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Internet of Things Business Ecosystems in Emerging and Advanced Economies

Master's thesis in Industrial Economics and Technology Management
Supervisor: Per Jonny Nesse
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Preface

This thesis represents the end of a master of Strategy and International Business Development in Industrial Economics and Technology Management. The dissertation represents 30 credits, similar to one semester. My background is from two years of Architecture studies and five years of Industrial Economics and Technology Management studies. I have a minor in computer science with a specialisation in Software Engineering and a major in Strategy and International Business Development.

I hope my research can contribute to broadening the understanding of IoT business ecosystems and the role of the telecom operator. Countless hours of reading suggests that telecom operators are on the verge of disruption, and therefore new business models and ecosystem strategies are needed. Thus, I hope managers in telecom operators can use this study for inspiration to various IoT ecosystem strategies. Furthermore, I hope scholars will continue my research to find out what business ecosystem strategies will prove the most successful in the long-run.

Firstly, I would like to thank my supervisor, Per Jonny Nesse, for insightful guidance sessions and helping me contact the Asian and European telecom operators. Secondly, I would like to thank all my interviewees for taking the time and helping me with my research. Thirdly, I would like to thank Martine E. S. Kverne and Espen M. Hansen for proofreading and helpful discussions. Fourthly, I would like to thank my parents, Cathrine Skogland and Martin Kverne, and my grandfather, Gunnar Skogland, for always encouraging me to work hard, staying motivated and be up-to-date on the latest technologies. Lastly, I would like to thank my quarantine family: Espen M. Hansen and Kyrre S. Haugland for helpful discussions in self-isolation.

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Abstract

The Internet of Things (IoT) represents a paradigm shift of novel opportunities for telecom operators in both emerging and advanced economies. IoT denotes a vast system of network-connected devices that can collect, transmit and exchange data. The smart devices require collaboration and innovation across verticals and technical layers. Acting in a co-evolving ecosystem are changing how the telecom operator innovates and operates. Research has shown that IoT business ecosystems create value through open innovation. In order to capture the generated value, IoT firms rely on servitised business models. The servitised business models are leveraging telecom operators network connection and adds significant value to its services. For telecom operators to capture a more significant cut from the value-adding services' revenue, it has to relocate and redefine its business operations to exploit the opportunities IoT provides.

This research aims to investigate six telecom operators' various IoT business ecosystems and identify the differences between emerging and advanced economies. In order to develop a profound understanding of the IoT business ecosystems, the research will compare how IoT ecosystems create value through open innovation and capture value through business operations.

The research methodology chosen to answer the research questions is a case-study. In total, ten interviews with top-level managers in Asian and European telecom operators have been conducted. The interview findings are supported by secondary documents of academic articles, industry reports, white papers, books and web pages. The case-study revealed three distinct types of IoT business ecosystems. The central disparity between emerging and advanced economies was the telecom operators' ownership of the full end-customer relationship. The emerging markets have organised for delivering full end-to-end IoT services, while the advanced markets concentrate on connectivity and platform services. Furthermore, a central finding was the difference between the emerging markets' investments in partners. The advanced economies are in a more favourable position as the partners require less follow-up and can thus concentrate on enhancing the product and service offering. These findings raise further questions concerning the future success of the strategies, and if the strategies can be transferred across economies. The research contributes to the literature by defining three types of IoT business ecosystems and describes in detail the differences between emerging and advanced economies. Furthermore, the research discusses the root cause of the varieties and what they imply.

Sammendrag

Tingenes internett (Internet of Things (IoT)) representerer et paradigmeskifte av nye forretningsmuligheter for teleoperatører i både fremvoksende og avanserte økonomier. IoT betegner et stort nettverk av enheter koblet til internett, som kan samle inn og utveksle data. De smarte enhentene krever samarbeid og innovasjon på tvers av vertikaler og verdikjeder. Å operere i et økosystem og skape merverdi i tillegg til nettilgang, vil endre hvordan teleoperatørene innoverer og drifter. Bedriftsmarkedet er kategorisert som markedet med mest å tjene på IoT. For å kunne ta en større del av potensielle inntekter, må teleoperatøren endre strategier og forretningsmodeller for å utnytte mulighetene IoT gir.

Denne forskningen tar sikte på å undersøke seks teleoperatørers forskjellige IoT-økosystemer, og illustrere hvordan økosystemene skaper og fanger verdier. Deretter vil funnene bli sammenlignet mellom voksende og avanserte økonomier. For å utvikle en rik forståelse av IoT økosystemer, vil forskningen sammenlikne hvordan IoT-økosystemer skaper verdi gjennom innovasjon og kaprer verdier gjennom sin forretningsmodell.

Forskningsmetodikken som er valgt for å svare på forskningsspørsmålene er en casestudie. Det er totalt gjennomført ti intervjuer med ledere i asiatiske og europeiske teleoperatører. Intervjufunnene støttes av sekundære dokumenter fra akademiske journaler, industrirapporter, whitepapers, bøker og websider. Casestudien avdekket tre ulike typer IoT økosystemer. Den sentrale forskjellen mellom fremvoksende og avanserte økonomier var teleoperatørenes eierforhold til den endelige sluttkunden. De fremvoksende markedene har organisert seg for å levere fullverdige IoT-tjenester, mens avanserte markeder konsentrerer seg om tilkoblings- og plattformtjenester. Videre er et sentralt funn hvordan fremvoksende markeder investerer i partnerne. For å samarbeide, må teleoperatørene utvikle og lære opp partnerne sine. De avanserte økonomiene er i en mer gunstig posisjon da partnerne krever mindre oppfølging og teleoperatørene kan følgelig konsentrere seg om å forbedre produkt- eller tjenestetilbudet. Disse funnene reiser ytterligere spørsmål om hvilken av strategiene som vil være suksessfulle i lengden, og om strategier kan overføres på tvers av økonomiene. Forskningen bidrar til litteraturen ved å definere tre ulike typer IoT økosystemer og beskriver forskjellene mellom fremvoksende og avanserte økonomier. Videre diskuterer forskningen årsaken til forskjellene og trekker lærdom av funnene.

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Table 1: List of acronyms and abbreviations

Short form	Full form	Description
2G-5G	Second to fifth-generation cellular networks	The 2G-5G networks are representing evolutions of cellular networks with different frequency bands.
AI	Artificial Intelligence	The use of computer programs that have some of the qualities of the human mind, such as the ability to understand language, recognize pictures, and learn from experience (Cambridge Dictionary, 2020).
API	Application Programming Interface	A way of communicating with a particular computer program or internet service (Cambridge Dictionary, 2020).
B2B	Business-to-Business	Describing or involving business arrangements or trade between different businesses, rather than between businesses and the general public (Cambridge Dictionary, 2020).
B2C	Business-to-Consumer	Describing or involving the sale of goods or services directly to customers for their own use, rather than to businesses (Cambridge Dictionary, 2020).
CSP	Communication Service Provider	A CSP offers telecommunications services or some combination of information and media services, content, entertainment and application services over networks, leveraging the network infrastructure as a rich, functional platform. CSPs include the following categories: telecommunications, content and application service provider, cable service provider, satellite broadcasting operator, and cloud communications service provider (Definition by Gartner (2020)).
CSR	Corporate Social Responsibility	Corporations doing social initatives in local communites to create shared value (Porter & Kramer, 2006).
CXO	Corporate executive	Typically CEO, CFO and other corporate-level executives.
E2E	End-to-end	Includes all actors and stages of the process (Cambridge Dictionary, 2020).
IoT	Internet of Things	Objects with computing devices in them that are able to connect to each other and exchange data using the internet (Cambridge Dictionary, 2020).
IIoT	Industrial Internet of Things	Industrial IoT use cases such as industrial manufacturing, utilities and smart cities.
Industry 4.0	Industry 4.0 or Industrie 4.0	The term represents the evolution from automatisation to intelligent automatisation of the industry. IoT and the cloud are key components of industry 4.0
LoRa	Long Range Radio	Network technology for IoT services.
LPWA	Low Power Wide Access Network	Network technology for IoT services.
LTE-M	Long Term Evolution for Machines	Network technology for IoT services.

Short form	Full form	Description
M2M	Machine-to-Machine	Describes machines that are connected in a system, equipped with sensors, software and electronics that make it possible for the machines to interact and transmit data.
M&A	Merger and Acquisition	The activity of buying or combining with another company or advising another company on how to do this (Cambridge Dictionary, 2020).
ML	Machine Learning	The process of computers changing the way they carry out tasks by learning from new data, without a human being needing to give instructions in the form of a program (Cambridge Dictionary, 2020).
NB-IoT	Narrowband IoT	Network technology for IoT services.
POC	Proof of Concept	Evidence, typically deriving from an experiment or pilot project, which demonstrates that a design concept, business proposal, etc. is feasible (Oxford Dictionary, 2020).
QoS	Quality of Service	Description of the overall performance of a service.
SMEs	Small and Medium-Sized Enterprises	In this thesis it is referring to companies with 50-999 employees.
VC	Venture Capital	Money that is invested or is available for investment in a new company, especially one that involves risk (Cambridge Dictionary, 2020).

1. Introduction

The Internet of Things (IoT) is smart, connected devices that unlock untapped business opportunities (Porter & Heppelmann, 2014). IoT denotes a vast system of network-connected devices that intelligently interact, extract and transmit data. It represents a paradigm shift for enterprises to develop novel service business models (Lee, 2019) with customised value propositions (Dijkman, Sprenkels, Peeters, & Janssen, 2015; Ju, Kim, & Ahn, 2016). The telecom industry has seen a rapid move from telephone charges, messaging services, and data packages to the new era of IoT services. Traditionally, the telecom industry has grown around the volume of SIM cards to mobile consumers (BearingPoint//Beyond, 2020). IoT, on the other hand, will have the most substantial impact on business customers (BearingPoint//Beyond, 2020; Lee, 2019). IoT introduces, therefore, new strategic choices of how value is created and captured, how data is utilised and managed, how to work with partners and what role the firm should play (Porter & Heppelmann, 2014).

IoT and machine-to-machine (M2M) connectivity are expected to grow 19% annually towards 2023 (Cisco, 2018). This rapid growth of connected devices unlocks the real value of the IoT, namely the data it generates and insights the data produce (Russo & Albert, 2018). IoT together with artificial intelligence (AI), machine learning (ML) and faster, reliable network connections like 5G are expected to produce invaluable analytical insights (Li, Xu, & Zhao, 2018; Palattella et al., 2016), servitise business models (Lee, 2019; Leminen, Rajahonka, Wendelin, & Westerlund, 2020; Suppatvech, Godsell, & Day, 2019), and help solve global challenges (Nesse, 2018).

To build end-to-end (E2E) IoT use cases, collaborative partner ecosystems consisting of hardware vendors, telecom operators, application providers, and software providers are imperative (BearingPoint, 2020). Mogg et al. (2017) address four potential scenarios of the future position of the telecom operator. The scenarios summarise the pivotal decision of telecom operators: having internal network technology competence and or owning the customer relationship (BearingPoint//Beyond, 2020; Mogg et al., 2017). Telecom operators will have to decide where to put its focus, on network competence or develop platform services and provide the customer with tailored offerings. BearingPoint//Beyond's (2020) report goes one step further and presents the role of the telecom operator to become an E2E IoT service provider. In fact, 32% of enterprises in Asia and Europe believe communication service providers (CSP), such as telecom operators, can be ecosystem facilitators and deliver complete E2E IoT services. 37% of European CSPs, on the other hand, expect their role to be uniquely a connectivity provider. The same number in Asia is 29%. Thus, even though about a third of CSPs expect their role to be a connectivity provider, two-thirds expect to change their focus and deliver value-adding services in addition to connectivity (BearingPoint//Beyond, 2020).

Telecom operators are investing in the latest network infrastructure to be able to serve new IoT use cases and the increased amount of connected devices. However, returns on assets declines as the network infrastructure lifespan have shortened over the last twenty years (Viguerie, Cowan, & Hindo, 2017). Therefore, to ensure a competitive position and successive growth, telecom operators need to look beyond connectivity. Telecom operators have to change focus towards a customer-strategy having a service-dominant logic (Binkhuysen, 2020; Long, Pinkney, Sturgess, & Wright, 2019). For IoT, this enables opportunities for telecom operators to deliver value-adding services in both the product and software direction (Porter & Heppelmann, 2014). In particular, Viguerie et al. (2017) describe how smart suppliers such as Texas Instruments, Intel, Bosch and Tesla and IoT platform, cloud and application providers such as Amazon, IBM, Google, Apple and Salesforce have a relatively higher growth potential than connectivity providers. Therefore, it is highly relevant for telecom operators to seek new positions in the emerging IoT value chain. The future telecom operators can become an attractive, innovative digital-service partner, instead of solemnly a network provider (Long et al., 2019).

To accelerate innovation, develop new business models and service solutions, the telecom operators have to learn how to create value and capture value in its respective business ecosystems. In order to create value, enterprises, small and medium-sized enterprises (SMEs) and startups are accentuated as vital components of the IoT business ecosystem (Eckblad, Gutmann, & Lindener, 2019; Mihailovic, 2019; Rocha, Mamédio, & Quandt, 2019). Collaborating with enterprises and SMEs provides the telecom operator with valuable resources, shared risk and cost of innovation, and a faster innovation cycle (Kwan, Schroeck, & Kawamura, 2020). Startups can further provide valuable benefits and be integral for success in the innovation ecosystems (Peter, Werro, & Back, 2019). In addition to startups, customers are essential collaboration partners for developing value-adding services (Long et al., 2019). Innovating with customers is integral to understanding their tacit knowledge and developing value-adding, complementing services (Chesbrough, 2011; Hein, Weking, et al., 2019; Vorbach, Müller, & Poandl, 2019).

A thriving IoT business ecosystem is dependent on local conditions such as macroeconomic factors, culture and regulations (Baig, Lakhani, & Mehdi, 2019). For example, in Asia, businesses might partner with CSPs due to their knowledge and expertise in connection technology. However in Europe, the main factor will be the CSPs ecosystem orchestration capabilities and managing complex programs (BearingPoint//Beyond, 2020). In the Asian markets, telecom operators can exploit their customers' confidence, as 92% of Asian businesses would consider buying new technology solutions from CSPs (BearingPoint//Beyond, 2020). Asian CSPs, on the other hand, are more focused on core business, and less about value-adding services (BearingPoint//Beyond, 2020). Even though particularly emerging economies face more hurdles than advanced economies, IoT provides telecom operators with new opportunities and a potential new role as ecosystem facilitator.

In sum, there are vast opportunities for telecom operators when it comes to monetising from new IoT services and solutions. Because IoT services have been in the market for some time, the competition has become fiercer and introduced new competitors such as technology firms (Long et al., 2019; Pujol, Elayoubi, Markendahl, & Salahaldin, 2016). The fragmented IoT platform market provides a challenge for operators to create sufficient scale and integrate with various standards (Leminen, Rajahonka, Westerlund, & Wendelin, 2018; Schreieck, Hakes, Wiesche, & Krcmar, 2017). The fragmentation proves a challenge for both advanced and emerging economies. Moreover, emerging economies' telecom operators face local hurdles, such as lower digital maturity and infrastructure services. However, this is about to change because entrepreneurship activities are progressing in the areas of ICT and IoT (Baig et al., 2019; Bosma et al., 2020; Fersht, Gupta, & Pillala, 2019).

1.1 Research Aim and Contribution

1.1.1 Previous research

There has been extensive research on business models (Johnson, Christensen, & Kagermann, 2008; Osterwalder & Pigneur, 2010; Teece, 2010), business ecosystems (Iansiti & Levien, 2004; Moore, 1993, 1996), platform ecosystems (Cusumano, 2002; Gawer & Cusumano, 2014) and innovation ecosystems (Adner, 2006; Gomes, Facin, Salerno, & Ikenami, 2018; Ritala, Agouridas, Assimakopoulos, & Gies, 2013). However, the literature lacks research on the dynamics of firms' value capture and value creation activities in an ecosystem context (Gomes et al., 2018). Likewise is the literature on IoT business ecosystems and business models primarily discussed in general terms (Ahokangas et al., 2018; Leminen et al., 2018; Rong, Hu, Lin, Shi, & Guo, 2015; Westerlund, Leminen, & Rajahonka, 2014). For example, is the research focusing on describing the existence of horizontal and vertical relationships of collaboration and competition (Ghanbari, Laya, Alonso-Zarate, & Markendahl, 2017) without explaining how the actors collaborate and compete. Alternatively, the research is focusing on how digital platforms enable co-creation between actors (Hein, Schreieck, et al., 2019; Hein, Weking, et al., 2019; Iivari, Ahokangas, Komi, Tihinen, & Valtanen, 2016; Leminen et al., 2018, 2020), without explaining how the value is captured and distributed among the digital platform ecosystem actors (Hein, Schreieck, et al., 2019; Helfat & Raubitschek, 2018). Furthermore, the research often describes the roles and the role structure in IoT ecosystems (Ikävalko, Turkama, & Smedlund, 2018; Lee, 2019; Lucero, 2016; Pujol et al., 2016), but fails to identify the role dynamics and their interactions (Rong et al., 2018). As a result, the literature has focused intensely on actors, structures and presence of actions, yet detached the actors and actions from its context by not recognising how value creation and value capture are intertwined. Ghanbari et al. (2017) propose that future researchers should explore companies' interactions in the IoT value network to understand how value-creating and value-capturing activities can fit into the ecosystem. Especially is more research needed on IIoT, and how the systemic nature of IIoT can connect business models to the value network (Leminen et al., 2020).

In addition to the lack of holistic view on value creation and value capture, the research fails to identify the role and business model of the telecom operator. Quintessentially, the firm-specific IoT business model is a servitised model describing actors in the service layer, like original equipment manufacturers (OEMs) (Lee, 2019; Suppatvech et al., 2019) or application service providers (Chan, 2015). Thus, more research is needed on telecom operators' IoT business models and IoT ecosystems.

A third aspect of the IoT business ecosystem research is the dynamic context of the studies. The business ecosystem and business model literature mostly study the context of advanced western economies, if not separated from the market altogether (Rong et al., 2018). Some scholars, like Christensen, Ojomo, and Dillon (2019) and Chesbrough (2011), explain emerging markets and how to approach the markets differently than developed markets. Ajadi and Bayen (2017), Fasnacht (2018) and Baig et al. (2019) refer to high entrepreneurial activity and enormous growth potential for IoT in Asian emerging markets. The Asian markets, in general, represent a high-context culture for relationships (Hollensen, 2008) and have conceived some of the world's largest business ecosystems like Alibaba, Tencent and Baidu (Greeven & Wei, 2017). The emerging markets have considerable potential to become IoT leaders, but in order to understand the different business dynamics from western economies, more research is needed on the emerging economies' IoT business ecosystems.

1.1.2 The research questions

This study aims to develop a profound understanding of IoT business ecosystems in emerging and advanced economies and fill elements of the IoT ecosystem research gap. The purpose is to identify the differences between the business ecosystems, and discuss how the findings relate to the literature. Two aspects are integral for the business ecosystem: creating value and capturing value (Gomes et al., 2018; Ritala et al., 2013). Creating value is commonly referred to as collaborative processes, co-creation with customers and innovation activities (Adner & Kapoor, 2010; Gomes et al., 2018; Ritala et al., 2013), and capturing value is how the firm operates to capture profits (Gomes et al., 2018; Ritala et al., 2013). Creating value is the prerequisite for capturing value (Gomes et al., 2018). The two research questions are consequently:

1. How does the IoT ecosystem create value through open innovation?
2. How does the IoT ecosystem capture value through business operations?

A case-study is conducted to answer the research question and find the differences between emerging and advanced economies IoT business ecosystems. In particular, value creation is needed to develop new IoT services and grow the IoT ecosystem. Thus, the research will try to describe value creation with existing partners (i.e. startups, SMEs, enterprises), with future partners (i.e. startups, SMEs, enterprises), and with customers (businesses and consumers). Furthermore, value capture is needed to develop a competitive and profitable business ecosystem. Thus, the research will try to explain the telecom operator's position in the ecosystem, each actor's value contribution, the revenue model, the utilised resources, and telecom operators' ecosystem strategy. Finally, the similarities and differences of emerging and advanced economies' value creation and value capture strategies will be discussed.

This thesis will begin by describing the research methodology of the study. Secondly, the theoretical foundation of the article is deducted. The article is built on three theoretical concepts: ecosystem literature, open innovation, and business models. Thirdly, a chapter about IoT technologies, IoT business ecosystems and IoT business models will be explained. Fourthly, the finished article is presented in its original form. Lastly, a review of the discussion, followed by the implications for scholars, managers and future thought-provoking research questions will be elucidated.

2. Research Methodology

2.1 Overview of Methodology

The research aims to investigate six telecom operators' various IoT business ecosystems and illustrate how the ecosystems create and capture value. The study will result in a theoretical discussion of different positioning strategies and the differences between emerging and advanced economies' IoT business ecosystems. The multiple case study methodology was selected due to the limited research on detailed descriptions of IoT business ecosystems and the exploratory and contemporary nature of the research (Eisenhardt, 1989; Yin, 2018). The case-study followed an inductive approach inspired by Strauss and Corbin's (1994) grounded theory. Grounded theory is a research methodology where theory evolves during actual research (Strauss & Corbin, 1994). The induction is reflected in the research process, where interview data and secondary literature were collected simultaneously, and the research questions were formulated after the interviews and literature search. The inductive approach in combination with a multiple case-study of telecom operators made it possible to explore the richness of details and the relationships between value creation and value capture in the IoT ecosystem models and its context (Eisenhardt & Graebner, 2007). In addition to using an explorative case study, the research is partially grounded in a preliminary literature review of Kverne and Vågen (2019). The literature review analysed the future business roles, business ecosystem and business models in the era of IoT.

