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TELECOMMUNICATION DATA MONETIZATION

Master of Science Thesis

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ABSTRACT

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The aim of the study was to find out what kind of telecommunication data monetization models are interesting and potential. The focus was on finding out what kind of business model trends there are already, how mature telco data monetization is, what kind of crucial elements it includes and how telco data monetization can be advanced by adopting already existing models or creating innovative ways to do business from scratch. Also, telco data monetization, its constraints and telco data collecting were handled.

Theoretical part of the study was done based on literature on the topic and empirical part consisted of theme interviews and workshops on the topics. All in all, eight interviews and two workshops were done. Four of the interviews were directly about telecommunication data monetization and four about supporting topics that need to be well understood in telecommunication data monetization. One of the workshops was done with operator representatives to understand operators needs and ideas about this topic and other one was with potential telco data customer organizations to understand customer perspectives.

The study indicates that internal telco data monetization is quite mature and it has been developed for a long time but many of the external telco data monetization projects are in piloting and testing phase. Telecommunication data monetization is quite similar with other data monetization processes, so already existing effective and profitable models can be adopted and clear need for creating totally new business models was not found. Location telco data based insight was seen as the most valuable way to do external monetization while also IoT and sensor telco data as a value were seen potential in the future. One effective constraint identified was data privacy and data security in general. In telco data monetization projects one of the biggest difficulties is to fulfill data privacy regulations and still keep the business profitable. Most essential elements found out during the research were the importance of partnerships and especially co-operation with a revenue share model. Furthermore, scalability was one way to overcome costs that specific data preparation causes. In lower risk models, B2B was a critical target segment but B2C was still seen as a potential option if some innovative idea is created.

PREFACE

I am studying master's degree of Information and Knowledge Management in Tampere University of Technology and my major is Knowledge and Competence Management. This thesis was undertaken at request of Nokia Networks, where I got a contract to do a thesis about this research area. Research topic in big picture came from the organization but I had a possibility to define it with my supervisor, Jorma Hietala. In that way, I got a possibility to fit the research topic into areas that I have studied and I am interested in.

The topic of this thesis was quite difficult because the target was to form new information about kind of new research area. That was one reason showing the importance of this thesis. During the process, I got possibility to meet lots of new people who taught important things to me around this topic and pointed out key areas. Without those contacts, it would have been a lot more difficult to achieve good results. I want to thank especially Adam Balogh and Antti Mansner who were always willing to answer my questions and helped me to concentrate on right things. The whole thesis process showed me how important it is to have contacts and partners in many business areas, in a way that everybody can get benefits from each other's expertise areas.

I want to thank my thesis director Hannu Kärkkäinen who helped me a lot during the whole thesis process. With his constructive feedback, I was able to advance the thesis and achieve better end results. I also want to thank my supervisor Jorma Hietala who has supported me during the whole process. I also want to thank my family who supported and motivated me during the study. Lastly, I want to thank interviewees and workshop participants who enabled the study to manage and I want also thank Anne Vuorenlehto for giving valuable feedback.

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LIST OF SYMBOLS AND ABBREVIATIONS

aaS	As-a-Service, means that subscription to use some product like analytics platform is sold, so the product itself is not sold.
Big data	Big data is about collecting, saving, analyzing and visualizing massive amounts of data.
Business model	Business model is a way how organizations create business and handles all the key elements that effects to the business.
B2B	Business to business means business where products or services are sold to business customers.
B2C	Business to consumer means business where products or services are sold to consumers.
CDR	Call detail record means every exchange between devices like mobile phones that are transferred through telecommunication networks.
Data aggregation	Data aggregation is a way to combine different data.
Data anonymization	Data anonymization is a way to turn personal data into a form where it is impossible turn back into personal data.
GDPR	General Data Protection Regulation that is European Union regulation.
Geolocation data	Geolocation data is data about electronic devices likes mobile phones that can be used find out user's or at least device's physical location.
IoT	Internet of Things, means that internet-networks are extending to devices and sensors that can be controlled and data collected over internet.
OTT	Over-the-top media services are services where media can be sold over internet to customers.
Telco data	Telco refers to telecommunications and in this thesis telco data means data coming from telecommunication networks.
SMS	Short message service is service that allows mobile phones to exchange short text messages through telecommunication networks.
Spatiotemporal data	It is data that have both time and space information. With spatiotemporal data, it is possible to track devices that can be only in one location at time.

1. INTRODUCTION

In the beginning of every main chapter there is a little introduction to the main things about the subchapters. Also, all those introductions include information about what is the main outcome of the chapter, so basically to which research questions it answers. Additionally, there is told how the information is gathered: is it theory or empiricism. This introduction chapter has information about backgrounds of this thesis, the main research problem and context, research questions and contents.

1.1 Background

Data has been collected and stored for a long time in different kind of companies. But in the last years the growth has been fast. That's partly because companies have started to realize the value of data usage and collection. (Fosso Wamba et al. 2015) Before it was more difficult to analyze massive amounts of data because the computers and software were not created for that. But nowadays, when there is enormous amounts of computational power and new kind of analyzing methods like deep learning, it is much easier to analyze those massive amounts of data and gain insight. (Chen & Lin 2014) Still, techniques itself are not enough, companies need also lots of know-how. People who can use those techniques and algorithms need skills like machine learning, mathematics, statistics, databases and artificial intelligence. Furthermore, those people need to understand what kind of information is needed and how those problems can be solved. Sometimes even a same dataset can give different kind of answers when users views are different. (Dhar 2013) Those topics make data analyzing interesting and challenging.

Other problems come from how to use the data and analytics to create new business. Now when companies do understand the benefits that data can offer, it has become common try to manage and use that data. That is why the need of information management has grown a lot. (M. Courtney 2012) Using data inside company to enhance processes and to create new products is only one way, data can also be sold to other firms and customers in some form. There are many ways to monetize the data: sell data itself, sell analyzes and dashboards cleaned from the data, sell some service based on the data or create some products based on the data for example. Data monetization has many different definitions meaning that it can be leveraged in multiple ways. (J. K. Adjei 2015) That is why data monetization has different point of views as well, like for example to use the data to get cost savings and other benefits in the company. Furthermore, sometimes when companies are big enough it may be expensive to build business analytics capabilities. That's why there are new kind of services like analytics as a service (AaaS) that companies can buy.

AaaS works like software as a service (SaaS), meaning that company can buy analytic capabilities from product provider and pay for use. (Naous et al. 2017)

When we are thinking about how data can be used to get cost savings, one good way is to use data in decision making inside the company. One approach is to see and analyze historical data and base decisions on that. Machine learning is widely used in different business areas. With machine learning algorithms, like classification or clustering, forecasts about future can be made and different kind of patterns and connections can be found. With machine learning, computers can learn like humans. Computers can gain important skills, new knowledge, understand existing knowledge and use that information to get benefits (Wang et al. 2009). It is something that gives even wider perspective comparing to the basic analytics. That offers new business models based on the data like predictive maintenance and preventive maintenance. (Susto et al. 2015)

Examples about data monetization can be found almost everywhere. Big companies are moving towards data based approaches and data is coming from multiple sources in a digital form (M. Somvanshi & P. Chavan 2016). Some of the older companies have lots of things that are done on paper and documented on paper. Another problem is that while most of the data would be in digital format, it may not be in any database, so analyzing it is hard (M. Courtney 2012). But when all that information will be transferred to systems and data storages the companies may find interesting patterns and things they did not realize before (M. Somvanshi & P. Chavan 2016). For example, in manufacturing digitalization can bring huge benefits to save costs in maintenance and to better optimize systems (Zhou 2013). Real time data collection and analyzing and furthermore historical data usage can give important insights for different kind of companies.

Some companies still struggle with their data because in some use cases it is not that simple to get profit from cost savings or from revenue growth. Sometimes it is very difficult to find out how the gathered data affects to the business and what kind of things should be collected in the database to be analyzed and what not. That makes the role of information management important. (M. Courtney 2012) But this is not the only problem area about data monetization. Sometimes with user sensitive data the problem is more about what can be analyzed based on laws, rules and expectations to maintain reliability and customer's trust, more than what to analyze (J. K. Adjei 2015). For example, there are multiple laws and decrees how customer data needs to be handled, protected and how it can be used. Priority is on data privacy. In some of the cases around customer data, it is not a problem to find a way how to get benefits from that data. Because almost in every industry customer data is very valuable in many ways. While of course sometimes the data is already used in multiple ways and then problem might be how to find new ways to use the data.

I have always been interested in data analytics and about the technology behind the analytics. I have previously done research about using big data and neural networks in stock

exchange analyzes. It is a good example about how different kind of data is tried to use even in quite surprising contexts. It is very fascinating that diverse data can offer so wide use cases and with the ability to combine different kind of datasets gives even more areas to discover. What is more, I am also highly interested in business and when the analytical side is combined into business perspectives the correct bundle is ready.

Therefore, the topic for this thesis is based on my interest areas. In 2016, I also got an opportunity to familiarize myself with the telecommunications industry. I was summer trainee at Nokia and in that way got basic information about mobile networks and about how bigger companies operate. It was logical to continue in Nokia also in 2017. I was highly interested in data monetization and that was a reason I began my thesis work around telco data monetization. It was an area of my interest as well an area that was in Nokia's interest. What makes telco data interesting, is that there are vast amounts of telco data collected every day but the use of that data is limited because of its sensitive nature. Using sensitive data has been on the news lately when different parties have published that they use user data for example to make account based marketing. There are multiple opinions about customer data usage in different industries. People tend to feel uncomfortable when their personal information is used even though the data is not spread to others or even if it is anonymized. Data privacy is widely discussed, what makes telco data monetization research even more interesting.

1.2 Research problem and context

In a wide perspective, the research problem is how to monetize telco data. Being able to monetize telco data needs of course lots of know-how about data analyzing technologies. In this research, the idea is not to examine deeply those techniques. Different business models and possible business areas are more in focus. This research includes still some basic information about data analytics and algorithms but deeper examination is excluded. Telco data is also quite complex area of investigation. So, there is a whole chapter about telco data but that chapter is more in a wider perspective as well. Telco data has also competitors and that is why those are also compared. This is quite wide topic and that is why it is only handled in big picture. Information about the techniques how the data is collected and what kind of specific parts it includes are not in scope.

There are lots of mobile users nowadays. Some of the statistics show that already on 2013 there were 6.2 billion GSM subscribers in the world. Meaning 87% of world's entire population (7.1 billion). (Rysavy Research 2013) Mobile operators handle that telco data, which means vast amounts of data from mobile phones every day (Y. Qiao et al. 2017). Of course, all this data is not collected by the same operator. There are lots of operators in different countries. That makes the data amounts little smaller per operator. In this research those massive amounts of data are in scope. The idea is to try to understand what kind of benefits can be gotten from the data without violating data privacy and security. It is obvious that the analytic technology or content of the data is not the limiting aspect

here, data privacy and data privacy/anonymization technologies are more important. The focus is not on the technical side, the focus is more in the possibilities of telco data usage and monetization as well as the limitations that data privacy causes. While, ethics of data usage are also an important area, it is not handled very specifically in this thesis. One boundary in data privacy side is that the focus is about data privacy in Finland. Because Finland is part of EU, also EU-laws are considered. Differences between data privacy laws in different countries are not researched but the problems those cause are handled. It may be also good to define that laws are researched only in a basic level because data privacy laws are not the main focus in this thesis either. Furthermore, there are interviews giving professional view about data privacy, data security and telco data.

