 35 Minutes |
| **B** | IP& Business | Personal Health | 2021-04-08 | 30 Minutes |
| **C** | IP counsel | Precision Diagnosis | 2021-03-24 | 60 Minutes |
| **D** | IP counsel | Personal Health | 2021-03-16 | 54 Minutes |
| **E** | IP & Business | Precision Diagnosis | 2021-03-26 | 45 Minutes |
| **F** | Product Manager | Personal Health | 2021-04-28 | 50 Minutes |
| **G** | IP& Business | Connected Care | 2021-04-13 | 36 Minutes |
| **H** | IP counsel | Image Guided Therapy | 2021-04-12 | 31 Minutes |
| **I** | IP& Business | Image Guided Therapy | 2021-04-12 | 32 Minutes |

*Table 3.1 Interviewees Summary*

#### 3.3.1.3 Design of the questions

The interview questions should be designed to follow some kind of topic guide according to previous research. The purpose of doing so is to avoid being tied up to frameworks and lose the ability to explore answers (Bryman & Bell, 2015). Easterby-Smith et al. (2018) also suggest a revision of the research questions according to the research design and sampling strategy, when preparing a topic guide in the interview schedule. Afterwards, the researchers need to prepare some reflection questions for the respondents. These steps can ensure the relevancy of the questions is coping with the interviewees' background, as well as to the researchers' aim.

In this study, the research questions were revised to best formulate the interview topic guide to meet the research purpose. This type of iteration was undergoing and interactive during the research phase, which aligned the findings to best fit the research questions (Bryman & Bell, 2015). Since the topic of this study concerning three main subjects, namely IP, value creation and data-driven business model in healthcare, the researchers intended to capture the concepts through the interview questions along the interviewing process. The interview questions were designed to dive into more depth when the interview questions were asked in a sequence. The concepts were picked to build a topic guideline, firstly discussing the understanding of a data-driven business model, secondly discussing the findings of technology assets and IP, thirdly discussing the role of IP to the named assets, finally discussing the value created through IP in data-driven business models. The questions were designed most in "How" and "What" questions, aiming at identifying phenomenon and understanding relationships. A detailed interview question list can be found in Appendix A.

#### 3.3.1.4 Interview process

The chosen method of the interview was preferably a face-to-face interview. Due to the pandemic situation, travelling and visiting were strictly restricted, therefore, the interviews were conducted via synchronous mediates, in this case, the Microsoft Teams platform. The platform was chosen due to the IT requirement of Philips, Microsoft Teams was the confirmed software for meetings to ensure information safety. The meetings were conducted with the camera on to achieve the best face-to-face effect, such as eye contact and facial emotional detection. Other types of remote interviews such as phone calls or emails are lacking immediate contextualization, depth and non-verbal communications comparing to face-to-face interviews (Easterby-Smith et al., 2018). The chosen synchronous mediated interview via online meeting, could greatly avoid remote interview issues and generate interaction and the good in-depth conversation almost the same way as a face-to-face interview. Although the remote online interview could be disturbed by the connection signal sometimes, it was still a superior method to other remote methods to keep a good interview quality. For this research, all the interviews were audio-recorded to keep the conversation digital stored for further transcription. All recordings have received consents from the interviewees. While processing the MS Team interviews, some handwritten notes were also be generated for further study. All interviews were transcribed from audio to texts, avoiding misunderstanding. The transcripts then were used for empirical finding quotes. All interviewees were pseudonymized in the thesis due to ethical and confidential considerations.

### 3.3.2 Secondary data

In this research, secondary data were extensively used and analysed to find the connection to the research topic. The secondary data might include research articles from the literature, books, journals, market reports or company reports. The researchers have adapted a searching strategy to find the most relevant data. The research method included the choice of the search engine, the decision of keywords, and selection criteria (Bryman & Bell, 2015). The most used electronic database was Google scholar and the Web of Science through the Chalmers library. Other search engines included Google and Bing. Search keywords were defined according to the research topic, concepts and various combination of the concepts, for instance, "intellectual property in the healthcare", " IP and big data", "data-driven business model in healthcare", "healthcare and business models", "healthcare and data-driven", as well as " Intellectual property and data" etc. The authors have defined the relevancy of date to be more recent, such as "after 2016" with a purpose to filter the older hits which may bring older insights and trends discussions. The citation rate was considered, but since the hit was not many, all the relevant articles and report was analysed to determine the usability. The topic of "IP in Healthcare" was a cross interdisciplinary area, in which both IP and healthcare could be independent research target to get many hits, but the combination was not easy to find. After the determination of the case, some Google searches with news and reports on the internet were conducted with a well-defined purpose.

Bryman & Bell (2015) suggest that multiple sources of documented data can be used in qualitative research. Such data sources can include personal documents in written form, public legal documents, organizational sources such as annual reports, policy documents and memoranda, as well as mass media articles, visual documents, or other internet-based virtual resources. When using these types of data source in research, the criteria for evaluating them are needed to be considered. When deciding what sources to use in this report, the authors had carried in mind the criteria of relevancy to the topic and credibility of the sources. The findings needed to be relevant to the background, the research questions, and the concepts. Nevertheless, criteria of credibility were checked according to Bryman & Bell (2015), by analysing the author and the motivation of the data, the location and site published, commercial interests and fashionable of the information. Moreover, when choosing secondary data, the researchers emphasized the characters of the documents to be: readable, produced not for the purpose of research, preserved to be available for analysis and relevant to the concerns of this research (Bryman & Bell, 2015).

In this research, some carefully selected secondary data were used. The company's annual reports allowed the researcher to understand the company strategy and operation facts with financial statements. Some media sources such as news or articles could also review some details about an interesting development in data-driven related business. Most secondary data were chosen from the public domain. Since the company is well-known, there were a lot of useful sources.

The advantages of using secondary data were to provide insights and save time and effort in understanding the research objective (Easterby-Smith et al., 2018). Some of the documents could also provide the right knowledge of technical concepts which could improve communication quality during the interviews when collecting the primary data.

## 3.4 Data Analysis Method

As Bryman & Bell (2015) emphasized that there are a few widely accepted rules for analysing qualitative data, which makes the process of deciding the method for conducting the qualitative data analysis tricky. Unlike quantitative data analysis, qualitative research generates large datasets quickly, consisting of different media of findings including notes, interview transcripts, or other documents, which makes the qualitative data analysis process as complicated since the analytic paths are difficult to locate (Bryman & Bell, 2015).

The techniques used in interpreting collected documents are generally four types according to (Bryman & Bell, 2015). The said approaches are qualitative content analysis, semiotics, hermeneutics, and historical analysis. The relevant approach for this study is the qualitative content analysis, which also concerning methods such as analytical induction, grounded theory, critical discourse analysis, narrative analysis, and a more and more commonly recognized method called thematical analysis (Bryman & Bell, 2015).

The thematical analysis aims to search underlying themes out of the materials being analysed, and the processes through which the themes are determined are usually undisclosed (Bryman & Bell, 2015). The emergence of themes to the theories is difficult to find sometimes because of the less structured interviews bringing new terms which have not been related to the literature. To solve the challenge, it was recommended to combine an inductive research strategy to which the data collection could be iteratively processed to build a framework instead of fitting a hypothesis. This is the phase that in an abductive approach the reasoning moves from deduction to induction (Bryant & Charmaz, 2019).

The thematical analysis has defined themes according to the relationships between concepts that were determined at the beginning of the study, in other words, technology assets, IP, value creation and data-driven business models. These concepts and themes were represented in a newly developed framework for illustrating the results. With this newly developed framework, the research purpose has been fulfilled by reaching a clear goal of understanding the phenomenon in a healthcare context by interpreting the views of interviewees. Therefore, the thematical analysis has fulfilled the goal of this study. In detail, the empirical findings were sorted by a thematical matrix which representing relations between concepts to interpret all the interview data. The interview quotes were fitted into themes according to the content of transcripts by confirming and sorting them. The themes were developed from the research questions with consideration in literature frameworks and concepts that were identified in the earlier phase of the study. The matrix of themes and empirical data have been extensively discussed in the analysis chapter of this report (Bryman & Bell, 2015). The Thematical Analysis Matrix could be found under Appendix C.

## 3.5 Quality of the Study

In this subchapter the quality of the study will be evaluated and discussed following Lincoln and Guba's four trustworthiness principles named as credibility, transferability and dependability, confirmability (Lincoln & Guba, 1985; Bryman & Bell, 2015). This framework is broadly applied and recommended concerning qualitative studies (Lincoln & Guba, 1985; Krefting, 1991; Riege, 2003) and will therefore be applied as the evaluation criteria for this research to ensure its quality.

### 3.5.1 Credibility

The credibility criteria assess that the research was performed in accordance with good practice and its findings to be corresponding with the perception of social reality to assure trustworthiness. In case the credibility criteria are not fulfilled, the research will end up in non-acceptance by others and its relevance diminishes (Bryman & Bell, 2015).

Since the research is constructed to perform an insightful case study at a single organisation the risk of biased opinions cannot be neglected. In order to encounter this argument, the data collection techniques applied were carefully chosen. This resulted in the foundation of the data collection were gathered as primary data from interviews or secondary data with emphasis on either peer-review papers or published by acknowledged firms such as *Mckinsey* and *Deloitte*. Moreover, the interviewees were selected to represent insights from all business clusters within Philips to supply the empirical findings with a broader understanding of the organization and several perspectives. By applying such a selection, the credibility of the gathered data enhanced (Eisenhardt & Grabner, 2007).

Since the interviews were only conducted at a single organization, it could lead to potential difficulties of generalizing our findings into a larger scope. Therefore, the researchers of the study have been careful to generalize their results as an instant truth. However, in regard to the research encompassing an extensive literature study and methodology chapter together with a thoroughly performed interview phase, the authors of the study considering the acceptability of others to be significant (Lincoln & Guba, 1985; Bryman & Bell, 2015).

Furthermore, to ensure the interview sessions were conducted clearly, the recited question could be both repeated and reframed to avoid misinterpretation (Krefting, 1991). In addition, due to the semi-constructed interview methodology, follow-up questions were given to expand the scope and generate a clear comprehension of the thesis. Finally, the primary data gathered from the interviewees were presented in its context or as direct quotes in the empirical findings to justify its trustworthiness. After finalizing the writing process, respondent validation was performed to assure the responses were complying with their views and interpreted correctly. This was then in parallel with agreeing on the publication of the study and confirmed in a written agreement (Krefting, 1991; Bryman & Bell, 2015).

### 3.5.2 Transferability

In qualitative research, the transferability criteria refer to the fact that the research usually is performed intensively to a small sample, which leads to certain characteristics that are dependent to the contextual uniqueness of the research setting. This makes the transferability criteria important to evaluate to provide the readers with indications if the findings could be applied in other contexts and groups. However, as Lincoln and Guba designate "It is, in summary, not the naturalist's tasks to provide an index of transferability, it is his or her responsibility to provide the database that makes transferability judgments possible on the part of potential appliers" (Lincoln & Guba, 1985, p.316). In addition, Lincoln and Guba (1985) describes how qualitative researchers are favored to engender what Geertz (1973) refers to as *a thick description*. It implies a rich account of details to culture is portrayed and due to this "database" of thick description, judgements of the transferability of the findings to other environments could be assessed by external parties (Lincoln & Guba, 1985; Bryman & Bell, 2015).

This research has been focusing on investigating theory developments in the interlinkage between IP and data-driven business models within a healthcare company. Therefore, the dissertation as such does not claim generalizability in relation to its findings. The intention of the research was rather to provide the first collection of data for enabling further research and judgments within the field of IP and data-driven business models in a healthcare company onwards (Lincoln & Guba, 1985).

### 3.5.3 Dependability

Lincoln and Guba (1985) suggest the researchers adopt what they call an "auditing approach" to ensure trustworthiness in the study. This implies that the complete material is maintained in all phases of the research process. For example, this refers to that before the competition of the study, all records from the research process as interview transcripts and data analysis decisions are kept intact. By doing so, peers could confirm the reliability of establishing correct procedures to ensure the quality of the study (Lincoln & Guba, 1985; Bryman & Bell, 2015).

Secondly, the researchers have concentrated on outlining a profound explanation of the research strategy and research design in the first two subchapters of methodology to ensure consistency in the dissertation being applied. Additionally, the data collection part was divided into two subcategories to clearly differentiate the methods of acquiring data to explain to the reader what the foundation for the analytical process of generating insights was based upon (Lincoln & Guba, 1985).

### 3.5.4 Confirmability

The confirmability criteria to evaluate the findings of the dissertation are the result of the interviewees and not the bias of the researchers. Absolute objectivity is not possible to achieve in business research and therefore function the confirmability criteria as an element to exhibit that the researchers acted in good faith and to the best of their abilities (Bryman & Bell, 2015). In order to minimize the impact of personal reflections in the study, the following mitigations were applied.

The collection of data from interview meetings was guaranteed to be correctly interpreted by recording and transcribing the full interviews. The application of such a process implied the validity of the research empirical findings. In tandem during the conduction of interviews, notes were taken from the passive researcher to ensure its context and simplify the thesis writing process onwards (Lincoln & Guba, 1985; Riege, 2003). However, potential mistakes from the understanding of the researcher's in relation to the interview sessions should not be neglected, for example in how a response was delivered to accents, hesitations, and intonations (Bryman & Bell, 2015).

## 3.6 Limitations

This dissertation has limitations considering the collection of empirical data. Mainly, by the fact that all primary data has been gathered from a single organization. This data collection has served as the foundation in the empirical findings chapter and highly influenced the outcomes in analysis and conclusions. As a substitute, additional global healthcare organizations could have been included in the study and enlarged the research scope to a multiple case study. With that said, the researchers decided to deselect a multiple case study since their chosen organization offered great access to conduct interviews with several key persons from various business clusters and roles. The in-depth understanding and broader application this implied correlate with the convenience sample strategy and is acceptable when the opportunity is too good to miss. Such research will not permit the generalization of the findings, which the authors are conscious of. However, the study can nevertheless provide a springboard for future research in the area and allow links to existing findings (Bryman & Bell, 2015).