The research design can be described in three phases. Step 1: explore and plan the case-study. Step 2: an iterative process of collecting and analysing data. Step 3: prepare and share the case-study findings. A precise figure showing the various phases are provided in Figure 2.1 below:

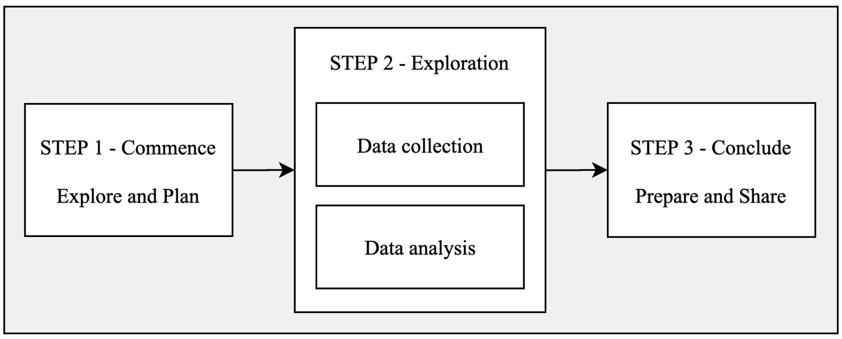


Figure 2.1: Overview of the three-step research methodology

2.2 Step 1 - Commence

2.2.1 The rationale for a multiple case-study

An exploratory, multiple case study was selected due to the limited research on telecom operators' IoT business ecosystems in emerging and advanced economies. An exploratory study is suitable for new research areas, where the primary purpose of the research is to explore phenomena and raise further questions (Yin, 2018). The case study is suited for research where the researcher does not need to control behavioural events and has a contemporary focus (Yin, 2018). Furthermore, a case study is suited for providing in-depth information and answering "how" and "why" research questions (Yin, 2018).

The multiple-case study was deemed appropriate to study telecom operators operating in emerging and advanced economies and explicate the differences. Four emerging economies' telecom operators and two advanced economies' telecom operators were selected based on literal replication and theoretical replication (Yin, 2018). Selecting an embedded multiple-case study approach makes it possible to study sub-units of the telecom operators, i.e. the IoT business (Yin, 2018).

2.2.2 The case-study sample

The case-study sample consists of six telecom operators, two in advanced markets and four in emerging markets. The operators in advanced markets are European, whereas the emerging markets are Asian. The study's subjects all had to have started some form of IoT business, and have some ideas and experiences from IoT innovation, IoT ecosystems and IoT business models. Furthermore, all telecom operators owned network infrastructure, such as 2G-5G, LTE and or NB-IoT. The telecom operators were relatively large, with a market share of mobile services between 26-57%. In addition to providing mobile and IoT services, the operators' activities were distributed among broadband services, TV services, mobile financial services and classifieds.

The six telecom operators came from different countries, and this was to increase the validity of the findings as it represented various markets with various local macroeconomic conditions. The selection of the two different continents was because of the lack of research on emerging markets IoT business ecosystems. The preliminary literature review (Kverne & Vågen, 2019), revealed interesting questions about IoT business models, IoT business ecosystem, the relationships and collaboration between participants, and innovation in IoT ecosystems. The innovation and collaboration in IoT ecosystems were the least explored topics. However, the literature review findings mostly covered western markets. Therefore it was deemed intriguing to compare IoT ecosystems across continents and economies.

2.2.3 Preliminary searches

A preliminary literature and industry search was conducted to complement the literature review and obtain a general understanding of the telecom industry in various markets. Both the databases of ORIA and Scholar were used in the literature searches, and Google was used for business searches to obtain a substantial sample of information. ORIA and Scholar are known for generating a wide array of results and are suited for general searches. Furthermore, it was desirable to limit the research to present-day literature to update the previous literature review. The introductory literature searches were conducted to complement the least explored topics of innovation and collaboration with startups in business ecosystems and Asian business ecosystems.

The first search: *"corporate innovation"* AND *"innovation"* AND *"startups"* AND *"South-Asia"*, provided no useful results. Therefore, the second search was modified to focus on why corporations collaborate with startups: *"benefits"* AND *"startups"* AND *"collaboration"* AND *"corporations"* AND *"Asia"*. The search provided some more insights and generated an overview of suitable keywords for future searches.

Secondly, Google searches on the selected telecom operators and its competitors were done systematically country by country by reading on its respective web-pages and news articles. In that way, it was possible to understand the industry and relevant socio-economic factors influencing each of the telecom operators.

The preliminary literature review and exploratory searches provided a broad overview of research topics: open innovation, IoT ecosystem, IoT business models, IoT business ecosystem strategy and roles, and collaboration with enterprises, SMEs, startups and customers. It was decided to collect qualitative industry and case-study data from interviews with managers, industry reports, whitepapers, and theoretical literature from academic journals and books. Interviews can provide insightful explanations of complex issues and personal opinions (Yin, 2018). Furthermore, having multiple secondary data sources can increase the validity of the case-study (Yin, 2018). The research topics formed the backbone of the formation of the interview guide and the research purpose. It was decided to start with collecting literature and interview data before formulating a specific research question. Starting with some fieldwork can, in many cases, suggest more relevant questions for the study (Yin, 2018). However, to guide the research, the focus of the study was on IoT ecosystems, collaboration, innovation, and co-creation with startups.

2.3 Step 2 - Exploration

2.3.1 Data collection

The theoretical literature was collected preceding, during and succeeding the interviews, following Eisenhardt's (1989) iterative approach of comparing primary findings to theoretical concepts. The data collected can be divided into five categories: interviews, academic literature, books, consulting whitepapers and industry reports, and other literature. The data collection consisted of two parts: collecting interview data and collecting literature data.

Collecting interview data

The case study participants from the six telecom operators were selected based on their role and knowledge of IoT ecosystems. All of the interviewees were typically managers with responsibilities in IoT, business partnerships and collaborative innovation. In total, ten interviews were conducted face to face or using video calls in the period February to April 2020. Video calls were used because of geographical distances.

Each interviewee had to consent to participate in the research formally and had to approve selected extracts from their interview to ensure correctness. During the interviews, the interviewee was asked to describe its position and provide a brief overview of its responsibilities. The rest of the interview was semi-structured, as it allowed for follow-up questions and detailed explanations of context-sensitive phenomena. At the end of each interview, each candidate was provided with an opportunity to add additional information and complement the provided answers. Each interview lasted between 30 to 70 minutes and was recorded and transcribed with the interviewees' consent. A general overview of the interview guide is provided in Appendix A.1. The interviewer followed an adaptive posture throughout the interviews, as recommended by (Yin, 2018). Because of the pandemic situation, several interviews had to be postponed or rearranged, and some interviews required follow-ups on emails.

The adaptive posture was also reflected when a critical discovery led to a change of the original case-study objective (Yin, 2018). During the interview with the first emerging market telecom operator, the focus on startups as main partners became too narrow. The interviewer realised that SMEs and enterprises should be considered as well, and adapted during the interview by modifying the questions. The small but vital change led to new insights about the topic and modified the research of considering startups to considering partners in general. Staying adaptive and recognise new insights can improve the case study and lead to invaluable findings (Yin, 2018).

Collecting literature data

In total, eight searches in the databases Oria, Scholar and Scopus were conducted in three rounds. Oria and Scholar were used for the first and second round, and Scopus was used for the third round. Oria offers a wide array of academic journals as well as articles, newspaper articles, reports and student theses (ORIA, 2020). Scholar is a database that offers the user a broad array of articles, indexes open-access literature, preprint archives, conference proceedings and material from institutional repositories (Alfonzo, 2016). The two databases provide access to multiple data sources and make sure that relevant articles are not overlooked. Scopus, on the other hand, is a more precise search tool where it is possible to create advanced queries limited to selected research fields (Elsevier, 2020). Furthermore, it was essential to obtain the latest research, and therefore, all searches were restricted on publication year.

For the first round, the set of keywords were initially selected based on the obtained topics from Step 1. The searches were performed early February, before the first interviews. The emphasis was on collaboration between corporations and startups in business ecosystems. Table 2.1 provides an overview of the keywords. Search one and two produced 1499 and 2590 results respectively, after constraining on the period 2015-2020. The numerous results produced considerable irrelevant articles. Therefore it was decided to stop the search when it no longer provided relevant results, as suggested by Fink (2014).

For search one, the search was stopped after reviewing 80 articles' titles, keywords and abstracts. Of the 80 articles, 24 were selected for further revision. For search two, the search was stopped after reviewing 50 articles. Of the 50 articles, 19 were selected for further revision. For search three, the search was reviewed in full, as the search only generated 30 articles, of which 12 were selected. The sample was small because the search tried to target the Asian region using selected countries (in the table shown as emerging markets* due to anonymity). For each of the searches, each article was screened based on title, abstract and keywords. If selected, the article was read in full. The article was included if the article supplemented interview findings, described theoretical concepts or served as a counterexample. From round 1, 13 articles were selected. The full elimination process is presented in Figure 2.2.

Table 2.1: Search round one with corresponding keywords

Keywords round one								
1	corporate innovation	⊗	startup, startup partnership, startup collaboration, startup cooperation					
2	corporate innovation, corporate venturing	⊗	startup, startups					
3	corporate innovation, corporate venturing, corporate accelerator, corporate incubator	⊗	startup, startups	⊗	emerging economies*	⊗	Telecom

*anonymisation of actual keywords for countries

Table 2.2: Search round two with corresponding keywords

Keywords round two							
4	corporate venturing, corporate innovation, open innovation	⊗	startups, startup partnership, startup collaboration	⊗	benefits for corporation	⊗	corporation value
5	corporate venturing, corporate accelerator, corporate incubator, open innovation,	⊗	startup collaboration, startup partnership, startup partnerships	⊗	internet of things, IoT, industry 4.0		
6	corporate venturing, corporate accelerator, corporate incubator, open innovation	⊗	startup collaboration, startup partnership, startup partnerships	⊗	internet of things, IoT, industry 4.0		

The second round was conducted late February to early March, after conducting three interviews. The interviews, in combination with the previous literature search, revealed the need for more specificity in the keywords. Also, it was desirable to get more results specifically concerning corporate venturing, IoT and telecom operators. The keywords are presented in Table 2.2 In round two, three searches were conducted all constrained in the period 2016-2020. The first search on Scholar provided 24 results, out of which seven were interesting. The second search on Oria provided 12 hits, whereas eight were selected for further review. The third search was identical to the second search but conducted on Scholar. As the Oria search provided few results, it was interesting to see if some new articles could be found using Scholar. Thus, the same search revealed 34 results, and 19 were selected for further review. After reading all the selected articles in full, six articles were included. The full elimination process is presented in Figure 2.2.

The third round was conducted late March to early April, after conducting eight interviews. The interviews had revealed exciting findings of IoT ecosystems, network structures, ecosystem strategies, partnerships with enterprises, SMEs and startups, and IoT ecosystem innovation. The new insights provided the need for a supplementary search round. According to Yin (2018), it is a strength of the case study to be aware of notable changes, if not done unknowingly. In this case, the change was a strategic decision of the author. Therefore it was decided to pursue the modified direction. The change did not impact the research design. However, it changed the research purpose to discuss the differences and similarities between the emerging and advanced economies IoT business models, including all types of partners. New keywords had appeared, and the focus on IoT, collaboration, innovation ecosystem, horizontal or vertical integration and partnership relations. The full keyword set is found in Table 2.3. The two previous search rounds had been using open, wide-targeting databases; however, these searches needed more selective results. Scopus made it possible to limit to subject-area, year and peer-reviewed articles. The first search provided 41 results, out of which nine were selected for full-text revision. The second search provided 20 results, out of which 13 were selected for full-text revision. The few results are due to all the restrictions being activated from the beginning. In total, 13 articles were selected as part of the total article sample. The figure of the precise elimination process is found in Figure 2.2.

Table 2.3: Search round three with corresponding keywords

Keywords round three									
7	IoT industry 4.0, internet of things, IIoT, smart	⊗	co-creation, collaboration, partnership, cooperation, strategic partnership	⊗	ecosystem innovation, innovation ecosystem, platform ecosystem, platform innovation, innovation network, open innovation	⊗	vertical, horizontal	⊗	value chain, revenue share, network relations
8	IoT, industry 4.0, industrie 4.0, internet of things, IIoT, 5G	⊗	co-creation, collaboration, partnership, cooperation	⊗	ecosystem innovation, innovation ecosystem, platform ecosystem, platform innovation, innovation network, open innovation, value network	⊗	business ecosystem	⊗	telecom, telco, MNO, TSP, CSP, network operator

In addition to the two searches in round three, a second iteration was made. The keywords: *"emerging economies"* OR *"emerging market"* OR *"developing market"* OR *"developing economy"* were added to each of the two searches. The two searches provided no results, and are therefore not included in the tables. Furthermore, using the four keywords in combination with *business ecosystem, Internet of things and telecom operators*, did not produce any new, relevant results, either on Scopus or Scholar. The lack of relevant results shows a clear preference for the literature to favour advanced western economies in research.

During the full-text screening, references and citations of the articles from the database searches that were particularly interesting were studied. The snowballing techniques are widely applied in research (Merriam, 2009; Webster & Watson, 2002). The snowballing technique can generate new insights and can be especially helpful in finding the origins of theoretical works (Merriam, 2009; Webster & Watson, 2002). In this study, snowballing resulted in 16 articles, seven from forward and nine from backward snowballing. Much of the backward snowballing referred to articles already found in the preliminary literature review. Hence, the duplications were disregarded. An overview of the total amount of articles and their origin is found in Table 2.4.

In addition to the database searches and snowballing, relevant industry reports and whitepapers were found through Google and management consultancies web pages. The white papers and reports were found by Googling: *white paper, IoT, telecom, business model, value chain, value network, ecosystem.* Furthermore, three books and five articles were known beforehand and provided to the author by the supervisor. Three books and 19 reports were included in the sample.

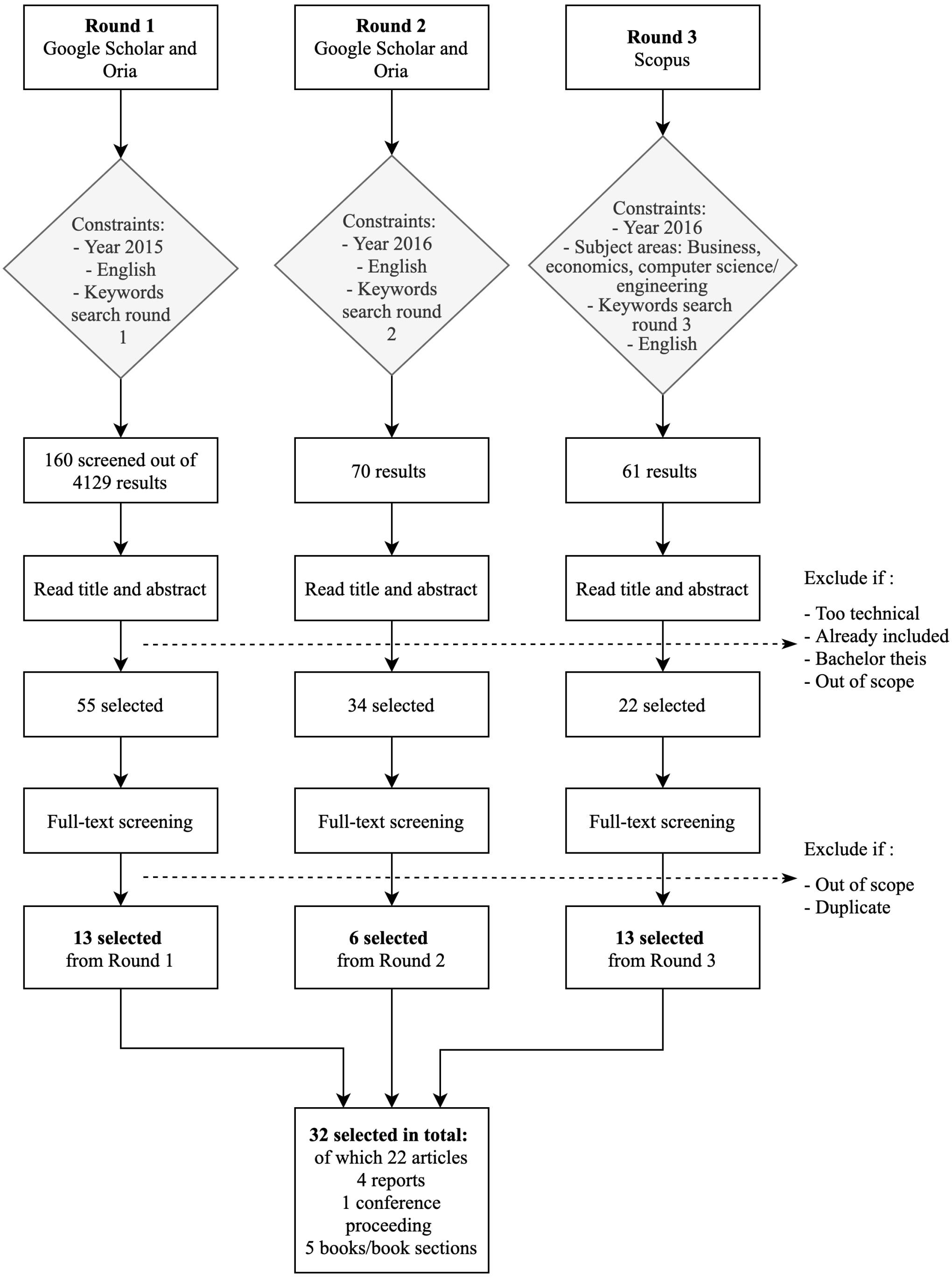


Figure 2.2: Process of retrieving and eliminating data from database searches

Table 2.4: Overview of the secondary literature sample

Search technique	**Data sources selected**
Database searches	32 (of which 5 books/book sections, 4 reports, 1 conference proceeding and 22 academic articles)
Snowballing (forward and backward)	16 (14 academic articles and 2 conference proceedings)
Preliminary literature review	50 (of which 2 reports, 4 conference proceedings, 7 books/book sections and 37 academic articles)
Previously known books	3 books
Previously known articles	5 articles
Googling	19 white papers and reports
Total amount	125 data sources

Characteristics of the data sample

An overview of the total data sample is provided in Table 2.5. Both the primary and secondary data sources provide insight into the main topics of: business ecosystems, business models, open innovation, collaboration, IoT, and IIoT.

Table 2.5: Description of the data sample

	Data Source	**Description of Source**
Primary Data	Interviews	10 interviews with different telecom operators, whereas 6 were from advanced economies, and 4 in emerging economies. All interviewees were managers with extensive experience from IoT, partnerships and business ecosystems.
Secondary Data	Academic articles	78 articles from academic journals to support theory on business ecosystems, business models and open innovation.
	Books	15 books covering open innovation, servitisation, business ecosystems and business models.
	White papers and reports	25 white papers and industry reports from leading management consulting firms: BCG, Deloitte, BearingPoint, Cambridge Consultants, Innosight, Arthur D. Little and Tata Consultancy, and industry reports exploring entrepreneurship, IoT and local conditions.
	Other literature	7 conference proceedings.

The secondary literature sample can be further investigated by examining the appearance of this research's main topics: *internet of things, open innovation, innovation, business ecosystem, and business models*. More than half of the literature researches IoT, IIoT, industry 4.0 or smart devices. The words *"open innovation or innovation"* appears in about 90% of the articles because it is often considered in both IoT, business models and business ecosystem literature. Business models and ecosystems are referred to in respectively 80% and 70% of the data sample. Approximately 50% of the literature sample talk about *innovation* AND *business models* AND *ecosystems*. The frequent occurrence of the three keywords indicates that the sample is representative and provides insight into the central keywords of the thesis.

The literature on emerging markets is, unfortunately, sparse. As presented in the research gap, the research on IoT business ecosystems in emerging markets is limited. By studying the main contributors of IoT literature, most of the researchers are located in Northern-Europe, with Finland and Germany at the forefront. Thus, case-studies typically consider European firms and European telecom operators. The western literature bias is reduced by including white papers and industry reports that consider Asian economies and emerging markets.

Looking at the time distribution of the secondary literature in Figure 2.3, it is evident that the graph is right-skewed. The skewed sample displays that most articles are newly published research. The time distribution makes the research more relevant by focusing on the latest theoretical developments and industry trends.