This kind of business creation based on telco data has been becoming general in the last years and companies are trying to find new business areas. Before, the telco data usage was more concentrated on how to improve telecommunication services to the customers when nowadays companies have started to search new kinds of customers to whom to sell the data and analytics. Therefore, data privacy concerns in different countries have also been researched a lot in previous years. (Calabrese et al. 2015) This new way to sell and use user data is not a new thing in some other business areas. For example, Google Maps users must accept Location Consent before using Maps. In that way, Google gets to use and collect anonymous data about its user's locations. (Neidhardt et al. 2013) This location based business is interesting and while anonymous location analyzing is also possible with telco data, its usage and monetization is target scope in this research. Also, some other telco data usage opportunities are investigated but the main target is on telco data coming from mobile phones and how it can be monetized. Furthermore, the aim is not to do research about how to implement and run business based on telco data. Instead the work is about how to find and model new business and in what elements to concentrate.

This work aims to find out what kind of business, business models and research is already created and published based on telco data to see the maturity level of this business. Furthermore, the idea is to find out what kind of models are used in other data monetization projects and could those be used in the telco data monetization projects as well. One problem area is also to form a framework about current business areas and try to find out what potential areas are missing, or if any. This research aims to help companies to understand the limitations and possibilities of telco data and what kind of new business could be created based on telco data and on what topics to concentrate. This also helps possible telco data customers to realize what kind of services telco data could offer.

1.3 Research questions

The purpose of this research is to form a big picture about what kind of things have already been done and published in the telco data monetization scope and what kind of possibilities there could be and what are the most potential ones. That is why the main research question is: **What kind of useful and interesting models could be developed**

for telco data monetization? To answer that question there are six sub research questions.

- Which types of business model overall trends can be identified?
- What is telco data and how can it be collected and monetized?
- What kind of and how mature business has been created based on telco data?
- What kind of business model components are essential for current telco data monetizing business models?
- How models from other business areas can be exploited?
- What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?

As can be seen from the research questions above, the sub questions are aiming to give vital information for answering the main question. So, the basic idea of the sub questions is to understand all the important aspects of telco data monetization. Most of the sub questions are handling the business side of data and that is why the target of this whole thesis is to concentrate on the business side. Not how to implement and run this kind of business but what kind of businesses could be created and what kind of business models used and what are the main elements to form telco data monetization business model.

1.4 Content

Content of this thesis can be divided into two different sections. First section is chapters from one to four, and those are theory chapters. Then rest of the chapters (5-7) are based on empiricism. In that way, it is easier to follow the content. Second chapter gives basic information about business models. Then the next chapter is about telco data and data monetization. That chapter includes theory about data monetization and big data, as well as information about telecommunications history, what is telco data and what are its competitors. There is also theory about telco data limitations and data privacy. Fourth chapter is the last theory chapter and it is all about business areas and business models used both in telco data based and other data based projects.

Fifth chapter is about research methodology including information about research methodology, research process and material collection. Chapters after this are based on empiricism and include a results chapter as well as discussion and conclusions chapter. Results chapter includes results from interviews and a workshop. Then, in the discussion and conclusion chapter all research results are examined and summarized with the help of needs and thoughts that came out from the theory part and from interviews and workshops. One special outcome of the discussion chapter is a business model formed with key elements found during the research and a summary. That model can be used as example and criteria when new models are created and evaluated. Last subchapters include a conclusion about the whole thesis and an evaluation how thesis process went and what are the possible further research subjects.

2. BUSINESS MODELS

This chapter includes basic theory about critical things concerning telco data monetization. Chapter starts with information about business models in a general level. Then there is theory about business model performance and lastly about business model trends. This chapter answers to the research question: “*Which types of business model overall trends can be identified?*”. The idea of this chapter is to give theory about the vital things considering and evaluating business models. It also gives good basic information before going more deeply into the research topic where already used business models and areas are identified. This chapter is fully theory based.

2.1 Business models and its concepts

Business models are an important part of different kind of businesses. In a big picture, business model is an explanation how organization works towards achieving its targets and goals. (Massa et al. 2016) Targets can variate a lot but those can be for example growth, revenue growth, brand awareness and value creation. One way to form the meaning is to emphasize the importance of value and that business model is a reasoning of organization’s value capture, creation and delivery (Osterwalder & Pigneur 2010, p. 14).

Business model design projects are always special, meaning that for example that situations, targets and contexts are different. Some business models are created for a new product that is going to market. In that case the whole organization’s perspective is needed to take into consideration and create a model that fits for the product itself as well as fits in bigger picture. Business models can be created for startup firms when the targets and objectives are totally different. One other example is that a company replaces its current business model because of a crisis with its existing business model or tries to prepare for the future by testing different business models. (Osterwalder & Pigneur 2010, p. 244) Therefore, reasons are multiple but still the main idea in business model creation is quite similar.

While business models are always unique, even similar products released to the market through different kind of business models causes different outcomes. This means that the business model is critical part of the businesses. If the business model is well made, even an average product can beat its better competitor’s products with not so good business models. Especially with new products, the business model creation may be difficult because there are no ready models to learn from, so the business models should be planned as well as the product itself. (Chesbrough 2010)

In the case where old business model is replaced with a better one, the business model creation may be even more difficult. Meaning that it is not anymore about creating a new

model, there is a need to create a better one. For doing that old problem areas, old benefits, future demands and targets, transitions and timings for example needs to be considered. What is more, there is a need for constructive actions that makes the changes possible. When every activity is planned based on the existing business model, multiple actions are needed to make the change possible. (De Reuver et al. 2013)

When looking more deeply in the business model concepts and explanations there can be seen a lot of differences. Sometimes the concept of business models is thought from a different direction making the whole big picture different. (Gorevaya & Khayrullina 2015) In organizations, it is important that everybody understands the business model description in a same way and misunderstandings could be avoided. That is a problem many firm's may be facing. Business model should be understandable and simple enough but because organizations have certain type of mandatory functions the model cannot be too simplified. Therefore, the correct balance between simplified and oversimplified needs to be found. (Osterwalder & Pigneur 2010, p. 15) One overall view, made by Chesbrough (2010) is that business models are consisting multiple functions. Those functions include business' value proposition, place in the value chain, market segment, revenue model, cost structure, competitive advantage and strategy (Chesbrough 2010).

In fact, that Chesbrough's view is quite similar as some other business model descriptions. For example, business model canvas is widely used model that includes similar kind of functions. Business model canvas is like a blueprint about organizations strategy that is followed through organization's every part. This canvas (Figure 1) consists of nine building blocks: Key Partners, Key Activities, Key Resources, Value Proposition, Customer Relationships, Channels, Customer Segments, Cost Structure and Revenue Streams. (Osterwalder & Pigneur 2010, pp. 15-19)

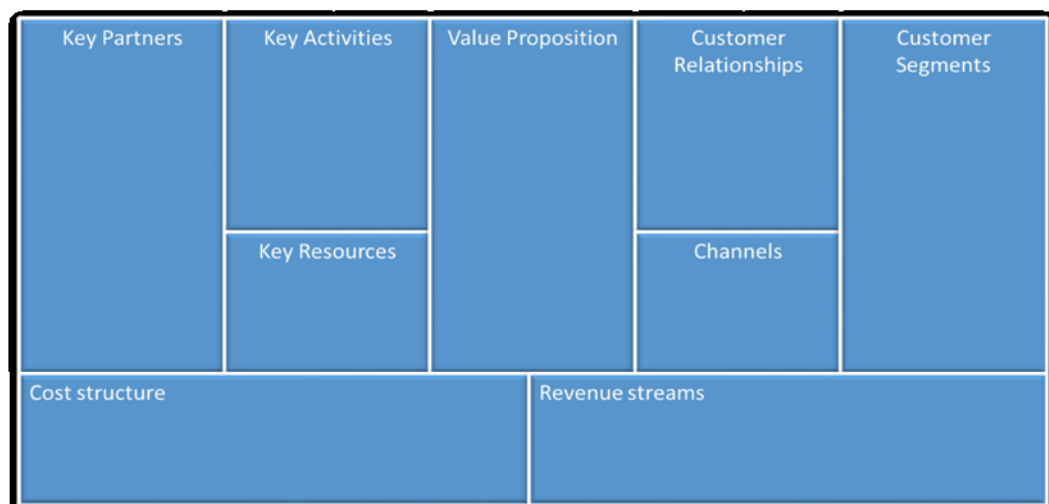


Figure 1. Business model canvas (Adapted from Osterwalder & Pigneur 2010, p. 44)

All the nine building blocks are important and none of those can be forgotten. Starting with Key Activities, it is a block with information about the most vital things for the

company to make its operations and the whole business model work. In turn, key resources are the most vital resources needed running the business and making the business model work. These resources can be any kind like intangible, economical, physical or humans. Key partners are a block for the partners needed running the business. Many times, it is clever not to do everything by itself. Partnerships can be for example strategic alliances to reduce risk, enhance revenues, acquire resources and optimize business model. (Osterwalder & Pigneur 2010, pp. 14-44)

Value proposition describes how business is going to work and how it gives value to customers. Value proposition is something that attracts customers to buy products or services offered. Customer relationships are in a close connection with customer segments because customer relationships define how customer relationships are handled. Meaning how company takes care of its customers to keep them happy and for boosting sales. This kind of relationships can be handled personally or automatically. Customer segments describes targeted customers for the company – customers that business tries to reach and is mainly made for. Different kind of customers need to be treated differently and in other way, everybody cannot be on target and that is why this building block is important. (Osterwalder & Pigneur 2010, pp. 14-44)

Channels are about how company can reach its customers in a planned way. Mainly about how company can communicate with its customers, delivering value at the same time. Last two blocks are about financial side. Cost structure describes what kind of costs this business model includes. Revenue model describes what kind of benefits and how much cash it gets from different customers. Different kind of pricing mechanisms are important for this building block and to the whole business model to succeed. (Osterwalder & Pigneur 2010, pp. 14-44)

Business model canvas includes important categories that companies need to deepen their thoughts. It is not enough to describe for example value proposition and revenue streams in a bigger scale and think that now those are handled. Deeper view is needed and all the blocks needs to be looked through properly. For example, revenue categories may have been identified but the model how the money really comes behind that may be unclear. Sometimes companies may focus on wrong things and forget some important aspects.