Another limitation in regard to the empirical data was the decision of finalizing the interview material after nine interviews. This was due to the limitation of time for the research and further empirical findings would have enriched and improved the credibility criteria. Additionally, the research could be questioned regarding not involving an adequate range of characteristics of the participants. Factors such as years in the company, age, gender etc. are not taken into consideration even though it could influence the interviewees' responses and impact the quality of the data.

A third limitation in relation to the collection of data was due to the impossibility to conduct the interviews in person. Due to the external circumstances of collecting and writing the thesis from Sweden during COVID-19 for a Dutch company, the authors were forced to execute all the interviews virtually with the participants. Even though the camera function was on with all occasions, factors such as body language or potential disruptions in the background were more difficult to extract. To some extent, this could have impacted the researcher's perceptions during and after the interviews. On a few occasions, the fact the interviews were conducted from distance led to connection issues and for short periods of the recordings, the responses were difficult to distinguish (Bryman & Bell, 2015).

## 3.7 Ethical Considerations

Ethical questions are critical to be considered for management and business research even though they rarely put lives at risk as medical research may do, but still could lead to economic harm if ethical rules are not followed by the researchers (Easterby-Smith et al., 2018). The main challenge of this study is to balance the internal in-depth study to report to a public domain as a dissertation.

Philips is a well-known innovative and technology-driven healthcare company. Thus, the detailed development strategy regarding data and business models are strictly protected. Since the purpose of this study is to discover relationships at a high and general level, the empirical interviews were welcomed by the managers, if the output information of the study being controlled properly. Confidentiality is a critical concern by the researchers. Before starting the study, the researchers have signed confidential agreements and been educated with an internal secrecy program to ensure they follow the secrecy rules of the company. Although bias of reporting may be argued, the researchers are trying to provide the most empirical data on a good level, with the confidential and ethical consideration in mind.

The other consideration regarding ethics is that the researchers should receive the consent of recording the interviews and the empirical findings should be pseudonymised. The findings involve much understandings and opinions based on personal experiences; therefore, it is important to keep them anonymized to avoid conflicts and judgement.

The research has no preferences in its study when concerning gender, age, nationality or other personal identical considerations, the sampling strategy for interviewees is well discussed in Chapter 3.3. Therefore, these personal parameters are not preferred when selecting participants, which means that this study has no ethical issues regarding these factors.

# 4. Empirical findings

*In this chapter, the empirical findings from the research will be disclosed. The chapter constitutes of four subchapters, highlighting various concepts in order to simplify the presentation of data to the research topic and research questions. The chapter is structured into four sub-categories as follow: Technology Assets, IP Control, Value Creation and Data-driven Business Models.*

In this chapter, the empirical findings will be organized into the pre-determined concepts that were explained in the theoretical frameworks. These concepts were developed in relevance to the research questions. The researchers have selected the most significant quotes from the interviews and summarized them in their original wording in Appendix B. From those tables, specific quotes are presented in the principal text of chapter four as samples that demonstrates significant findings from the interview sessions.

## 4.1 Technology Assets

From the interview data, the empirical findings disclosed that at Philips, the development of technology assets is crucial to sustaining competitiveness in their business areas (QA2; QG12; QI10; QI30). Technology assets that are specifically mentioned as important are the ones closely interlinked with the acquisition of data. As interviewee E explained, “you really need to have access to hardware in order to produce data. So, the data-driven world would be very much also linked to the to the hardware innovation” (QE6). This argument was expressed on several occasions by various interviewees confirming the significance of integrating data acquisition through hardware innovations. Interviewee G said, “I think still in many cases, the enabling devices are equally important technology assets. Everything is going digital, but there has still to be especially in the healthcare side, a device behind it” (QG11).

Even though Philips investments on the R&D side is shifting from being hardware-focused to more software-oriented, the importance of developing technology assets on the device side was said not to be ignored. Interviewee A disclosed the following: “The difference between when you can enable a digital service to the user is when you have products that are really capable of capturing data and generating data that are useful for your services” (QA2). This was further explicated by interviewee A of how Philips must continuing to distribute products that enable the inclusion of digital services as the value offering by saying “...what needs to happen there is bringing products on the market that get the data that would allow a digital service to be built on top of that” (QA3).

When discussing technology assets in relation to data-driven business models, the responses captured the meaning of evaluating its value for the business proposal. For example, sensors were widely mentioned as the main technology asset for capturing the raw data needed for implementing data-driven business models. Interviewee I explained, “…sensors enable you indeed to have the data and to give advice on the data really adds value for the user…” (QI22). Additionally, since the acquisition of data plays such a central part in the outcome of the patient insights, some interviewees pointed out the device itself to be as significant as the software system managing and generating the insights. Interviewee G explicated “the precision or the accuracy of every measurement that you do of every therapy is so important, and also highly regulated, the devices still remain key” (QG12).

In the larger context, the technology assets cannot only be designed for improving the amount of data that is collected. Procedures of how to analyse and create value back to the user must be examined.

(QD3; QG11; QI6) Many of the participants mentioned artificial intelligence impact in streamline such operations. Interviewee A said "the advancement that we need is how can we make use of the data in the best possible way to provide a benefit to the consumer? And then I'm thinking of AI algorithms and AI solutions, data-driven solutions that allow us to make health-related conclusions on the data that we receive, that is the most important part" (QA4). This is strengthened by interviewee I, reflecting "How can you extract most value out that data? So, you'll see a lot of attention also for AI" (QI25) to emphasize the need in concluding AI's involvement in generating value out of data.

## 4.2 IP Control

The role of IP at Philips is seen as central to monetize upon value offerings according to interviewee C who stated, "You try to commercialize with the help of IP, because IP in this case, it gives exclusivity" (QC13). This is further strengthened by interviewee E explaining "We do see that the whole IP asset pool will play a big role" (QE7). Consequently, the IP control mechanisms cannot be ignored in strengthening the competitiveness of Philips. Further discussion addressed by Interviewee C, "IP serves for mainly two purposes, either for commercialization an asset class, or for strategic defensive purposes from other companies" (QC8). The interviewee continues by raising the importance of understanding the firm's technology assets in order to understand what needs to be protected by IP (QC9).

Within Philips, several various IP control mechanisms are applied. The discussion between which intellectual property right to utilize in which situation originates from the business model. Interviewee E explained it by "it all starts with the business model, taking that where you're going to earn revenues, and reviewing what are the IP assets available to secure those activities" (QE11). Interviewee C explained "it really depends on the field. So even within the healthcare, you have different fields, some of them are technology driven, which means they're patent driven. Some of them are software driven, which means that only patents might not be enough, you also need to have trade secrets or copyright. And it might be other marketing companies, which are purely trademark and copyright driven" (QC9). In summary, various IPs were highlighted in the discussion around what control position should be captured, which were stated to be dependent on the situation, the detectability of the technology functions and the business intentions. As interviewee C concluded "It depends on the segment. You cannot generalize it" (QC14).

In relation to the applicability of various IP types, the two most discussed IP control mechanisms during the interviews were patents and trade secrets. Patents have for a long time been the central intellectual property right to ensure exclusivity for their inventions (QC13). Interviewee H reflected by saying, "The 2000s was really focused on patents as a number game. Yeah, file as many applications as possible, get high number of patent applications. And then after, in the new decennium, as of 2010, I think, improved awareness of what we would file, so more focus on quality rather than quantity" (QH10). Along with the technology development, the software has enhanced in importance and the need for trade secret protection has become more visible. Interviewee C explained "I do see a trend that trade secrets are becoming much more important in every business… But at the same time, I acknowledge that patents won't go away. So, it will be just a different perspective, that patents and trade secrets, they will complement each other…" (QC11). Interviewee G strengthened this argument by saying "…for many years now, we have actually becoming more digital company, there has been more emphasis on trade secrets. So, more emphasis towards, let's say, R&D and innovation on trade secrets, and really putting a value on, let's say, generating trade secrets, if you can call it that. So that is a change that we see. With that said, patents are still at the core of most of whether its exclusivity model or a risk mitigating model, or of course, our licensing programs, the patents remain key there…" (QG20).

In addition to patents and trade secrets, a few other intellectual property rights were mentioned in the discussion around IP's role in data-driven business models. For example, trademarks were highlighted as an important protection tool to utilize in relation to your value offerings. Interviewee G talked about protecting the brand recognition by exemplifying "…trademarks to maintain the brand and the sort of trust that you build up as a company" (QG18). Besides trademark protection, design rights were mentioned as a control aspect to the device part and service interface. Interviewee G continued "…design rights, they will be key for, at least certainly for the device part, but also for parts of the analytics and the interfaces" (QG16).

During the interview sessions, discussions about how to utilize patents versus trade secrets in the IP strategy had turned out to be an engaging topic. Several discussions in addition to the historical trend were raised. Interviewee B emphasized focus on necessity as well as the technology enhancements by reflecting "I think the trend will be driven by necessity. I think it's always best if you can obtain the patents. And if you do not mind disclosing how you do things, because disclosing how you do things will not give away your core technology. In that case, it's always good to obtain a patent. But if it's extremely difficult to reverse engineer, so actually nobody will never be able to, or you'll never be able to prove that your patent is used. In that case, you better count on trade secrets" (QB9). This argument addressed the discussion towards what intellectual property right to adopt to which technology asset. As interviewee A explicated "...we will use mainly patents for particular hardware solutions. For software that's a little bit more difficult. We have a few options there, of course, we can rely on copyright, which is automatically generated when you write your software" (QA7) and "we have trade secrets…" (QA8).

The transition from hardware-related technology features into more software-oriented solutions in value-offerings have also impacted the role of IP at Philips. It has already been mentioned how a combination of patents and trade secrets are applied to the business practices to maximize its value (QB9; QI16; QG17; QI18). In order to succeed by protecting their technology solutions, several of the interviewees talked about determining IP control points as central. Interviewee A described "…the challenge is not only we should become and a service-oriented company, but the solutions that we provide also needs to be protected in the IP portfolio that we have" (QA5). Interviewee B explained a control point by saying "To make it a control point, it means that there are limited different ways to do the same thing. Otherwise, it's not really a control point" (QB5). Further discussion about the combination of locating the accurate IP control points in relation to leveraging the business models were summarized by interviewee G as "…for a long time at Philips, we talk about integrated intellectual asset management. And I think that's still key here. It's sort of the combination of, of the different types of IP" (QG19).

When it comes down to IP strategy recommendation, one thing that constantly mentioned during the interview sessions was the importance of engendering value through the IP activities aligned with the company strategy. With that said, in order to ensure that the competitiveness increases with the IP strategy, the IP strategy must be aligned with the firm's business strategy (QA14; QB11; QE5; QG12; QG21). Interview E reflected as: "Think about what and where the value will be located based on your business model. So, it all starts with the business model, taking that where you're going to earn revenues, and reviewing what are the IP assets available to secure those activities…" (QE11). Interviewee A explicated "An IP strategy always starts with the business model needs to be clear, if the business does not know how to make money with data, then as an as an IP counsel, you are really clueless" (QA14). This argument confirms that IP is a supportive tool to help the business capture control position and alignment with the business intention. The business model needs to be in place before any IP strategy could be integrated.

### 4.3 Value Creation

In a large organization like Philips, the variety of value-creation activities are seen in different manners. In the perception of value created through technology assets, interviewees agreed that the interlinkage of hardware and software in the value offering ensure a competitive strength of Philips in data-driven businesses (QA2; QG12; QH2; QH13; QI10; QI21; QI26). Interviewee I expressed as “You could say that data is flown through the system. So, because we have those good sensors, we can collect user data and develop a personalized value offering. I think that puts us in a unique position” (QI21).

When it comes to value created through data-driven business models the process of how to translate the raw data into useful insights is central. To ensure this process runs smoothly and value is generated, Philips must invest in data strategies to ensure its impact (QC3; QI25; QI27; QI28). By reflecting upon value creation activities from a historical context, interviewee I explicate, “…traditionally, our IP strategy was very much focused on indeed, patents, making sure you have the patent portfolio on the right topics, that you monitor what your competitors are doing. And that is all still true and all still important. But next to that, we are now slowly developing a data strategy and data IP strategy because data is getting more important in our total business” (QI28). The view around increasing data importance in the business practice was shared among participants (QG11; QH5; QH13). Interviewee I emphasized the argument by stating “it's all about the data. Without the data, you will not generate the value” (QI7).

When discussing the impact of data in value-creation activities, the inclusion of AI and algorithm development were mentioned as key undertakings (QH12; QI6; QI26). Interviewee H explained, “I cannot ignore the combination with data, because often, a lot of the value that you have for the AI algorithm is acquired during the training phase. So, you need access to the data sets to train the network and get the outputs that you want to see” (QH13). The opinion is strengthened by interviewee I when highlighting the importance of acquiring the right data and train the algorithm in a way that makes the algorithm unique for the business (QI10).

From a long-term perspective, value creation activities can be considered to the competition. Interviewee B explained, “I would say it really depends what type of product you're talking about. Because what's important is always in comparison with what the consumer uses or prefers, but also what competitor is doing” (QB6). To differentiate from the competition in regard to technology features is an interviewee expected to be more difficult in the future and therefore more concentration will be turned to algorithm development. Interviewee I explicates, “I would say, probably more and more difficult to really distinguish yourself at the long term. So, you also see now more and more attention indeed, for algorithm development” (QI24).

Additionally, the interviewees underlined the significance of collaborating with third parties in development activities as well as the importance of distinguishing themselves in relation to their competitors. Interviewee I said, “if you know that you can't be exclusive in certain things, you can also open it for thirds. If you can sell your platform, and by having a platform also have access to data, that also provides new possibilities” (QI30). The strategy of offering services that over time can generate new business possibilities is a well-integrated mindset. An example of this is how revenues for one service could generate additional revenues due to the data and customer insights it captures. Interviewee G explained, “Once you have a solution in place and you get revenues for that, you have the possibility to couple that to another solution. So, it may also open up new possibilities, not necessarily even for the same business segment" (QG9).