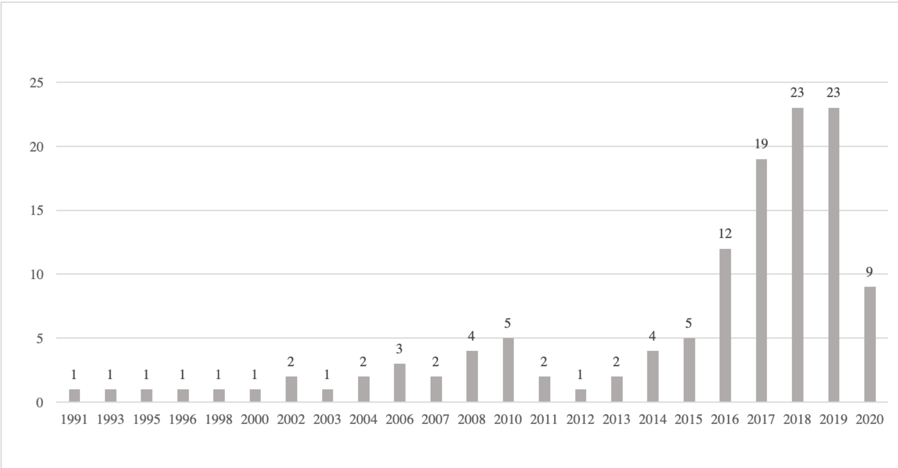


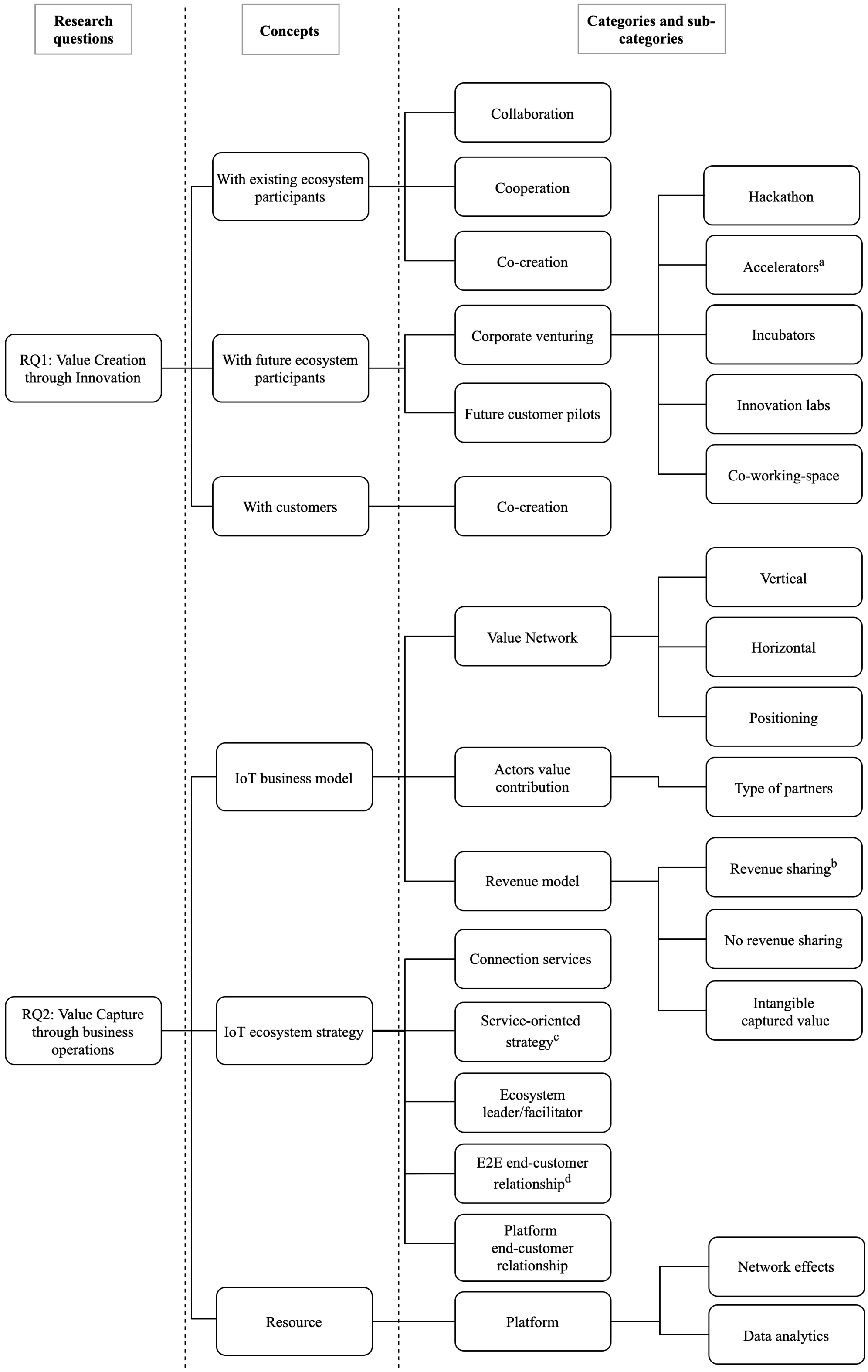
Figure 2.3: Time distribution of literature sample

2.3.2 Data analysis

The final phase of the research was to synthesise meaning and develop theoretical insights from the analysed interviews and literature, which is an essential step of the theory building (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). The theoretical conclusions were drawn by cross-case analysis and continuously comparing the analysed data to findings in the literature. Because the research on IoT business ecosystems in emerging Asia is limited, the industry reports and whitepapers were indispensable for finding evidence and material.

Coding process

A three-step coding strategy was pursued to analyse the interview data. Categorising the data using codes is a method to find meaning, structure and compare data (Basit, 2003). As the interview questions were designed for each market, the coding had to cover various local concepts and topics. Pre-coding, each transcript was read in-depth and compared to provide an overview of the topics and give an idea of suitable categories for the analysis. The first step was open coding, looking at each question as a whole and marking essential concepts and phrases. The second step was to group the markings into an overall category. The grouped categories descriptions were then rewritten in the authors' own words, to make sure that the category was fully explained and understood. The rewritten categories and follow up questions were then sent back to the interviewees for confirmation, changes and additional information. The last step was to compare across the cases and synthesise the categories into overall concepts for describing the findings. The overall concepts revealed the concepts of creating and capturing value and consequently steered the formulation of the two research questions. An example of the first-order coding in combination with the categories and concepts is provided in Figure 2.4.



First-order coding of selected categories:
[a] Originally a corporate social responsibility (CSR) initiative. It shortlists startups and help to scale the product offering. The winner gets funding and is potentially onboareded as a partner. There are startups from different verticals and not only IoT.
[b] The revenue-sharing model is divided into three parts.
[c] The future strategy is to use the collaboration model to sell value-adding services with partners, in addition to regular SIM sales.
[d] Wants to provide E2E solutions, i.e. take hold of the end-customer relationship

Figure 2.4: Overview of the categories and concepts and an excerpt of first-order coding

Synthesising

Following the coding of the interviews, the findings were compared to the secondary literature. It was a continuous process of comparing different data sources. The findings in emerging markets and advanced economies were compared using cross-case analysis. During this process, the research questions were finalised. The questions were derived directly from the higher categories: creating value through innovation and capturing value through business operations to describe the IoT business ecosystem.

2.4 Step 3: Conclude

After wrapping up the literature searches, interview sessions and analysing all findings, the last step was to conclude the research. Concluding the research was done by structuring the analyses and presenting the findings in this thesis. The linear analytical approach of Yin (2018) was selected to structure the thesis. The linear structure is standard in journal articles (Yin, 2018). Furthermore, the article in the thesis was structured according to the selected academic journal.

2.5 Limitations to the Methodology

2.5.1 Case-study limitations

According to (Yin, 2018), there are four tests to check for case study design validity and reliability: construct validity, internal validity, external validity, and reliability. However, internal validity is not relevant for exploratory or descriptive case-studies (Yin, 2018).

Construct validity

Construct validity is about ensuring the concepts induced from the case-study findings is generalisable. The case study must use multiple sources of evidence, have a transparent chain of evidence and have the draft case study report reviewed by critical informants, to ensure construct validity (Yin, 2018). The findings of this study have been categorised in concepts derived from interviews, industry reports, academic journals, books and whitepapers. The multiple sources increase the construct validity of the study. Furthermore, the study has tried to maintain a transparent chain of evidence by clearly stating the rationale for each decision, so that the study is replicable for external researches.

The study wanted to research emerging and advanced economies' telecom operators IoT business ecosystems. In order to study the ecosystems, two aspects of the literature are often discussed: creating and capturing value (Adner, 2006; Ritala et al., 2013). The research was narrowed by specifying that creating value is by innovation activities and capturing value is about business operations. It was decided to use multiple sources of qualitative evidence to describe the phenomena to study how IoT ecosystems create and capture value. The multiple case-study methods were suited to explore the differences between the phenomena. After deciding on the qualitative, exploratory case study, it was decided to use interviews to explore the intricate relationships between the phenomena. When analysing and coding the interviews, to make sure that no concept or theory is misunderstood, selected parts of the interview were approved by the interviewee and supported by multiple sources of evidence. Finally, construct validity is increased because the supervisor has supervised the case study. The supervisor is similar to Yin's (2018) key informant. The supervisor was also present on several interviews and read the raw-data transcription of all interviews he could not attend.

External validity

External validity is about the generalisability of the study's findings (Yin, 2018). The tactics for raising external validity is for multiple-case studies to use replication logic (Yin, 2018). First, this study has tried to increase external validity by using literal replication logic in the emerging and advanced economies and theoretical replication logic between the different economies. In order to use replication logic, the case-study subjects had to come from a diverse set of operators. Telecom operators were selected based on their presence in various countries, and their investments in IoT activities, presence in an IoT ecosystem and future ambitions in the IoT industry. The emerging market countries were different when it comes to digital maturity, GDP, infrastructure, culture and entrepreneurial activities. The advanced market telecom operators were different, as one was locally oriented, and the other was global oriented. By finding similarities despite the local conditions, the generalisability and thus the external validity is increased. Secondly, because the findings are discussed in light of the existing theory and secondary literature, external validity is assured.

Reliability

In pursuance of increasing the study's reliability, bias and errors in the research must be reduced to a minimum (Yin, 2018). Reliability is about another researcher replicating this research arrives at the same conclusions. Each of the interviews was conducted digitally and in the afternoon (morning for the interviewer). Because of the pandemic situation, all of the interviewees were situated at home. However, minor technical issues were experienced. Thus, the participant error is deemed low for this study. The participant bias, on the other hand, can have influenced the interviews. Either because the interviewee did not want to reveal certain aspects, or because the interviewee had reasons to answer in a certain way. The author tried to minimise this error by acting objective, letting the participant speak, being non-judgemental and by following Yin's (2018) best practices for interviews. Also, the researcher had appropriately prepared in advance with articulating questions and follow-up questions to ensure that all questions were properly articulated, and therefore harder to misinterpret.

To minimise the researcher error and bias, the author began the case-study having a deep knowledge of IoT business ecosystems, business models and innovation activities because of the preliminary literature review fall 2019. During the interviews, the author concentrated on being curious and asking open questions. If the answer was not satisfactory or produced new insights, follow up questions were asked. Also, all of the interviews were transcribed in full-text, providing an opportunity to re-read and listen to the recordings several times, and removing the error of interviewers recognition and note-taking skills. The transcription was particularly necessary as none of the interviewees nor the interviewer were native English speakers. Furthermore, to reduce the researcher bias to a minimum, all arguments are backed with several secondary sources.

3. Theoretical Foundation

This chapter will provide an overview of the theoretical basis. The theories examined in this section will provide the background of the theoretical section and discussion in the article. First, the chapter will clarify the concepts of business ecosystems, platform ecosystem and innovation ecosystem. Subsequently, the literature on open innovation and value creation in business ecosystems will be explained. Finally, the concept of the business model and value capture will be elucidated.

3.1 Ecosystem Analogies

3.1.1 Business ecosystems

The literature on business ecosystems began with Moore (1993) describing the business ecosystem using the ecology metaphor. Moore (1993) argued that a business ecosystem is where: *"companies co-evolve capabilities around an innovation: they work cooperatively and competitively to support new products, satisfy customer needs and eventually incorporate the next round of innovations" (Moore (1993), p. 76).* The concept built on the idea that firms are part of a vast network of stakeholders, spanning multiple industries. Corporations that seek to leverage competitive advantage have to take into account all actors influencing the firm's performance (Moore, 1993). Furthermore, it has to compete according to the stage of the business ecosystem, namely, birth, expansion, leadership and self-renewal or death (Moore, 1993). The various stages call for different collaborative and competitive focus (Moore, 1993).

Moore (1996) described the business ecosystem as:

> *"An economic community supported by a foundation of interacting organizations and individuals - the organisms of the business world. This economic community produces goods and services of value to customer, who themselves are members of the ecosystem. The member organisms also include suppliers, lead producers, competitors and other stakeholders." (Moore (1996), p.26)*

Like its ecological counterpart, the business ecosystem is highly self-organising and unstructured (Moore, 1993, 1996). The business ecosystem actors co-evolve over time and tend to align their position according to the directions of the ecosystem leaders (Moore, 1996). The most desirable ecosystem position is the leadership position of a keystone actor, which has significant influence over the evolution and direction of the business ecosystem (Moore, 1996). The leadership position requires a deep understanding of value creation and value capture to incentivise ecosystem actors and drive competitive advantage (Moore, 1996). Figure 3.1 displays the various stakeholders in Moore's (1996) business ecosystem.

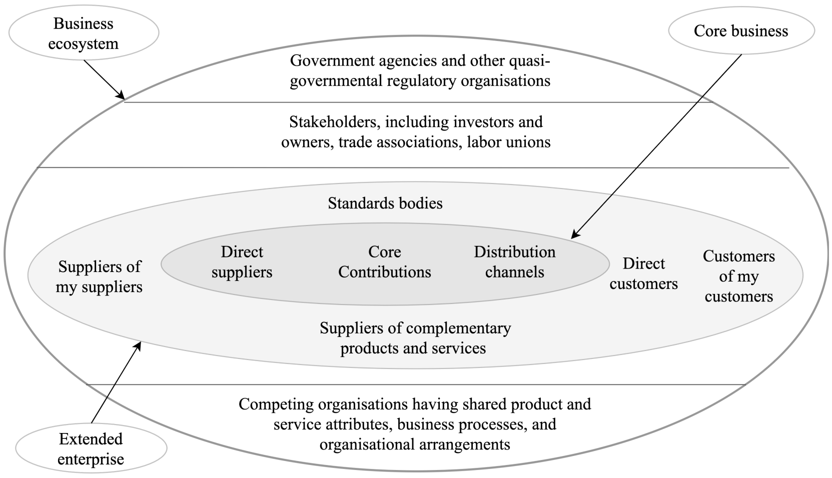


Figure 3.1: Moore's (1996) business ecosystem

Iansiti and Levien (2004) further built on the ecology metaphor and characterised the business ecosystem as *"a large number of loosely interconnected participants that depend on one another for their effectiveness and survival"(Iansiti and Levien (2004), p. 5).* The survival of the business ecosystem is dependent on all actors because the actors are mutually interdependent (Iansiti & Levien, 2004; Peltoniemi & Vuori, 2004). Iansiti and Levien (2004) described three ecosystem strategies: keystone, physical dominator and niche. The keystone actor has the leading position and the ability to influence the ecosystem's productivity and robustness and are instrumental for the ecosystem's health. The physical dominator is a keystone actor that has integrated vertically and absorbed the position of other actors. Ultimately the physical dominator will become its ecosystem, and thus maximise short term profits. The niche strategy is a company developing specialised products that are differentiated and complementing the other ecosystem actors. Niche players are the drivers of innovation and value creation (Iansiti & Levien, 2004). Because the ecosystem is co-evolving, a niche player can be a keystone actor in another ecosystem (Iansiti & Levien, 2004).

Peltoniemi and Vuori (2004) offer a synthesised definition of the business ecosystems of Moore (1993, 1996) and Iansiti and Levien (2004):

> *"a dynamic structure which consists of an interconnected population of organizations. These organizations can be small firms, large corporations, universities, research centres, public sector organizations, and other parties which influence the system." (Peltoniemi and Vuori (2004), p. 13)*

The business ecosystem consists of all stakeholders that influence the system in a network structure (Peltoniemi & Vuori, 2004). The network structure displays the value created in the business ecosystem. Peltoniemi and Vuori's (2004) business ecosystem is self-organising, emerging and co-evolving. The relationship between actors can be both competitive and collaborative, forming a self-sustaining business ecosystem (Peltoniemi & Vuori, 2004).

3.1.2 Platform ecosystems

Platform ecosystems and value networks are closely associated with business ecosystems. The value network consists of the actors in the business ecosystem that are directly affecting value creation for the focal firm (Brandenburger & Nalebuff, 1995). Typically the actors are complementors, suppliers, customers and substitutors, which are actively influencing the firm's value creation and value capture (Brandenburger & Nalebuff, 1995). The value network can also describe the value flows of tangible and intangible value, such as revenue streams and knowledge flows (Allee, 2000). Firms relying on a platform can use the value network for strategic positioning, i.e. pursuing a vertical or horizontal economy of scope strategy (Stabell & Fjeldstad, 1998).

The platform brings novel business opportunities of how to create value by matching two or more parties (Evans & Schmalensee, 2016), leverage network effects (Gawer & Cusumano, 2014), and create innovations from cross-sectional partnerships (Rajala, Hakanen, Mattila, Seppälä, & Westerlund, 2018). Google, Amazon, Facebook, Apple (GAFA) (Gawer & Cusumano, 2014) and Baidu, Alibaba and Tencent (BAT) are some of the most well-known platform ecosystem keystone companies (Greeven & Wei, 2017). The keystone leaders participate in platform-based "ecosystem" innovation (Iansiti & Levien, 2004; Moore, 1996). What distinguishes the platforms is the presence of network effects (Gawer & Cusumano, 2014). Network effects are the cumulative effect of; the more ecosystem partners innovate, the more value is created for the platform and its users, and the more users it attracts and vice versa for partners (Gawer & Cusumano, 2014).

Gawer and Cusumano (2014) describe the internal, company-specific, and external, industry-wide, platform. The internal platform describes a company and suppliers working together around incremental innovation of reusable components or technologies (Gawer & Cusumano, 2014). The external platform describes a system of one or more firms developing products, services or technologies, where third-parties can further build complementary innovations (Gawer & Cusumano, 2014). The third-parties are typically complementors which can generate network effects. The industry-wide platform is different from the internal platform because of the network effects and because it serves two or more markets (Cusumano, 2002; Evans & Schmalensee, 2016; Gawer & Cusumano, 2014). Owning the platform and taking a platform leadership position is the most envious position, yet most difficult (Gawer & Cusumano, 2014). The position is similar to Moore (1993, 1996) and Iansiti and Levien's (2004) keystone leader. The platform leadership position can be highly rewarding but strategically problematic as the platform's survival relies on innovations and investments of third-parties (Gawer & Cusumano, 2014).

In order to create and capture value from platform ecosystems, three dynamic capabilities are essential: innovation capabilities, scanning and sensing capabilities, and integrative capabilities (Helfat & Raubitschek, 2018). Value creation can further be enhanced by opening up the platform to external partners (Gawer & Cusumano, 2014). Teece (2017) and Helfat and Raubitschek (2018) further argue that business model selection, learning, transformation and ambidexterity capabilities are essential for firms in platform ecosystems.

3.1.3 Innovation ecosystems

Evolving from platform and business ecosystem theory is the concept of innovation ecosystems. The platform serves as an innovation ecosystem where complementors or other external innovators, e.g. niche actors, can develop new products, services and technologies (Gawer &

Cusumano, 2014). The innovation ecosystem is described as both innovation clusters (Ritala et al., 2013) and business ecosystems where actors collaborate and co-create around a business objective (Adner, 2006). Adner (2006) argues that being part of an innovation ecosystem entails a set of risks of other firms not being able to innovate at the same pace to the same quality. To reduce risks, firms can vertically integrate (Adner & Kapoor, 2010). Actors in the innovation ecosystem can either be in direct association with the platform (Gawer & Cusumano, 2014) or be a subset of actors present in the business ecosystem (Galateanu & Avasilcai, 2018).

As Gomes et al. (2018) argue, it is not easy to distinguish the innovation ecosystem from the business ecosystem as the literature has tended to use the terms interchangeably. An innovation ecosystem is building on the concept that actors are interdependent (Adner, 2006; Adner & Kapoor, 2010). Innovation ecosystems' primary focus is value creation (Galateanu & Avasilcai, 2018; Grønning & Afshin, 2019). Similar to Gawer and Cusumano's (2014) separation of innovative and competitive platforms, the innovation ecosystem can be distinguished from the business ecosystem by the focus on value creation and innovation (Gomes et al., 2018). Oppositely is the business ecosystem related to value capture (Gomes et al., 2018). For emerging technologies, value creation predominates over value capture (Gomes et al., 2018). The sequence implies that in order to create thriving business ecosystems, the primary focus must be on developing an innovation ecosystem to spur value creation and afterwards focus on the overall business ecosystem's value capture.

3.1.4 Summary of the ecosystem analogies

The various ecosystem designs have different purposes, motivations and goals. Table 3.1 explains the value network, business ecosystem, platform ecosystem and innovation ecosystem. The table highlights what purpose each ecosystem serves, the actors present and the desired positioning strategy.