Osterwalder et al. has focused how to make even better business models. In their model, after creating the business model canvas, people should concentrate to deepen the views and create value proposition canvas. That value proposition canvas is about value proposition and customer segments. It is about how to target created value just for the customers' needs. (Osterwalder et al. 2014, pp. 8-19) Value proposition canvas consist of value map and customer profile. The idea is to try to fit those two categories to company's products and services in a way those are serving needed value for customer. Customer profile is about customer jobs, pains and gains. That is why customer jobs describe topics that are important for customers and about what they are trying to achieve. That kind of

things may be for example problem solving, task completing or some other needs. In customer jobs phase the idea is to think from customer's point of view. (Osterwalder et al. 2014, pp. 6-13)

Then the last two parts of customer profile handles customer pains and gains. Pains are all the topics that are preventing, bothering or decreasing outcome of customers to get those customer jobs done. There exist different pain levels from moderate to extreme and it is important to identify the severity. In turn, customer gains describe benefits customers are trying to acquire. Gains can variate a lot, some of them are required and expected but there can be even gains that are unexpected. With gains, it is also important to identify the relevance level from nice to have to essential. (Osterwalder et al. 2014, pp. 14-17)

Next category is value map. That category is made in same way than customer profiles, so the idea is to share that category into three parts: products and services, pain relievers and gain creators. This whole category is made of company's point of view. So, products and services describes what the company is offering. Products and services may also include ancillary elements for customers to help them make decisions and understand the value offered. Pain relievers help customers to overcome the problems and uncertainties that may prevent customer to get jobs done. All pains cannot be handled but it is important to understand what pains company could ease best. In turn, gain creators is the part that describe how customers can achieve their targets and get multiple benefits –gains. Gain creators should include matters company knows best and matters making difference and value to customer. Every customer need cannot be fulfilled. Pain relievers and gain creators should be classified in range from nice to have to essential.

As we noticed, value map and customer profile includes same kind of topics but the perspective is different. Company focuses on how to serve customer in a best way and customer tries to achieve as good benefits as possible to solve its problems and reduce pain. This value proposition canvas aims at fitting those two parts in a way that company produces products and services in a close relationship with customers, takes care of their needs and creates profitable business model (Osterwalder et al. 2014, pp. 42-43).

2.2 Business model performance

Successful business model implementation and development is hard and lots of knowledge and experience is needed. Organizational challenges need to be defeated with a proper strategy. In implementation phase, business model performance needs to be considered to survive and succeed in competition. Business model performance is an area of research that has been popular lately and that is why there exists multiple different opinions about performance drivers and mechanisms. Haggège et al. (2017) have introduced their view about the key business model performance drivers and mechanisms based on 38 recent research studies about this area. Those drivers can be divided into static drivers and dynamic drivers.

Static drivers consist of three drivers: rethinking customer engagement, reconfiguring external linkages and optimizing internal processes. Rethinking customer engagement is about how customers are involved in the whole business model. Mechanisms for that is to find a way to shift costs from organization to customers. At the same time, expansion of customer loyalty and user-driven innovations are key mechanisms as well. It is not enough to identify the key customers for the business model, it is important to manage relationships to them as well as understand what kind of value can be given to them. (Meyer Haggège et al. 2017)

Next static driver is reconfiguring external linkages. These external value networks should be well managed to achieve strong relationships. Especially for small companies' strong partnerships are important but bigger companies as well needs to focus on strategic partnerships and maintaining those relationships. Furthermore, external linkages are a clever way to search for new business areas and new knowledge with collaboration. Lock-in effect is also one effective way to reconfigure external linkages. (Meyer Haggège et al. 2017)

Lock-in is a driver that keeps customers and partners attracted to the company and its offerings. With the help of lock-in effect customers and partners are not looking for other options and are not willing to change provider. There are multiple ways to achieve that lock-in effect like discounts and so on but one good example is Facebook. In Facebook, users have used a lot of time to create their profiles to look good and they have lots of friends there and they can follow also other interesting people there. In that way, it is more likely that people are not willing to switch using other social media platforms. Also, when advertisers have used a lot of time for creating their advertisements into Facebook and got positive reviews and ratings they may not want to stop using the platform. Furthermore, when Facebook has so many users, it would not be clever to switch platform in that way either. (Zott & Amit 2010)

Other important value drivers to evaluate business model performance like lock-in, are novelty, complementarities and efficiency. Novelty is about estimating the level of innovation with evaluating activities, like how business model's activities help to satisfy customer needs, how those activities can be linked innovatively and is there some innovative arrangements about who is going to do those activities. Also, it is important to evaluate how each participants of that new business model network are having value and is the revenue model supporting the value creation. Complementarities are about that these different key activities are linked to each other in a way that as much value is created as possible. Efficiency is about saving costs with clever activities and connections between linkages. (Amit & Zott 2012)

“Optimizing internal processes” is the third static driver. Most important mechanisms for that is to keep the entire process' time and costs optimized. Especially time to market is an important aspect and it needs to be kept as short as possible. Obviously, time and costs

are important performance drivers and with good project management those factors need to be optimized with a good strategy. Optimizing internal processes is aiming for excellent quality with low overall time and optimized costs. (Meyer Haggège et al. 2017)

As mentioned before, business model performance drivers can be divided into two distinct categories: static drivers and dynamic drivers. These dynamic drivers consist of two categories: “cultivating strategic awareness” and “developing reconfiguration capacity”. Dynamic drivers help organizations not to concentrate only for the existing businesses and relationships. Target for these drivers is to prepare for the future. “Cultivating strategic awareness” is a driver that helps to prepare for change. Preparing for change is about identifying and enhancing uncertainties and developing new opportunities. Good business model cannot be trusted too much, companies should be prepared for change all the time. (Meyer Haggège et al. 2017)

Another dynamic driver is “developing reconfiguration capacity” and mechanisms for that are ongoing learning and development. Organizational learning is an ongoing process to learn from trying and failing. With this kind of examples and tests organizations can learn effective ways of doing business and be ready to develop new cases. Development processes should also consider business model portfolios. Even though those are once properly planned, it is important to develop those actively. (Meyer Haggège et al. 2017)

2.3 Business model trends

Business models has been developed for over 100 years. First versions of business models were about shop placements near potential customers and then next step was bait-hook based business models. The basic idea of bait-hook model is that the main product is sold at a low price and then the real benefits come from the hook that are some necessary spare parts for the main product. One example is razors and blades. In that example razors, can be sold in a very low price and then the money comes from blades that people need to buy for using that razor. (Gorevaya & Khayrullina 2015)

While bait-hook strategy is kind of old it is still nowadays widely used model. Bait-hook term is only one of many concerning this same strategy. Mobile phones are one good example about the strategy. Sometimes mobile phones are sold with no price or with very low price only to get people hooked to buy for telecommunication services. In that way company gets money for a long time and finally gets benefits from the contract. (Gorevaya & Khayrullina 2015) In telco data monetizing business models, bait-hook strategy would work in a way that customers get a free test service, where customer’s needs are fulfilled with telco data insight but only some limited data is used or limited parameters. After that the customer may be hooked to see the whole service.

Since bait-hook strategy business models have evolved fast. New IT technologies for example have changed business models a lot. The nature of business is different when things

can be done online and offline. To concentrate more on the types of models that are widely used, there can be seen five different patterns can be seen (Figure 2). (Gorevaya & Khayrullina 2015) Patterns represent reusable concepts for designing business concepts. It is normal that one business model can fit into more than one category. (Osterwalder & Pigneur 2010, pp. 52-56)

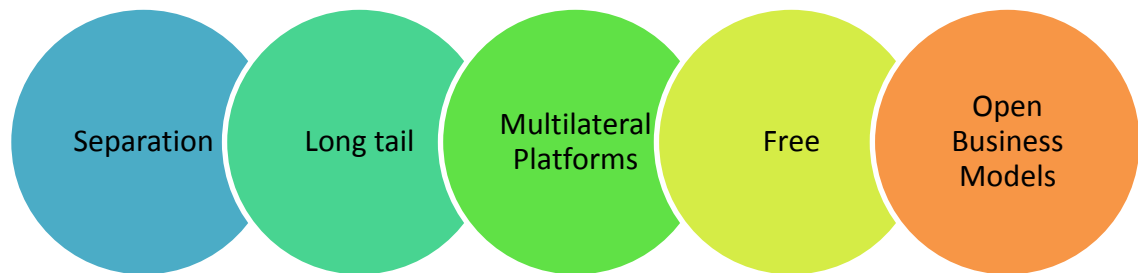


Figure 2. Business model patterns (Adapted from Gorevaya & Khayrullina 2015)

First pattern is separation. In separation, existing business model is divided into smaller models by creating new companies or at least individual units. (Gorevaya & Khayrullina 2015) For example car producers like Toyota and Honda have done that. Both have separated their luxury car and basic car production. For example, in the Toyota case, its basic cars are under Toyota brand and luxury cars under Lexus brand. In that way, both can be focused on different markets and offer different kind of value. (Koen et al. 2011)

Separated business concept can also be considered in a way that companies include three types of businesses - infrastructure businesses, customer relationship businesses and product innovation businesses. Those distinct categories have different types of targets and ways of doing things. Those three types can be in a one company but they should be separated. Three key differences between those categories are in the areas of economics, culture and competition. If we are thinking about business model canvas that was previously presented (Figure 1), it can be divided into those three categories. Key activities, key resources and key partners are about product/service innovation business, value proposition is about product innovation and customer relationships is those three boxes on the right side: customer relationships, channels and customer segments. (Osterwalder & Pigneur 2010, pp. 55-60) In telco data perspective, telco data business can be separated from the basic business to enhance customer relationship with internal enhancements or to do product innovation by creating new services based on telco data that already exists.

Second identified business models is “Long tail”. Long tail is a model that concentrates to niche product buyers. (Gorevaya & Khayrullina 2015) The idea is to offer massive amounts of niche products each of them having low buying volumes. But when there is a huge selection of small volume products and a well-made online sales platform for buying

and sometimes for selling those things, long tail business model can be successful. (Osterwalder & Pigneur 2010) Zipcar is a good example of that (Gorevaya & Khayrullina 2015). They target to rental car customers but in a new way. Their business model is to give a platform that allows car renting in urban locations, even very short rental times. This new business model may attract new consumers that would not otherwise have rented a car. (Koen et al. 2011) Long tail model could fit to telco data business because telco data insight can be targeted to multiple niche companies and different kind of insight services could be sold via online sales platform.