### 4.4 Data-driven Business Models

"The idea of a data-driven business model is, how can you generate revenue in a digital way, where you no longer rely on your product, but you rely on what is your product doing for the user" (QA1). Those are the words of interviewee A when answering the question about how a data-driven business model should be interpreted. However, the definitions of what a data-driven business model is varied to some extent. Interviewee E framed it as when "Your main revenues are residing in the data flow rather than in selling devices" (QE1), which copes with what Interviewee G thought the data-driven business model should be device agnostic (QG7). At the same time, a different opinion described by interviewee D as "The use of data generated by the devices, on their usage and perhaps also user behaviour" (QD1).

With that said, the interviewees were in general aligned in the statement that the data aspect will be more relied upon in comparison to the hardware solutions in the transition from a traditional business model to a data-driven one. However, the hardware aspect was said to not be ignored. Interviewee E commented, "you really need to have access to hardware in order to produce data" (QE6) and this explicates how a data-driven world also is linked to hardware innovations to generate raw data.
When it comes to the challenge of transforming Philips's more traditional business models into data-driven ones the interviewees raised various perspectives. First, interviewee C stated that data-driven business models are quite complex due to the terminology you are using in the field. People and organizations might have a various understanding of what a data-driven business model is, which makes the transition towards it more difficult (QC15). Interview A did not see the struggle with the transition and argued it to be quite simple as soon as you know what sort of data you require. When the desired data is determined in alignment with what the consumer is willing to pay for, the healthcare organization is only said to develop that sort of hardware that can produce the required data (QA13).

IP's role has not changed significantly according to the empirical findings. Interviewee D said that in the role as a part of an IP department the daily working procedures do not change significantly from a traditional business model to a data-driven business model and explained "the role from the IP department isn't much different in data-driven business models as it is in the traditional business model of creating superior mechanical products. We need to look for the opportunities which are out there in the in the development cycles and identify the potential inventions which are out there or in in those proposals. And get those on the table together with the innovation community" (QD5). This was further corresponded by interviewee A who is explicating the importance of creating a perception in the role as an IP expert to other employees especially around AI-solutions (QA4).

Hardware sales, especially within certain business clusters have been the main revenue source historically. However, due to the increasing acquisition of raw data in the value-offerings, the hardware position has started to be challenged by data value. Interviewee E explained "Hardware sales drive the largest revenues for this business. However, business does recognize that combining all these devices in one ecosystem, which would deliver data in and analysing data and then offering our customers data analysis, is the future" (QE2). Interviewee B expressed it as "…businesses, who are offering products or solutions involving quite a number of data, that data can be provided in various ways. But I think when we talk about data-driven business models, we mean, in that we really want the data to be core to the solution or the product that we are offering" (QB1).

In summary, value around what a data-driven business model trying to outbring at Philips was recognized. As interviewee G expressed “contrary to sort of normal transactional business where you buy a machine or you buy a box, a data-driven business model, in my view is most of the time a longer term solution or service, and it's enabled by data. And it can be pay per use pay in healthcare, even pay per outcome or throughout the number of patients” (QG1) and “I think Phillips is really transforming into a data-driven solutions company. And that strategy is very clear here” (QG3).

# 5. Analysis

*In this chapter, the empirical findings are analysed in relation to the theoretical frameworks. The purpose of the analysis is to extract similarities and differences in the intersection of the theoretical frameworks and empirical findings to answer the research questions and encourage future research. This chapter is divided into three sections according to the themes: Technology Assets in a Data-driven Business Model, IP Control of Technology Assets in Data-driven Business Models, and Value Creation through IP in Data-driven Business Models.*

## 5.1 Technology Assets in a Data-driven Business Model

The analysis steps presented in Chapter 5.1 are according to the thematical design and are developed to answer the first sub-research question regarding how technology is developed to data-driven business models in a healthcare company.

### 5.1.1 Categorization of Technology Assets according to IAM framework

In order to categorize the technologies expressed in chapter four concerning the research topic, the study utilizes the IAM framework (Chapter 2.1.2) as guidance for identifying various technology assets from the interviewees' responses.

*Data* is a technology asset category in the IAM framework that refers to the collection of information as raw data, which for example could constitute results from measurements and clinical tests (Petrusson, 2016). From the conducted interviews, data was a highly discussed technology asset as the significance of personalized information that is collected through devices. This data provides Philips with information regarding user behaviour and device usage (QD1; QF1). Data could be captured almost anywhere through devices nowadays, according to interviewee H's explanation "We find data anywhere almost that can range from images of patient images as they are acquired by the system as a raw images or images with what we call annotations" (QH5). In addition, interviewee H mentioned that all kinds of data in relation to aspects in diagnostic procedures have been logged for a long time, such as X-ray tubes, application usage, etc. However, it is the first in the last couple of years the business has seen much more value in the logged data to understand how procedures were carried out (QH2). In summarization, data was clearly extracted from the empirical findings as a technology asset and confirmed its usage within Philips.

*Databases* is the second category in the IAM framework and refers to data being captured in an organized structure. A database provides value as a technology asset due to the infrastructure it provides and the enabling of development of insights from the captured raw data. Interviewee H discussed databases as a technology asset when for example talking about data protection and how it could be translated to IP protection through certain copyright to databases (QH8). Interviewee G mentioned the significance of databases as an asset by saying "…really just integrating data from multiple sources to further enable all kinds of analytics and connecting care from multiple sources and multiple parts of the care system…" (QG7).

*Instruction* is another categorization applied to the study from the IAM framework that relates to how actions are directly linked to instructions, where a characteristic example of an instruction for a technical solution is the algorithm. Throughout the interviews, algorithms were elaborated as an important technology asset category by several interviewees (QG17; QH13; QI16). The interviewees highlighted how algorithms create a lot of value in combination with data. During the training phase of the AI algorithm for example, it was said the access to data sets generates value for the algorithms and that the outputs then become better (QH13). Algorithms were also lifted as important in collaborations with the clients and how it would benefit both parties. For example, when a doctor captures data of their patients, improvements of the algorithms occur due to the enlarged data sets. However, it is important that the developed algorithms also benefit the doctor with insights and more value can be created for both parties through the algorithms' development (QI16). As interviewee I explained, "…I would say, probably more and more difficult to really distinguish yourself at the long term. So you also see now more and more attention indeed, for algorithm development" (QI24).

*Software* is a category explained in the IAM framework which refers to its performance of specific tasks, where platforms and systems are examples of where software produces value. From the interview sessions, software was mentioned as a crucial technology asset to enabling data-driven business models (QA10; QE12; QH12). It was said that the transition towards data-driven business models is driven by an increasing trend in digital, more software-related work. As interviewee A said, "…I think we need to rely on hardware and software. Also, if we are going towards the hardware-less company…" (QA10). Consequently, this has increased the interest in examining artificial intelligence-related topics (QG11; QH12).

*Solution* is the fifth categorization from the IAM framework, which implies the engineered solution to a problem. Solution as a technology asset in Philips was mentioned by interviewees while discussing hardware devices and software solutions (QA10; QE6; QI1). Interviewee E explained the importance of having access to hardware in order to produce data, which makes the technology asset as a solution central to the business. By transforming into a data-driven world, the hardware solutions distributed must be organized in a manner that suits software-related business solutions (QE6). Interviewee I lifted the fact that Philips in the past was an organization concentrating on developing certain technologies, which were sold as "hardware boxes". The difference now is that Philips wants to be a company that provides solutions for their customers and not only selling boxes (QI1). Interviewee A also explicated that the company relied on both hardware and software solutions, but the IP protection would shift under the transition to a digital-oriented company (QA10).

*Visualization* is the last applied categorization from the IAM framework in the thesis and it refers to the element of design through models, prototypes, and drawings. The framework suggests that this category is applicable when the design adds additional value to an engineered solution. This was mentioned a few times during the interviews, but not to the same extent as the above-mentioned categories (QB8; QG16; QH3). Interviewee H mentioned how the collection of data could improve the design of Philips' products by measuring their usage (QH3).

When identifying the six chosen categories of technology assets using the IAM framework from the empirical findings, it was significant that all of the categories were mentioned to some extent by the interviewees. Determining which category of the technology assets that was mostly discussed is difficult since at least the first five described categories above were all elaborated around frequently. Additionally, several of the categories were assessed to be closely interlinked to the research topic and many of the quotes could have been placed in multiple spots, showing that Philips has an advanced combination of technology assets in its ongoing business.

## 5.1.2 Technology Assets to the Data-Driven Value Chain

To understand the meaning of technology assets to a data-driven business model, the researchers have discussed six technology asset categories in Chapter 5.1.1. This chapter then intends to analyse the integration of identified technology assets in a data value chain (Senthilkumar et.al, 2018). The data value chain consists of five steps; acquisition, storage, management, analytics, and visualization & reporting and is developed to increase the awareness around big data process in healthcare (Senthilkumar et.al, 2018).

The first part of the data-driven value chain is *data acquisition*, which implies the way about how data is acquired by the healthcare company. From the IAM framework, this corresponds with the technology asset category *solution*, which captures data through hardware inventions as sensors. From the empirical data, interviewee B reflected on the importance of developing hardware solutions that could succeed with capturing the data needed for developing personalised solutions (QB2). Interviewee E also stressed that all acquired data was still provided by devices, which made the transition towards data-driven business models still dependent on hardware (QE5).

In the data acquisition part, the technology asset as *data* could also be clearly identified as central. Through developing technology solutions, the enabling of collecting information in the form of raw data was discussed. As described in the IAM framework, data as an asset category engender value through gathering measurement results, which were confirmed by several interviewees saying that the capturing of raw data in the data acquisition part enabling the data-driven business model (QE5, QF4). For example, in order to succeed with the business model directed towards personalized care, the acquisition of data from each patient is necessary (QA2).

The second part of the data value chain is *data storage*, which refers to how data is stored within the healthcare company and how it later applies analytics solution that generates value (Wang & Hajli, 2017; Senthilkumar et al., 2018). Data storage could be linked to mainly two categories from the IAM framework, namely software and database. Software is referring to platforms, systems, and applications. Databases are also closely interlinked with the data storage part due to their function of organizing raw data into a structure that is needed to produce insights. From the empirical findings, data storage was elaborated around when discussing software and databases by interviewee C explicating "Because from the perspective of digitization, you are digitizing more and more information. So you're building a pool of information, a cluster, data lake, so to say. So you're building a data lake of information to actually extract value from that information. And then digitalization, you automate manual processes with digital processes" (QC1). Interviewee C continued the reasoning by saying that all fit together with how data-driven business models extract value from the captured data through the software solutions and bring that back to the customer. This is for example seen in the many patient platforms Philips have (QC1).

The third part displayed in the data value chain, *data management*, organizes, clean and govern stored data to simplify the data analytics (Wang & Hajli, 2017: Senthilkumar et al., 2018). Related to the IAM framework, data management corresponds to the technology assets of databases, software platforms, and instructions. This part of the data value chain reminds to some extent to the discussion around databases for data storage, however a larger focus in data management is towards the governing part of the database. From the empirical findings, data management was elaborated around when discussing how the value-offering could be improved by increasing the support to the medical staff during procedures, and governance the data security internally. Databases of information to the medical staff during procedures would simplify their decision making and it is important that all data derived is managed properly (QI3). As discovered in the interviews, data management requires organizational efforts in securing technology assets development (QI17; QI20).

The fourth and often most researched part of the data value chain is *data analytics*, where data is turned into insights through analytical capabilities. The data analytics part supplies the healthcare company with information of great value through the power of algorithms, which patterns would be difficult to identify otherwise (Wang & Hajli, 2017; Senthilkumar et al., 2018). Technology assets in the data analytics found through the IAM framework are instruction and software. Instruction as algorithms are seen as central technology assets functioning in the data analytics due to the capacity of generating value. For data-driven business models, algorithms are explicated as crucial since it provides value by analyzing the data and generate insights (Wang & Hajli, 2017). For example, interviewee C discussed the significance of using algorithms to yield diagnostic and prognostic insights and how it enables business opportunities through data-driven business models (QC5). The technology asset as software is important in data analytics by how it utilizes data to build ecosystems behind the user platforms. With such platforms, the healthcare companies are said to bundle customers to their enterprise platforms through connecting various data insights and analysis to useful analytics contents (QC2).

The fifth and final step of the data value chain is *data visualization and report*, where the healthcare data is presented back to the user. Through this step, the analytical insights developed by the healthcare company will be understandable for the receiver (Wang & Hajli, 2017; Senthilkumar et al., 2018). Taking this into account, the IAM framework identified the technology asset as visualization. From the empirical findings, visualization and report were elaborated around when discussing increasing customer satisfaction when using Philips' user interface (QH4).

When pairing a data-driven value model with the IAM's categorization of technology assets, it was significant that the models integrated smoothly. The distinguished technology assets were adapted to the data-driven context by interpreting the interviewees' responses. The analysed five parts of the data-driven value chain all incorporate some technology asset in the researchers' assessment. This suggests that the IAM framework and the data-driven value chain functions as a profound foundation when discussing how technology assets are viewed in relation to data-driven business models within a healthcare company.

## 5.2 IP Control of Technology Assets in Data-driven Business Models

The empirical findings of the study have acquired well-described opinions regarding the different IPs. As Chapter 5.1 trying to categorize the technology assets according to the IAM Framework and data-driven value chain, Chapter 5.2 is looking into potential IPs according to the IAM framework and data-driven value chain.

### 5.2.1 Categorization of IP assets according to the IAM Framework

The first mentioned category in the IAM framework, *inventions*, which could be captured as patents or patent applications, was discussed as various IP protections in the interview phase. As Interviewee A explained, the majority of current IP protections are in the form of patents, which heavily rely on the technology behind it. The aim of such patent protections is always focused on the technical effect (QA9). In relation to the IAM framework, the effort behind the innovation of Philips is to capture IPs on their technology assets from inventions to obtain control positions. This implies that when deciding what technology invention to be patented, it needs first to be thoroughly analysed (QB9).

Furthermore, patents were mentioned as an important IP in various areas at Philips. Primarily, a patent was mentioned as an important IP to the hardware inventions like for example sensors and devices (QA3; QD4; QF8; QG16). Moreover, patents were also expressed as a potential control position in software-related inventions like algorithms, even though the discussion often resulted in its usefulness compared with trade secrets (QF9; QG17; QI13). Finally, patents were also mentioned to the likelihood of detectability and how that interacts with what sort of control position to select (QI14).