Table 3.1: The characteristics summarised

	Value Network	**Business Ecosystem**	**Platform Ecosystem**	**Innovation Ecosystem**
Focus	Mapping the value flows and actors	Value capture, co-evolution, interdependence, competition and cooperation	Network effects, serving two or more markets	Value co-creation, co-evolution, interdependence, collaboration
Actors	Complementors, substitutes, competitors, customers	Company, complementors, competitors, suppliers, customers, governments, organisations and other influential stakeholders.	Platform owner, complementors, customers, suppliers	Platform or ecosystem leader, complementors, customers, suppliers, governments, universities and other influential stakeholders
Strategy	Strategic positioning to change the rules of the game	Strategic positioning: Keystone, niche and physical dominator	Vertical or horizontal platform objective and degree of openness for network effects	Strategic positioning: Ecosystem orchestrator or ecosystem complementor

3.2 Open Innovation

Open innovation is built on the idea that intelligence and inventive ideas are universally distributed in the economy (Chesbrough & Bogers, 2014). Chesbrough (2003) and Chesbrough and Appleyard (2007) first described open innovation as a model that leverages internal, unused knowledge and external sources of knowledge. The idea of open innovation is to rescue the false negatives (innovations that were omitted from further development but would have succeeded) (Chesbrough, 2003). Initially, open innovation centred around the single-firm, but the concept was later expanded to include networks and systems of actors (West, 2014). Chesbrough and Bogers (2014) propose a newer definition of open innovation:

> *"We define open innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model" (Chesbrough and Bogers (2014), p.17)*

The open innovation processes describe how value is created in the value network, supplemented by the business model that describes how the actor(s) capture value (Chesbrough & Bogers, 2014).

There are three modes of open innovation: inside-out, outside-in and the coupled process. Inside-out innovation is the process of which the firm comes up with an idea internally that may spread outside the firm's boundaries by, for example, spin-offs (Chen & Vanhaverbeke, 2019; Chesbrough & Bogers, 2014). Outside-in innovation is innovations that appear outside the company but are launched inside the company (Chen & Vanhaverbeke, 2019; Chesbrough & Bogers, 2014). Gassmann and Enkel (2007) further introduced the coupled process, which is a combination of the outside-in and inside-out processes. The various modes of innovation call for different innovation strategies, which must be matched to the ecosystem to reduce the chances of failure (Adner & Kapoor, 2010).

The open innovation processes can be leveraged in all stages of new product development: ideation, development and commercialisation (Cooper, 2008; Docherty, 2006). During ideation, firms can search for complementing resources outside the firm boundaries to jointly develop new services and search for solving customer problems and unmet needs (Cooper, 2008). Throughout development, outside-in open innovation is related to searching for a specialist to solve technology problems or acquire externally produced innovations. Furthermore, inside-out innovation is present in out-licensing internally developed innovations (Cooper, 2008). At the time of commercialisation, outside-in innovation is related to acquiring commercialised products that suit the company's product portfolio. Inside-out innovation is present in out-licensing internally commercialised innovations (Cooper, 2008). By taking advantage of external ideas and resources at various stages, significantly more value is created and realised (Docherty, 2006). The various open innovation types in the three stages of innovation are displayed in Figure 3.2 below, where arrows crossing the boundaries are examples of the inside-out and outside-in innovation processes.

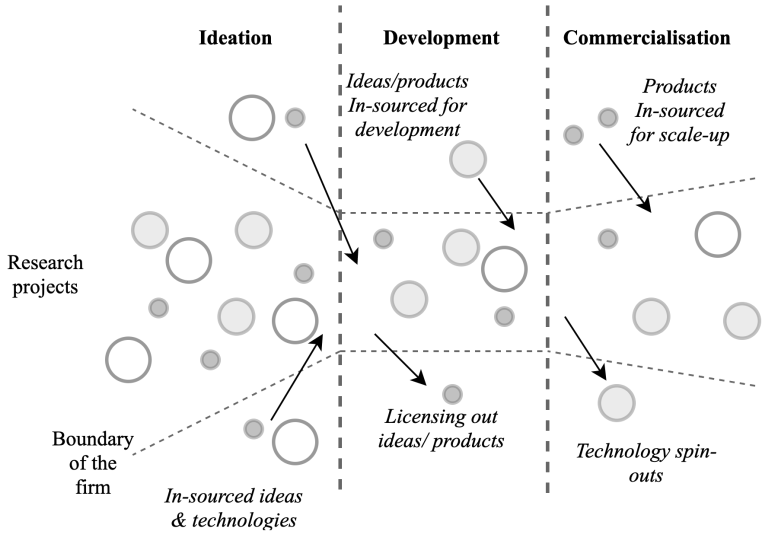


Figure 3.2: Open innovation in the various stages of innovation (adapted from Docherty (2006))

Collaborating with external actors is an integral part of value creation in business ecosystems (Vanhaverbeke, 2017). Open innovation can yield new products, services or business models (Chesbrough & Bogers, 2014). The motivations for firms to participate in open innovation differs. SMEs are motivated to take part in open innovation because it can lead to increased profits from selling niche products, or adding valuable, differentiating, services (Vanhaverbeke, 2017). Furthermore, SMEs enjoy the benefits of access to new technology and market insights, being at the forefront of new business opportunities (Chesbrough, 2010; Vanhaverbeke, 2017), and building legitimacy and reputation (Brunswicker & van de Vrande, 2014). Enterprises, on the other hand, can benefit from sharing risk and costs of innovation, access to diverse capabilities and reduce the time to market (Kwan et al., 2020). The diverse capabilities are typically speed and agility, as larger firms often lack those capabilities (Smith, 2018; Vanhaverbeke, 2017; Weiblen & Chesbrough, 2015). Other benefits from open innovation are the adoption of entrepreneurial culture in the corporation, a more attractive brand (Gobble, 2018; Vanhaverbeke, 2017), and it can potentially anticipate and drive disruptive innovation (Gobble, 2018). For startups, collaborating with SMEs or enterprises can provide them with desirable resources and drive business model innovation (Vanhaverbeke, 2017).

Peter, Back, and Werro (2019) present nine modes of corporate-startup collaboration:

1. Co-working space (outside-in): community-based, open workspaces for startups.
2. Innovation lab (outside-in): open programs supporting startups in the early stages for a couple of months.
3. Business incubator (outside-in): company supported space that incubates new ideas and develops new business models from scratch.
4. Corporate accelerator (outside-in): company either owns or supports an accelerator that focuses on growing and developing startups through workshops, mentoring, tutoring and so on.
5. Procurement (outside-in): the startup supplies strategic or operational resources to the corporation.
6. Merger and Acquisition (M&A) (outside-in): strategic consolidation of two companies or their assets.
7. Corporate venture capital (outside-in): direct investment in smaller growth startups with

strategic and financial motivations.
8. Startup platform programs (inside-out): platforms open for startups to build customer-centric solutions.
9. Corporate company builder (coupled): experimentation and building a large number of seed startups using internal or external ideas.

The various collaboration modes can again be structured into ambidexterity (exploration and exploitation) and locus of opportunity (internal and external) (Gutmann, 2019). To ensure long-term sustainable growth, Viguerie et al. (2017) recommend that corporates develop collaborative partnerships either through ad-hoc projects or systematic searches, and invest or acquire smaller growth companies.

3.2.1 Summary of open innovation

In sum, open innovation is innovation activities with third-parties. Open innovation is about collaboration and co-creation and reaping the synergies of the innovation activities. The business ecosystem theory on value creation can be related to open innovation theory (Chesbrough & Appleyard, 2007). Chesbrough and Appleyard (2007) argue that open innovation and business ecosystems are linked through value creation and value capture methods. To capture the value of the open innovation activities, it can either benefit the single-firm or the community of actors (Chesbrough & Appleyard, 2007). Therefore, open innovation in business ecosystems require innovative business models.

3.3 Business Models

The literature does not provide any commonly accepted definition of a business model (Johnson et al., 2008; Kiel, Arnold, Collisi, & Voigt, 2016; Teece, 2010; Westerlund et al., 2014). The business model is crucial for executing the business strategy (Pateli, 2003). Dijkman et al. (2015) characterise a business model as a description of how a company does its business. Quintessentially it incorporates concepts such as customers and the firm's value proposition, partnerships and their contribution, and the firm's financial structure (Johnson et al., 2008; Osterwalder & Pigneur, 2010; Teece, 2010).

The origin of the business model concept was introduced in Chandler's (1962) *Strategy and Structure* (Chesbrough & Rosenbloom, 2002). The concept entailed how the strategy incorporated a course of action and allocation of resources (Chesbrough & Rosenbloom, 2002). According to Chesbrough and Rosenbloom (2002), Andrews (1971) was one of the first to differentiate between the corporate and business strategy, which proves an equivocated business model definition. Chesbrough and Rosenbloom (2002) builds on the previous research and explains an early detailed operational definition of the business model:

> *The functions of a business model are to: articulate the value proposition, i.e. the value created for users by the offering based on the technology; identify a market segment, i.e. the users to whom the technology is useful and for what purpose, and specify the revenue generation mechanism(s) for the firm; define the structure of the value chain within the firm required to create and distribute the offering, and determine the complementary assets needed to support the firm's position in this chain; estimate the cost structure and profit potential of producing the offering, given*

the value proposition and value chain structure chosen" (Chesbrough and Rosenbloom (2002), p.533)

Their definition of a business model includes the elements of a value proposition, description of the customers, the structure of the value chain, the required resources and complementary assets, and the cost and revenue structures.

Johnson et al. (2008) later refined the business model concept to include four main elements: *"A business model, from our point of view, consists of four interlocking elements that, taken together, create and deliver value" (Johnson et al. (2008), p. 52).* The four elements in Johnson et al.'s (2008) business model are:

1. The customer value proposition: describes the target customer, the target customer's job to be done and the offering to the customer. The customer job to be done is a description of the customers' needs or problems the company's offering solves. The offering includes how the product is sold.
2. The profit formula: describes the company's revenue model (price $*$ volume), cost structure, margins, and resource velocity (i.g. lead times, inventory turns, and asset utilisation).
3. The key resources: describes the resources needed to deliver the value proposition and might include people, technology, equipment, information, channels, partnerships and brand.
4. The key processes: describes the processes, rules and metrics, and norms to deliver the customer value proposition. Processes are often product development, sourcing, manufacturing, marketing, IT, hiring, and design. Rules and metrics are margin requirements for investment, credit terms and related measures. Norms are describing the firm's investment baseline, approach to customer service and channels.

Elements from Johnson et al. (2008) are present in later business ecosystem conceptualisations. One of the most recognised descriptions of a business model is Osterwalder and Pigneur's (2010) business model canvas. Their business model consists of nine interconnected building blocks that together describe how a firm creates, delivers and captures value (Osterwalder & Pigneur, 2010). The nine elements in Osterwalder and Pigneur's (2010) business model are:

1. Key partners: The firm's partners required to operate the business model.
2. Key resources: The firm's assets and capabilities that are instrumental in operating the business model.
3. Key activities: The firm's activities required to operate the business model.
4. Value proposition: The firm's offer of products and services to the customer segments.
5. Customer relationship: The firm's type of relationship with its customer segments.
6. Customer channels: The firm's channels to communicate and reach its customer segments.
7. Customer segments: The firm's target customer segments.
8. Cost structure: Describes the incurred costs
9. Revenue streams: Describes how a firm generates revenue

Teece (2010) have a similar approach to the business model concept as Osterwalder and Pigneur (2010). *"A business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits" (Teece (2010), p. 173).* Amit and Zott (2012) further emphasize how the elements of the business model are linked through their definition of the business model: *"A system of interconnected and interdependent activities that determines* *the way the company "does business" with its customers, partners and vendors." (Amit and Zott (2012), p. 42).*

In essence, the various business model definitions include value creation and value capture activities. Osterwalder and Pigneur's (2010) value creation activities refer to the customer value proposition. Value creation can, for example, occur through solving a customer's job, reduce costs and customise the product or service offering (Osterwalder & Pigneur, 2010). In order to deliver the value proposition, the firm has to have its key partners, activities and resources in place. Value creation is likewise described by Johnson et al. (2008) and Teece (2010) as the customer value proposition enabled by key resources and processes. Value capture, on the other hand, is directly related to the cost structure and revenue streams, i.e. monetisation (Osterwalder & Pigneur, 2010). The value capture component of the business model is often about financials. Chesbrough and Rosenbloom (2002) describe value capture as the profit formula, i.e. financial structure of revenue and costs. The financial structure Teece (2010) follows is related to the revenue generated, margins and incurred costs.

The distinction between value creation through innovation and value creation for the customer is relevant for this thesis. The difference lies in the activities required to present the customer offering. Value capture, on the other hand, is the business model activities following the definition: *"a business model lays the foundations for a company's value capture (...)" (Amit and Zott (2012), p. 46).* Therefore, in this thesis, value creation refers to the innovation activities pre-value proposition, and value capture refers to the business activities, resources and financials required to capture the value created.

3.3.1 Business model innovation

Amit and Zott (2012) describe business model innovation as a new source of competitive advantage. The business model should be innovated if it is not able to monetise and absorb innovations (Johnson et al., 2008), or if it is not suited to meet future market conditions (Teece, 2010). Business model innovation can refer to adding novel activities supporting forward or backward integration. Second, it can refer to linking activities in novel ways and thus change the processes and structures. Third, it can refer to changing one or more parties that perform any of the activities (Amit & Zott, 2012). The three changes are not mutually exclusive. Thus, to be able to transform the business model successfully, a holistic view of the business model is needed (Amit & Zott, 2012).

3.3.2 Summary of business models

The business model concept entails a set of characteristics to describe how a firm operates. It describes how the firm creates value for its customers, how it delivers that value and how it captures the value. Furthermore, it describes how the firm operates by describing its processes, activities and resources. Some resources or activities might be provided by an external actor, which is also present in the business model. In sum, the business model offers companies an opportunity to describe its business operations required to execute their strategy.

3.4 Summary of the Theoretical Concepts

The concepts of a business ecosystem, open innovation and business model are interrelated. The business ecosystem creates value through open innovation and captures value through an innovative business model. The open innovation concepts enable delivering a differentiated customer offering for the business ecosystem participants, which in turn can lead to increased value capture. The business model can either describe how a single-firm captures value or how the ecosystem as a whole, captures value. According to platform ecosystems, innovation activities can lead to increased network effects which attract more customers and therefore generate more value.

4. IoT Prospectives

Industry 4.0 represents the evolution from automatisation to intelligent automatisation of the industry. It is frequently referred to as industrial IoT (IIoT) (Müller, Veile, Kiel, & Voigt, 2018). Industrial use cases of IoT applications are often referring to industrial manufacturing, intelligent automation, utilities, smart agriculture, predictive maintenance and logistics (Northstream, 2018). Figure 4.1 shows the IIoT and IoT use cases. The main difference between industrial and consumer IoT is in the strict requirements of security, critical operability in all environmental conditions and autonomous M2M interaction without the interference of humans. Together, the two areas enable a new way of doing business by changing the value network structure, building communities through business ecosystems and servitising business models (Kverne & Vågen, 2019). This chapter will present IoT enabling technologies and use cases, the IoT business ecosystem and IoT business models.

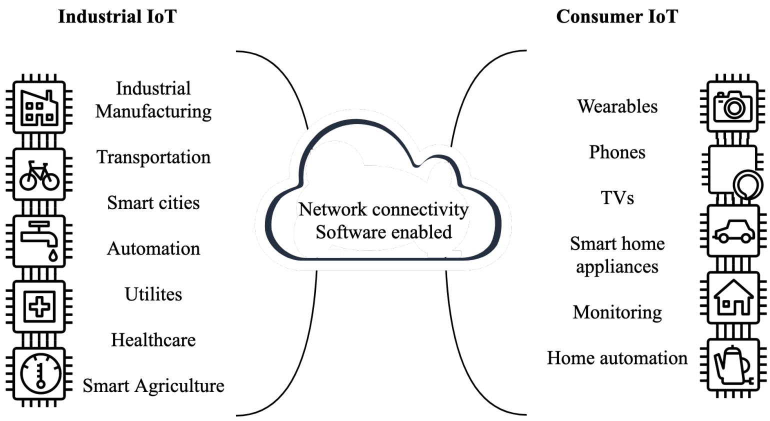


Figure 4.1: IIoT and IoT use cases

4.1 IoT Technologies and Use Cases

The new, robust network infrastructure technologies, sensors, processors, data storage, batteries and data analytics are integral for enabling IoT and IIoT use cases (Nesse, 2018). IoT sensors usually rely on IoT specific networks, either unlicensed or licensed network technologies. The unlicensed and licensed network technologies serve different purposes and have different technical, commercial and ecosystem related requirements (Northstream, 2018). Licensed technologies are mobile cellular network, i.e. 2G, 3G, 4G and 5G, and LPWA (Low Power Wide Area) networks, i.e. NB-IoT (Narrowband Internet of Things) (Nesse, 2018) and LTE-M (long term evolution for machine type communication) (GSMA, 2018; Northstream, 2018).

LPWA networks are designed to send small amounts of data to minimise battery consumption, have a low unit cost, simplify network topology and scalability, have high-security standards and have improved outdoor and indoor coverage (GSMA, 2018). For IoT sensors, it is vital that the sensors can operate and transmit data in all types of conditions (i.e. water leakage sensors in sewage systems) and LPWA networks can fulfil those requirements. The LPWA networks are enabling massive IoT (GSMA, 2018). Massive IoT is a large number of sensors connected with ultra-long battery life that transmits small amounts of data (Northstream, 2018). It typically serves industrial and consumer use cases such as agriculture, smart cities, utilities and logistics (GSMA, 2018; Northstream, 2018). Telecom operators all over the world have deployed LPWA networks to support IoT use cases. Asian telecom operators have a preference towards NB-IoT and European operators are ambiguous towards LTE or NB-IoT (Northstream, 2018). However, the LPWA networks are not able to transmit large amounts of data, which is a prerequisite for several IoT use cases.

The most recent network technology development is 5G connectivity. 5G enables high-speed transmissions of massive amounts of data, ultra-low latency, high scalability, strict security requirements, and enables dynamical allocation of network resources, i.e. real-time spectrum management (GSMA, 2018). With more connected devices, more sensor data can be captured and analysed in real-time with 5G technology. 5G technologies are, on the other hand, demanding more power than LPWA technologies (Northstream, 2018). The 5G technology is especially useful for industrial use cases such as autonomous vehicles and vehicle-to-everything communication, remote surgery using virtual reality technology, and industrial automation of heavy machinery (Northstream, 2018). These industrial, critical communication use cases have strict requirements for reliability and latency and are therefore best supported by 5G (Northstream, 2018). For consumers, 5G implies faster data transmission and enjoying the benefits of remote surgery and autonomous vehicles. Together are 5G and LPWA technologies able to serve both massive and critical IoT use cases.

The unlicensed technologies serve as a lower cost, local coverage alternatives that are typically deployed by non-telecom operators (Northstream, 2018). LoRa and Sigfox are examples of unlicensed network technologies (Northstream, 2018). The benefits of using unlicensed network technologies are low energy consumption, low cost and good scalability. However, the unlicensed technologies have limited Quality of Service (QoS), which results in more jittering and higher loss of data packages (Northstream, 2018). LoRa network can complement LTE-M and NB-IoT in remote areas with a private customised network. Due to the limited QoS, it is ideal for use cases such as agriculture and environment meterings that occasionally send small amounts of data (Northstream, 2018).

IoT, together with 5G, AI and big data analytics, is said to transform the smart future (Li et al., 2018). The data generated by the sensors have enormous monetisable potential by providing business customers with valuable insights (BearingPoint//Beyond, 2020; Russo & Albert, 2018). However, it is an ongoing discussion of how data can be analysed and shared without revealing sensitive information. Open digital platforms generate more network effects as opposed to closed platforms (Iivari et al., 2016). Hence, there are benefits of opening up and sharing aggregated data. However, business-to-business (B2B) platform customers are under strict regulations and hinder full openness (Hein, Weking, et al., 2019). Therefore, sharing data with selected ecosystem partners to co-create business analytics services is a feasible option. Then IoT platform security and trust will be essential. GSMA (2019) believes that telecom operators are in a position to create a trusted data ecosystem. Telecom operators have core capabilities in network security and privacy (GSMA, 2019) and are therefore well-positioned to handle the complexity with the usage of industrial and consumer device data.

4.2 The IoT Business Ecosystem

In order to deploy an E2E IoT solution, multiple ecosystem actors need to work together (Northstream, 2018). The E2E IoT value network is consisting of hardware vendors, network connectivity actors, IoT platform providers and cloud services, IoT application and service providers, and occasionally system integrators (Lee, 2019; Lucero, 2016; Pujol et al., 2016; Viguerie et al., 2017). Figure 4.2 displays the IoT value network in accordance with the IoT architecture. Hardware vendors include both device vendors such as smart meters and component vendors of sensors. Network actors are providers of network connection such as cellular and LPWA networks. Platform and cloud providers are often telecom operators and or technology firms. Application and service providers are actors providing analytics and business applications. System integrators are often connecting all the layers and selling a white-labelled solution. In the figure, they are presented as an individual unit, because they integrate the complete solution. Even though the figure presents a vertically aligned figure, collaboration in the ecosystem takes place across layers. Therefore, hardware vendors can collaborate with IoT platform providers and are not restricted to collaborate with network providers.