Furthermore, online shopping companies like Ebay and Amazon are good examples of long tail business model. Those online shops provide online sales platform where small firms and individual people can sell their products easily and other people can easily buy and review products from the platform. With the help of eWOM (electronic word of mouth) information about those different small volume products goes on and people may buy products that they wouldn't have bought without eWOM. (Lee et al. 2011) What makes this business model even better is that those companies create usually lock-in effects. Meaning that the possibility to get their products sold is higher with the platform because those platforms have massive amounts of customers daily. When everything goes right and they start to get products sold and get good recommendations and ratings – the lock-in effect is present. Then they won't easily change the platform or stop selling. (Zott & Amit 2010)

Third business model is “Multilateral platforms”. Multilateral platform's idea is based on massive amounts of people. These platforms can be beneficial and get revenue only if there are a lot of users. Multilateral platform companies do not get money direct from customers, they get revenue in other ways based on big user counts. (Gorevaya & Khayrullina 2015) Platform makes interactions between different kind of user groups but that is only possible if there are multiple user groups present. Value for the platform comes from connecting these different user groups. One quite much used example is Google. It offers search platform that is free to use and Google gets revenue from advertisers using Google's targeted text advertising possibilities. In that way Google connects people who search products, services and other content to companies that offer those things. Without massive amounts of people using Google's searching abilities, this model couldn't work. (Osterwalder & Pigneur 2010, pp. 76-81) This kind of business model is more difficult to fit for telco data business but with proper idea B2C business model that uses telco data as one data source would be possible.

Fourth model is Free. This option means that at least some important customer segments need to have possibility to benefit from free services. Revenue is coming from some payable functions or from advertises. (Gorevaya & Khayrullina 2015) This business model can be divided for example into three different subcategories: bait & hook, freemium and advertising based. All those subcategories can be fixed to serve the specific need, so sometimes business models include only some parts of these subcategories. Bait & hook

model we went through previously but to summarize, its basic idea is to give something attractive for free and get the buyer hooked to buy those products or new components for it in the future. (Osterwalder & Pigneur 2010, pp. 88-107)

Freemium comes from words free and premium combined. Freemium's idea is that the basic product, app for example, is free but the revenue comes from premium purchases. These purchases can be for example in-app purchases that gives customer some upgrades or additional functions. Freemium based apps are popular in mobile gaming industry and for example Clash of Clans has made huge revenues with this business model. In turn, advertising means that the product, app for example, is free to use but it includes advertisements. Sometimes in-app advertising is combined to the game for example in a way that player can get virtual currency in exchange of watching some advertisement video or those advertisements are just popping up from time to time. (Tang 2016) This model is a fixed version of multilateral platforms because without lots of users these free products cannot earn much money and advertisers go away. This model is used a lot in mobile apps but as well in other businesses like with free newspapers that have both news and advertisements. (Osterwalder & Pigneur 2010, pp. 92-95) As multilateral platforms, this kind of model can work with telco data as well but the model may need to be targeted to B2C to make that possible. Some telco data based app for individual customers could give users some important information about crowd movements and with extra payments they could get even more accurate or special information for example.

Fifth business model is called "open platforms" (Gorevaya & Khayrullina 2015) or "open business models" (Osterwalder & Pigneur 2010, p. 109). Open business models represent a model where all value is created based on cooperation with external partners. In that way, companies can found innovative ways to do business and get new innovative ideas from outside the company. Hackathons are good examples of that. In those events the idea is that experts from different business areas come to one place and try to develop something new or solve some given problem. (Gorevaya & Khayrullina 2015) To sum up, the idea is to open the company's R&D to other companies and maybe to individual people as well. This can happen in two ways: outside-in or inside-out. Outside-in means that the company takes ideas from outside of the organization and uses those in its own processes and inside-out means that the organization sells or licenses its own ideas and intellectual property. (Osterwalder & Pigneur 2010, p. 109) Telco data business needs creative ideas and it can be beneficial in multiple industries, that is why open business models could be a good option. Figure 3 shows a little summary about those five business model patterns.

Separated	Long tail	Multilateral Platforms	Free	Open Business Models
<ul style="list-style-type: none"> •Company has divided into three distinct categories, each of them having own targets: infrastructure businesses, customer relationship businesses and product innovation businesses 	<ul style="list-style-type: none"> •Wide selection of small volume niche products with effective online sales platform •Ebay for example 	<ul style="list-style-type: none"> •Benefits only from wide user amounts •Google search for example 	<ul style="list-style-type: none"> •Some of the key customers needs to have opportunity to get free services •Revenue is coming for example from advertises 	<ul style="list-style-type: none"> •Co-operation with external partners is key element •Idea is same kind as in hackathons

Figure 3. Business model patterns described (Adapted from Gorevaya & Khayrullina 2015)

These five categories are only one opinion describing what are the trends now in business models' area. Concentrating more on the app-sector, multiple different business and pricing models that are popular in these days, can be found. For example, there can be seen an enormous number of mobile apps with business models like freemium, paid, paidmium and in-app advertising. Freemium and in-app advertising were introduced as part of a free sector, so let's focus to paid and paidmium. Paid is very basic way to do app based business meaning that user needs to buy the app before use. This model is common but it does not fit to every app based business. Some people are so used to downloading only free apps, that putting even a small price tag on an app may cause lower popularity. Still, sometimes paid apps are very popular. (Tang 2016) Therefore, it is important to find the correct business model for a specific app or service.

Paidmium is a combination of paid and in-app purchases. In that strategy company gets revenue both from charges to buy the app and charges concerning in app purchases like some extra features. This model is more widely used in apps like navigation where people buy navigation services in some target country and then those users can buy different kind of extra maps and extra features for it. (Tang 2016) Consumer mobile app business is really demanding nowadays and the importance of business models and strategy is high. Gartner's research tells that only less than 0.01 percent of consumer mobile apps through 2018 can reach financial success. (Stamford 2017) Therefore, a clever idea is not enough if business model is not well made.

Business models can be turned around in one further way as well. Various kinds of as-a-service models are popular. There are many different examples of those like platform as a service (PaaS), software as a service (SaaS), analytics as a service (AaaS) and infrastructure as a service (IaaS). All those models are based on the same idea where the "service", meaning platform, software etc., is not sold to the customer. Customer only pays for using it. In that case customers' costs are proportion of service used. (Naous et al. 2017) Licensing has a similar kind of an idea: the customer can buy a permission to use for example some product for an agreed time. (Mittal et al. 2017) In these ways, customers

won't need to make big investments when they buy and implement new services. Thinking on the service provider side, this kind of business model can bring new customers, when it is much easier for customers to just test the new system without paying a lot of money for example.

Another common revenue model in platform, service and app businesses is subscription based model. In that way, customer needs to pay for example monthly for using the app, service or platform. This allows customer to use the paid service as much as needed with the same monthly price. (Mittal et al. 2017) Sometimes it is hard to classify firm's business model into one specific business model, because those may have aspects from multiple different models. Sometimes classifying is easy but it is important to remember that this is not necessary. It is normal that companies have aspects from multiple patterns. (Osterwalder & Pigneur 2010, pp. 52-56)

3. TELCO DATA AND DATA MONETIZATION

This chapter starts with basic information about big data and data monetization to better understand the context of this thesis. Next comes information about telecommunications industry and its development, what is telco data, what kind of constraints does it have, comparison with competitive data sources, data privacy and anonymity concerns.

This third chapter answers to the question “*What is telco data and how can it be collected and monetized?*”. This chapter is fully theory based. The main outcome of this chapter is to get a good overall view of telco data and topics that needs to be taken care of in data monetization and to fully understand telco data and data monetization terms. The idea of this chapter is to give basic information on the boundaries and problem areas of telco data before going to look at the business models.

3.1 Big data and data monetization

This 3.1 chapter is first about big data and then about data monetization. Big data is a term that pops up in many different cases. Telco data can be seen as big data because of its nature and that is mainly the reason why there is a whole sub-chapter about big data. Then again data monetization is the key thing in this thesis, so a sub-chapter about it is needed to better understand what it is about.

3.1.1 Big data

Big data is an important term to understand when data monetization is handled. That is mainly because data monetization includes almost always massive amounts of data that companies are trying to monetize, so it is important to understand what kind of distinct characteristics data has. (Arthur D. Little 2015) Big data is a term that has multiple definitions. One way to define it is that big data is a massive collection of data that cannot be operated with conventional analysis tools (Chaudhary et al. 2015; Weldon 2016, p. 337). To describe big data more accurately it can be defined with the help of three V's (Figure 4): Variety, Velocity and Volume (Berman 2013, p. 20). Volume means the size of data and it can vary a lot between data types and timespans used. (Gandomi & Haider 2015) Data volumes have risen highly in the last years and one reason for that is the popularity of social media (Chaudhary et al. 2015). In 1800s one kilobyte was big data, one megabyte in 1960s and nowadays data storages and systems can handle over petabytes of data in continuous manner. One petabyte is thousand terabytes, meaning 10^{15} bytes. (Weldon 2016, p. 337)

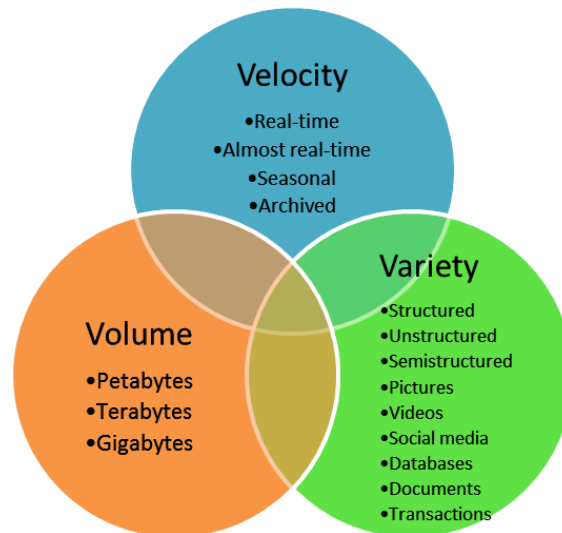


Figure 4. 3V-model for big data

Next V is about Variety. It means that data structure can variate (Gandomi & Haider 2015). Data can be structured, semi-structured or unstructured (Sagiroglu & Sinanc 2013; Gandomi & Haider 2015) A big portion of data in nowadays is unstructured, meaning that it is not collected and stored in a structural way. Data can be for example from social media, sensors or mobile devices' GPS. The data can include pictures, videos, text, messages, updates and so on. (McAfee et al. 2012) One example of unstructured data is text from emails, tweets, chats and documents. That kind of data cannot be stored and indexed properly without making it structured. (Berman 2013, p. 2)

Last V is Velocity and it means how fast new data is coming or created and in other side how fast it needs to be analyzed and decisions made based on the data. At present, it is very usual that decisions need to be done fast and services like online shops should work in real time. That is why the velocity aspect is important. Many companies need capability to analyze data in real time or at least near real time. (Gandomi & Haider 2015)

As said before, big data has multiple definitions and it is hard to find exact factors for the term. Besides 3V, big data can also be defined with 7 V's. First three V's are the same but there are additionally Volatility, Veracity, Validity and Value. Starting with value, it is a factor that combines all the other V's. Big data analyzes are focusing on producing as huge value as possible for company itself and for customers and partners etc. Volatility means that old data may not be valuable and overall that data is becoming useless in quite fast manner. Veracity is about how much people can trust to the results coming from analyzes. (Ali-ud-din Khan et al. 2014) For example, Lehtikoinen and Koistinen (2014) point out that how much can people trust for analyses that are made based on complicated algorithms and who is responsible if decisions made based on those analyzes are wrong.