*Designs* is also mentioned in the IAM framework as an important control position due to its registration and the possibility to exclude others from using similar designs (Petrusson, 2016). This IP was mentioned by a few interviews at Philips, but not to a greater extent. Interview B explained its usefulness by saying that for some products the best IP may be design or copyrights, which protect the uniqueness of the products from being imitated (QB8). Furthermore, interviewee H linked the improvement of design to create value for the user by increasing usability and further attract more users (QH4). This opinion gives the evidence of designs seen as an IP for capturing the favourable parameters to increase customer base. Interviewee G explained the design right to be important for capturing products due to their interfaces, forms, and shapes (QG16).

*Artistic and literary work* is described in the IAM framework as the protected work of art and literature and is given upon creation, which represents copyright protection in IP. While conducting the interviews, copyright was mentioned as an IP providing control at Philips (QA7; QB8; QC9; QE8; QG16; QH8). However, it was not elaborated to the same extent as for example patent protection. In addition, the strength of the copyright IP was questioned due to the fact that the copyright IP is generated upon creation and not through registration (QA7), and the protection only covers a direct replica/usage. This interpretation copes with the view of the nature of copyrights since it gives weaker protection (Cockburn & Long, 2015). Copyright though is still seen as a necessary and inevitable IP to capture in data-driven business models, as interviewee E explained by saying "…but in digital driven world with data flow, a lot would be trade secrets, a lot would be copyrights…and depending on the situation, either one of these assets might have a heavier weight. So the weight factor for each of the assets would be changing" (QE8).

When discussing data-driven business models, databases and data were repeatedly mentioned as important technology assets (QC3; QD1; QG7; QH8). According to the IAM framework, databases can be copyright protected mainly due to its original work in organizing and structuring the data (Petrusson, 2016). In the interview sessions, databases were explained as "…when I talk about data protection, IP protection for data in addition to patents, I primarily think of trade secrets… you could use certain cases copyrights, perhaps for certain databases or certain kinds of data" (QH8). Databases were expressed as an important asset in the transition towards data-driven business models for their storage capacity of capturing raw data. This makes databases a competitive advantage against the competition due to its unique data content and important to be protected carefully. Interviewee I expressed the view by saying "patents on hardware still remain relevant and that it's on sensors. And as soon as you come to algorithms, you see that there is now kind of shift between, yeah, that trade secret data or database rights, maybe even here, data ownership, so you get all kinds of different, let's say ingredients to keep your value proposition unique" (QI15). In addition to databases as a distinguish IP in the IAM framework, databases rights can be captured as IP rights under certain jurisdictions as the framework discussed in chapter 2.

*Trademark* is defined as an IP asset category in the IAM framework and is a controllable symbol due to either registration or establishment (Petrusson, 2016). During the interview, trademarks were mentioned only by a few interviewees as an important IP. Interviewee G clarified trademarks as an important IP to preserve brand recognition and reputation (QG18). Interviewee C touched upon trademarks in a larger context while answering what IPs are distinguished in data-driven business models by saying "…which means that only patents might not be enough, you also need to have trade secrets or copyright. And it might be other marketing companies, which are purely trademark and copyright driven. So even within healthcare, you find different flavours" (QC9).

*Trade secrets* is an IP category that does not result in an exclusive right if they cannot be protected properly. Therefore, actions must be taken to fulfil the criteria of secrecy to prove a disclosure would damage the information holder towards competition (Petrusson, 2016). In the empirical findings, trade secrets have been discussed extensively as an important IP concerning creating control positions for data-driven business models. Particularly, trade secrets were mentioned as central protection in relation to software and algorithms since a patent could be difficult to enforce. Interviewee G explained "… some algorithms, AI models, etc, that can likely better be kept secret, because it may be difficult to get the protection we want and proving infringement to actually enforce patents, even if we would get them can be quite a challenge. So it may be worthwhile to keep things a secret" (QG17). Trade secrets were also mentioned as an important IP that always has been around but firstly now received more attention as valid protection. Interviewee I explained "trade secrets have always been around. But now we start realizing more that we really have much more trade secrets than we thought" (QI18). In addition, interviewee B highlighted the importance of identifying and protecting trade secrets to bring value to the business (QB10). Another aspect that was raised was that efforts are needed for organizations in planning organizational policy and rules to meet the legal criteria of trade secrets. This point was verified by interviewee I mentioning that it was important that the organization need to deal with trade secrets properly for its usefulness: "… more recognition now, trade secrets, they are nice, but your organization needs to be, really, let's say a tentative for, those methods to really keep the trade secret trade secret" (QI16).

Summarizing the categorization of IP assets according to the IAM framework towards the empirical findings, a clear linkage could be extracted. It is also obvious that the most discussed IPs in relation to the research topic at Philips are patents and trade secrets. All the interviewees elaborated extensively around these two categories of IPs in the transition towards data-driven business models. The other four categories: designs, copyright, databases, and trademarks, were all discussed to some extent, however, the discussion around these IPs were often short. The fact they were mentioned as IPs only by a few and not by everyone, indicating their importance as applicable IPs to be seen as less significant in comparison to patents and trade secrets at Philips regarding data-driven business models. The researchers are aware that Philips is a company that owns great brand equity, but in the empirical findings, this part was not discussed greatly. This may disclose that in regard to the data-driven business models, branding position with trademarks is placed behind other IPs which are more tightly connected to technology assets, such as patents and trade secrets. It should also be mentioned that the research has highlighted the technology aspect of value creation for data-driven business models, which made the responses automatically prioritize patents ahead.

### 5.2.2 IP in the Data-Driven Value Chain

In the data value chain, the first part, *data acquisition*, was identified to hold onto the technology asset solution, which for example could be sensors (QB3; QE6; QI22; QI23). These technology assets in data acquisition are often seen protected through patents. Interviewee I explained patents to be central IP when protecting the technology functions generating the raw data (QI5; QI22).

The technology asset data was also seen as central in the data acquisition part. On the other hand, data as a technology asset is not protected through patents, but rather as trade secrets (QH8; QI15). Data is seen as important technology assets to be captured and giving a control position (QA2; QB2; QC12; QE8)

The second part of the data value chain, data storage, was distinguished to possess the technology asset categories of software and database. By now integrating IPs role to these technology assets identified in data storage, software systems as platforms and applications could be protected through the IPs of copyright, trade secrets and potentially even trademarks (QC1; QC9; QI30). As Interviewee C explained "…Some of them are software-driven, which means that only purely patents that might not be enough, you also need to have trade secrets or copyright… So even within healthcare, you find different flavours" (QC3).

The other identified technology asset, databases, is mostly protected through the database itself since it is both a technology asset and intellectual property asset in the IAM framework. The IP protection of databases are covered by copyright-related legislation and gives the person compiling a large amount of information the exclusive right to produce copies to the public (Petrusson, 2016). By collecting empirical data from the interviewees, databases were also said to be protected by trade secrets or database right, in addition to copyright, which was something the IAM framework did not mention (QH8; QI15).

The third stage of the data-driven value chain, data management, was identified in alignment with the technology asset database. In similarity to the description of databases in data storage, the IP assets connected to the database are having the same names (QA7; QH8; QI17; QI20; QI28). Copyright and trade secrets were mentioned by the interviewee H as common IPs by saying "…when I talk about data protection, IP protection for data in addition to patents, I primarily think of trade secrets… you could use certain cases copyrights, perhaps for certain databases or certain kinds of data"(QH8).

Data analytics is the fourth step of the data-driven value chain, where the technology assets instruction and software are identified. Instructions could be protected by the IP asset copyright when for example algorithms are discussed. However, other ways of protecting instructions were interpreted to be through trade secrets and patents according to the interviewees (QF4; QG16; QI5; QI25; QI26). Interviewee G expressed that when it came to analytics and interfaces, trade secrets and copyright were the often-used IPs, and perhaps a small part of it could be patented as well (QG16).

Software is a technology asset that could be protected with several IP assets dependent on its function. For example, software computer programs could hold elements of both solutions and instructions as technology assets. This makes the IP evaluation of software broadened into several IP categories. Platforms and applications could for example be protected through copyright, design, trademarks, and trade secrets. Systems and codes could be protected through trade secrets, patents, and copyright. The empirical findings give a good view regarding software's IP, since software was discussed frequently with broader IP categories (QA7; QC9; QE12; QH12; QI20). Especially, as interviewee H mentioned, "This is driven by a transition, increased trend in digital, more software-related work. Particularly last few years, what we see the heavy interest in artificial intelligence-related topics" (QH12). This leads to a discussion in IP for instructions as algorithms, which are necessary to simplify the data analytics stage, which is confirmed by great resources are invested here (QG16; QI5; QI25; QI26).

The last stage in the data-driven value chain, data visualization and report, was mainly linked with the technology asset visualization. Visualization is protected through the IP assets as designs and trademark. These categories were not extended discussed as explained earlier in the analysis, but the interviewee confirmed that visualization could create user value and increase customer base (QH4).

Summarizing IPs role to various technology assets in the data-driven value model, hardware devices are still seen as important assets playing a big role in capturing the right data, where patents could contribute to a control position. This point is still valid and confirmed when looking at the patenting trends and survey results revealed in earlier literature in Chapter 2.2. Moreover, the captured data being processed in data analytics through software and algorithms are protected more frequently through trade secrets. The organizing of data is also seen as crucial to establishing data management for data-driven business models, where building up unique databases and training AI algorithms could result in a competitive advantage against competitors.

## 5.3 Value Creation through IP in Data-driven Business Models

The empirical findings have been analysed towards the IAM framework and data value chain in the above chapters. In 5.3, the interlinkages between researched concepts and the developed TVID framework will be discussed. By examining the participants views, the researchers of this study realised the need of iterating established models to fit the research purpose of understanding how IP is applied into data-driven business models and creating value within a healthcare company. This led to the TVID framework originating to show what significant factors that are needed for creating value in a healthcare company towards data-driven business models. The TVID framework, see Figure 2.4 below, highlights the interplay between technology assets, value creation and IP in relation to the data-driven value chain.

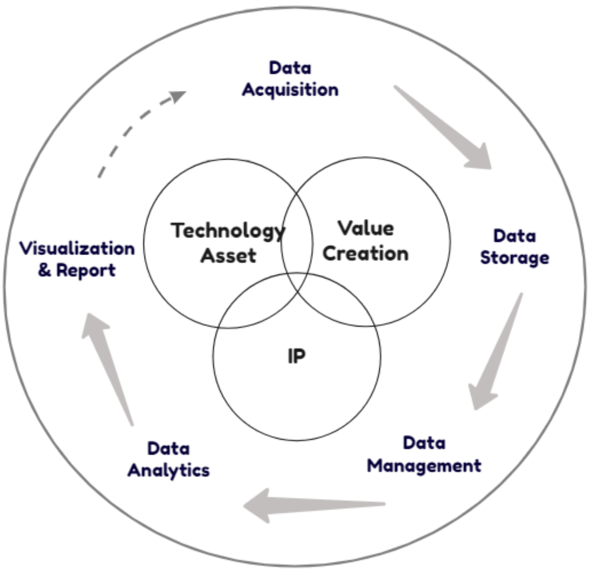


*Figure 2.4: TVID Framework Developed by the Authors*

Data-driven business models are seen to have a significant need of representation of technology assets, value creation and IP in accordance with the TVID framework. Firstly, the interlinkage is discussed by many interviewees. It was clear to see that data becoming more important, and the drivers of the integrating could be technology assets including devices, interfaces, and platforms. For instance, device innovation is secured by IP, where the devices collect data and give instructions and insights to the users.

Then the users' activities and feedback are further collected through using the device or interfaces, which also bring value and promote service improvement for future innovations.

These aspects are included in the product development cycle according to the empirical findings at Philips (QD2; QD5; QE4; QF2; QI21). Interviewee E emphasized the interlinkage between data-driven and hardware innovations and further argued that specialized devices can be integrated into a software platform, which will allow a broader user base and collect more data (QE6). This discussion bundles the relations between IP, technology assets and value creation into the data-driven value chain. As interviewee G concluded: "I think Phillips is really transforming into a data-driven solutions company. And that strategy is very clear here" (QG3).

When zooming into the inner circles of the TVID framework, and looking at the applicable IPs in the data-driven business model, many interviewees concluded that the combination of IPs, particular the interplay between patents and trade secrets, are creating crucial value for data-driven business models (QA9; QC10; QD4; QF9; QG15; QH9). The interview findings displayed that the interviewees' perceptions about IPs role varied in the discussion around which IP category was more applicable for data-driven business models. Some interviewees expressed that patents were viewed as more central as IP protection (QA9), while others acknowledged a trend towards greater significance in trade secrets (QC11). However, conformity was identified that the combination of various IPs builds strong protection. Interviewee D said that it would depend on whether it would disclose the technology that is difficult to imitate. In this case, it would be better to protect it with trade secrets (QD4). The relation between patents versus trade secrets and how the trend will continue was extensively explained by interviewee B saying that patents are always good protection to obtain. However, if the technology scope would not be possible to reverse engineer, or if it would not be able to prove a patent infringement, trade secrets would be a better alternative (QB9). Interviewee C also made it clear that the two most important asset categories were patents and trade secrets and the most important strategy is to keep a mix of two (QC10).

Other types of IP were not extensively discussed by most of the interviewees as disclosed in Chapter 5.2. But the fact that all types of IPs were identified in the empirical findings disclosing the great variety of potential IPs a large healthcare company like Philips evaluates. For example, design rights, in the empirical findings together with trademarks, were still mentioned as protection for analytical results and interfaces (QE8; QG16).

To secure that the IP strategy creates value for the business, one important step is to adapt the IP accordingly to the technology assets needed for the business (QA9; QD4; QE8; QF8; QG19; QG17; QH14; QI11; QI14; QI27). As recognized above, the planning of IP need to correspond to the business strategy, and the business strategy determines what kind of products and services are central, which further connects to what technology assets should be protected. According to the TVID framework, the technology assets involved are those that contributes to value creation in a data-driven value chain. The out layer of the TVID framework, represents data process and flow in a data-driven business model, and displays the needs of activities regarding data. Some detailed discussion has been addressed in Chapter 5.1, to recognize and summarize technology assets applied in the data-driven value chain at Philips.