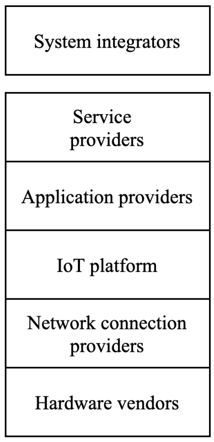


Figure 4.2: IoT business ecosystem actors presented according to the IoT architecture

Projected revenues from IoT services is most significant in the service layers, i.e. the full IoT solution providers (Long et al., 2019) and data analytics services (Lucero, 2016; Viguerie et al., 2017). Therefore, telecom operators are discussing three new positioning strategies to partake in revenue growth. The first option is to keep its position as a network provider, delivering reliable, low latency network connection services (Chan, 2015). The connection expert is focused on economies of scale. The second option is to vertically integrate and secure the position as IoT platform provider (Chan, 2015). The platform provider is a central player (Gawer & Cusumano, 2014) and is therefore in a position to orchestrate and facilitate the IoT business ecosystem. The position further introduces new business opportunities by developing (either in-house or with partners) vertical-specific solutions or horizontally standard solutions (Ahokangas et al., 2018; Nakayama, de Mesquita Spínola, & Silva, 2020). The third option is building on the vertical-specific platform provider, namely providing full E2E IoT solutions (BearingPoint//Beyond, 2020). The full E2E IoT solution provider owns the end-customer relationship and has a significant influence on the IoT business ecosystem. Therefore, the owner of the end customer relationship has a keystone leadership position (Moore, 1993, 1996) and can drive value creation and value capture of the IoT ecosystem.

Apart from the telecom operator role, IoT solutions introduce new actors in the business ecosystem. Lee (2019) presents five key players in the IoT business ecosystem: hardware vendors, connectivity and network providers, application providers, software providers, and users and customers. First, the IoT introduces IoT device manufacturers that enable new IoT use cases (Lee, 2019). Secondly, the connectivity level introduces new actors in addition to telecom operators: spectrum brokers and other managed connectivity brokers (5G-PPP, 2017; Ikävalko et al., 2018). The spectrum broker role will emerge because 5G enables real-time spectrum management. Thirdly, the application and service providers will introduce new actors such as technology companies providing business analytics services and cloud and data storage providers (5G-PPP, 2017; Lee, 2019; Pujol et al., 2016). The new actors can either be startups, SMEs or larger technology enterprises. Lastly, the users and customers are an integral part of the IoT business ecosystem (Lee, 2019). The customer should be invited into the innovation of new IoT services because it makes it easier to design value-adding services (Hein, Weking, et al., 2019). All actors in the IoT ecosystem influence the business ecosystem's value creation and value capture.

4.3 The IoT Business Models

The IoT business models are likewise affected by the business ecosystem and IoT technologies. IoT business models are a result of collaborative value creation across the IoT value network. Because IoT solutions are dependent on various actors, the IoT business must reflect the interdependence. Therefore, Leminen et al. (2018) and Westerlund et al. (2014) argue that IoT business models should have a systemic view of value creation and value capture. Firms operating in IoT business ecosystems must decide the optimal strategic position in the business ecosystem, and adjust its business model accordingly (Leminen et al., 2018). For example, a business analytic startup can pursue a complimenting ecosystem role and specialise its capabilities on niche big data services: the more specialised and desirable services, the higher the margins.

The IoT business model presents several changes to traditional business models. First, the customer value proposition of IoT companies is predominantly customer-oriented (Dijkman et al., 2015) and service-oriented (Bucherer & Uckelmann, 2011; Lee, 2019; Suppatvech et al., 2019). The service-orientation is both including novel as-a-service businesses selling complementing services (Bucherer & Uckelmann, 2011), and businesses offering value-adding services in addition to the product offering (Chan, 2015). The focus on services and customisation is a direct result of insight extracted from the generated sensor data (Bucherer & Uckelmann, 2011; Suppatvech et al., 2019). Johnson et al. (2008) argue that the customer value proposition must target the customers' job. IoT makes it possible for firms to have deep insight into the customers' pain points and needs because of the sensor data analyses. With supporting business analytics technologies such as AI and ML together with critical infrastructure, is IoT able to perform formerly challenging use cases, and create differentiated customised value propositions. Furthermore, IoT value propositions will have more focus on providing convenient, high-performance services (Dijkman et al., 2015; Ju et al., 2016). Hence, the value proposition will have a service-orientation, that focuses on delivering value to the customer.

The servitised value proposition enables new continuous revenue streams and lower cost structures (Bucherer & Uckelmann, 2011; Suppatvech et al., 2019). The cost structure will mainly be related to IT, hardware, personnel cost and maintenance (Dijkman et al., 2015; Ju et al., 2016). However, IoT solutions can omit the need for physical branches and owning physical products, because asset-heavy investments can be provided by a partner in the IoT ecosystem (Bucherer & Uckelmann, 2011). Removing asset-heavy investments reduces costs by eliminating the need for maintenance and repairs.

The IoT revenue streams will include tangible and intangible value. The tangible, monetary value, will come from subscription-based services, leasing or renting payments, pay-per-use arrangements, and similar servitised revenue structures (Suppatvech et al., 2019). Furthermore, in addition to paying for the value offering, the customer often pays for value-adding services. Thus, the revenue streams will increase with the value of the extra services. Value-adding services can either be an internal service innovation or a result of open innovation in the IoT ecosystem. For example, corporate venturing activities resulting in spin-offs, sales and divestment (Neumann, Hintzen, Riel, Waldhausen, & Dismon, 2019). The intangible revenue streams will come from the spillovers of knowledge-sharing and technology-sharing in the IoT ecosystem (Chan, 2015). Cross-synergies and spillover knowledge are highly beneficial even though it is not monetary (Bucherer & Uckelmann, 2011; Smedlund, Ikävalko, & Turkama, 2018; Westerlund et al., 2014).

In order to deliver the value proposition and leverage cross-synergies, new ecosystem partners like enterprises, SMEs, and startups will be a part of the IoT business model resources. Multiple actors from hardware to application and service level need to be involved in delivering a complete E2E IoT solution. Therefore, partners are a vital component of the business model (Chan, 2015; Ju et al., 2016; Lee, 2019). The primary segments outlined to serve as IoT partners are service providers and data analytics companies (Ju et al., 2016; Veile, Kiel, Müller, & Voigt, 2019). Because business analytics and information are one of the unique benefits of IoT, more businesses will see the value of paying for information services (Ju et al., 2016). Partnering up with IT firms can significantly increase the utility of the value proposition (Ju et al., 2016). Moreover, several new IoT business models will not be sustainable without partners (Suppatvech et al., 2019). For example, a truck leasing company that does not own the trucks will be worthless without its truck partner. Partners are essential in the IoT business model because they provide vital resources to operate the value proposition. Thus, IoT ecosystem actors need to cooperate and co-innovate on a contractual and non-contractual basis (Smedlund et al., 2018) to create and capture value (Lee, 2019).

A second partner that will be involved with the development of the value proposition is the customer. Customer co-creation is a fundamental part of IoT business models (Dijkman et al., 2015; Ju et al., 2016; Lee, 2019). The customer relationship will be increasingly closer and has to be mutually beneficial for both parties (Leminen et al., 2018). Customers can be complementors subscribing to platform services, companies buying IoT solutions, consumers and users using IoT solutions. The customer does not necessarily have to be the end-user, as some companies buy IoT solutions, but it is its customers, i.e. users, who utilise the solution.

Furthermore, smart devices create enormous amounts of data (Porter & Heppelmann, 2014) that firms must know how to analyse. The data analytics will, therefore, be part of IoT business models, either through activities provided by a partner or by having the capabilities in-house (Chan, 2015; Dijkman et al., 2015; Iivari et al., 2016; Ju et al., 2016). Nevertheless, the IoT business models processes must support the shift of using analytics of preventive and predictive decision-making.

In addition to the servitised value proposition, increased collaboration activities and new financial structures, new capabilities are needed. IoT firms must have strong partnering management and relationship capabilities, collaboration and value creation capabilities, and understanding the value flows in the business ecosystem (Leminen et al., 2018; Smedlund et al., 2018; Westerlund et al., 2014). IoT businesses will need to collaborate to adapt to the fast-changing technology industry. Therefore, having a firm understanding of the IoT ecosystems' value flow makes it easier to know how to position in the ecosystem strategically. The competition will be between the business ecosystems, not ecosystem actors (Smedlund et al., 2018). Thus understanding the ecosystem as a unit is imperative for the long-term success and survival (Smedlund et al., 2018; Westerlund et al., 2014).

5. Article

Telecom Operators and IoT Business Ecosystems in Emerging and Advanced Economies

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Abstract

The Internet of Things (IoT) represents a paradigm shift for telecom operators. Telecom operators have to redefine how they create and capture value in a business ecosystem. This research aims to investigate six telecom operators' IoT business ecosystems and illustrate how the ecosystems create value through innovation and capture value through business operations in emerging and advanced economies. The purpose of the research is to develop a profound understanding of IoT business ecosystems and compare market differences. The selected research method is a multiple case-study using interviews with managers in Asian and European telecom operators. The case-study revealed three distinct groups of IoT business ecosystems. The central disparity between emerging and advanced economies is the telecom operators' ownership of the full end-customer relationship. The emerging markets are organising for delivering complete end-to-end IoT services, while advanced economies concentrate on connectivity and value-adding platform services. The research contributes to the literature by defining three IoT business ecosystems and elucidates the differences between emerging and advanced economies.

Keywords: *Internet of Things, Telecom Operator, Business Ecosystem, Emerging Economies, Open Innovation, Business Models*

1 Introduction

The Internet of Things (IoT) is representing a paradigm shift by enabling enterprises to develop novel service business models (Lee, 2019). The telecom industry has seen a rapid move from telephone charges, messaging services, data packages to the new era of IoT services. Traditionally, the telecom industry has centred around the volume of SIM cards to consumers (BearingPoint//Beyond, 2020). IoT, on the other hand, will have the most substantial impact on business customers (BearingPoint//Beyond, 2020; Lee, 2019) and industrial IoT (IIoT) use cases such as industrial manufacturing, automotive and utilities. IoT and IIoT introduces new strategic choices of how value is created and captured, how data is utilised and managed, and what role the firm should play (Porter & Heppelmann, 2014).

For telecom operators, IoT and machine-to-machine (M2M) connectivity are expected to grow by 19% annually towards 2023 (Cisco, 2018). This rapid growth of connected devices unlocks the real value of the IoT, namely the data it generates and insights the data can produce (Russo & Albert, 2018). IoT together with both data analytics using artificial intelligence (AI) and machine learning (ML), and faster, reliable network connections are expected to produce invaluable analytical insights (Li, Xu, & Zhao, 2018; Palattella et al., 2016), servitise business models (Lee, 2019; Leminen, Rajahonka, Wendelin, & Westerlund, 2020; Suppatvech, Godsell, & Day, 2019), and help solve global challenges (Nesse, 2018).

To build end-to-end (E2E) IoT use cases, collaborative partner ecosystems consisting of device vendors, telecom operators, and software and application providers are imperative (BearingPoint, 2020). Mogg et al. (2017) address four potential scenarios of the future position of the telecom operator. The scenarios summarise the pivotal decision of telecom operators: having internal network technology competence or owning the customer relationship (BearingPoint//Beyond, 2020; Mogg et al., 2017). Telecom operators will have to decide whether to focus on network competence or platform services with tailored customer solutions. BearingPoint//Beyond's (2020) report goes one step further and presents the role of the telecom operator to become an E2E IoT service provider. In fact, 32% of enterprises in Asia and Europe believe communication service providers (CSP), such as telecom operators, can be ecosystem facilitators and deliver complete E2E IoT services. For European CSPs, on the other hand, 37% expect their role to be solemnly a connectivity provider. The same number in Asia is 29%. Thus, even though about a third of CSPs expect their role to be a connectivity provider, two-thirds expect to change their focus and deliver value-adding services in addition to connectivity (BearingPoint//Beyond, 2020). The telecom operators have to change its focus from product-strategy to customer-strategy and service-dominant logic (Binkhuysen, 2020) in order to become an attractive, innovative digital-service partner (Long, Pinkney, Sturgess, & Wright, 2019).

To accelerate innovation, develop new business models and service solutions, the telecom operators have to learn how to create value and capture value in its respective business ecosystems. In order to create value, enterprises, SMEs and startups are accentuated as vital components of the IoT business ecosystem (Eckblad, Gutmann, & Lindener, 2019; Mihailovic, 2019; Rocha, Mamédio, & Quandt, 2019). Collaborating with enterprises and SMEs provides the telecom operator with valuable resources, shared risk and reduced cost of innovation, and a faster innovation cycle (Kwan, Schroeck, & Kawamura, 2020). In addition, the corporations must collaborate with startups as well to be able to prosper in the innovation ecosystem (Peter, Werro, & Back, 2019). Eckblad et al. (2019) show that the trend of corporate venturing as a practice for corporations to innovate with startups are growing. In addition to startups, customers are essential collaboration partners for developing value-adding services (Long et al., 2019). Innovating with customers is integral to understanding their tacit knowledge and developing value-adding, complementing services (Chesbrough, 2011; Hein, Weking, et al., 2019; Vorbach, Müller, & Poandl, 2019).

Local conditions, such as macroeconomic factors and regulations, must be taken into consideration to develop a flourishing IoT business ecosystem (Baig, Lakhani, & Mehdi, 2019). For example, in Asia, businesses might partner with CSPs due to their knowledge and expertise in connection technology, but in Europe, the main factor will be the CSPs ecosystem orchestration capabilities and managing complex programs (BearingPoint//Beyond, 2020). In the Asian markets, telecom operators can exploit their customers' confidence, as 92% of Asian businesses would consider buying new technology solutions from CSPs (BearingPoint//Beyond, 2020). CSPs, on the other hand, are more focused on core business and less about value-adding services (BearingPoint//Beyond, 2020). Even though particularly emerging economies face more hurdles than advanced economies, IoT provides telecom operators with new opportunities and a potential new role as the ecosystem facilitator.

1.1 Previous research

There has been extensive research on business models (Johnson, Christensen, & Kagermann, 2008; Osterwalder & Pigneur, 2010; Teece, 2010), business ecosystems (Iansiti & Levien, 2004; Moore, 1993, 1996), platform ecosystems (Gawer & Cusumano, 2014) and innovation ecosystems (Adner, 2006; Gomes, Facin, Salerno, & Ikenami, 2018; Ritala, Agouridas, Assimakopoulos, & Gies, 2013). However, the literature lacks research on the dynamics of firms' value capture and value creation activities in an ecosystem context (Gomes et al., 2018). Likewise is the literature on IoT business ecosystems and business models primarily discussed in general terms (Ahokangas et al., 2018; Leminen, Rajahonka, Westerlund, & Wendelin, 2018; Rong, Hu, Lin, Shi, & Guo, 2015). For example, is the research focusing on describing the existence of horizontal and vertical relationships of collaboration and competition (Ghanbari, Laya, Alonso-Zarate, & Markendahl, 2017) without explaining how the actors collaborate and compete. Alternatively, the research is focusing on how digital platforms enable co-creation between actors (Hein, Weking, et al., 2019; Hein, Schreieck, et al., 2019; Iivari, Ahokangas, Komi, Tihinen, & Valtanen, 2016; Leminen et al., 2018), without explaining how the value is captured and distributed among the digital platform ecosystem actors (Hein, Schreieck, et al., 2019; Helfat & Raubitschek, 2018). Furthermore, the research often describes the roles and the role structure in IoT ecosystems (Ikävalko, Turkama, & Smedlund, 2018; Lee, 2019; Lucero, 2016; Pujol, Elayoubi, Markendahl, & Salahaldin, 2016), but fails to identify the role dynamics and their interactions (Rong et al., 2018). As a result, the literature has focused intensely on actors, structures and presence of actions, yet detached the actors and actions from its context by not recognizing how value creation and value capture are intertwined. Ghanbari et al. (2017) propose that future researchers should explore companies' interactions in the IoT value network to understand how value-creating and value-capturing activities can fit into the ecosystem. Especially is more research needed on IIoT, and how the systemic nature of IIoT can connect business models to the value network (Leminen et al., 2020).

In addition to the lack of holistic view on value creation and value capture, the research fails to identify the role and business model of the telecom operator. Quintessentially, the firm-specific IoT business model is a servitised model describing actors in the service layer, like original equipment manufacturers (OEMs) (Lee, 2019; Suppatvech et al., 2019) or application service providers (Chan, 2015). Thus, more research is needed on telecom operators' IoT business models and IoT ecosystems.

A third aspect of the IoT business ecosystem research is the dynamic context of the studies. The business ecosystem and business model literature mostly study the context of advanced western economies, if not separated from the market altogether (Rong et al., 2018). Some scholars, like Christensen, Ojomo, and Dillon (2019) and Chesbrough (2011), explain emerging markets and how to approach the markets differently than developed markets. Ajadi and Bayen (2017), Fasnacht (2018), and Baig et al. (2019) refer to high entrepreneurial activity and enormous growth potential for IoT in Asian emerging markets. The Asian markets, in general, represent a high-context culture for relationships (Hollensen, 2008) and have conceived some of the world's largest ecosystems like Alibaba, Tencent and Baidu (Greeven & Wei, 2017). The emerging markets have considerable potential to become IoT leaders, but in order to understand the different business dynamics from western economies, more research is needed on the emerging economies IoT business ecosystems.

1.2 The research purpose

This study aims to develop a profound understanding of IoT business ecosystems in emerging and advanced economies and fill elements of the IoT ecosystem research gap. The purpose is to identify the differences between the business ecosystems, and discuss how the findings relate to the literature. Two aspects are integral for the business ecosystem: creating value and capturing value (Gomes et al., 2018; Ritala et al., 2013). Creating value is commonly referred to as the collaborative processes, co-creation with customers and innovation (Adner & Kapoor, 2010; Gomes et al., 2018; Ritala et al., 2013), and capturing value is how the firm operates to capture profits (Gomes et al., 2018; Ritala et al., 2013). Creating value is the prerequisite for capturing value (Gomes et al., 2018). Therefore, the two research questions are presented:

1. *How does the IoT ecosystem create value through open innovation?*
2. *How does the IoT ecosystem capture value through business operations?*

A case-study is conducted to answer the research questions and find the differences between emerging and advanced economies IoT business ecosystems. In particular, value creation is needed to develop new IoT services and grow the IoT ecosystem. Thus, the research will try to describe value creation with existing partners (i.e. startups, SMEs, enterprises), with future partners (i.e. startups, SMEs, enterprises), and with customers (business and consumer). Furthermore, value capture is needed to develop a competitive and profitable business ecosystem. Thus, the research will try to explain the telecom operator's position in the ecosystem, each actor's value contribution, the revenue model, the utilised resources, and its ecosystem strategy. Finally, the similarities and differences of emerging and advanced economies business ecosystems' value creation and capture strategies will be discussed.

The article will begin by describing the theoretical foundation the case study is deducted: namely ecosystem literature, value creation through open innovation, and value capture through its business operations. Secondly, the research design, data collection and data analysis will be described. Thirdly, the findings of how IoT business ecosystems create and capture value will be discussed. Lastly, a conclusion of the discussion will be presented, followed by the implications for scholars, managers and future thought-provoking research questions.

2 Theory

2.1 Ecosystem Designs

The literature on ecosystems began with (Moore, 1993, 1996) describing the business ecosystem using the ecology metaphor. Moore's (1996) ecosystem is a continuously co-evolving, self-organising system of customers, suppliers, complementors, vendors, governmental bodies, organisations and other stakeholders that influence the firm. The main idea of the business ecosystem is to broaden the firm's perspective of competing in an industry, to compete where there are customers (Moore, 1993, 1996). Iansiti and Levien (2004) further built on the ecology metaphor and introduced the ecosystem strategies of keystone actors, niche players and the physical dominator. The various actors create value in symbiosis, and the survival of the ecosystem is dependent on all actors (Iansiti & Levien, 2004; Papert & Pflaum, 2017; Peltoniemi & Vuori, 2004).

Platform ecosystems and value networks have emerged from business ecosystem theory. The value network consists of the actors in the business ecosystem that are directly affecting value creation for the focal firm (Brandenburger & Nalebuff, 1995). Typically the actors are complementors, suppliers, customers and substitutors (Brandenburger & Nalebuff, 1995). The value network can describe the value flows of tangible and intangible value (Allee, 2000; Stabell & Fjeldstad, 1998). Firms relying on a platform can use the value network for strategic positioning, i.e. pursuing a vertical or horizontal economy of scope strategy (Stabell & Fjeldstad, 1998). The platform brings novel business opportunities of how to create value by matching two or more parties (Evans & Schmalensee, 2016), leverage network effects (Gawer & Cusumano, 2014), and create innovations from cross-sectional partnerships (Rajala, Hakanen, Mattila, Seppälä, & Westerlund, 2018). In order to create and capture value from platform ecosystems, three dynamic capabilities are essential: innovation capabilities, scanning and sensing capabilities, and integrative capabilities related to value chain positioning and network effects (Helfat & Raubitschek, 2018).