Lastly about validity, it is near veracity but it concentrates more on the accuracy and validity of the data. Meaning that some data is suitable for one situation but may not be

as valid with other situations. (Ali-ud-din Khan et al. 2014) While one of the V's is about volume, it is good to remember that value of data does not grow at the same scale as the size of data. So, adding data does not always add value. Sometimes the value can even decrease and processing times become higher. (Weldon 2016, pp. 337-343)

Good examples about companies using Big Data successfully are for example Google, Facebook, Netflix and Amazon. Considering data amounts used and processed, Google is the leader. (M. Žagar & D. M. Poljak 2015) While big data is widely used, it has still many difficulties and problems. When data amounts are massive, there can be found wanted dependencies somewhere on the data and then the true dependencies may not be found. That is why it is important not to have ready assumptions before research because then researchers may just try to fit the data to the assumptions. (Berman 2013, pp.145-148)

When thinking about big data analyzing process in a whole, there are different kind of chains made for describing that but let's look through two possible examples. One of those includes two phases: data management consisting of acquisition, extraction, cleaning and integration and second phase is analytics consisting modeling, analyses and interpretation (Gandomi & Haider 2015). Other model is data value chain that includes three phases: data discovery, data integration and data exploration. Data discovery starts with collecting the data. After collection, it is prepared and organized. In that way data accesses and structures are made. Data integration is to form a representation that helps in the exploitation phase. That last phase is about analyzing, visualizing and lastly making decisions. (Miller & Mork 2013) In overall those two examples of big data process are quite similar. This is still only the big picture and this process can variate a lot based on situation and used data. Especially, technology choice affects a lot to the chain. Modern techniques allow multiple ways to do data analytics and one recently quite popular way of analyzing is machine learning and especially deep learning (LeCun et al. 2015).

3.1.2 Data monetization

Companies like telecommunication organizations are producing massive amounts of data continuously. Many companies have understood that this data can be used and it can be valuable when used right. The problem is how to turn that data into money – how to monetize the data. (Arthur D. Little 2015) One reason making data monetization difficult is that it is hard to define a price for data or for information. Information gives different kind of value for each different business, so it is hard to find same kind factors that fits for all. However, there are multiple ways to categorize data like for example into qualitative and quantitative information. One way to find out information value is to find out volume of information's meaning to the business, information productions costs and from what timespan the information is. Still, this is only one way to define information value and it shows how hard it is to calculate value for intangible assets. (Sajko et al. 2006)

Another way to place price for information is to share it into quotative value of investment, incorporated risk and buyer's rate of return. These variables are still not simple to calculate. For example, rate of return may sometimes be hard to estimate when it is not straight forward to find one value for that. As well, risks are difficult to turn into numbers that would be comparable in multiple situations. (D. Rao & W. K. Ng 2016) Still, information value can be calculated in diverse ways but the intangible nature of data makes that process difficult and in many cases the results are more directional than accurate.

Data monetization would not be that valuable without modern technology offering new kind of powerful analytic capabilities. New innovative ways of doing business based on data may have a huge positive impact to company's revenue but there are many risks that needs to be taken care of. (M. Žagar & D. M. Poljak 2015) Risks are for example lack of data awareness, meaning that companies need to know what kind of data they do collect and have and how it needs to be handled to follow rules. Also, ethical side of data usage needs to be taken care of. (Arthur D. Little 2015) Problems arises for example with global regulations like EU's data protection regulation that is handled later.

Another risk is that the data can be stolen or misused because of poor data security. Transparency of data is also one risk area, sometimes it is unclear for users that is their data used in some purposes or not. Surprises may come if users get to know that their personal data is used while users did not know that. In turn, data inaccuracy may cause lots of problems and it may be quite hard to find out before it is too late. Meaning that data collecting should be well planned. (Arthur D. Little 2015) Information value includes multiple risk factors that needs to be identified. Information can be divided into different kind of assets like for tangible assets, intangible assets, paper documents and so on. (Sajko et al. 2006) That is why it is important to understand the differences in value and in risks between different kind of assets. For example, personal identity information has many risks and if that kind of data is used, there needs to be trust between company using the data and customers. (J. K. Adjei 2015)

One way to examine data monetization is to split it into two categories, to internal and external monetization. (Arthur D. Little 2015) Other way to do the splitting is to characterize into direct and indirect information (Sajko et al. 2006). These two ways to do the splitting is quite similar. Internal monetization is about to increase company's revenue with data usage. There are multiple ways to do that but to name few, revenue can be increased by improving product offerings and understanding customer need. Or revenue can be achieved with enhancing sales with personalized offerings for example, customer care and engagement, production and channel planning efficiency for example. Optimizing and enhancing production and maintenance can bring huge savings for the company. (Arthur D. Little 2015) Direct information using means pretty much the same. The directly affecting information supports human needs, technology, technical infrastructure and other secondary activities. (Sajko et al. 2006)

In turn, external monetization like indirect information use means that data is used for offering services and products for customers. (Sajko et al. 2006; Arthur D. Little 2015) Direct information influences in multiple ways like to create and enhance company's products, services and business process support. In that way companies can offer better quality for customers for example. Still, both indirect and direct information have similarities and outcomes for both can be same kind. Outcomes can be market success, better decision making and quality. (Sajko et al. 2006) Division between internal and external monetization is also hard to do precisely when there can be found similarities as well.

External data monetization can include data selling, information selling, analyze studies or predictions for example. Data can be used as well in a base of some new service. Sometimes it is just enough to sell the data and customer uses it with its own analyzing tools. Customers can also combine their own data to the bought data or compare different data sources and gain some valuable information. Usage ways are multiple and examples about telco data monetization comes in the next main chapter. (J. K. Adjei 2015)

3.2 Telco data

This chapter is about telecommunication data and important topics related to it. The chapter starts with little information about telecommunications industry to understand what is the context in bigger picture. Then there is a subchapter about what telco data really is, next is about what kind of competitive data sources does it face in data monetization context. After that is telco data limitations and telco data privacy and anonymization concerns. The idea of this 3.2 chapter is to form wide understanding about telco data without going into too detailed facts.

3.2.1 Telecommunications industry

Basic idea for telecommunication companies has been to create technology for lowering distance between different countries and places. Before telecommunications messages were transferred with help of messengers who transported messages by walking or by horse or by some another transportation possible. After first telecommunication technologies were invented, messengers started to be less important and replaced. In 1794 developed mechanical telegraph and in 1837 came copper wires. Development continued all the time because people started to understand the possibilities it enables. In 1896 communications were done using electromagnetic waves and optical fiber came in 1973. Telecommunications means all transmissions done by wire, radio, visual or by using some electromagnetic systems. (Huurdean 2003, ss. 1-8) Telecommunications industry has always needed to evolve and especially a lot in the last years. Calling and SMS are not anymore only options that mobile networks needs to handle. High user amounts with for example internet using, videos and social media have forced wide expand in core network traffic. More and more data is moving in networks all the time. (Weldon 2016, ss. 15-18)

Rapidly evolving need of fast and mobile data transfer has forced also access technologies to advance. Starting approximately from year 1995, cellular accesses have developed a lot. Figure 5 shows the order and roughly the years. As we can see from the Figure 5, there has been lots of different technologies. If we look at the data transfer speeds, we can see improvements from less than 0.1 Mb/s with Edge to over 10 Mb/s with LTE. 5G is not yet here but forecasts and researches show that it can reach over 100 Mb/s. There are forecasts showing that around year 2025 user data rates can be over 1000 Mb/s. (Weldon 2016, ss. 204-205)

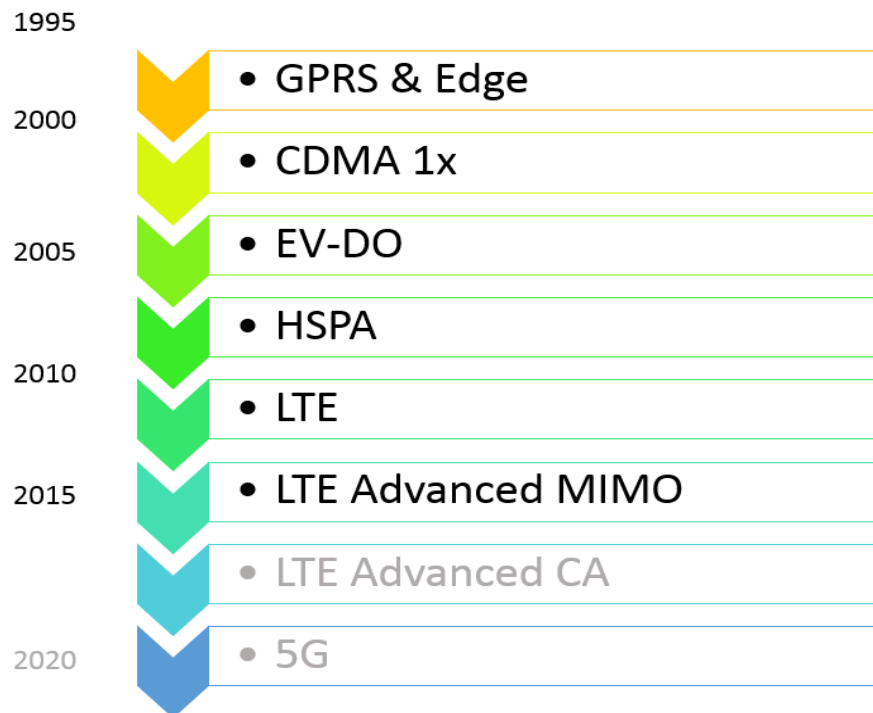


Figure 5. Rough figure about evolving cellular technologies. (Adapted from Rysavy Research 2013 and Weldon 2016, ss. 201-208)

Market demand for fast cellular accesses as well as rapidly evolving technologies have affected and changed the whole industry structure. Business models, frameworks, plans and technologies needs to be able to change fast if companies want to keep or enhance their place in the market. Fast changing markets are affecting challenges for telecommunication firms. (Li & Whalley 2002)

People's daily lives have changed because of the new technologies like artificial intelligence, analytics, IoT, cloud and platforms. That can be called for fourth industrial revolution and telecommunications industry is one of the parts making it possible by providing access and interconnectivity possibilities. Digital transformation is ongoing almost everywhere and it is providing huge benefits for telecommunications industry that is support-

ing it to happen. Telecommunication industry's ecosystem is quite wide and it is connected to following business segments: device manufacturers, content and aggregators, network equipment, wireless distribution and semiconductors. (Mittal et al. 2017)

3.2.2 What is telco data

Telco data is data coming from telecommunication networks. Each device that uses those networks is producing telco data that operator can collect. For example, each mobile phone with mobile subscription leaves digital traces almost all the time. This happens because functioning mobile phones are all the time connected with operator's infrastructure. Mobile phones are like sensors in IoT networks. (Calabrese et al. 2015) In Figure 6, there is a summary about telco data sources and more specifically about cell phone data type examples that is possible to get from the network devices. Digital traces are only one way of data that can be collected. Every call, message, internet connected app usage and internet connection can also be seen from the data exchange between mobile phones and cell stations. (Zheng et al. 2016) Telecommunications operators collect and manage billions of connection events daily. Those enormous data amounts make it difficult to analyze and find right kind of insight from the data. To fully use the data, proper knowledge about mobile network events is needed. (Dashdorj et al. 2013) One advantage in telco data is that from the data exchange, each mobile subscription user's average geographic position is possible to recognize. (Calabrese et al. 2015) Techniques of that are described more detailed later.