Some empirical findings reveal trends regarding the IP protection shifting historically at Philips. Such trends are not directly seen from the TVID framework, but still helpful in understanding the findings to answer the research questions, therefore, the researchers address such discussion additionally. The historical usage of patents and trade secrets disclosed a significant point that several interviewees brought up (QG20; QH10; QH11; QI15; QI23; QI28). Interviewee G described the need for the transition of IPs was due to the digitalization process and the changes in R&D (QG1; QG20). Interview I explained that new technology assets such as algorithms and databases were seen as primary reasons that shift patenting to other IP protections by saying "…the role of patents is, is may or may overtime, maybe changing for both parts of the system. So patents on hardware still remain relevant and that it's on sensors. And as soon as you come to algorithms, you see that there is now kind of shift between, yeah, that trade secret data or database rights, maybe even here, data ownership, so you get all kinds of different, let's say ingredients to keep your value proposition unique" (QI15). Moreover, interviewee H acknowledged a trend in a growing interest for trade secrets and they are being more actively adopted during the past five years in finding viable protections than patents (QH11). In corresponding to the discussion, theory has also indicated that the traditional way of adopting IP is facing challenges in the digital economy, such as companies intend to rely more and more on trade secrets to capture competitive advantages in healthcare especially due to software development (Weider et al, 2016).

Furthermore, theories and empirical findings have both explained the difficulty in protecting trade secrets in a data-driven business context as interviewee I expressed "…must keep it secret all the time, which is quite an effort for the organization"(QI17). Interview I further explained, to keep the data value offering unique, it was important to acquire data ownership throw database right or trade secrets (QI15). Some distinctions on how to utilize IP in protecting AI were also discussed since AI was meant to be more and more adapted into the healthcare business for providing insights and benefits (QA4). Interviewee D explained that due to the importance of computer-related models, it would not be helpful to publish them, but protect them as trade secrets (QD4). Interview G then added on the argument that algorithms that kept as secrets because if patented, it would still be difficult to prove infringement caused by others usage (QG17). Another challenge addressed by Interviewee G was that in the healthcare context, regulations would impact the adoption of new technologies (QG5), which affect IP adoption.

When analysing value creation according to the TVID framework, the researchers compared the value creation theories with the empirical findings. Products and services represent the value creation internally to the company and externally to the customers in various ways as the literature discussed in Chapter 2.3. This value is well discussed and are said to be delivered through existing business models. Relating to the TVID framework as the authors developed, the outer circle of the model represents the value-creating activities through data-driven business, which are relied on and interplayed with the inner circles of technology assets, value creation and IP. The products and services needed in a data-driven business are covered by the data-driven value chain by activities in collecting, storing, managing, analysing, and reporting data and data insights. As identified and analysed in Chapter 5.1 and 5.2, the findings on the relations between these concepts are well coped with the developed TVID framework, which also leads to that the inner circles of the three concepts are interplaying and overlapping to build up strong competitiveness for the data-driven business model, and the competitive advantages improve the whole value offering in the healthcare company. As interviewee A has described, to achieve value creation in a data-driven business model, it needed the whole adaption of product to enable the data generation for the future, and an IP strategy adapted accordingly (QA14).

IP has been a traditional asset in commercializing with exclusivity. However, today's data-driven business needs more considerations around IP (QC13; QG10; QI19). More specifically connecting with the empirical findings, IP protects the technology such as sensors or devices to create unique competitive advantages such as better images and accuracy. The point was supported as interviewee G introduced: "…the precision or the accuracy of every measurement that you do of every therapy that you do, is, is so important, and also highly regulated, the devices still remain key" (QG12). Furthermore, data protected through IP could give a unique position of value creation through AI models, by training AI using unique databases. Interviewee H expressed that a lot of value created for data-driven business were through training AI with the right data, and the data sets were important to combine for getting outputs (QH13). Interviewee I confirmed the view and added that the right data would allow the company to train the algorithm to be unique in competition (QI10; QI13; QI15).

The value IP created is not only connected to the exclusivity, because in certain scenarios, the company will not have exclusivity always (QI27; QI30). Additional value can be brought by IP was mentioned by a few. Interviewees disclosed that IP can create value by directly licensing out which contribute to the bottom line, and this was especially true in the company as Philips (QA10; QG20; QH14). Even by moving towards the data-driven business model, new technology assets such as data can capture a valuable position through the right IP protection. Interviewee I and interviewee E named openness and data sharing through platform and collaborations, which were examples that indicating extra value potential (QE12; QI8; QI30). From the business perspective, the value of capturing data can also impact the revenue in the long-term as interviewee G argued, "…it also means recurring revenues. Once you have a solution in place and you get revenues for that, you have the possibility to couple that to another solution. So it may also open up new possibilities, not necessarily even for the same business segment., … that longer term relationship that it creates, also creates a lot of opportunities for additional value…" (QG9).

By overviewing the TVID framework, the value creation model that contains technology assets, value creation and IP are circled around by the data-driven value chain. The whole setting builds up a data-driven business model that is tested in the studied case of Philips. The empirical findings disclose a well-established view regarding how the IPs can create value for the data-driven business model, which fits well in the interpretation of the TVID framework. As many interviewees explicitly claimed that the IP strategy should align with business strategy (QA14; QB11; QC8; QE11; QG21), reflecting well on the framework that the inner model being integrated with the data-driven value chain forms the core driven force of a data-driven business model. Interviewee E explained it explicitly by saying "…recommend first to take some time to think about what and where the value will be located based on your business model. So, it all starts with the business model, taking that where you're going to earn revenues, and reviewing what are the IP assets available to secure those activities…" (QE11).

To conclude the analysis, the developed framework TVID serves a good view of the relationships, where the three concepts interplay with each other in the value creation model, generating value and maintaining competitiveness for the data-driven business model in a healthcare company like Philips. At Philips, defining and adapting IPs towards the transition of technology assets is helping the business to keep competitive advantages in the data-driven business models, which is believed to lead to long-term success. As a final word of the analysis, interviewee G captured the overall thinking by saying "…generating the value in a data-driven business model… The business strategy and the IP strategy, they have to be fully aligned to get value from these kind of propositions" (QG21).

# 6. Conclusions

*In this chapter, the research questions are answered and conclusions from the study are presented. In addition, theoretical and managerial contribution from the research are discussed as well as recommendations for future research. This chapter is divided into three subheadings: Answering the Research Questions, Theoretical and Managerial Contribution and Outlook on Future Research.*

## 6.1 Answering the Research Questions

Throughout the research about IP's role in creating value in data-driven business models in a healthcare company, empirical findings have been analysed and presented both towards theoretical frameworks and literature findings. In this conclusion section, the sub-research questions will be answered first to build up the understanding to answer the main research question.

**SQ1:** *How are technology assets developed according to data-driven business models in a healthcare company?*

Throughout the study, the significance of developing both hardware and software technology solutions for data-driven business models has been highlighted. By growing the strength of technology assets both on the hardware and software, emphasizing the acquisition of necessary data is expected to be essential. The IAM framework was therefore utilized to distinguish technology assets at Philips in this study. All used IAM categories were identified and elaborated, which indicates the technology development needed for data-driven business models. All the selected technology assets from the IAM framework were mentioned in the empirical findings but often clustered in categories, which makes it difficult to extract specific technology assets to be of higher value. This finding indicates that Philips has a broad scope of technology assets in mind in innovation and technology development to data-driven business models.

By examining technology assets in the data-driven value chain, the research displayed a well-functioning integration. Technology assets are identified in each part of the value chain, where data acquisition, data storage, and data management corresponding to solution, data, and databases while data analytics, data visualization, and report highlighting instructions as algorithms, software, and visualization.

Lastly, when comparing existing literature with the summary of the interviewees' perceptions around how technology assets are developed to data-driven business models in a healthcare company, the role of AI could not be ignored. AI was considered crucial in relation to technology assets due to the increasing amount of raw data collected through connected devices. This imposes that processing raw data into insights is central and in need of AI to succeed in giving customized insights back to the user.

**SQ2:** *What are the most applicable IPs in controlling such technology assets to data-driven business models?*

By utilizing the categorization of IP assets from the IAM framework to distinguish IPs in the empirical findings, all selected IP asset categories from the IAM framework were elaborated by interviewees. However, the empirical findings displayed that the most applicable IPs in controlling technology assets to data-driven business models are still patents and trade secrets. The implementation of data-driven business models in Philips was said to be noticeable and include a combination of IPs to strengthen the protection. Patents were noticed to maintain a central position in the IP strategy, which was explained by interviewees due to that hardware was still having a key role in capturing the data and was frequently protected as patents. Therefore, patents were still seen as an applicable IP to data-driven business models for securing strong exclusivity positions in technologies.

Trade secrets were in addition to patents the most discussed IP asset in the interviews. Several interviewees pointed out that trade secrets enhanced in importance and especially to data-driven business models. Trade secrets as an IP protection were mentioned especially as a strong complementary tool to other IPs, for example to patents or copyrights or database rights, when detectability of certain technology function was difficult to distinguish.

The other categories of IP assets discussed from the IAM framework as designs, copyright, databases, and trademarks, were all mentioned in the interviews however in fewer proportions compared with patents and trade secrets. This indicated these IPs to be less focused upon in data-driven business models for taking control positions for Philips.

Overall, by examining IP assets in the data-driven value chain, patents were confirmed to protect technology assets in various parts. In the data acquisition phase, the patents were captured primarily due to the protection in, for example, sensors and devices; in the data analytics phase, patents were also seen as protections for software solutions. Patents were found concluding the entire data-driven value chain by patenting methods. Trade secrets were distinguished as the most adapted protection in data analytics for the algorithms, but also for keeping data proprietary. Nevertheless, in the data acquisition phase, certain hardware parts which were seen as difficult to detect through reverse-engineering could also be protected by trade secrets.

**SQ3**: *How could healthcare actors create value through IP strategy in data-driven business models?*

In order to visualize how healthcare actors could create value through the IP strategy in data-driven business models, the TVID framework has been developed by the researchers to display what important elements are needed for creating value in a healthcare company towards data-driven business models. The TVID framework pointed out that the interplay between technology assets, value creation, and IP with the data-driven value chain was essential and the framework corresponded well with the interviewees' perceptions of how the value was created through the IP strategy. By presenting the TVID framework, the researchers have proposed an applicable tool for how healthcare actors can establish and maintain competitiveness in data-driven business models.

Furthermore, the empirical findings highlighted a combination of IPs could strengthen the strategy. Firstly, data’s increasing impact as a value-creating asset was clearly defined. This has corresponded with the focus on developing devices, interfaces, and platforms that generates useful data at Philips, where the IP strategy was securing the technology innovations, including data and databases. The success factors included a combination of IPs to provide the strongest protection at Philips, where especially patents and trade secrets were central in the discussion. The protection is still actual concerning data-driven business models. This conclusion is emphasized from the developed TVID framework, that the inner circles of technology assets, value creation, and IP are integrated into the centre of the data value chain in the data-driven business model. This further indicates the protection through IP to device-related technology assets are not to be neglected by healthcare companies.

Moreover, the design of the IP strategy needs to correspond with the business strategy for it to create value for Philips. This opinion was shared among all interviewees significantly. Since the business strategy decides what R&D activities to prioritize in order to develop the desired products and services, the IP strategy needs to be aligned to secure value is being generated for Philips. The interviewees agreed upon that in a data-driven business setting, more considerations were needed around IP. In more traditional business models, concentrations of IP towards hardware for sensors and devices have been prioritized to secure control and competitive advantage. In comparison, in data-driven business models, data, databases, and AI algorithms were lifted as important technology assets and value creation elements that needed emphasis in the IP strategy.

Lastly, creating value through the IP strategy did not always have to imply keeping the exclusivity of technology assets, since value could also be generated from licensing out activities. Especially, in the data-driven business models, technology assets as raw data and databases can engender unique value propositions and generate competitive advantages for the company, if properly protected by applying the right IP strategy. Data-sharing platforms and openness to collaborations are also potential parts of the IP strategy that could keep such value.

**MRQ**: *How is IP applied to data-driven business models and creating value within a Healthcare company?*

The main research question was answered through the investigation of firstly exploring the interviewees' perceptions in comparison to existing theoretical frameworks and then addressing a new framework TVID to conclude the findings. From the empirical findings, it became obvious that IP possesses an important role in data-driven business models. IPs are central for creating value by protecting hardware and software solutions since both aspects are essential for generating required data to enable data-driven business models. Various IPs are applied to data-driven business models and creates value within Philips by protecting various technology assets thoughtfully. The implementation of AI solutions is a specific example of how technology is generating value to data-driven business models in Philips. The increasing amount of raw data collected through connected devices addresses the urgent need of processing data into insights, where AI solutions play significant roles for generate value and therefore need to be protected with IPs.

IPs were often seen to be applied as various control mechanisms and the combination of IPs strengthened the protection according to the findings. The ability of data in enhancing prerequisites for creating value at Philips demands R&D activities in developing devices, interfaces, and platforms that capture and generate useful insights. Patents and trade secrets were the two most common IPs mentioned for protecting technology solutions adapted for data-driven business models, with the accompany of copyright and database right playing mentionable roles.

To ensure the accurate IPs were applied in the right situations in data-driven business models, it was disclosed in the empirical findings that the IP strategy should be aligned with the business strategy to create value. The way that IP strategy aligns with the business strategy is illustrated in the developed TVID framework by the researchers to best answer the question. The combination of technology assets, value creation, and IP were three aspects that led forward to the creation of the TVID framework. The TVID framework further integrates these categories into the data-driven value chain to display what important elements are needed to be considered in the data-driven business models for a healthcare company. The TVID framework is expected to be a useful tool for healthcare actors to understand that applying IPs in combination with the company’s technology assets for creating value in data-driven business models is essential. Therefore, developing and presenting the TVID framework as a contribution of this study, carrying the interviewees' views in comparison to existing theories could help the healthcare actors to ensure their incorporation of IPs creates value to data-driven business models.