Evolving from platform and business ecosystem theory is the concept of innovation ecosystems. The platform serves as an innovation ecosystem where actors can co-develop new products, services and technologies (Gawer & Cusumano, 2014). The innovation ecosystem is described as both innovation clusters and business ecosystems where actors collaborate and co-create around a business objective (Gupta, Mejia, & Kajikawa, 2019; Ritala et al., 2013). As Gomes et al. (2018) argue, it is not easy to distinguish the innovation ecosystem from the business ecosystem as the literature has tended to use the terms interchangeably. An innovation ecosystem is building on Iansiti and Levien's (2004) concept of all actors being dependent on each other (Adner, 2006; Adner & Kapoor, 2010). Its primary objective is value creation (Galateanu & Avasilcai, 2018; Grønning & Afshin, 2019). Similar to Gawer and Cusumano's (2014) separation of innovative and competitive platforms, the innovation ecosystem can be distinguished from the business ecosystem by the focus on value creation and innovation (Gomes et al., 2018). Oppositely is the business ecosystem related to value capture (Gomes et al., 2018). For emerging technologies, like IoT, value creation predominates over value capture (Gomes et al., 2018). The sequence implies that in order to create thriving IoT business ecosystems, the primary focus must be on developing an innovation ecosystem to spur value creation and afterwards focus on the overall business ecosystem's value capture. Building on the innovation ecosystem and business ecosystem theory, the following sections will present how the IoT ecosystem creates and captures value.

2.2 Creating value in an IoT ecosystem

The IoT business ecosystem is an optimal platform for open innovation (Müller, Veile, Kiel, & Voigt, 2018; Nesse, 2018; Rocha et al., 2019; Smedlund, Ikävalko, & Turkama, 2018). Open innovation is built on the idea that intelligence and inventive ideas are universally distributed in the economy (Chen & Vanhaverbeke, 2019; Chesbrough & Bogers, 2014). Chesbrough (2003) first introduced open innovation as a model that leverages internal, unused knowledge (inside-out) and external sources of knowledge (outside-in). Gassmann and Enkel (2007) further introduced the coupled process, which is a combination of the two. Initially, open innovation was about the single-firm, but the concept has evolved to include networks and systems of actors (West, 2014). Open innovation in the IoT ecosystem is related to collaboration, co-creation and explorative ecosystem innovation activities (Ikävalko et al., 2018; Kiel, Arnold, Collisi, & Voigt, 2016; Lee, 2019; Suppatvech et al., 2019).

Collaborating with partners is an integral part of open innovation in business ecosystems (Mihailovic, 2019; Vanhaverbeke, 2017), and is highlighted as integral for value creation in IoT ecosystems (Ghanbari et al., 2017; Kiel et al., 2016; Lee, 2019; Leminen et al., 2018). The partners in the IoT ecosystem are SMEs, enterprises and startups at the hardware, network, application and service layer (Kwan et al., 2020; Lee, 2019; Lucero, 2016; Pujol et al., 2016). The benefits of collaboration and co-creation for enterprises are reduced time to market, risk and cost-sharing, access to diverse capabilities and resources (Kwan et al., 2020). For SMEs, the need to change their business models drive open value creation (Vanhaverbeke, 2017). The benefits SMEs enjoy is the access to necessary resources, new technology and market insights, being at the forefront of new business opportunities (Chesbrough, 2010; Vanhaverbeke, 2017), and building legitimacy and reputation (Brunswicker & van de Vrande, 2014).

Collaborating with startups is seen as one of the most important criteria for long-term competitiveness in IoT business ecosystems (Arthur D. Little, 2018; Awais et al., 2019; Peter, Werro, & Back, 2019; Viguerie, Cowan, & Hindo, 2017).

Entrepreneurs in the Schumpeterian theory are said to be the drivers of innovation by introducing new technologies and business models to the firm, which lead to long-term survival (Yun, 2017). Larger firms, like telecom operators, often lack the startups' speed, agility and entrepreneurial orientation (Smith, 2018; Vanhaverbeke, 2017; Weiblen & Chesbrough, 2015). Additional benefits from the startup-corporate collaboration are the adoption of entrepreneurial culture in the corporation, it makes the firm and brand more attractive (Gobble, 2018; Vanhaverbeke, 2017), and it can potentially anticipate and drive disruptive innovation (Gobble, 2018). The key is to find startups with complementary value propositions (Vanhaverbeke, 2017). Companies can collaborate with startups using various collaboration forms, e.g. startup platform programs (inside-out), corporate company builder (hybrid), co-working spaces (outside-in), innovation labs (outside-in) business incubators (outside-in), corporate accelerators (outside-in), procurement (outside-in), M&A (outside-in), and corporate venture capital (outside-in) (Peter, Back, & Werro, 2019). Corporate venturing usually refers to accelerators, labs, hackathons, incubators and corporate venture capital (Neumann, Hintzen, Riel, Waldhausen, & Dismon, 2019).

The various collaboration modes must be pursued in alignment with the company's objectives (Mocker, Bielli, & Haley, 2018; Neumann et al., 2019; Gutmann, 2019). Because the IoT business ecosystem is in its infancy, to solve business problems and expand horizontally into new markets, three collaboration modes are appropriate: partnerships, investments and acquisitions (Mocker et al., 2018). Likewise, if the goal is to attract partners and co-develop product and services, which is often the case in IoT business ecosystems, then business accelerators, incubators, co-working spaces and hackathons are more suitable (Gobble, 2018; Kupp, Marval, & Borchers, 2017; Mocker et al., 2018). Ideally, the accelerators can act as a complementor in the IoT business ecosystem (Kohler, 2016). Albeit accelerators are resource-demanding (Peter, Werro, & Back, 2019; Kohler, 2016), corporates can potentially tap into new sources for innovation, new customers, new suppliers or new partners (Weiblen & Chesbrough, 2015). Often corporates' motivation for corporate venturing initiatives is strategic, and financial motivations is a secondary goal (Gutmann, 2019; Kanbach & Stubner, 2016; Neumann et al., 2019).

The fourth type of collaboration is the customer co-creation. Traditionally, product-oriented firms have thought of their customers as consumers (Chesbrough, 2011). IoT changes traditional product businesses into service businesses (Ikävalko et al., 2018; Kiel et al., 2016; Leminen et al., 2018; Suppatvech et al., 2019) and therefore requires an in-depth understanding of the customers' job (Chesbrough, 2011). Inviting the customer into the innovation process makes it easier to design value-adding services to IoT devices (Hein, Weking, et al., 2019) because co-creation can share customers' tacit knowledge with suppliers, and as a result create a differentiated value proposition (Chesbrough, 2011; Vorbach et al., 2019). Value-adding services can either be tailored vertical services or services that are applicable to numerous segments in different verticals (Ahokangas et al., 2018; Porter & Heppelmann, 2014). Furthermore, co-creation creates a stronger relationship between the customer and the supplier (Chesbrough, 2011). Open innovation with partners and customers can help companies escape the commodity trap (Christensen & Raynor, 2013; Fasnacht, 2018; Yun, 2017). Because, the co-creation makes it possible to detect the customers' pain points and speed up the innovation cycle (Vorbach et al., 2019; Yun, 2017).

Value creation in an IoT business ecosystem is related to explorative and exploitative innovation activities. Exploitation and exploration are commonly referred to as ambidexterity (March, 1991). Ambidexterity is both being able to meet today's business demands and being adaptive to environmental changes (Raisch & Birkinshaw, 2008). Ambidexterity for business ecosystems can be pursued through three strategies: (1) exploiting capabilities for profitability, (2) exploring opportunities for innovation and growth, and (3) collaborating in an innovation ecosystem (Fasnacht, 2018). Ambidextrous, open IoT business ecosystems are achieved by leveraging the capabilities of sensing, seizing and absorptivity (Helfat & Raubitschek, 2018; Teece, 2017). Ambidexterity is essential for developing tomorrow's business models while at the same time, satisfying shareholders, investors and client's needs (Fasnacht, 2018).

Shifting the focus of open innovation in advanced economies to emerging economies raises new challenges and opportunities (Chesbrough, 2011). Christensen et al. (2019) stated that emerging economies are often overlooked because there are no consumers who can afford the innovation. Innovating in emerging markets is about meeting nonconsumers, and truly understanding the customers' job to be done through market-creating innovation (Christensen et al., 2019). To gain customer insight, companies in emerging markets should co-create with customers or hold the end-customer relationship, in order to receive valuable feedback directly from customers (Chesbrough, 2011).

Collaboration with partners is likewise imperative for servitised businesses in emerging markets as advanced economies (Chesbrough, 2011). Innovating in emerging economies often faces hurdles such as lack of qualified partners and poor infrastructure. To overcome these hurdles, firms must focus on collaborating, developing and investing in their partners (Chesbrough, 2011; Christensen et al., 2019). Sims and Seidel (2017) discovered in their research on coupled innovation processes in business ecosystems that providing help to partners has a positive effect on innovativeness because the help led to new insights. Furthermore, to grow the IoT startup ecosystem and create the desired partners and complementors, Murphy (2010) proposes investing in accelerators and incubators. These findings show that emerging markets differ from advanced economies by demanding more resources and investments in partners for the ecosystem's service offering to flourish (Chesbrough, 2011).

2.3 Capturing value in an IoT ecosystem

The literature identifies several ways of how business operations in the IoT business ecosystem facilitate to capturing value. This article uses Amit and Zott's (2012) description of the business model to explain value capture: *"a business model lays the foundations for a company's value capture (...)" (Amit and Zott (2012), p. 46).* The literature does not provide an official definition of a business model (Johnson et al., 2008; Kiel et al., 2016; Teece, 2010). Still, the IoT ecosystemic business model often contains four elements: the actors, their contribution to the value proposition, the key resources, and the revenue streams (Chan, 2015; Lee, 2019; Veile, Kiel, Müller, & Voigt, 2019; Westerlund, Leminen, & Rajahonka, 2014). Therefore, to capture value in the IoT ecosystem, one must consider the systemic nature of the ecosystem (Leminen, Rajahonka, & Siuruainen, 2015; Porter & Heppelmann, 2014; Westerlund et al., 2014) consisting of the value network structure, participants' contributions, the revenue sharing model and the mediating IoT platform.

To capture value in IoT ecosystems, telecom operators must either deliver specific use cases in the smart industry which requires vertical cooperation or it can provide general solutions to various verticals and let it be up to the customer to develop solutions (Ghanbari et al., 2017; Mogg et al., 2017; Nakayama, de Mesquita Spínola, & Silva, 2020). Both cooperation, suppliers collaborating with customers, and coopetition, simultaneous competition and cooperation, are types of business relationships present in IoT business ecosystems (Ghanbari et al., 2017; Leite, Pahlberg, & Åberg, 2018). Monetisation for telecom operators is from value-adding services (Porter & Heppelmann, 2014), which requires telecom operators to search for strategic or financial partnerships and move up in the value chain (BearingPoint, 2020; Binkhuysen, 2020; Porter & Heppelmann, 2014). However, findings from Karapantelakis and Markendahl's (2017) IoT case study show that telecom operators only provided connectivity. The operator took a supporting role to the ICT actors who provided the complete service and were the owner of the end-customer relationship (Karapantelakis & Markendahl, 2017). Therefore, provided the operator wants to take a more substantial percentage of IoT value, it has to innovate its business model (Mihailovic, 2019).

Business model innovation can refer to adding new activities (content), linking activities differently (structure) or changing one or more parties that perform any of the activities (governance) (Amit & Zott, 2012). IoT businesses can add value through services (Ju, Kim, & Ahn, 2016; Lee, 2019; Suppatvech et al., 2019), introduce new parties offering the service (Ahokangas et al., 2018) and also link activities differently such as inviting the customer into the innovation process (Bucherer & Uckelmann, 2011; Dijkman, Sprenkels, Peeters, & Janssen, 2015; Ju et al., 2016). IoT business models create new opportunities for servitisation (Kortmann & Piller, 2016; Lee, 2019; Suppatvech et al., 2019), and co-creating activities with suppliers and customers (Kortmann & Piller, 2016). Servitisation can aid customising the telecom operators' value proposition (Chesbrough, 2010), and shaping unique IoT business models.

In order to monetise from the value-adding services, new revenue models must be implemented (Chesbrough, 2010). Revenue streams come from users and customers' payments (Lee, 2019). Niyato et al. (2016) propose new revenue streams by bundling sensing data and service subscription fees. Depending on the business model, various revenue streams will be suitable. Leminen et al. (2018) describe four types of IoT business models that capture value through open standards, cost savings, efficiency and customisation. Weking, Stöcker, Kowalkiewicz, Böhm, and Krcmar (2020) find nine patterns for industrial IoT business models. The three super-patterns integration, servitisation and expertisation, capture value through traditional sales, revenue sharing, rent/lease models, freemium models and subscriptions. A by-product of open innovation is increased value capture opportunities

(Vanhaverbeke, 2017). Open innovation can lead to raising profits from being the market leader and taking premium prices from niche products (Vanhaverbeke, 2017). To maximise the value in a network, every partner should be better off as a result of joining the network (Vanhaverbeke, 2017).

The mediating IoT platform enables the monetisable value-adding services for telecom operators. The IoT platform can also encourage value co-creation through network effects (Hein, Weking, et al., 2019; Yablonsky, 2020) and stimulate information sharing from the generated data (Hakanen & Rajala, 2018). It is complex to facilitate the B2B IoT platform, as the facilitator needs to incentivise various actors across the IoT platform (Hein, Weking, et al., 2019; Yablonsky, 2020), and depending on complementors autonomy, manage loose control and flexibility (Parker, Van Alstyne, & Jiang, 2017). The B2B landscape already has vertical-specific solutions and numerous IoT platforms, which increases the complexity and difficulties (Russo & Albert, 2018). However, platforms can help telecom operators to simplify operations, launch products and valuable services faster, and enhance customer service (Ramakrishnan & Selvarajan, 2017).

3 Research Method

The research aims to investigate six telecom operators' various IoT business ecosystems and illustrate how they create and capture value in their respective economies. The study will result in a theoretical discussion of different positioning strategies and the differences between emerging and advanced economies' IoT business ecosystems. The multiple case study methodology was selected due to the limited research on detailed descriptions of telecom operators' IoT business ecosystems and the exploratory and contemporary nature of the research (Eisenhardt, 1989; Yin, 2018). The case-study followed an inductive approach inspired by Strauss and Corbin's (1994) grounded theory. Grounded theory is a research methodology where theory evolves during actual research (Strauss & Corbin, 1994). The inductive procedure is reflected in the research process, where data collection and data analysis were done simultaneously, and the research questions were formulated after the data collection. The inductive approach in combination with a case-study made it possible to explore the richness of details and the relationships between the value creation and value capture in the IoT ecosystem models and its context (Eisenhardt & Graebner, 2007). In addition to using an explorative case study, the research is based on a preliminary literature review of Kverne and Vågen (2019). The literature review analysed the future business roles, business ecosystem and business model in the era of IoT.

3.1 Data collection

The six telecom operators were selected based on their market presence in emerging, Asian, or advanced, European, markets. Each operator had started IoT operations, were part of an IoT ecosystem, had experience with IoT innovation and business models, and owned IoT network infrastructure. The study holds a focus on the emerging economies as four out of six telecom operators are from emerging economies. The emerging economies are different in terms of digital maturity, entrepreneurial growth, economic growth, and culture. The variety of emerging economies operators helps to increase the validity and theory building of the findings (Eisenhardt, 1989). The interviewees were selected based on their role, knowledge, and experience in the telecommunications industry and IoT ecosystems. Interviewing highly knowledgeable informants can limit interview bias and thus strengthen the study's reliability (Eisenhardt & Graebner, 2007).

In total, ten interviews were conducted face to face and using video calls. Video calls were used because of geographical distances. Each interviewee had to consent to participate in the research formally and had to approve selected extracts from their interview to ensure reliability. During the interviews, the interviewee was asked to describe its position and provide a brief overview of its responsibilities. The rest of the interview was semi-structured, as it allowed for follow-up questions and detailed explanations of context-sensitive phenomena. At the end of each interview, each candidate was provided with an opportunity to add additional information and complement the provided answers. The interview guide was adapted to fit the emerging and advanced economies IoT situation. A general overview of the topics covered in the interviews is provided in Appendix A.1.

The secondary literature was collected preceding, during and succeeding the interviews, following Eisenhardt's (1989) iterative approach of comparing primary interview findings to theoretical concepts. The data can be divided into four categories: academic literature, books, whitepapers and industry reports, and other literature. Table 1 presents the full data sample. The various secondary sources are critically selected to either supplement interview findings, describe theoretical concepts or serve as a counterexample to the findings.

Table 1: Description of the data sample

	Data Source	Description of Source
Primary Data	Interviews	10 interviews with different telecom operators, whereas 6 were from advanced economies, and 4 in emerging economies. All interviewees were managers with extensive experience from IoT, partnerships and business ecosystems.
Secondary Data	Academic articles	78 articles from academic journals to support theory on business ecosystems, business models and open innovation.
	Books	15 books covering open innovation, servitisation, business ecosystems and business models.
	White papers and reports	25 white papers and industry reports from leading management consulting firms: BCG, Deloitte, BearingPoint, Cambridge Consultants, Innosight, Arthur D. Little and Tata Consultancy, and industry reports exploring entrepreneurship, IoT and local conditions.
	Other literature	7 conference proceedings.

3.2 Data analysis

A three-step coding strategy was pursued to analyse the interview data. Categorising the data using codes is a method to find meaning, structure and compare data (Basit, 2003). As the interview questions were designed for each market, the coding had to cover various local concepts and topics. During pre-coding, each transcript was read in-depth and compared to provide an overview of the topics that all interviewees covered. The first step of the analysis was open coding, looking at each question as a whole and marking essential phrases. The second step was to group the phrases into categories. The categories were deducted from literature, industry reports and white papers. The grouped categories were then rewritten in the authors' own words. The rewritten categories and follow up questions were then sent back to the interviewees for confirmation, changes and additional information. The interviewee approval was done to increase the validity and reliability of the analysis, and make sure that no findings were misinterpreted. The last step was to compare and synthesise the categories into overall concepts for describing the findings. The overall concepts revealed the concepts of creating and capturing value and consequently steered the formulation of the two research questions.

Figure 1 displays the coding categories and overall concepts for the first research question regarding value creation. The focus has been to understand the categories, their connections, and the nuanced variations amid the concepts. Figure 3 in Appendix A.3 illustrates the categories and concepts related to research question two and provides selected extracts of the first step of open coding.

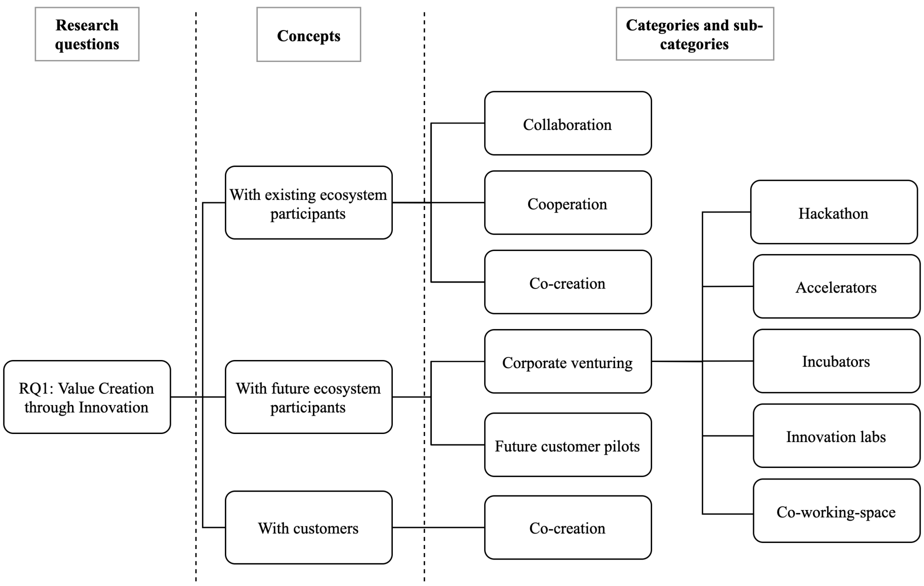

Figure 1: Categories and concepts related to research question one

The last step of theory building is to synthesise meaning and develop theoretical insights from the analysed interviews and collected literature (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). The theoretical conclusions were drafted by comparing, examining and synthesising different data sources. The findings in emerging markets and advanced economies were investigated using cross-case analysis. During this process, the research questions were finalised. The questions were derived directly from the higher categories: creating value through innovation and capturing value through business operations to describe the IoT business ecosystem.

4 Findings

This study found three different IoT ecosystem types with unique value-creating and value capturing methods. Table 2 displays each of the IoT ecosystem types in detail. The table provides a general overview of the value creation and value capture activities and provides a network view over the telecom operators position in the business ecosystem with regards to the IoT architecture layers.

Furthermore, the table shows how the telecom operator contributes to partners and offers to customers. In some cases, the differences between partners and customers are blurred, because some operators call their customers partners and vice versa. To avoid this confusion, customers are solely referring to buyers of IoT connection or platform for advanced economies, e.g. OEMs, and buyers of the full IoT solution, e.g. OEMs customers, for emerging economies. For the full table differentiating the various telecom operators see Appendix A.2.