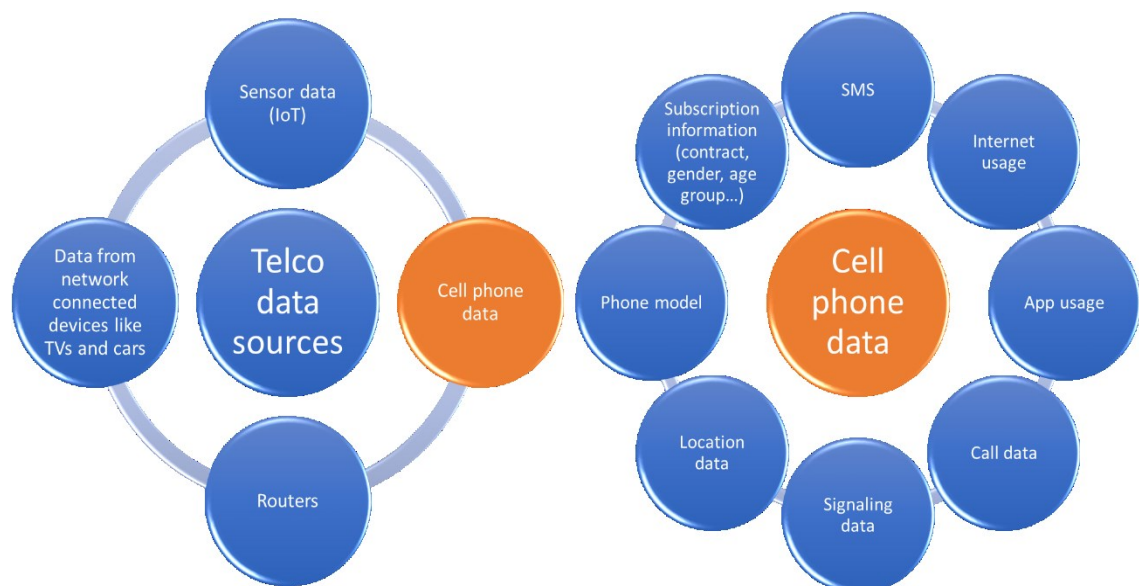


Figure 6. Telco data framework. Examples about telco data sources and more specifically cell phone data types (Adapted from Calabrese et al. 2015)

Location detecting of mobile subscribers makes it possible to do analyses based on crowd movements. Crowd analytics is a business and research area that has a lot of possible outcomes. Public organizations may be interested in public transportation passenger

tracking like traffic hours, user-groups, ways of transportation (car, train, airplane etc.) and overlapped trips (Elias et al. 2016). Location detecting can be used in many other cases as well. For example, people's daily behaviors can be identified based on their movements: where they live, where are they working, when they go to work, where they buy their food, where they use time and so on. To get more information out of that data, those anonymized people can be even categorized into different kind of blocks like to IT and Finance professionals or into male and female. Comparing those different people and their daily behavior gives even more valuable information. Specific research can also be made in some area of investigation like customer flows in and out stores and between stores for example. (Zheng et al. 2016)

Location detecting is still only one area of telco data. Telco data includes also all kind of other mobile networks events like SMS, calls and data connections. With all that data, it is possible to get information about what users are doing, not only where they are. (Dashdorj et al. 2013) With that kind of data privacy concerns are also quite big because content of those messages, internet data and calls are private. But with calls, messages and internet usage there is also a lot of other use cases like the amounts of those events. For example, some event organizers may examine how much people use their mobile phones during the event and for what purposes. (Calabrese et al. 2010)

Telco data can be used also in operators' own perspectives. With telco data, it is possible to understand mobile network cells' coverage areas, network topologies and how to enhance those (Neidhardt et al. 2013). Furthermore, operators can identify and predict traffic peaks and try to optimize the network to handle that kind of special peaks properly. Other possible security risks and vulnerabilities can also be identified and predicted with telco data. (Mittal et al. 2017) Churn rates (how many users are changing operator or just quitting current service) can be analyzed with telco data and other data sources. In that way operators can understand what is affecting to it. There can be issues like call amounts, SMS amounts, service call amounts, pricing plans, marketing and so on. With that kind of information companies can try to understand why people are changing operator and try to change that. (Huang et al. 2015)

To sum up, Figure 6 shows us how many kinds of things can be analyzed based on anonymized telco data. With telco data, it is possible to analyze where people use time, how much, why and how do they use their mobiles and where and why. Telco data is a data source that has multiple advantages like, fast real-time data, easily collectable data and wide user range (X. Chen et al. 2009). Possible use cases for using that data are huge and in the next chapters those possibilities are examined. The possibilities are handled mainly in purpose to understand human behaviors, so, there is no detailed information about how operators can enhance their services. What makes telco data even more interesting is that there are many limitations like laws affecting to the usage. Another interesting aspect is people's thoughts about crowd movement analyses. It is interesting to try to understand people's different opinions against this kind of analysis because there can be opinions

from “big brother is watching - how can I stop this happening” to positive opinions. That is why the main target of this research is business possibilities related to location data from mobile networks.

3.2.3 Comparing telco data to other competitive data sources

Telco data has multiple competitive data sources. To mention few of the most popular sources, there are for example Google, Skype, Snapchat, Twitter, Pinterest, Instagram and online shops like eBay. In case of data gathering and analyzing, Google may be the best option because it has so wide user range and especially with Google maps most of the people are sharing their location information. There are still plenty of other apps that are collecting GPS information, like Snapchat, Twitter and Facebook. These apps can provide various kinds of information about users, their habits, their life situation, their interest areas and their locations and so on but those all have one common disadvantage compared to telco data – user count. (Futuresight 2011)

For example, a survey done in UK, Spain and Singapore with total sample of 4,121 mobile phone users in 2011 is showing that only 71 % of the users are using the app heavily. Only 68 % of all smartphone users in the survey were using mobile internet or apps and the rest were non-users. That is why all those people’s crowd movements or another anonymized analyzes can be done based on much bigger user counts with telco data. That makes more accurate analyzes possible. (Futuresight 2011) While apps can collect many kinds of data from app users, same kind of information can be gathered from telco data as well. Telco data makes it possible to analyze anonymously for example data about users’ network usage that reveals information about visited websites, online buying and used apps. Data privacy concerning to telco data makes boundaries when all the used data needs to be anonymized and that is why all the possibilities to benefit from the data cannot be used. (Dashdorj et al. 2013)

Still, telco data has also some problems based on user counts. Countries have multiple different operators and that’s why one operator’s data set does cover only one part of the all users. In Finland, we have 3 major operators: DNA, Elisa and Telia and the users are quite well divided to those three options. According to DNA’s annual report, in the end of 2016, DNA had 27 % of all Finnish mobile operator users, Elisa 40 % and Telia 32 %. (DNA Oyj 2017) That means if one operator’s data is used it is pretty good representation of the whole country. But this may not be the situation in other countries. Also in Finland, if one is using data from DNA for example, they may miss some area of people that are using only Sonera and Elisa. To sum up, with telco data there can be data about the people group not using mobile internet or apps at all – people that cannot be analyzed with other data sources like Google or Facebook.

But if we do want to concentrate more into location data and crowd movements, telco data competitors like Google or other apps' collecting location data may be more accurate. GPS data is quite accurate in various places of world when telco data may include a lot of uncertainties. Telco data based location data is dependent of cell tower amounts and connection speeds. Therefore, in big cities locations may be quite accurate and in countryside very inaccurate. Also, what is good for competitive data sources is that all the time more people are getting mobile phones with GPS capability (Muhtaroglu et al. 2013). Figure 7 shows a short summary about the pros and cons of telco data's competitive data sources.

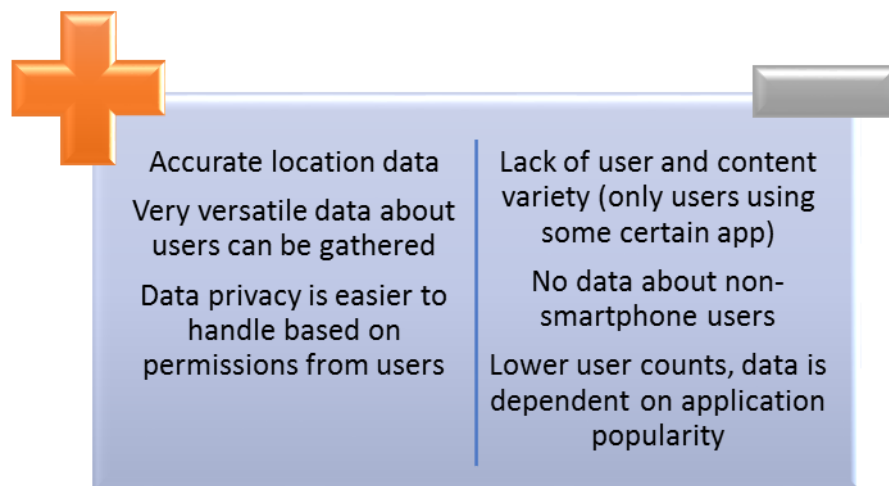


Figure 7. Pros and cons of competitive data sources for telco data

With modern technology like 4G and coming 5G those locations taken from telco data are becoming all the time more accurate. For example, with 5G positioning accuracies can be 80 % of occasions from 10 m to less than 1m. Furthermore, 5G based localization costs are almost same or lower than the other localization techniques like satellite systems or 4G solutions. (Alliance 2015)

3.3 Telco data limitations

Telco data as personal data usually has limitations. Nowadays people have started to understand that giving personal data to organizations may not always be a good thing or at least that there are some risks. Increasing attention towards data privacy is affected by many different cases. One clear factor is that news has dealt with data privacy topics a lot lately. One of the biggest news was Snowden's NSA leak in 2013 that rose attention over the world especially for people that are interested in politics, society and digital communication technologies. Snowden leaked information about global Internet and phone surveillance program that NSA has developed and used. (Chadwick & Collister 2014) That leak started a debate in many countries and especially after that interest about personal data usage and data privacy has been growing.