## 6.2 Theoretical and Managerial Contribution

This study establishes a representative case within the unexplored research field of IPs role for creating value in data-driven business models within a healthcare company. By investigating a single case in-depth, the research examines how various IPs enables a healthcare company to protect their technology assets properly in an ever-changing business impacted by data.

Moreover, this study also contributes to existing research by adopting a healthcare company's perceptions around IP's impact on data-driven business models. In existing IP research to data-driven business models, the healthcare setting as such and particularly not a specific healthcare company has been explored. This makes this exploratory study's findings and insights around IP's role in data-driven business models for creating value within a healthcare company comparable with future research in the study field or as a cross-section analysis comparing various industry fields towards each other. Additionally, in existing research discussing IP's impact on healthcare companies, the focus has not been framed towards data-driven business models. Existing research has rather emphasized the role of IP within healthcare in relation to more traditional business models or other study disciplines as legal regulation or to R&D activities. This contributes to the single case study of significance since it concentrates on the unexplored field of IPs in relation to data-driven business models. Due to data-driven business models are enhancing in importance, this study will contribute to a field that the researchers of this study expect to be intensified onwards.

Furthermore, the research has displayed important takeaways for other similar healthcare actors concentrating on establishing IP protection to their data-driven business models. IP's role for creating value to data-driven business models cannot be ignored, however, what IP protection to apply in which situation is not distinguished. The research emphasizes a variety of IP could be applied and the basis for selection is dependent on the situation.

Lastly, the developed TVID framework could contribute to future research around data-driven business models' usage viewed from an IP-, technology asset- and value creation perspective. The framework is free to apply in future research and thereby intends to contribute to theoretical achievements within the research topic. Additionally, the framework could easily be applied to other industry fields by utilizing the same categorization to data-driven business models. For future studies, the researchers encourage iterations and new ideas around improving the framework to better suit other researchers' scopes. For example, the categorization of the inner circles is perceived to be feasible to modify in order to apply new perspectives around data-driven business models.
This study establishes a representative case within the unexplored research field of IPs role for creating value in data-driven business models within a healthcare company. By investigating a single case in depth, the research examines how various IPs enables a healthcare company to protect their technology assets properly in an ever-changing business impacted by data.

## 6.3 Outlook on Future Research

The researchers of this study are well aware that from the findings presented, it is difficult to extract general conclusions for the industry due to the empirical findings only consist of interview data from one company. Due to this fact, the researchers wish future researchers to further investigate the research topic and apply it to other healthcare organizations.

Moreover, it would be very interesting to recognize future research applying other methodologies to investigate IP's role in data-driven business to create value. For example, applying a multiple case study would broaden the understanding of how other healthcare companies perceive the study topic and thereby pointing out similarities and differences would be enabling a more overall perspective. A quantitative approach to the research topic is also viewed as interesting, where IPs in nominal terms would explain the importance of various usage concerning data-driven business models. Any of these suggestions upon the outlook on future research would contribute to a broader empirical base where comparisons between actors are made.

Moreover, the study has investigated and presented the view from a large organisation operating globally. Data-driven business models in healthcare are also developed by smaller actors and how they apply IP to their growth strategy would be an interesting angle of approach for future research. Such research would contribute to a broader understanding of the research topic and describe the reality of start-ups and small businesses experiences. Such findings could potentially also be interesting for the larger organizations for them to learn from smaller businesses, which usually have it easier to adopt new business models.

Finally, investigating the research topic in other industries will also bring new insights to understand the role of IP to data-driven business models. The digital transformation is happening across industries and societies, where capturing control through IP and adapting new data-driven business models will be actual challenge for each business sector. Therefore, the researchers believe this study will shield a light on an interesting topic and encourage future research.

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# Appendices

## Appendix A: List of Interview Questions

| Research Questions | |
|---|---|
| **Main Research Question:**<br><br>How is IP applied into data-driven business models and creating value within a Healthcare company? | - In your understanding, what is a data-driven business model?<br><br>- How do you think PHILIPS as an organization is coping with data-driven business models? |
| **SQ1:**<br><br>How are technology assets developed according to data-driven business models in a healthcare company? | - How is your department working with it? In what way?<br><br>- How do you think data-driven business models are creating value in your business area?<br><br>- What do you see as important technological assets in a data-driven business model?<br><br>- What control mechanisms are used in enabling and protecting such assets, in what way? |
| **SQ2:**<br><br>What are the most applicable IPs in controlling such technologies to data-driven business models? | - How do you interpret the role of IP when it comes to the controlling of these assets?<br><br>- Which of these IPs do you see as most useful one for each of the assets? Why?<br><br>- What do you see as most valuable control mechanisms in your business cluster? Why?<br><br>- When it comes to Patents and Trade secrets, have you identified any changes in approach within the organization? How? Why? |
| **SQ3:**<br><br>How could healthcare actors create value through IP strategy in data-driven business models? | - What IPs do you see as most applicable for creating value in a data-driven business overall? Why?<br><br>- How could you create more value through IP-strategy in data-driven business models? |

## Appendix B: Empirical findings – Quotation Tables

| Interviewee A | Concepts | Quotations |
|---|---|---|
| **QA1** | 3. Value Creation<br>4. Data-driven Business models | "...you will rely more on the data aspect of things instead of hardware solutions. And the idea of a data-driven business model is, how can you generate revenue in a digital way, where you no longer rely on your product, but you rely on what is your product doing for the user." |
| **QA2** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "The difference between when you can enable a digital service to the user is when you have products that are really capable of capturing data and generating data that are useful for your services." |
| **QA3** | 1.Technological assets<br>3. Value Creation | "...what needs to happen there is bringing products on the market that get the data that would allow a digital service to be built on top of that." |
| **QA4** | 1.Technological assets<br>2. IP control | "…I think that the most the advancement that we need, and I also link it to IP, of course, the advancement that we need is how can we make use of the data in the best possible way to provide a benefit to the consumer? And then I'm thinking of AI algorithms and AI solutions, data-driven solutions that allow us to make health-related conclusions on the data that we receive, that is the most important part. And from an IP perspective, it is creating awareness, also with the people who are working on AI generated inventions…" |
| **QA5** | 2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "…the challenge is not only we should become and a service-oriented company, but the solutions that we provide also needs to be protected in the IP portfolio that we have." |
| **QA6** | 3. Value Creation<br>4. Data-driven Business models | "In an ideal situation, we become one company that gathers data from all kinds of services, and try to use the data in such a way that you can extract health conclusions for in different domains." |
| **QA7** | 2. IP control | "...we will use mainly patents for particular hardware solutions. For software that's a little bit more difficult. We have a few options there, of course, we can rely on copyright, which is automatically generated when you write your software." |
| **QA8** | 2. IP control | ”We have trade secrets. So where we keep our software protected, and make sure it does not leak or exit the company |

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| | | in somehow in some way. But it is also a bit tricky, because you have to be very careful on the information that you put out there. Also you have employees leaving the company, what information do they take with them to another company, it's always very difficult to track that.” |
| **QA9** | 2. IP control | “…I think still the majority of our protection would be with patents. And then I think I already mentioned it earlier, we have to rely on being very critical on the things we protect. And always try to pinpoint what is now the technical effect of these solutions. So software as such, you can protect, but there should always be an effect of it…” |
| **QA10** | 2. IP control | “…I think we need to rely on hardware and software. Also, if we are going towards the hardware-less company, that we still have protection for those hardware solutions to license them out. So that's one way but of course, we are becoming more and more digital oriented. And in the invention disclosure generation targets that I said I want to have 80% of IP related to digital and an automatic consequence of that is that you will have less possibility to protect your technology with patents because of the nature of that technology…” |
| **QA11** | 2. IP control | “…the patent system as it is, at the moment does not allow us to have adequate protection or strong enough protection for this solution that we provide to the customer. So that is the trade-off that we have to make now every time like okay, is this more useful for keeping it in-house and not making it public? Or should we still try to protect it with a patent application with the consequence that we will have a publication and still not be able to get protection because the patent office may not see the value or may not see it to be a patentable.” |
| **QA12** | 2. IP control | “…as IP-specialists, we are not making hardware, we are not making the software solutions. So we need to identify, where can we generate IP, and we need money to make that clear to the business and to research. And I think control points should be there related to the adaptation of our products, to make them ready to deliver the services of the future…” |
| **QA13** | 4. Data-driven Business models | “…it's pretty simple, actually, you have a set of products at the moment, how can you adapt and transform those products that they will be ready in a data-driven or they can be used in a data-driven business model. And for our healthcare data is easy. You need to have more data, you know, so that the device needs to get more data from the user that can be used in in the data-driven business model. And then the question is, okay, what data do you need? What data would be most valuable to the user and would generate the most revenue for which the consumer is willing to pay? And if you know, all those factors of the business model, you can, you can flatten it down one level lower, okay, which hardware would be required to get |

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| | | that data? And then it's very easy. Okay, we need those sensors…” |
| **QA14** | 4. Data-driven Business models | “The whole adaptation of the product to enable it into this data-driven business model, where all the data that it generates can be useful for the future. And I think that is the a very high level way of an IP strategy for a data-driven business model. So, it always an IP strategy always starts with the business model needs to be clear, if the business does not doesn't know how to make money with data, then as an as an IP counsel, you are really clueless.” |

| **Interviewee B** | **Concepts** | **Quotations** |
|---|---|---|
| **QB1** | 4.Data-driven Business models | “…businesses, who are offering **products** or **solutions** involving quite a number of **data**, that data can be provided in **various ways**. But, I think when we talk about **data-driven business models**, we mean, in that we really want the data to be **core** to the **solution** or the **product** that we are **offering**.” |
| **QB2** | 3. Value Creation<br>4. Data-driven Business models | “…so we need to find also ways to **capture** this data. And if possible, **personal** data, at least in **personal health**, what we are trying to achieve how we want our **product** and **solution** to be **personal life preserver**, this is one of the **strategic actions** of our **businesses** with nature.” |
| **QB3** | 1.Technological assets | “Well, you have different **technologies**, of course, the first one you can think of is **sensing** because you need to **collect data**, and if you need to, especially to **collect personal** data, then you need to sense the data. So we're using **sensors** that are already available, that we may use in different ways. So these can be in the sensors can sense any type of **signals**, it can go via **camera**, it can go via **extra sensors** that you would put in, in a product like either a **hairdryer** or a **shaver.”** |
| **QB4** | 2. IP control | “…if you were the only one to have some **IP** on the type of **sensor audit executive era** used in this **sensing mechanism** that could give you a **control points**. The difficulty with defining this is that you need to read to **understand** how the **product works**, and what is really key. So you need to **understand** exactly what you need to **achieve**.” |
| **QB5** | 2. IP control | “To make it a **control point**, it means that there are **limited** different ways to do the same thing. Otherwise, it's not really a **control point**.” |
| **QB6** | 1.Technological assets<br>2. IP control<br>3. Value Creation | “I would say it really depends what **type** of **product** you're talking about. Because what's **important** is always in **comparison** with what the **consumer uses** or **prefers**, but also what **competitor** is **doing**. So<br>suppose that you are **launching** a product with a **completely** new **technology**, this technology was not known before, it's a brilliant new technology. And also a bit **difficult** to **reverse** |

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| | | **engineer**. But yeah, **complex technology**. And having patents to protect the basics of this technology would be the most, the **most** valuable **IP** that you can have on this type of product. Because then if you **protect** this **technology**, the basis of the technology, then you can **prevent everyone** to **copy** you." |
| **QB7** | 1.Technological assets<br>2. IP control<br>3. Value Creation | "We do have some **basic IP**, although it's not **protecting** the **basic technology**, but protecting **commercially** very interesting **implementation** of the **technology**. And those patents are very, very **valuable."** |
| **QB8** | 2. IP control | "…then the best IP that you have on this **product** might be the **design** or the **copyright**, because that's what makes your product **unique**. And that might also be what **everybody** wants to **copy."** |
| **QB9** | 2. IP control<br>3. Value Creation | "I think the **trend** will be driven by **necessity**. I think it's always best if you can obtain the patents. And if you do not mind **disclosing** how you do things, because **disclosing** how you do things will not give away your **core technology**. In that case, it's always good to **obtain** a patent. But if it's extremely **difficult** to **reverse engineer**, so actually **nobody** will never be able to, or you'll never be able to prove that your patent is used. In that case, you better count on trade secrets". So I don't think it's really a wish that we really wants to put more **emphasis** on the **trade secrets**, then on **patents** compared with the previous time." |
| **QB10** | 2. IP control | "We have to be more **aware** and be **able** to **detect** when we have actually a **trade secret** that brings a lot of value to a **business**. So **identifying** the trade secret, and then make sure that we **protect** the spreadsheet with as they should be legally speaking, so that we can also take the **benefit** of the **trade secrets** if we would have to." |
| **QB11** | 1.Technological assets<br>2. IP control<br>3. Value Creation | "…but if there would be too much of a **disconnect** between the **ambition** of the **business** and the **strength** of our IP, we've not a **comfortable position**, not **sustainable**. So we always have to be clear that our IP **strengths** is in line with the **business strategy**." |

| Interviewee C | Concepts | Quotations |
|---|---|---|
| **QC1** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "Because from the perspective of **digitization**, you are **digitizing** more and more **information**. So you're building a pool of **information**, a **cluster**, data lake, so to say. So you're building a data lake of information to actually **extract value** from that **information**. And then **digitalization**, you **automate manual processes** with digital processes. And that's the history behind it. Now, how it fits all together, **data-driven business** |