For all types of IoT business ecosystems, value creation is related to collaboration and co-creation between actors in the ecosystem. Value capture is related to the various revenue-sharing strategies utilised. There is a clear distinction between the emerging economies and the advanced economies ecosystem strategies with regards to positioning. The emerging economies are more concerned about owning the end-customer relationship and developing bundled vertical E2E solutions that target specific industry use cases. The advanced economies are approaching IoT differently by providing network connection and value-adding platform services, which enables the industry customer to sell its bundled products as usual. All the three types of ecosystems consider the industrial market most attractive and profitable for IoT services. Hence, customers from hereon will be referred to business customers if not specified.

4.1 Type 1

The first type of IoT business ecosystem pursues an E2E strategy and outsources the IoT platform to a technology partner. Value creation activities, as presented in Table 2, are collaboration and co-creation with partners and customers. The telecom operator employs a cherry-picking strategy to find new ecosystem participants. Most often, new ideas for IoT use cases come from internal analyses. Thus cherry-picking actors have higher utility than pursuing explorative corporate venturing activities. In order to create value, it is crucial to collaborate and innovate with partners to solve technical issues and create a bundled IoT offering.

The telecom operator has positioned itself at the network level and service provider level to capture the created value. Thus, the telecom operator focuses on network connection expertise, utilising its sales arm, market knowledge, customer engagement and branding. To make it attractive for partners to be a part of the product offering, the telecom operator follows a revenue-share model. In the partner-oriented strategy, the telecom operator prefers local partners offering reliable, on the ground support as the main differentiator. The goal of the IoT activities is to offer the customers value-adding services and grow the ecosystem to capture higher profits associated with IoT services.

4.2 Type 2

For the second type of IoT business ecosystem, the telecom operator is pursuing an E2E strategy and operates an IoT platform internally. Value creation activities are mainly related to collaboration and co-creation with partners and customers, and certain explorative corporate venturing activities related to accelerators and hackathons with startups. Learnings from previous innovation activities state that spending time developing partners is a prerequisite for successful innovation. Equity-based models are often used when collaborating with startups. The ideas for new use cases come from internal market analyses, and the partners are selected based on their offering and ability to collaborate. Sometimes the process is reversed, and the partner approaches with a use case. Nevertheless, the use case has to be internally validated to be deemed profitable.

To capture value, the telecom operator has positioned itself at network, platform and service level.

Thus, the telecom operator pursues a technology-oriented and customer-oriented position. The position makes it vital to focus on connectivity and platform expertise, sales, marketing, scale-up capabilities for developing partners and also facilitate the ecosystem and integration of technology. To motivate and provide an incentive for being an IoT ecosystem partner and sell more IoT devices, the telecom operator pursues various revenue share models. Furthermore, the platform makes it possible to capture aggregated data and utilise it in the future. The main goal is to use the platform, IoT capabilities, and connection expertise to become an ecosystem facilitator. In order to do such a change, the telecom operator focuses on the customer and develops value-adding services to help make IoT more attractive.

Table 2: Description of findings

			Type 1	**Type 2**	**Type 3**
Create value	**With existing partners**		Collaboration Co-creation	Collaboration Co-creation	Collaboration Co-creation
	With future partners		Selective targeting Labs	Selective targeting Corporate venturing activities	Selective targeting Corporate venturing activities
	With customers		Co-creation	Co-creation	Co-creation Toolkit
	Preferred type of partners		Local presence	Local presence SMEs	Regional presence SMEs and enterprises
Capture value	**Positioning in the value network**	**System integrator**		SI partner	SI partner
		Service provider	Ser.partner + Tel.operator	Ser.partner + Tel.operator	Ser.partner
		Application provider	App.partner	App.partner	App.partner
		IoT platform	App. partner	Tel.operator	Tel.operator
		Network provider	Tel.operator	Tel.operator	Tel.operator
		Hardware vendor	Supplier to partner	Device partner	Device partner
	Contribution to partner collaboration and customer co-creation		Partners: connection, market knowledge, branding, customer engagement and sales arm Customers: connectivity, access to the partner network, customisation	Partners: connection and platform, co-developing pilots, market knowledge, sales arm, scale capabilities, branding Customers: connectivity and platform, access to the partner network, customisation	Partners: connection and platform, access to partner network, brand Customers: connectivity and platform, access to the partner network (if needed), customisation, toolkit for pilots
	Revenue model		Revenue-sharing	Revenue-sharing	Contract and sub-contract
	Business ecosystem strategy		Value-adding services, Grow the ecosystem, Make customer see the utility of IoT, Business model innovation, Full E2E end-customer relationship	Ecosystem facilitator, Service-oriented, Value-adding services, Expert in SIM sales and IoT solutions, Full E2E end-customer relationship	Ecosystem facilitator, Service-oriented, Value-adding services, Data analytics and platform services, End-customer relationship with regards to platform services

4.3 Type 3

For the third type of IoT business ecosystem, the telecom operator is focusing on core connectivity combined with selling value-adding IoT services connected to the IoT platform. Instead of co-developing the IoT service together with partners and selling it as a bundled solution, the customer sells the bundled solution, and the telecom operator provides components of the solution. Thus, collaboration with partners is more about integrating solutions, developing pilots, and setting the partner in contact with other actors. Growing the IoT ecosystem is about creating partners, but also developing new customers. Therefore, the telecom operator collaborates with universities, students and startups to grow the future ecosystem. It usually does not pursue equity models with startups, but can help them integrate connectivity in their solution. The main concern about working closely with startups is the different working cultures, time frames and agility. Therefore, the operator developed a unique toolkit to incentivise existing customers of network connection, startups, students, and others to get started with IoT.

To capture value, the telecom operator has created a partnership model where customers have access to an extensive partner network both at hardware and software level, in addition to its connection, security and technology expertise. The telecom operator is positioned in the lower middle end of the value chain, providing connectivity and IoT platform services. The positions allow for different partner constellations depending on the use case. In most cases, the telecom operator functions as the primary collaboration partner for customers. In other cases, the system integrator sells its IoT offering and acts as primary contact with the customer. The telecom operator follows traditional contracts and not a revenue-share model per se. The network effects of joining the IoT platform ecosystem is, therefore, more related to branding, access to technology and connectivity expertise and that the more partners and customers, the better the platform solution will become. The overall IoT strategy is to be an ecosystem facilitator, providing value-adding services to its customers while orchestrating all ecosystem participants.

5 Discussion

The findings revealed three distinct IoT business ecosystem types deducted from the six telecom operators positioning strategies. Figure 2 displays the three types of IoT business ecosystems differentiated on the telecom operator's strategic position. The IoT business ecosystems of the first and second type, i.e. emerging economies, are of stark contrast to the third type, advanced economies. The main contrast lies in owning the full end-customer relationship by offering bundled E2E IoT solutions. This discussion compares the emerging and advanced economies types of IoT ecosystems by reviewing their value creation and capture strategies, and by comparing the findings to the secondary literature.

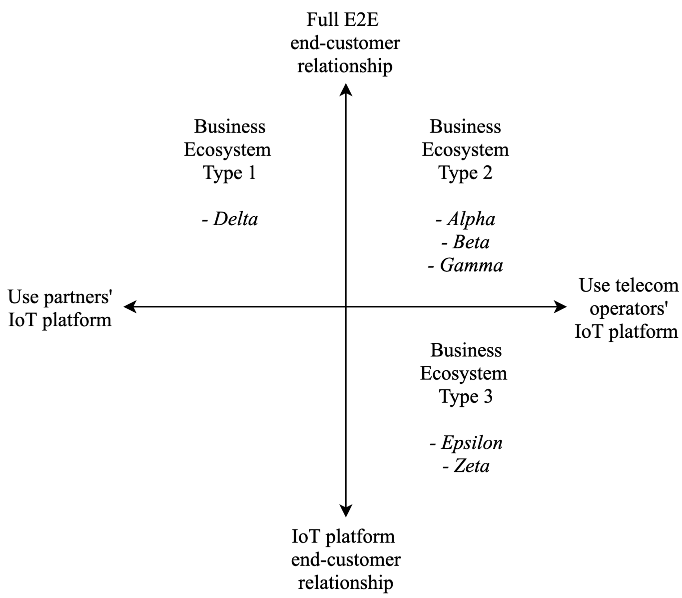

Figure 2: Three types of IoT business ecosystems (author's own)

5.1 Creating value

In all the ecosystem strategies, it is essential to collaborate with ecosystem partners to spur innovation. All pursued an open innovation approach (Chesbrough & Bogers, 2014; Chesbrough, 2011; Vanhaverbeke, 2017) with enterprises, SMEs, startups and customers. The emerging economies emphasise that collaborating with SMEs is favourable because they can manage lower cost levels, are technology specialised and have a faster innovation cycle than larger firms. The benefits are directly in line with the secondary literature findings (Chesbrough, 2010; Vanhaverbeke, 2017). The advanced economies also find collaborating with SMEs attractive, as they have specialised niche products that can be advantageous to complement business analytics, applications and other service-level features. Collaborating with enterprises for both emerging and advanced economies is favourable in the cases where the telecom operator relies on a strong brand with access to diverse capabilities and resources (Kwan et al., 2020). Thus, the rationale for collaborating with partners is essentially alike. The difference is the prerequisites of collaboration. In advanced economies, firms can take for granted that collaboration partners can deliver, are up-to-date on technology and security, and have their supply chains in order. For the emerging markets, it is vital to spend time developing and investing in collaboration partners. These findings are in line with Christensen et al. (2019) Chesbrough's (2011) research. Furthermore, the difference in digital maturity might also be a factor for needing to develop its partners.

The difference of having to invest in its partners discover a fundamental distinction between emerging and advanced economies IoT business ecosystems. IIoT today is in its nascent phase, especially in the emerging economies, which might explain the need to accelerate partners' investment towards smart solutions. Binkhuysen (2020) states that two-thirds of corporate executives (CXOs) have no formal strategy to IIoT. Thus, there are opportunities to take leadership in IIoT, both for emerging and advanced economies. Spending time developing and educating partners and customers can, therefore, pay off in the future. Because partners are interdependent in the IoT ecosystem (Adner & Kapoor, 2010; Ahokangas et al., 2018), the telecom operator can leverage their trust, technology competence and brand (BearingPoint//Beyond, 2020; GSMA, 2019) to position strategically in an intermediary ecosystem facilitator role (Ikävalko et al., 2018).

On the other hand, it is a balance of involvement and return of investment (Binkhuysen, 2020; Mogg et al., 2017). The advanced economies have more partners and customers doing similar services in their IoT ecosystems. Therefore, they can specialise in connectivity expertise and enhancing their customer offerings. For the emerging economies, because value capture is still in its early days, the focus on value creation through collaboration and co-creation resembles an innovation ecosystem. For the advanced economies, with more mature business models, the IoT ecosystem matches more a business ecosystem.

A second difference is how telecom operators collaborate with startups. The difference is directly related to developing its partners, namely, the use of equity-based models. The emerging markets second type of IoT ecosystem sometimes uses equity-based models with startups and small companies. It represents a way to develop partners by providing them with necessary resources, or tap into new areas of the value chain (Peter, Back, & Werro, 2019; Vanhaverbeke, 2017; Weiblen & Chesbrough, 2015; Yun, 2017). The Asian ecosystems, such as Alibaba, Tencent and Baidu, are known for having aggressive horizontal investment strategies to expand and grow its ecosystem and create new revenue streams (Greeven & Wei, 2017). Whereas western ecosystems like Google, Amazon, Facebook and Apple (GAFAs) more often use vertical investments or joint collaboration arrangements as an innovation and expansion strategy (Miguel & Casado, 2016). In the emerging market case, the investments are related to developing its partners (Christensen et al., 2019). None of the business ecosystems leverages M&A systematically as an innovation and expansion strategy for IoT. Therefore, it could be argued an untapped opportunity for growing fast and innovating efficaciously. However, from the perspective of the advanced economies, successful joint value creation of startup-corporate collaboration does not necessarily need to be equity-based. Arthur D. Little (2018) stresses that telecom operators should reinvent how to collaborate with startups. The benefits of collaborating with startups such as agility, speed and entrepreneurial thinking (Awais et al., 2019; Gobble, 2018; Rocha et al., 2019; Vanhaverbeke, 2017; Yun, 2017) can help develop a culture of innovation and be equally desirable (Arthur D. Little, 2018).

The three strategies pursue similar explorative innovation activities to find and attract new partners and customers. The more nuanced differences are present when looking at the underlying purpose. For example, both emerging and advanced economies use corporate venturing activities such as accelerators, hackathons and innovation labs. However, the motivation of the particular activities in the emerging markets is more related to developing and growing the ecosystem, solving selected use cases and social responsibility initiatives. Corporate social responsibility (Porter & Kramer, 2006) initiatives build on the idea that the corporates' success will increase with the improvement of the society, or in this case, the ecosystem (Murphy, 2010). For advanced economies, the motivation for corporate venturing activities is to stay up-to-date on technology, spur interest around entrepreneurship and the operator and research on cutting edge technologies. The corporate venturing initiatives can serve both the objectives of emerging and advanced economies (Gutmann, 2019; Mocker et al., 2018; Weiblen & Chesbrough, 2015). The telecom operator has a wide range of tools to accelerate startup growth and is positioned optimally to create value across verticals (Gutmann, Kanbach, & Seltman, 2019). The startups possess the innovation capabilities that telecom operators need (Gutmann et al., 2019).

Despite the differences, the three types of telecom operators will only take startups as partners once they have a commercially viable product, a proof of concept. The literature says collaborating with startups is crucial for long-term competitiveness and innovation in the ecosystem (Arthur D. Little, 2018; Awais et al., 2019; Peter, Werro, & Back, 2019; Viguerie et al., 2017). Thus the two approaches for explorative innovation are different, but in theory equally advantageous, because the emerging markets are focusing on grooming startups and search for partners to solve use cases, and the advanced markets are researching IoT technology. Contradicting this argument is the importance of rethinking how to collaborate with startups. There are internal operational benefits that come with collaborating closely with startups, namely: leaner and more agile processes (Arthur D. Little, 2018), which is directly related to adaptiveness to environmental changes (March, 1991). Furthermore, by collaborating closer, Kirsner (2017) argues that the most critical phase of corporate venturing activities is the transition of the idea to the organisation, and that requires tight collaboration processes. The telecom operators could leverage from startups filling complementing niche roles in the IoT innovation ecosystem, for developing value-added solutions to the operators' customers.

Collaborating with customers is deemed equally necessary across all IoT ecosystem types. As Chesbrough (2011) argues, for service-oriented businesses, it is vital to know the customer to create value-adding services. Still, how the firms collaborate with customers differ. Telecom operators of the third type approach business customers for connecting their offering, whereas operators of the first and second type offer a bundled IoT solution to businesses and consumers. In this case, the advanced economies have a more structured model of how to collaborate with customers. For example, Zeta has a differentiating customer model. For various customers, it can innovate and integrate connectivity, the IoT platform, and work together to optimise the customers' product. Furthermore, it has innovated customer co-creation by utilising an IoT toolbox that requires minimal contact between the customer and the telecom operator. Customer co-creation is, therefore, a result of feedback from the toolbox and use-case specific innovations. The feedback represents innovations applicable to all verticals in the IoT ecosystem, and the customer-specific co-creation represent innovations tailored for selected verticals (Ahokangas et al., 2018). In the emerging markets, the customer co-creation is likewise built on feedback from the IoT solution, and from ameliorating the solution according to the customer's specifications and needs. Except, the co-creation is around the bundled E2E IoT solution in addition to the platform and connectivity.

To summarise, there are variations between the IoT ecosystems' value creation strategies. The differences are mainly related to how emerging economies invest in their partners and spend time developing necessary capabilities. The advanced economies' collaboration activities are more about optimising solutions and delivering connectivity and the IoT platform. The optimal value-creating strategy is to be able to reach operational targets and at the same time, be reactive to changes (Raisch & Birkinshaw, 2008). The first and second type of IoT ecosystems have explorative corporate venturing activities and exploitative activities with ecosystem partners and customers. The third IoT ecosystem type has explorative activities with innovation labs and VC funds, and exploitative activities with partners and customers. For all telecom operators, they pursue a collaborative innovation cycle that is quintessentially a description of outside-in open innovation in SMEs (Vanhaverbeke, 2017). First, the telecom operator spots a business opportunity, and then it attracts necessary partners either vertically or horizontally, to develop the business solution. For open innovation to flourish in the three types of business ecosystems, the telecom operators are due to enhance its absorptive capacities of innovations beyond ecosystem boundaries (Teece, 2017).

5.2 *Capturing Value*

Comparing the networks in the IoT ecosystems, the first striking difference is the network of actors and the respective value flows. The first type of IoT ecosystem has different partners in all levels of the value network and locates itself at the connectivity and the service level. The second type of IoT ecosystem has different partners at IoT hardware, application and service level and positions at the network, platform and service layer. The third type of IoT ecosystem has various partners in all layers and positions at the connectivity and platform layer. The partners are often SMEs, but might also be startups and larger enterprises. The partners fill the role of niche complementors (Iansiti & Levien, 2004). The three various network structures describe a vertical tailored solution orientation, with and without an IoT platform offering, and a horizontal technology offering (Ghanbari et al., 2017; Mogg et al., 2017; Nakayama et al., 2020). The emerging economies pursue the vertical structures, and the advanced economies pursue the horizontal structure. All provide opportunities to create value-adding services to the customer, which is at the forefront of capturing value (BearingPoint//Beyond, 2020; Mogg et al., 2017; Viguerie et al., 2017).

The three distinct ecosystem structures raise the question of which role the telecom operator wants to pursue in the IoT business ecosystem. Karapantelakis and Markendahl's (2017) study presented telecom operators in a supporting role as connectivity providers. It was the ICT actors who owned the end-customer relationship (Karapantelakis & Markendahl, 2017). Instead of letting other players dominate the upstream services, the telecom operators in both emerging and advanced economies have used the added value strategy (Brandenburger & Nalebuff, 1995) and increased its added-value in the network. Both the emerging and advanced economies want to be an ecosystem facilitator. Here the ecosystem facilitator refers to Moore's (1993, 1996) ecosystem leader, Iansiti and Levien's (2004) keystone actor, and Cusumano's (2002) platform leader. However, according to Papert and Pflaum's (2017) research, the keystone actor in an IoT ecosystem is the solution integrator, namely the firm bundling all the required services of hardware, network, applications in a full E2E IoT solution.

An example of solution integrators is an OEM (Papert & Pflaum, 2017). The telecom operators in the emerging markets do take the integrator role and are, therefore, their ecosystem's respective solution integrator. The advanced economies telecom operators have an instrumental role in the ecosystem as a platform owner but do not have the same role as the emerging economies telecom operators. That is, they are platform owners, but their customers will most likely hold the solution integrator role. For example, when the customer already has a platform and only needs application programming interfaces (APIs) to integrate the platform functionality, the telecom operator will only become a supplier of connection and device management. Still, changing the perspective of the IoT ecosystem, the platform operator has a central role as keystone actor (Dedehayir, Mäkinen, & Roland Ortt, 2018). That is, the platform is what connect the sensors, OEMs, application and service providers. Arguably there exist various perspectives of what an ecosystem keystone actor is and why it is a favourable position. Still, being the ecosystem facilitator does not implicate success and competitive advantage. Because possessing a leadership role connects the telecom operator to its most important customers, it can be challenging to address disruptors in the market (Christensen & Raynor, 2013; Gawer & Cusumano, 2014).

The second difference is the business model innovation from a traditional telecom operator to IoT operator. The changes are related to adding new content (the platform and IoT services), structure (network and interconnections) and governance (actors' contribution) (Amit & Zott, 2012). For operators of type one, the innovation lies in the structure and content. Instead of offering connectivity directly to the customers, it bundles connectivity in the IoT solution. The bundled solution is made possible by new actors in the ecosystem. Likewise, operators of type two rely on new partners and offer new content. Operators of type three's innovation are the content, as it offers the IoT platform in addition to connectivity. For all operators, new content is present in the form of value-adding services like security, analytics, cloud storage and management of IoT devices.

The governance of each telecom operators' contribution to the value proposition differs across the IoT ecosystem types. In the vertical E2E business ecosystem strategies, the telecom operator offers its partners customer engagement, sales arm and market knowledge. The platform owner also offers additional platform expertise and market insights to develop the business case. The partners contribute with their field of expertise, after-sales services, maintenance, development of analytics and other supporting services. As opposed to the vertical strategies of the emerging economies, the advanced economies contribute solemnly on connectivity and platform expertise. The operators' partners contribute by integrating their solutions to create the customers E2E bundled service. All of the ecosystem's partners contribute by branding, and access to the partner network to both customers and partners. The business model innovations reveal a more radical business model change of operators in type one and two, compared to three.

The third difference is the revenue models. Telecom operators of the first and second type include ecosystem partners in their revenue streams and thus pursue a revenue-sharing strategy. Telecom operators of type three, on the other hand, use traditional contracts and do not share revenue. The revenue-sharing strategies of one and two provide an incentive for all partners to join the ecosystem and is typical for IoT business ecosystems (Weking et al., 2020). The emerging markets IoT ecosystem provides a foundation for maximising value creation in the network by using a revenue share strategy (Vanhaverbeke, 2017). Furthermore, it incentivises collaboration and incremental innovation to optimise the IoT solution and produce novel services to sell more devices and capture more profits. Telecom operators in the third IoT ecosystem can incentivise complementors to develop valuable applications for the IoT platform. However, the incentives will be more related to potential market access, branding and access to expertise instead of shared revenue.