Furthermore, there has been lots of cyberattacks that has raised attention towards data privacy and security time to time. There have been massive attacks like Sony's email hack that caused over 10 million euros loses to Sony. It is understandable that after some cyberattacks people are afraid to give their personal information to the attacked company or overall to companies. So, cyberattacks are not only affecting costs to attacked companies but those cause also damage to the companies' brands. It is important that customers understand the possible risks and what kind of policies firms have against those risks. Even small enterprises need data privacy policies. Trust between companies and customers is a vital aspect. (Low 2017)

European union is updating its regulations about data privacy partly to enhance the data privacy and make data protection rules into this new digital era. Because of the new coming regulation, all the companies in EU need to handle and secure the data in same way. The regulation will be applied 25 May 2018. Companies can then better use and benefit their data in Europe when it is clear how much protection data needs and what can be done with the data and in other way around customers can trust that companies are handling their data in protected way. (European Comission 2012)

A little different but still one of the biggest problems in telco data using is accessibility. Operators are the ones that have legal access to that data and are responsible to follow rules and regulations. In that case, when telco data is wanted to use, access to that data is needed. Operators may not be willing to give that kind of data easily at least if they are not getting any benefits from that. (Shengguang et al. 2015) Those laws and data security aspects are important in telco data monetization, so next subchapter includes basic theory about data privacy and data anonymity.

3.3.1 Data privacy and anonymity

Data privacy is always important when companies are handling and using personal data. World is full of mixed thoughts and opinions about personal data, its usage and how it should be kept in safe. However, millennials seem to be most optimistic about sensitive data. Gallup done in the U.S. shows that millennials do understand possible security risks about personal data especially in social media but they do not worry about those. Comparing millennials to other generations, millennials trust more to different institutions' personal data safeguards than other generations do. Interesting concerning to this thesis work is that average trust for mobile phone carriers is only 17 % with millennials and 13 % with other generations. (Adkins & Fleming 2016) It is an interesting result when there are so many mobile phone users in the U.S. and in the entire world of course. When something is that vital as mobile phones, people still use those despite the low trust rates.

Considering data analyzing and the sensitive side of data, we can divide data into three distinct categories. First one is sensitive data itself, meaning data from where individuals can be identified. Next category is called quasi-identifier or pseudonymized personal data

(Official Journal of the European Union 2016). It means data that is not directly sensitive but quasi-identified data combined with additional information reveals sensitive data. Last category is benign data that is not sensitive, so individuals cannot be identified from that data, not even by combining it to other data. This is easier to understand considering email sending. Sender's name, email address and ID are sensitive data because the sender can be identified with that information. Then date, city and zip information are quasi-identified because only with that information sender cannot be identified. Lastly, email's subject and message itself are benign data because those do not reveal any identifiable data unless the message does include that. (Ying & Grandison 2016)

Considering bigger perspective, security challenges with data and especially with personal data can be shared to three distinct categories. Those categories are infrastructure security, data privacy and data management. In this thesis, we are concentrating into data privacy part but those other categories need also to be considered properly to fulfil data security demands. Data privacy consists of data encryption, data anonymization and access control. In telco data monetization purposes data anonymization is an effective way to give data access to more people in a safe manner. When data is fully anonymized, individuals cannot be identified and then data can be used more freely. Data encryption and anonymization is handled more detailed later. (Ye et al. 2016)

Accessibility in telco data is important because the telco data is sensitive and it cannot be monetized in that format. Furthermore, the operators own that data, so other people cannot get access to the telco data without permission from operator. With anonymization data can be transferred in to non-identified format to fulfill data privacy laws and then it can be monetized. Telco data is sensitive and one reason for that is because telco data includes peoples' mobility data. With telco data people's homes, working places, travel routes and so on can be identified and it is a big security risk if that data is revealed with personal information. (Calabrese et al. 2015)

What makes data privacy in telco data even more important is that De Montjoye et al. (2013) research shows that if four spatio-temporal points of one individual are known, there is a 95 % chance to identify that person with additional information. That is why extra attention needs to be taken to really make data anonymized. (De Montjoye et al. 2013) This is a good example about dealing with the boundaries between quasi-identified data and fully non-identifiable data. It causes questions how the boundary between those two data categories can be identified. In some researches like Elias et al. (2016) the anonymity aspect is cleared with changing user identity numbers. In that way one person can be tracked only one day with same ID number and then it must be changed for security reasons. That is quite big limitation for the analyses but security topics needs to be handled to keep people's identity safe when using the data. (Elias et al. 2016)

When the data is anonymous, different laws are affecting to it. For example, the new coming EU regulation about data protection does not apply fully anonymous information.

If the personal data is “changed” to be unidentifiable it is easier to use. Still data protection laws and regulations are needed to be fulfilled before the data is rendered anonymous. (Official Journal of the European Union 2016)

EU-regulations and laws are handled more specifically in the results part with this areas professional’s interview. As personal data using has risen attention quite much, also European independent advisory data protection and privacy working party under article 29 of directive 95/46/EC have wanted to give their opinion on anonymization techniques. That article shows problems that data anonymization faces. Data anonymization can be done using multiple techniques like aggregation, permutation, k-anonymity, l-diversity, t-closeness, hashing, noise addition and the working party opinion shows that all of them has weaknesses related to whether individuals are still able to find out or link to records or be inferred. (Article 29 Data Protection Working Party 2014)

Anonymization technique should be selected carefully based on the purpose and comparing it to its strengths and weaknesses. Sometimes it may be clever idea to combine different techniques to decrease weaknesses. Still, anonymization is quite difficult area, because techniques evolve all the time meaning that also re-identification may become possible or easier. As the anonymization field has lots of risks and unknow aspects, risks about anonymized personal data should be re-evaluated periodically and be ready to change techniques when it is necessary. (Article 29 Data Protection Working Party 2014) Telco data is very sensitive data and that is why companies cannot pay too much attention for focusing on the data privacy, data security and anonymization. Mistakes in that field may affect big problems in customers trust affecting decrease also in brand name valuation for example.

4. BUSINESS AREAS AND MODELS USED

This chapter answers three research questions. First is: “*What kind of and how mature business has been created based on telco data?*” and the second is: “*What kind of business model components are essential for current telco data monetization business models?*”. Questions have been answered based on theory. As the telco data monetization is a relatively new area of business, research into existing literature did not provide many telco data monetization business models. Analyzing various data monetization options gives new and different kinds of perspectives to search ideas from others kind of data monetization businesses as well.

The third research question this chapter is answering is: “*How models from other business areas can be exploited?*”. Answers to that question are theory based as well and it is partly answered also in the results part. Therefore, the main outcome of this chapter is to form a view about what has already been done around telco data monetization and to combine and compare the answers to different data monetization businesses.

4.1 Business areas in telco data based business

Concentrating to data based business areas, there can be seen a wide range of different business areas. Almost in every industry data is important at least somehow but in this chapter focus is in business areas that can be identified only in telco data based businesses. Business areas in telco data based business can be roughly categorized into three distinct categories: public organizations, companies and network operators (Figure 8).

Current business areas		
Public organizations	Companies	Network Operators
Public transportation	Restaurants	Churn
Route planning	Retail	Network analyzing
Tourism		Predictive maintenance
Public Safety	Advertising	
Travel / Transportation		
Traffic		
Urban planning		
Infection spread identification		

Figure 8. Business areas identified from literature

Based on the literature that can be seen on Appendix A, all the researches can be included under public organizations, companies and network operators. Figure 8 is a rough summary about those researches done to show how many business areas could get benefits from telco data. In the literature research, public organizations had the most of different use cases, so let's start with that. Figure 8 shows only business areas that were able to find based on the literature research, so that is why it does not include all existing business areas in telco data business and is just directional.

4.1.1 Public organizations

Public organizations can use telco data in multiple ways. Examples about telco data usage in public organizations are not always directly used in some public organizations. Still, all the coming examples have that kind of nature that those at least could be used and benefitted in public organizations.

One way to use telco data is route planning where the data can offer valuable information about how people move and what roads and transportation options do they use. In route detection, it is possible to find out what routes people use to go from one place to another. That makes it possible to plan routes for example. Route planning is not the only option for public organizations. From the same kind of research there can be found information about traffic spots and times and transportation systems as well. (H. Hendrikx & M. Núñez-del-Prado-Cortez 2016)

Traffic detection is a common way to use telco data. There are multiple researches where traffic has been identified and used in various purposes like public transportation, transportation, traffic and even urban planning. (X. Chen et al. 2009; Elias et al. 2016; Parwez et al. 2017) Transportation planning is interesting area of business to plan with help of telco data. With that kind of data organizations can identify differences between individual and public transportation. In public transportation, user-groups can be identified and that helps in transportation planning. Another way to enhance public transportation is to look out each user's movement in purpose to find out if user is using public transportation, individual transportation or both. (Elias et al. 2016) Especially use cases when user use both individual and public transportation to achieve its destination may reveal vital information if frequent patterns in some area can be found. This can show places where public transportation could be enhanced.

Urban planning is also very common way to use telco data. Urban planning is not only about route planning because it includes multiple other aspects as well. Urban planning can include things like how people use urban places, how they move from place to another, how special events affect to travel demand or to mobile network demand. Urban planning can be focused as well to energy waste or to noise problems. (Calabrese et al. 2015) Urban activities in some certain location and time can also be find out. (X. Chen et al. 2009) Activities can include information about what people are doing in some location,

like if they are listening to music, searching internet, using some app or calling for example (Haoxi et al. 2015). Sometimes research can be done only to understand how many people are in some location in some timespan. Visualizations about that kind of data can reveal essential information for public organizations as well as to other organizations. (Reades et al. 2007; Wu et al. 2016) Data can be also gathered in purpose to find where people's homes are and where do they work (M. Dash et al. 2014a; M. Dash et al. 2014b).

That kind of urban behaviors are not only important for urban planning, that kind of data can also reveal some virus spread patterns for example. For example, with this data some virus spread can be visualized and propagation predicted. With data and predictions some dangerous virus spread patterns can better be understood and even tried to prevent. (M. P. A. R. Abeyrathna et al. 2016) Last block in the organization category would be tourism but as it is important for companies as well, it is handled in next sub chapter.