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| | | **model** is that you try to tap into those products both digitally once, and data was to, for instance, **extract value from that data, bring that to customers, so that you can get revenue from it.** A good example from that would be many different **patient platforms** that we have." |
| **QC2** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…take specifically **healthcare companies**, both on medtech perspective but also on pharma perspective, they're trying to build **ecosystems** behind the platforms. So they try to build **enterprise** platforms for **analysing** different **information**." |
| **QC3** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…Because first of all, to create products, you need to have a lot of **insights** around them. This is one flavour of it. So you can **create value** just by **analysing existing data**, and **structuring** the data that is a **challenge** of its own. So really different types of data, you how you bring them together, you know, that, it seems from your logic, so from this perspective, it's a different type of **challenge** by itself…" |
| **QC4** | 1.Technological assets<br>3. Value Creation | "…**analyzing** data is one **flavor**. It has many different subfields, like analyzing data for **efficiency**, analyzing data for new **insights.** So different flavors of it. Now, analyzing data, that is only one aspect, how you can **create value**. The other aspect is the so called **Advanced Analytics**, what is advanced analytics, you have a pool of data, you try to extract **meaningful prognostic influence** from it. What prognostic means, prognostic in this case means that you have a **pool** of data, and you're trying to make **predictions**…" |
| **QC5** | 3. Value Creation<br>4. Data-driven Business models | "…and this is the other big part, how we can **create value**. So really, based from **diagnostic approach** to a **prognostic approach**, that is a **completely different perspective**, that's a **mind shift** altogether. And this is what prognostic data, not diagnostic data, with data-driven **business models** and healthcare can **achieve**." |
| **QC6** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…you might heard about **data science**. And you might heard that data science **70%** of the what they're doing is they're **cleaning** up **data**. And this is because partly, not solely. But **partly**, this is **because** in order to get the **insights**, you need to **structure** the data, you need to **clean** up the data." |
| **QC7** | 2. IP control | "…**IP** per **definition** is driven that okay, we **invent something**, we **protect something**, there are many flavors of it. But that is general the gig behind. Now, when you have IP assets, they are meant to protect the technology behind. And in order to **understand IP assets**, you need to **understand** the **purpose** of |

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| | | **protecting**. So in IP, you have many different purposes of **protecting**, it might be a **defensive** purpose…” |
| **QC8** | 2. IP control<br>3. Value Creation | “…in general, **IP** serves for mainly two **purposes**, either for **commercialization** an **asset class**, or for **strategic defensive purposes** from other **companies**. There are other things, but those are the two main ones.” |
| **QC9** | 2. IP control<br>3. Value Creation | “…it really **depends** on the **field**. So even within the **healthcare**, you have different fields, some of them are **technology-driven**, which means they're patent driven. Some of them are **software-driven**, which means that only **patents** might not be enough, you also need to have **trade secrets** or **copyright**. And it might be other **marketing companies**, which are purely **trademark** and **copyright-driven**. So even within healthcare, you find different flavours.” |
| **QC10** | 2. IP control<br>3. Value Creation | “…I believe **patents** are the most **important asset class** in **combination** with **trade secrets**, because a good **patent strategy** combines two **asset classes**. So you build a **fence** behind and you know, in order to build value, you disclose some of the **information**, but some of the **information** you keep **secret**. It's a mix between the two.” |
| **QC11** | 2. IP control | “… So I do see a **trend**. And that's my **personal** perspective, I do see a trend that **trade secrets** are **becoming** much more **important** in every **business**… But at the same time, I **acknowledge** that **patents** won't go away. So it will be just a **different** perspective, that **patents** and **trade secrets,** they will **complement** each other…” |
| **QC12** | 4. Data-driven Business models | “…**data** is the new **currency** of different **fields**. So in 20th century, it was **oil**. Now the oil is the data behind. And it's true. So you see already Google as a component, which brings a lot of **data** behind the **business model**. So it's purely **data-driven**…” |
| **QC13** | 2. IP control<br>3. Value Creation | “You try to **commercialize** with the help of **IP**, because IP in this case, it gives **exclusivity**.” |
| **QC14** | 2. IP control<br>3. Value Creation | “It **depends** on the **segment**. You cannot **generalize** it”. |
| **QC15** | 4. Data-driven Business models | “My point is that data-driven business models, first of all, they're quite **complex**. There are many flavors too, to sum up. And second of all, it depends on the **terminology** that you're using good in the field, because **different people**, and unfortunately, **different companies** might **understand different things** in relation to this.” |

| Interviewee D | Concepts | Quotations |
|---|---|---|
| **QD1** | 1.Technological assets<br>3. Value Creation | "The use of data generated by the devices, on their usage and perhaps also user behaviour." |
| **QD2** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "What I see **happening** is that the **use** of **data** gets more and more **important**… I think that **two main drivers** for this, the first driver is on the **mechanical** side, we are more or less at the end of the **innovation** cycle… on the other hand, you can also **make** your **product** more **interesting** for users to **provide relevant feedback**. So that is that is I think the first way, data-driven can be used as kind of **business model** at its use since the use of your **device**. By using their data in that way to provide **better guidance** to the user on how to use the **devices**…" |
| **QD3** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…first thing one and one is the **movements** of the **device** itself. That is that is **useful feedback** and **pressure** of **device** off of how **forcefully** the user is **pushing**… you also try to **enforce information** from **questionnaires**. There was that person that you didn't application, normally, you add in further down in the list of questions that they're there, they actively talk about **acquiring** a **user profile**, which might have some data in itself, which you may use for your **analysis** later on for the **advice**. So that so that can be an **independent** source of your **information**, apart from just the **device** itself…There will be a lot of **different types** of **data** in relation to the **business model**. So that will be **collected** through **different methods**." |
| **QD4** | 2. IP control<br>3. Value Creation | "…and you can **measure** all kinds of **things** during the **activity**, what the **device** is doing that is, if you can take it apart, I would say builds the **invention IP** around it, **invention patents**. That's the I think the more **advanced models** have all kinds of things which are **computer related models**, some kind of magic going on somewhere in computer code. Which most **likely** is **not helpful** to **publish** in a **patent application** how the **trick works**. So for that, I think you may choose to rely on **trade secret** like **approaches**. " |
| **QD5** | 2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "…the **role** from the **IP department** isn't much different in **data-driven business models** as it is in the **traditional business model** of creating superior **mechanical products**. We need to look for the **opportunities** which are out there in the in the **development cycles** and **identify** the **potential inventions** which are out there or in in **those** proposals. And get those on the **table** together with the **innovation community**." |

| Interviewee E | Concepts | Quotations |
|---|---|---|
| **QE1** | 3. Value Creation<br>4. Data-driven Business models | "..data-driven business model is when you when the business and **incomes become device agnostic** irrespective what would be the devices providing such data and your main **revenues are residing in the data flow** rather than in selling devices or anything related to devices, market." |
| **QE2** | 3. Value Creation<br>4. Data-driven Business models | "It is indeed still **a large revenue**. **Hardware sales** drive the largest revenues for this business. However, business does recognize that combining all these devices in **one ecosystem**, which would deliver data in and analysing data and then offering our **customers data analysis**, is the future. So my cluster is invest in a lot of effort and innovation thought into starting **combining existing devices**." |
| **QE3** | 1.Technological assets<br>3. Value Creation | "…it feels like **a no brainer**, but apparently that's the case. So even within one company, if we talk about **MRI business, CT business, and a diagnostic X ray business**, each of these businesses has their set of product lines, products that they are offering. And each of these products has their own user interface. So it means that if the radiologists in CT get to the console at MRI, they are going to **have a completely different experience**." |
| **QE4** | 3. Value Creation | "…the added value is that they need to **invest time** in order to learn how to use a new device and you don't want people to invest time because they They have already invested time in learning how to use the other device…" |
| **QE5** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "I think important is actually a realization, because right now, this data-driven models is very populistic word that everybody likes using, and many people forget to appreciate. And this is my personal opinion that all the data are provided still provided by devices." |
| **QE6** | 1.Technological assets<br>3. Value Creation | "So you really **need to have** access to hardware in order to produce data... So the data-driven world would **be very much also linked to the to the hardware innovation,** in a different evolution stage, maybe not the same, how we do it, at some point, maybe the **good be specialized companies potentially providing hardware units for all users in** the world... that would **be a platform common platform** everybody's going to use." |
| **QE7** | 2. IP control | "…we do see that the whole IP asset pool will play a big role…" |
| **QE8** | 2. IP control | "But in digital driven world with data flow**, a lot would be trade secrets**, **a lot would be copyrights,** one need not forget about this, **and trademarks,** potentially, because you also want to see how we use **leverage your brand or create a new brand.** And, and **depending on the situation, either one of** |

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| | | **these assets might have a heavier weight.** So the **weight factor for each of the assets would be changing**." |
| **QE9** | 1.Technological assets<br>2. IP control | "…because if you are so heavily relying on the hardware, it might be harder to move away to a trade model or trade secret model as easier as, as with for example, what is it? Some healthcare offline software platforms which allow to manage their health, medical images offline? So this would be **quite different.** So each of the businesses will have **their own evolution**, how to get there, and **two different weight factors and assets combination package."** |
| **QE10** | 2. IP control | "…big importance is that once you start saying, I want to **make trade secrets as an important asset** that I'm going to leverage from, in order to announce something as a trade secret, there is a legal… and **especially when you talk about corporate, and when you talk about sharing knowledge in order to boost innovation, this needs to be handled very much more carefully. If we talk about trade secret discrimination and control over it."** |
| **QE11** | 2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "…recommend first to take some time to think about what and where the value will be located based on your business model. So, it all starts with the business model, taking that where you're going to earn revenues, and reviewing what are the IP assets available to secure those activities…" |
| **QE12** | 2. IP control<br>3. Value Creation | "Another important thing is **open source** nowadays, if you are based on the software, platforms that it is so tempting to start with some open source, so packages, but one needs to **realize once you sign up and start commercial exploitation, very** often **open sources have a clause** saying that, by that you **give away access to all people using this open source access to your own IP**." |

| Interviewee F | Concepts | Quotations |
|---|---|---|
| **QF1** | 4.Data-driven Business models | "In principle that you get **value** in the **short term** or **long term** from **data**." |
| **QF2** | 3.Value Creation<br>4.Data-driven Business models | "That should lead to sort of **business model** where you can, in the end, **earn** money in the long run, but it could also be on a short term. You need to make **investments** to **build** first **knowledge** and then use that to build a **long-term strategy** to **monetize** it." |
| **QF4** | 3.Value Creation | "…how we can make a **combination** of this **data** to, for example, **predict** the **health** of the **baby**, or to **advise parents** on what to do with certain **conditions** of the baby." |

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| | 4.Data-driven Business models | |
| **QF8** | 1.Technological assets<br>2. IP control<br>3.Value Creation | "I think we are quite good in **protecting** our **assets** and with the **technologies** that we develop, and to **build** a **strategy** around how to protect them." |
| **QF9** | 1.Technological assets<br>2. IP control | "All the **hard** work that the **technical team** puts into new **innovations**. For the data part thing, we're not there yet. So at least, I don't know yet how to **properly protect** our **algorithms**, our **strategy**, and what do we need to **assign IP** at all on these kinds of technologies? Or whether it would be better to keep it as a **company secret**." |

| **Interviewee G** | **Concepts** | **Quotations** |
|---|---|---|
| **QG1** | 3. Value Creation<br>4. Data-driven Business models | "…in my perception, yeah, contrary to sort of normal transactional business where you buy a machine or you buy a box, a data-driven business model, in my view is most of the time a longer term solution or service, and it's enabled by data. And it can be pay per use pay in healthcare, even pay per outcome or throughout the number of patients. |
| **QG2** | 3. Value Creation | "…it's also weighed to sort of tie in a relationship with your customer, or even partner." |
| **QG3** | 4. Data-driven Business models | "I think Phillips is really transforming into a data-driven solutions company. And that strategy is very clear here." |
| **QG4** | 3. Value Creation<br>4. Data-driven Business models | "So the one driver is we are what's called the quadruple aim. So improve patient outcomes, improve patient experience, staff experience, and importantly, in the healthcare system was a reduced cost or improve efficiencies at the same time, and topics like platformer zation ecosystem thinking are also very important for sort of enabling this step towards data-driven business." |
| **QG5** | 3. Value Creation | "…I think it's pretty slow in the healthcare side, because it's a highly regulated area reimbursement as models are not just changed like that…" |
| **QG6** | 3. Value Creation<br>4. Data-driven Business models | "…which is important but that's in principle just leased or rented the value is really the analytics and the network of care-givers that use this analytic, so it that is, in a sense, already really a data-driven model,…" |

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|---|---|---|
| **QG7** | 3. Value Creation<br>4. Data-driven Business models | "…really just integrating data from multiple sources to further enable all kinds of analytics and connecting care from multiple sources and multiple parts of the care system. So and it's even device agnostic. So it doesn't necessarily even have to be Philips devices…" |
| **QG8** | 3. Value Creation | "…the, sort of the income that you get from whatever whatever agreement that you have, …it's often coupled to a longer term relationship with with the care provider, it can be a co creation relationship.…" |
| **QG9** | 3. Value Creation<br>4. Data-driven Business models | "…it also means recurring revenues. Once you have a solution in place and you get revenues for that, you have the possibility to couple that to another solution. So it may also open up new possibilities, not necessarily even for the same business segment., … that longer term relationship that it creates, also creates a lot of opportunities for additional value…" |
| **QG10** | 3. Value Creation<br>4. Data-driven Business models | "…it's also what you see also with sometimes the with, with risk sharing, for example, that that risks of investment, or it can be more shared between the say, company like Philips who provide some solution and some business and, and the care organization that that that then measures the outcomes and the patient throughput." |
| **QG11** | 1.Technological assets | "…is really the data science. So the the analytic, artificial intelligence capabilities, really being able to, to, to do something with the data to add value. With that said, "I think still in many cases, the enabling devices are equally important technology assets. Everything is going digital, but there has still to be especially in the healthcare side, a device behind it." |
| **QG12** | 1.Technological assets<br>2. IP control | "…the precision or the accuracy of every measurement that you do of every therapy that you do, is, is so important, and also highly regulated, the devices still remain key." |
| **QG13** | 1.Technological assets<br>2. IP control | "…but the relationship or the understanding of the customer needs of the clinical needs, is also an important asset to get this all the work." |
| **QG14** | 1.Technological assets<br>2. IP control | "…it's a combination as those you will have IP to protect your devices you will IP to protect in one way or another the analytics part I think also the interfaces are really key here." |
| **QG15** | 1.Technological assets<br>2. IP control | "…also the customer clinical insights, the access to data, these these aspects altogether also create control points,…" |
| **QG16** | 1.Technological assets<br>2. IP control | "…still patents, in some cases, design rights, they will be key for for, at least certainly for the device part, but also for parts of the analytics and, and the interfaces. So it's not, so that every part of analytics has to be a secret, there has to be copyright, there's still possibility to patent parts of that." |
| **QG17** | 1.Technological assets<br>2. IP control | "…of course, some algorithms, AI models, etc, that that can likely better be kept secret, because it may be difficult to get the protection we want and proving infringement to actually |