In addition to the revenue model, IoT platforms produce new revenue streams by offering value-adding services (Leminen et al., 2018; Weking et al., 2020). Telecom operators of type one stand out as they do not operate a platform internally but rely on an external technology partner. However, operators of type two and three offer an IoT platform in addition to connectivity. The IoT platform creates enormous opportunities to monetise from the analysed data captured from the devices (BearingPoint, 2020; Porter & Heppelmann, 2014; Ramakrishnan & Selvarajan, 2017; Russo & Albert, 2018). Furthermore, an IoT platform can simplify business operations, launch services faster and enhance customer services (Ramakrishnan & Selvarajan, 2017). The IoT platform is, therefore, beneficial for increasing value capturing.

The captured value from the IoT business ecosystem also includes the intangible value (Lee, 2019; Leminen et al., 2018; Smedlund et al., 2018; Westerlund et al., 2014). The benefits of collaboration and co-creation with enterprises, SMEs, startups and customers result in faster innovation cycles, shared risk and costs (Pearce, 2018), technology insights, knowledge sharing (Chesbrough, 2011), and market insights (Chesbrough, 2010; Vanhaverbeke, 2017). Furthermore, the platform offers network effects for both suppliers and customers (Hein, Weking, et al., 2019; Iivari et al., 2016; Schreieck, Hakes, Wiesche, & Krcmar, 2017; Smedlund et al., 2018). For example, it is beneficial for a sensor manufacturer to integrate their sensors with the IoT platform and reach new customers, because the customers get new sensors to choose from, which can attract more users (Hein, Weking, et al., 2019). The network effects will increase by the openness of the platform (Parker et al., 2017). The openness is where we find the emerging and advanced economies' strategies differing. The advanced economies have a more open platform compared to the emerging economies' ecosystems. For the emerging ecosystems, there are still too few IoT actors to make it beneficial to open the platform. Alpha of type two is, for example, more concerned with being able to integrate the platform with other platforms so it can leverage multi-sided platform support.

Summarising the value capture differences, the three IoT ecosystem strategies all embrace servitisation through open innovation and business model innovation with new revenue streams. They are all relying on collaboration and attracting partners with different fields of expertise to develop innovative IoT services. The emerging markets first type of IoT ecosystem pursues a strategy where it wants to focus on value-adding services and to grow the ecosystem. In order to do so, it has to focus on making the customer understand the utility of IoT. The emerging markets type two IoT ecosystem pursues a similar strategy of service-orientation and creating value-adding services for customers. Both one and two deem it imperative to own the end-customer relationship and therefore pursue the natural ecosystem leader role (Papert & Pflaum, 2017). The dominant focus of value creation and collaboration reflects an innovation ecosystem's objectives, in comparison to the advanced markets value capture focus of a business ecosystem. The advanced markets' type three IoT ecosystem also sees the advantages of becoming an ecosystem facilitator. It pursues a different strategy focused on its core competencies of connectivity and platform technology. It is likewise service-oriented and offers the platform and value-adding services. The last apparent difference between the emerging and advanced economies is the revenue models and the openness of the IoT platform.

6 Conclusion

In this article, emerging and advanced economies IoT business ecosystems value creation through innovation and value capture through business operations have been presented. The emerging economies pursue the full E2E vertical solution provider strategy, which can suit the Asian market well, according to BearingPoint//Beyond (2020). The E2E IoT service provider role makes it possible to influence industry standards and make themselves invaluable for the other ecosystem players. Furthermore, as most OEMs have not started to utilise IoT solutions (Binkhuysen, 2020), and have yet to see the potential of what IIoT can do for them, new opportunities arise for telecom players. The advanced economies follow Mogg et al.'s (2017) strategy of owning the end-customer relationship with regards to the platform customers. In the advanced markets, the IIoT market is different. Specialised tacit industry knowledge is needed to serve complex industrial customers. However, if the telecom operator desires a full E2E position, operators can look to emerging economies and their ecosystems for inspiration.

The article contributes to the literature by defining three distinct IoT business ecosystems and telecom operators strategic position. This study provides insight into a limited research field of emerging economies, collaborative relationships, and dynamics inside IoT business ecosystems. The research provides valuable knowledge of telecom operators' role in the IoT ecosystem and raises new questions of which role will prove the most successful.

For managers and scholars, the study provides detailed insights into how IoT changes telecom operators' business models and creates new business opportunities. For multinationals, it can be relevant to examine the contrasting approaches in emerging and advanced economies and identify transferable strategies.

6.1 Limitations and further research

The limitations of the case-study are related to interview bias, generalisability and the validity of the findings. Throughout the process, the author has tried to reduce interview bias by providing the interviewees with a rewritten sample of the interview, which they were free to comment and modify. It is a discussion of whether the sample is generalisable for other advanced and emerging economies. In order to validate the sample, each of the operators was selected based on its presence in diverse countries with unique local macroeconomic conditions. The last constraint is related to IoT technology. IoT is still in its emerging phase, and thus ecosystem strategies may evolve as a consequence of the maturing technology. However, the author emphasises that these findings apply to initial ecosystem strategies. Despite the presented limitations, the article has explored uninvestigated emerging markets IoT business ecosystems, which contributes to the IoT research. Furthermore, the article presents an original comparison between emerging and advanced economies IoT business ecosystems.

Therefore, future research could conduct a longitudinal study of the business ecosystem strategies and see how the IoT business ecosystems perform and mature. Furthermore, a study of the ecosystem partners and customers, what ecosystem model they prefer and how the revenue sharing strategies work in the long-run would be appealing to examine. The telecom operator sample could further be expanded to various regions, and include mobile virtual network operators and technology companies providing IoT services. The last research area that should be further examined is the benefits of customer participation and which co-creation forms are most successful regarding IoT technology.

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A Appendices

A.1 Interview Guide

1 About the research project

- Information about the research project
- Ensure anonymisation and formal consent

2 About the respondent

- Describe position and role

3 The IoT business ecosystem

- IoT use cases (B2B and B2C use cases)
  - Collaboration activities
  - Type of partners (Enterprises, SMEs, startups)
  - Attracting and selecting partners
  - Ecosystem value network
  - Actors contribution
  - Revenue model
  - Customers involvement
- Long-term strategic goal
  - Connectivity provider
  - IoT Investments
  - Service-orientation to become an E2E service provider
  - Connectivity and value-adding services (i.e. platform as a service)
- Ecosystem position – the role of the telecom operator:
  - Ecosystem facilitator/orchestrator
  - Complementing supportive role in the IoT business ecosystem
  - Passive supplier of services
- Competitive landscape
  - Ecosystem competitors
  - Other telecom operators in the market
  - New competitors to telecom operators
- Hurdles for IoT ecosystem to succeed

4 The IoT platform

- Network effects
- Data analytics
  - The openness of the platform
  - The sharing of data
- Customer benefits of joining the platform

- Customisation of platform services

5 IoT ecosystem: open innovation

- Partnerships and co-creation impact for innovation
    - Preference of partners
    - Role of parties and contribution (co-development)
    - Innovation idea from inside or outside the firm
- How to create the desired ecosystem
    - Attract and retain partners
    - Startups and Corporate venturing
    - M&A
- Long term vs short term results
    - Balance of innovation investments and dividend/short-term profits
    - Balance of incremental, exploitative innovation versus radical, explorative innovation activities
- Type of innovation use cases
- Innovation intermediary

6 Collaboration with startups

- Startup-corporate collaboration
    - Strategic or financially motivated
- Collaboration activities
    - Corporate venturing
        - Selection of startups
        - Financial prerequisites or POC
    - M&A
    - Supplier, procurement
- Business model and absorption of new revenue streams

7 Wrapping up

- Opportunity to add or modify information

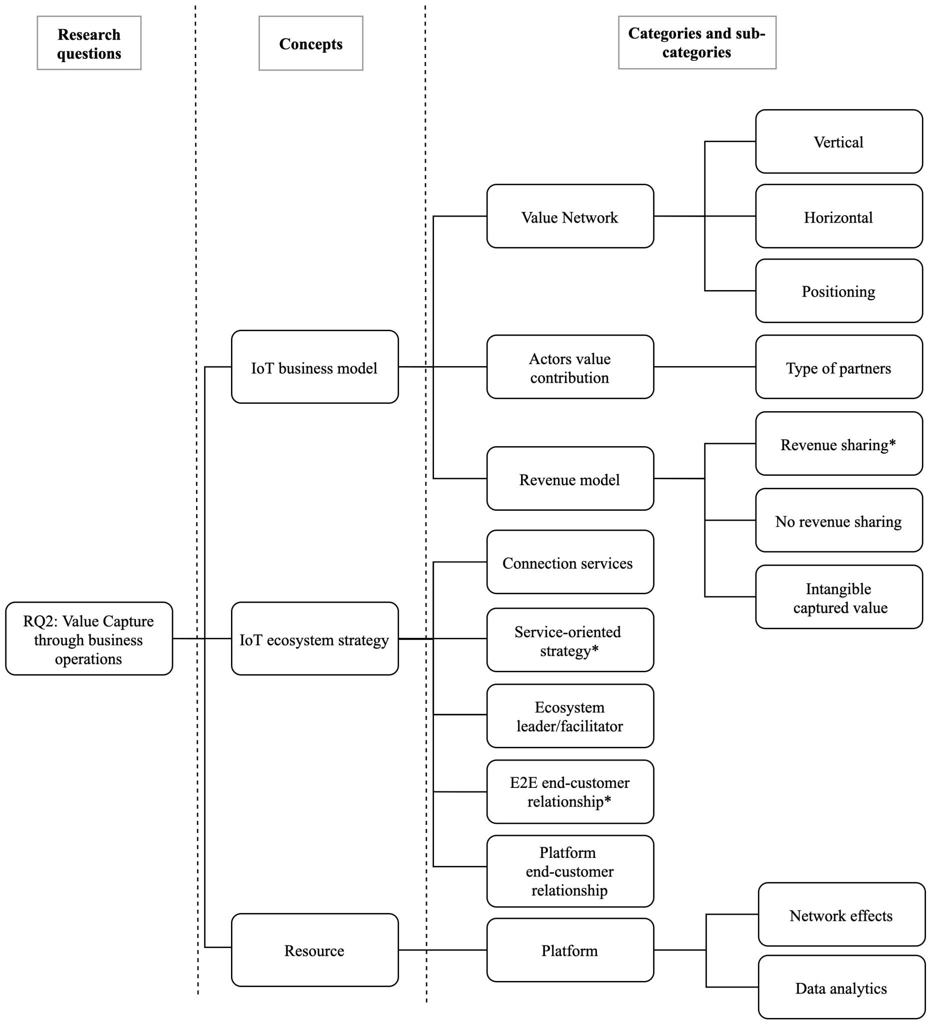
A.2 Detailed Description of Findings

Table 3: Findings from the six telecom operators

			Alpha *Type 2*	**Beta** *Type 2*	**Gamma** *Type 2*	**Delta** *Type 1*	**Epsilon** *Type 3*	**Zeta** *Type 3*
Create value	**With existing partners**		Collaboration, Co-creation	Collaboration, Co-creation	Collaboration, Co-creation	Collaboration, Co-creation	Collaboration, Co-creation	Collaboration, Co-creation
	With future partners		Accelerator Hackathon	Accelerator Hackathon	Selective targeting	Selective targeting Labs	Co-working space Labs Hackathon VC fund	Selective targeting Labs
	With customers		Co-creation, Toolkit	Co-creation	Co-creation	Co-creation	Co-creation, Toolkit	Co-creation
	Preferred type of partners		Local presence, SMEs	Local presence, SMEs	SMEs and Large enterprises	Local presence, SMEs and Large enterprises	SMEs and Large enterprises	Regional presence, SMEs and Large enterprises
Capture value	**Positioning in the value network**	**System integrator**			SI partner		SI partner	SI partner
		Service provider	Ser.partner + Alpha	Ser.partner + Beta	Ser.partner + Gamma	Ser.partner+ Delta	Ser.partner	Ser.partner
		Application provider	App.partner + Alpha	App.partner	App.partner	App.partner	App.partner	App.partner
		IoT platform	Alpha	Beta	Gamma	App.partner	Epsilon	Zeta
		Network	Alpha	Beta	Gamma	Delta	Epsilon	Zeta
		Hardware vendor	Supplier to partner	Device Partner	Device Partner	Supplier to partner	Device Partner	Device Partner
	Contribution to partner collaboration and customer co-creation		Startup partners/ customers: lead, after-sale services, brand, marketing, billing, connectivity expertise	Partners: connectivity and platform expertise, access to the partner network, customer reach, scaling capabilities, sales channels and brand	Partners: connection expertise and platform, co-developing pilots for each use case, scale-up capabilities	Partners: connection expertise, market knowledge, branding, customer engagement and sales arm	Partners: connectivity and platform technology expertise, access to the customer network, brand, marketing	Partners: connectivity and platform technology expertise, access to the customer network, brand

		Alpha *Type 2*	**Beta** *Type 2*	**Gamma** *Type 2*	**Delta** *Type 1*	**Epsilon** *Type 3*	**Zeta** *Type 3*
	Contribution to partner collaboration and customer co-creation	Larger partners/ customers: developing the business case, pricing, brand, product proposal, go-to-market plan	Customers: connectivity and platform, technology expertise, value-adding services, customisable solutions, access to the partner network	Customers: connectivity and platform, technology expertise, access to partner network, customisation	Customers: connectivity expertise, access to partner network, customisation	Customers: connectivity and platform, technology expertise, access to the partner network (if needed)	Customers: connectivity and or platform, technology expertise, access to partner network (if needed), strategising and pre-developing solutions
Capture value	**Revenue model**	Revenue sharing	Revenue sharing and contract	Revenue sharing	Revenue sharing	Contract	Contract and sub-contract
	Business ecosystem strategy	Ecosystem facilitator Service-oriented Value-adding services Expert in SIM sales and IoT services End-customer relationship	Ecosystem facilitator Service-oriented Value-adding services Expert in SIM sales and IoT services End-customer relationship	Ecosystem facilitator Grow the ecosystem Value-adding services Build awareness for businesses and community End-customer relationship	Value-adding services Grow the ecosystem Make the customer see the utility of IoT Business model innovation End-customer relationship	Ecosystem facilitator Service-oriented Value-adding services Become a community IoT platform services	Ecosystem facilitator Service-oriented Value-adding services Data analytics IoT platform services

A.3 Coding: Categories and Concepts



First-order coding of selected categories:

Revenue sharing:
The revenue-sharing model is divided into three parts: Non-recurrent costs, recurrent costs and change requests.

Service-oriented strategy:
The future strategy is to use the collaboration model to sell value-adding services with partners, in addition to regular SIM sales.

E2E end-customer relationship:
Wants to provide end-to-end solutions, i.e. take hold of the end-customer relationship.

Figure 3: Categories, concepts and selected first-order coding excerpts related to research question two

6. Conclusion

6.1 Differences between Emerging and Advanced Economies

The findings revealed three different IoT business ecosystems for telecom operators in emerging and advanced economies. Emerging economies pursue the full E2E vertical solution-provider strategy, and the advanced economies pursue the end-customer relationship with regards to IoT platform customers. The E2E IIoT service provider role is favourable in an emerging market, as the telecom operators are in a position to influence industry standards and make themselves invaluable for the other ecosystem players. Furthermore, as most OEMs have not started to utilise IoT solutions (Binkhuysen, 2020), and have yet to see the potential of what IIoT can do for them, new opportunities arise for telecom players. In the advanced economies, the situation is different. The telecom operators have taken the role as technology experts of connection and platform services. The more complex IIoT ecosystems, the more specialised tacit knowledge is needed, which makes it more challenging to be a full E2E IIoT service provider.

The value creation through open innovation differences are mainly related to how emerging economies invest in their existing partners and spend time developing necessary capabilities. The advanced economies' collaboration activities are more about optimising solutions, delivering connectivity and the IoT platform. The optimal value-creating strategy is to be able to reach operational targets and at the same time, be reactive to changes (Raisch & Birkinshaw, 2008). Type one and two IoT ecosystems have explorative corporate venturing activities and exploitative co-creation activities with ecosystem partners and future customers. The third IoT ecosystem type has explorative activities with innovation labs and VC funds, and exploitative co-creation activities with partners and customers. For all telecom operators, they pursue a collaborative innovation cycle that is quintessentially a description of outside-in open innovation in SMEs (Vanhaverbeke, 2017). First, the telecom operator spots a business opportunity, and then it attracts necessary partners to develop the business solution. For open innovation to flourish, the telecom operators are due to enhance its absorptive capacities of innovations beyond ecosystem boundaries (Teece, 2017).

To capture value, the three IoT ecosystem strategies all embrace servitisation through open innovation and business model innovation with new revenue streams. They are all relying on collaboration and attracting partners with different fields of expertise to develop innovative IoT services. The emerging markets first type of IoT ecosystem pursues a strategy where it wants to focus on value-adding services and to grow the ecosystem. In order to grow the ecosystem, it has to focus on making the customer understand the utility of IoT. The emerging markets type two IoT ecosystem pursues a similar strategy of service-orientation and creating value-adding services for customers. Both one and two deem it imperative to own the end-customer relationship and therefore endeavour the natural ecosystem leader role (Papert & Pflaum, 2017). The dominant focus of value creation and collaboration reflects an innovation ecosystem's objectives, in comparison to the advanced markets business ecosystem where the main focus is capturing value. The advanced economies' type three IoT ecosystem, on the other hand, also recognises the advantages of becoming an ecosystem facilitator. They pursue a different strategy focusing on their core competencies of connectivity and platform technology. They are likewise service-oriented and offer the platform and value-adding services. The last apparent difference between the emerging and advanced economies is the revenue-sharing models and openness of the IoT platform. The emerging economies utilise revenue-sharing models to incentivise ecosystem participants in a closed ecosystem. The advanced economies have a more open ecosystem but without revenue-sharing models.

6.2 Implications for Managers and Scholars

The article contributes to the literature by defining three distinct positions for telecom operators in the IoT business ecosystems and describes in detail opportunities and challenges with each role. This study provides insight into a limited research field of emerging economies, collaborative relationships, and dynamics inside IoT business ecosystems. The research provides valuable knowledge of telecom operators' role in the IoT ecosystem and raises new questions of which role will prove the most successful.

For managers and scholars, the study provides detailed insights into how IoT changes telecom operators' business models and creates new business opportunities. For multinationals, it can be relevant to look at the contrasting approaches in emerging and advanced economies and identify transferrable strategies.

6.3 Future Research

For future research, it would be interesting to conduct a longitudinal study of the IoT business ecosystems and see how the IoT business ecosystems perform and mature. Furthermore, a study of the ecosystem partners and customers, what ecosystem model they prefer and how the revenue sharing strategies work in the long-run would be appealing to examine. The telecom operator sample could be extended to various regions and include other types of telecom operators, e.g. mobile virtual network operators. The last research area that could be examined is the benefits of customer participation and which co-creation arrangements are the most successful regarding IoT technology.

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Appendix

A.1 Interview Guide

1 About the research project

- Information about the research project
- Ensure anonymisation and formal consent

2 About the respondent

- Describe position and role

3 The IoT business ecosystem

- IoT use cases (B2B and business-to-consumer (B2C) use cases)
    - Collaboration activities
    - Type of partners (Enterprises, SMEs, startups)
    - Attracting and selecting partners
    - Ecosystem value network
    - Actors contribution
    - Revenue model
    - Customers involvement
- Long-term strategic goal
    - Connectivity provider
    - IoT Investments
    - Service-orientation to become an E2E service provider
    - Connectivity and value-adding services (i.e. platform as a service)
- Ecosystem position – the role of the telecom operator:
    - Ecosystem facilitator/orchestrator
    - Complementing supportive role in the IoT business ecosystem
    - Passive supplier of services
- Competitive landscape
    - Ecosystem competitors
    - Other telecom operators in the market
    - New competitors to telecom operators
- Hurdles for IoT ecosystem to succeed

4 The IoT platform

- Network effects
- Data analytics
    - The openness of the platform
    - The sharing of data
- Customer benefits of joining the platform
- Customisation of platform services

5 IoT ecosystem: open innovation

- Partnerships and co-creation impact for innovation
    - Preference of partners
    - Role of parties and contribution (co-development)
    - Innovation idea from inside or outside the firm
- How to create the desired ecosystem
    - Attract and retain partners
    - Startups and Corporate venturing
    - M&A
- Long term vs short term results
    - Balance of innovation investments and dividend/short-term profits
    - Balance of incremental, exploitative innovation versus radical, explorative innovation activities
- Type of innovation use cases
- Innovation intermediary

6 The collaboration with startups

- Startup-corporate collaboration
    - Strategic or financially motivated
- Collaboration activities
    - Corporate venturing
        - Selection of startups
        - Financial prerequisites or proof of concept (POC)
    - M&A
    - Supplier, procurement
- Business model and absorption of new revenue streams

7 Wrapping up

- Opportunity to add or modify information

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