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| | | enforce patents, even if we would get them can be quite a challenge. So it may be worthwhile to keep things a secret.” |
| **QG18** | 2. IP control | “…trademarks to maintain the brand and the sort of trust that you build up as a company. ” |
| **QG19** | 2. IP control | “…for a long time at Philips, we talk about integrated intellectual asset management. And I think that's still key here. It's sort of the combination of, of the different types of IP.” |
| **QG20** | 2. IP control | “…for many years now, we have actually becoming more digital company, there has been more emphasis on trade secrets. So more emphasis towards, let's say, R&D and innovation on trade secrets, and really putting a value on, let's say, generating trade secrets, if you can call it that. So that is a change that we see. With that said, patents are still at the core of most of whether its exclusivity model or a risk mitigating model, or of course, our licensing programs, the patents remain key there…” |
| **QG21** | 2. IP control | “…generating the value in a data-driven business model… The business strategy and the IP strategy, they have to be fully aligned to get value from these kind of propositions.” |

| **Interviewee H** | **Concepts** | **Quotations** |
|---|---|---|
| **QH1** | 4. Data-driven Business models | “…way of doing business, which is mainly driven by data. So where the value is predominantly based on exchanging data in some way and that can be in a broader sense, I would say.” |
| **QH2** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | “I think, already for a long time, these systems, We've been able to log all kinds of data relating to aspects of that procedure, usually X-ray tube, certain software apps, certain applications used, which parts of the system are active and when, for maintenance purposes… But I think over the past few years, we've also quite clearly seen that the business sees much more value in that kind of logging data, and that you can use it to understand what procedures, how they are carried out.” |
| **QH3** | 1.Technological assets<br>3. Value Creation | “…on a sufficiently large scale, you can see how your customers are performing and use that to better tailor the use of the design of the systems to their needs, and to the way they are being used in clinical practice.” |
| **QH4** | 1.Technological assets<br>3. Value Creation | “…create value by improving the design of the system and making them more appealing to customers and say… Philips systems being considered as more user-friendly. Yeah, that's also a good chance that more customers, hospitals, will ask for Philips instead of competitors.” |

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| **QH5** | 1.Technological assets | "We find data anywhere almost that can range from images of patient images as they are acquired by the system as a raw images or images with what we call annotations." |
| **QH6** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…it's also often the interaction with cross modality, as we say, so it's an interaction with other devices in the room that can bring additional insights…" |
| **QH7** | 2. IP control | "I would say it's a bit of a change, because in the past, we focused heavily on patents, of course. And I would still say that, that we would like to have patents wherever possible." |
| **QH8** | 2. IP control | "…when I talk about data protection, IP protection for data in addition to patents, I primarily think of trade secrets… you could use certain cases copyrights, perhaps for certain databases or certain kinds of data." |
| **QH9** | 2. IP control | "I would say that the main part is protection a combination of patents and trade secrets." |
| **QH10** | 2. IP control | "The 2000s was really focused on patents as a number game. Yeah, file as many applications as possible, get high number of patent applications. And then after, in the new decennium, as of 2010, I think, improved awareness of what we would file, so more focus on quality rather than quantity. |
| **QH11** | 2. IP control | "I think, really, the renewed interest in trade secrets and an increased focus on that as a complimentary tool, to patents is something of the past five years, and that it's really more actively propelled as a protection tool and as a viable alternative to patent protection." |
| **QH12** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "This is driven by a transition, increased trend in digital, more software-related work. Particularly last few years, what we see the heavy interest in artificial intelligence related topics." |
| **QH13** | 1.Technological assets<br>3. Value Creation<br>4. Data-driven Business models | "…I cannot ignore the combination with data, because often, a lot of the value that you have for the AI algorithm is acquired during the training phase. So you need access to the data sets to train the network and get the outputs that you want to see." |
| **QH14** | 2. IP control<br>3. Value Creation | "…moved to this data-driven technologies and the increasing importance on trade secrets. I would say also, part of that responsibility shifts back to the business itself. With patents. |

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| | 4. Data-driven Business models | It's quite straightforward. We draft an application, we file it, it's another responsibility from IP&S for the lifetime of the patents. We need to discuss a license it will be up to IP&S to do that." |

| Interviewee I | Concepts | Quotations |
|---|---|---|
| **QI1** | 1.Technological assets<br>2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "In the past, the transformation is already going on for quite a while. So in the past, Philips was more of a kind of, you could say, broad, very broad technology firm, then it already started to concentrate on certain technologies, but it still included all kinds of non-medical technologies … But the other transformation is that Philips doesn't want to be the only company that creates, let's say, hardware boxes … wants to move to providing solutions…" |
| **QI2** | 3. Value Creation<br>4. Data-driven Business models | "...And in that whole transition, there's also much more attention for, yeah, when you're providing solutions, you also want to provide kind of services. And so we don't make want to make money only with let's say, shipping hardware and selling hardware, we also want to, to generate income with those services…" |
| **QI3** | 3. Value Creation<br>4. Data-driven Business models | "… they also know about data-driven business models. So for example, hospitals, they know that they're the data that they have, can have quite some value … we want to also to, to really increase our support to medical staff during procedures that they know for when they do the procedure that they know and understand when the next step comes in the procedure. And you can for example, derive that from all kinds of data in the procedure." |
| **QI4** | 3. Value Creation | "And so with our IGT system, we can navigate and track, our stent is going to be placed where it is. And when you see that it is at a target location, when it gets to a target location, you can of course, start notifying the doctor that you have reached your target location. In the meanwhile, you can, you know, collect all kinds of data to make already a report for the data for the for the doctor, because at the end of the procedure, you want to have a report what's being done. And you also want to track how much time has taken and for the efficiency of the procedure,…" |
| **QI5** | 1.Technological assets | "…and we need each other to be able to optimize our algorithms. So they have, of course, what we call them annotated data." |
| **QI6** | 1.Technological assets 3. Value Creation | "…what was the data that tells you, you are at the right spot, and that's the data that the doctor has in the hospital has, and we need that data to be able to, to optimize our algorithms. And so they know from their sides, of course, that they have also a kind of value. And so in this partnership, we need to find out how we can both benefit, we can benefit from the data, they |

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| | | can benefit from the improved algorithms. So well, and by working together, and we hope to create value for the hospital, but also then for other hospitals.” |
| **QI7** | 1.Technological assets 3. Value Creation | “…that it's all about the data. Without the data, you will not generate the value. “ |
| **QI8** | 3. Value Creation<br>4. Data-driven Business models | “…to find our positions here. Sometimes we also find out new, new potential models to work together, or to provide information to the third party. So they are in the cath lab. There is, of course, during the procedure … a lot of data is generated. And third parties now get also more interested in getting some access to our data. And because they can use the data also, for example, for one of the potential applications.” |
| **QI9** | 3. Value Creation<br>4. Data-driven Business models | “And we need to understand better how we differentiate from those third parties, because it could be that we have certain data that they can't offer, because of our, let's say, send sensors that we have in the system. And if we have data that is really unique, we can of course see how we can create value with it.” |
| **QI10** | 1.Technological assets<br>3. Value Creation | “…but if you have the right data, you may be able to train the algorithm in a way that this makes that makes the training algorithm unique.” |
| **QI11** | 1.Technological assets<br>2. IP control<br>3. Value Creation | “And if you cooperate with a third party in a hospital, for example, and you need to negotiate, then, of course, I'd say this this whole negotiation, this whole contracting, and getting access to the data, and yeah, if preferably have the, the annotated data, so the data where the doctors have added information, what really is important,…” |
| **QI12** | 1.Technological assets<br>2. IP control | “So you may have more, you may have an advantage for a certain amount of time, unless you can keep the data really the say exclusive for you.” |
| **QI13** | 1.Technological assets<br>2. IP control | “So the train algorithm, yeah, you can try to, to protect it with a patent. But you can really ask yourself, what's the value of that patent?... someone else can also train an algorithm, okay, so can I stop that with a patent?” |
| **QI14** | 1.Technological assets<br>2. IP control | “…how well is everything detectable so detectability of algorithms is also and challenge. So to be able to find out whether your patents Is this your patented technology is used by a third party, you would you would be you would need to really do some kind of Yeah, tests or a reverse engineering, it can be quite tricky to find out…” |
| **QI15** | 1.Technological assets<br>2. IP control | “…the role of patents is, is may or may overtime, maybe maybe changing for for both parts of the system. So patents on hardware still remain relevant and that it's on sensors. And as soon as you come to algorithms, you see that there is now kind of shift between, yeah, that trade secret data or database rights, |

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| | | maybe even here, data ownership, so you get all kinds of different, let's say ingredients to keep your value proposition unique." |
| **QI16** | 2. IP control | "…there is now a big change going on, … more recognition now, trade secrets, they are nice, but your organization needs to be, really, let's say a tentative for, those methods to really keep the trade secret trade secret." |
| **QI17** | 2. IP control | "…must keep it secret all the time, which is quite an effort for the organization." |
| **QI18** | 2. IP control | "…trade secrets have always been around. But now we start realizing more that we really have much more trade secrets than we thought." |
| **QI19** | 2. IP control | "…because most trade secrets are probably non technical trade secrets. For example, marketing plans, roadmap, financial data, supplier lists, there's all of value." |
| **QI20** | 2. IP control | "…we have group information security, and they have all kinds of also tracking software and to see where information is going. If we if we have labeled certain information as really, let's say trade secret affiliate, we can track where that information is flowing in the system." |
| **QI21** | 1.Technological assets<br>2. IP control | "…You could say that data is flown through the system. So because we have those good sensors, we can collect user data and develop a personalized value offering. I think that puts us in a unique position." |
| **QI22** | 1.Technological assets<br>3. Value Creation | "And based upon those measurements, you can give an advice to the doctor, oh, here is the problem. And you can also give the advice that after the treatment, how it has improved. And so this kind of this kind of sensors enable you indeed to have the data and to give advice on the data really adds value for the user…" |
| **QI23** | 1.Technological assets<br>2. IP control | "… you see some some changes happening. And so traditionally, there was, of course, a lot of focus on IP on the, on the on the sensors, and you could say, so, the imaging sensor, the source and the detector." |
| **QI24** | 1.Technological assets | "I would say, probably more and more difficult to really distinguish yourself at the long term. So you also see now more and more attention indeed, for algorithm development." |
| **QI25** | 1.Technological assets | "How can you extract most value out that data? So you'll see a lot of attention also for AI." |
| **QI26** | 1.Technological assets | "AI is nice, but you have two problems with AI. So one is how are you going to find out that actually being used at the detectability. The second AI is nice when you have the right data." |
| **QI27** | 1.Technological assets | this will become more and more important in the future, not only to have the right patent, because you need to be able to |

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| | 2. IP control<br>3. Value Creation | have your, your hardware still less exclusive, but also to be able to train your system, you need the right. contacts in the right. hospitals, the right key opinion leaders. |
| **QI28** | 1.Technological assets<br>2. IP control<br>3. Value Creation | "…traditionally, our IP strategy was very much focused on indeed, patents, making sure you have the patent portfolio on the right topics, that you monitor what your competitors are doing. And that is all still true and all still important. But next to that, we are now slowly developing a data strategy and data IP strategy because data is getting more important in our total business." |
| **QI29** | 2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "And that also helps us to come with new, maybe more creative collaboration schemes, because you really need partnerships here. It's not just a transactional model and what was in the past you need Co-Creation, and co-creation will become more important in the IP strategy as well." |
| **QI30** | 2. IP control<br>3. Value Creation<br>4. Data-driven Business models | "if you know that you can't be exclusive in certain things, you can also open it for thirds, if you can sell your platform, and by having a platform also have access to data that also provides new possibilities." |

## Appendix C: Thematical Analysis of Quotations

| Themes Developed according to Theoretical Frameworks | Technology Assets categorization with IAM | Technology Assets in Data-driven Value Model | IP assets According to IAM | IP in Data-driven Value Model | Value Creation through IP in DDBM |
|---|---|---|---|---|---|
| **Interview A** | QA10 | QA2 | QA3, QA7, QA9 | QA2, QA7, | QA4, QA9, QA10, QA14 |
| **Interview B** | QB8 | QB2 | QB8, QB9, QB10 | QB2, QB3, | QB9, QB11 |
| **Interview C** | | QC1, QC2, QC5 | QC3, QC9 | QC1, QC3, QC9, QC12 | QC8, QC10, QC11, QC13 |
| **Interview D** | QD1, | | QD1, QD4 | | QD2, QD4, QD5 |
| **Interview E** | QE12, QE13 | QE5 | QE8 | QE6, QE8, QE12 | QE4, QE6, QE8, QE11, QE12 |
| **Interview F** | QF1 | QF4 | QF8, QF9 | QF4 | QF2, QF8, QF9 |
| **Interview G** | QG7, QG16, QG17 | | QG7, QG16, QG17, QG18 | QG16 | QG1, QG3, QG5, QG9, QG10, QG12, QG15, QG16, QG17, QG19, QG20, QG21 |
| **Interview H** | QH2, QH3, QH5, QH8, QH12, QH13 | QH4 | QH4, QH8 | QH8, QH12 | QH9, QH10, QH11, QH13, QH14 |
| **Interview I** | QI1, QI16, QI24, | QI13, QI17, QI20 | QI13, QI14, QI15, QI16, QI18 | QI5, QI15, QI17, QI20, QI22, QI23, QI25, QI26, QI28, QI 30 | QI8, QI10, QI11, QI13, QI14, QI15, QI17, QI19, QI21, QI23, QI27, QI28, QI30 |

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