4.1.2 Companies

Tourism is wide area of business that multiple companies can benefit from. With telco data, it is possible to categorize data into different user groups like tourists for example. Still, tourists are only one option and telco data can be categorized in other ways like age groups or gender. With grouping, more detailed information about users can be achieved. (Dashdorj et al. 2013) Information about tourists can give valuable insight for companies like hotels and restaurants and so on that benefits from tourists. Companies as well as public organizations can anonymously track where tourists move and how much time they use in different specific locations. (Sikder et al. 2016)

Transportation is also one of the common business areas between public organisations and companies. We handled transportation quite well in the previous part so let's move on to the next category which is restaurants. Restaurants can benefit from tourist data as well but another benefit is to see where all customers come to the restaurant, how long do they stay there, do they use their mobile there and where do they go next. In that way restaurants can gain insight about how they need to change their services or how they can gain new customers. This kind of analyses about peoples' movements in some specific location like restaurant, shopping mall, retail store or some shop for example offers valuable insight for different kind of companies. (Zheng et al. 2016)

Another clear business area is advertising. It is possible to create many kinds of B2C advertising based on telco data. One way is SMS based advertising. In that way advertisement and other information can be sent to people in certain locations for example. (V. Smailovic et al. 2013) Another way to use telco data in advertising is billboards. The idea is to change the ad in billboard based on the biggest people groups passing the ad board in some timespan. It is also possible try to achieve new customers by doing advertising in some locations where live people that uses some shopping center often for example or

in some areas where live people that does not yet use the shopping mall. Because companies can see where people come to their firms, it offers a wide range of possibilities to arrange targeted advertising. (Zheng et al. 2016)

4.1.3 Network operators

This category means business areas that help network operators benefit from the data. Network operators can create business based on telco data by selling the data or information. But to separate this category from the previous one, the idea is to focus on how network operators are enhancing their main services – internal monetization. One way to do that is churn prediction and preparing. With help of telco data operators can identify what kind of matters may lead to churn and unhappy customers. In that way organizations can enhance their services and prevent churn or/and achieve new customers. (V. Smailovic et al. 2013; S. Ashraf & S. A. Khan 2015)

Network analyzing is also one way to improve customer satisfaction. In this context network analyzing means analysis about how mobile networks are working and serving customers. With proper network analyzing operators can identify anomalies in networks like network traffic. With that kind of analyzes and predictions resources can be shared in a way that customers get best possible networks as possible. Mobile network fault avoidance is also possible. That is why predictive maintenance is also mentioned under the network operator's category. (Parwez et al. 2017)

4.2 Business models

Business model in normal data based businesses and in telco data based businesses have same kind of nature as in both the key advantage is around data. That is why next two subchapters are going to handle first business models in data based business and then business models in telco data based business. In that way, new business models to telco data usage can be identified and copied from other business industries. Other reason is that telco data based business models are not widely handled in the literature, so other data using models are in the purpose to understand the big picture better: what has been done already and what could be done.

4.2.1 Potential data based business models close to the target company's current models

Analytics and business intelligence are essential elements in data based business models. As can be seen in Figure 9 which is a summary of Gartner's 2017 hype cycle about analytics and BI, there are multiple types of analytics that are near the peak of inflated expectations. To mention few that are near to this research area, prescriptive and predictive

analytics are there as well as personal analytics, geospatial and location intelligence, mobile app analytics and real-time analytics. Visual data discovery is the only one that is already in the plateau of productivity phase. (Schlegel & Hare 2017)

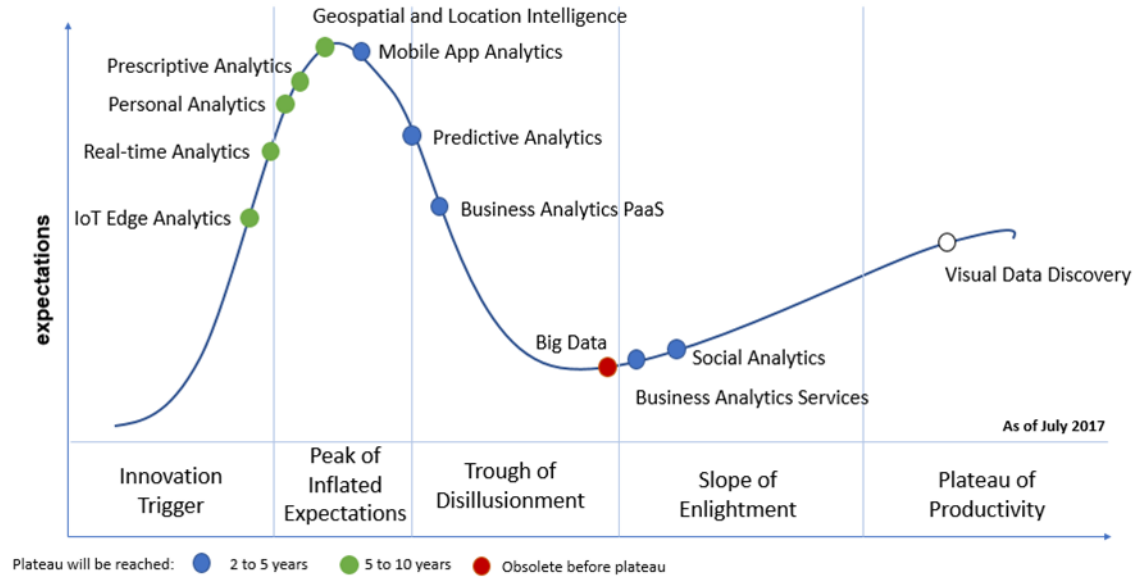


Figure 9. Summary about important elements from Gartner's 2017 hype cycle about analytics and business intelligence (Adapted from Schlegel & Hare 2017)

As the Figure 9 shows, expectations in different kind of analytics and business intelligence are quite high. Hype around big data itself is not as big anymore but it is showing signals to get through disillusionment phase. (Schlegel & Hare 2017) To sum up, there are lots of things going on in the data based business field and only time shows what are the ideas and innovations that can achieve long time benefits and popularity. One thing to notice is that data can come from various sources, so while it is common that big platforms with masses of people bring lots of interesting data, there is still lots of other options as well. Companies own data from their databases and sensor data for example.

In big picture, data based business models have lots of similarities and same kind of models can be used in different use cases. But still, every business model is different and has its own specialties. Next, there are potential business models that are already close to the target company's current models. Those models are: AaaS, DaaS, health care data and cloud based platforms for real-time data processing and analyzing.

Analytics as a Service (AaaS)

Analytics as a service (AaaS) is one innovative way to create business and its idea is basically as with Platform-as-a-service (PaaS) models. New services like cloud, has made it possible to process, store and access massive amounts of data efficiently. That has changed the business models creating a new layer to handle data for example from IoT. Cloud based solutions provide flexible and scalable access to data and applications made

based on the data. The earning logic is also innovative, when customers are paying only as they use. Models like subscription or pay-per-use can be used. In that way, it is not big investment for customer starting to use or test that kind of services when there is no need to buy the whole system at the beginning or later. The variety for this kind of “as-a-Service” types are huge, there are topics like Sensor Event as a Service, Video Surveillance as a Service, Big Data Analytics as a Service and Data as a Service for example. (Jayaraman et al. 2017)

AaaS value proposition is based around data processing, analyzing and visualizing. That kind of services can support different kind of data sources that companies have and need. Data is also possible to integrate from multiple sources like location data, real-time data, social media data or data from, web, sensors, devices and so on. After data is collected, AaaS services provide processing and preparation for that data. After preparation, cloud based systems usually analyze the data in the needed way. Analytics can be descriptive, predictive or prescriptive for example. To show analytic results, AaaS services provide visualization like dashboards, location maps and interfaces. Furthermore, easy access and collaboration tools to use those with wanted device types. Earning logic is to get revenue based on subscriptions, or in other way around pay-per-use. Therefore, revenue may be based on the hours customers use the service and how much they use storage capacity. (Naous et al. 2017) Or to go one step even further, payments could be collected based on value achieved – pay-per-value.

Customer segments in AaaS business models have four key areas. Business users are all the people that can leverage from the data and analytics. Next segment is business analysts who need possibility to create reports. Third user segment is data scientists and developers who need possibility to create data models for example. Last important segment is IT architects who needs data to better manage data sources. In turn, customer relationships are tried to handle as much as possible via online channels like customer portals and communities. This online customer relationship handling is only one ideal situation, so there are also traditional ways to handle customer relationships as well. What comes to channels is that companies providing AaaS services need direct channels like online channels and then indirect channels including partner networks. Partner networks are important and those include software vendors, equipment manufacturers and system integrators. To sum up, partnerships are basically about different kind of technology partners and furthermore resellers are needed. (Naous et al. 2017)

AaaS services could fit to telco data monetization in a way that customers are offered with analytics-as-a-service where operator and/or service provider provide service where they add customer’s data to telco data and in that way, give more valuable analytics and insight to customers. Because all the a-as-services are quite near to each other, the simple idea would be to offer a platform like analytics platform or insight platform to customers providing telco data insight services. Or on service provider perspectives, they could sell analytics-as-a-service to operators to form analytics out of telco data and then operator

could sell those analytics to business customers. With little specifications analytics-as-a-service could be used in telco data monetization and totally new business models may not be needed. Furthermore, novel ways to link business model's activities to each other are an important value driver for business models (Zott & Amit 2010). In this kind of as-a-service models many activities can be tied to one entirety what may also effect lock-in.

Data as a service (DaaS)

Second innovative and new way in data based businesses is data as a service (DaaS). It is one step away from AaaS, meaning that DaaS concentrates more into providing right kind of tools and services to get data into useful form. Its idea is to process, integrate and configure all the data that companies have in distinct databases to a form that it is easily accessible. (Cai et al. 2016) It has many similarities with AaaS but DaaS does not handle the analytics and visualization part. Biggest benefits in DaaS is to get real-time data by making the whole data collection and processing more efficient. (Vedicis and Alcatel-Lucent Join Forces to Launch Innovative Smart Data as a Service with a Disruptive Business Model, 2015) When the data is in a proper form already, customer companies can concentrate to use the data in a proper way. Also, DaaS business model consists of same kind of blocks as AaaS, of course there may be small changes when the analytic and visualization part is not included but mainly the blocks are same kind.

Target company is already using this kind of as-a-service models and that is why those could be easy to use in other business areas as well. But that DaaS model may be more difficult for telco data monetization when operators may not want to sell their data. Still in case, if operator would be ready to sell (anonymized) telco data, it could be sold in a model where operator and service provider change the telco data and customers data into same format and put the data easily accessible and then customer itself can do whatever analytics to the combined data as they want.

Health care models

Another popular value proposition area is health care and especially health data based business models. Activity trackers like step count trackers and pulse trackers are used in multiple analyzing purposes. With that kind of devices people produce all the time more and more data that can be analyzed for finding patterns and important information. (Paul et al. 2015) Health care data is still not only data from activity or monitoring trackers and devices, it includes also data from medical records, costs, medical companies R&D data and all kind of other medical content. With that data companies can for example provide customers value with preventive care services, give valuable information for insurance companies, help doctors to make decisions or help medical R&D projects. Options in this area are also huge. (Muhtaroglu et al. 2013)

Health care is near to target company's current business and health care is one good example about combining B2C and B2B. Business customers can leverage from the data

and insight in many ways like mentioned above, but also individual customers can leverage with the data about their own health (Muhtaroglu et al. 2013). If network connected health sensors become even more popular, more telco data about those sensors can be collected. That kind of business models with health care value propositions can become popular. One reason why B2C health care service models could work well are that lock-in may be really strong when customers realize that services are getting their health better and strong lock-in is one of the important effectivity elements for business models (Meyer Haggège et al. 2017). Furthermore, both target segments B2B and B2C can be used and that is why there are plenty of revenue models to use. In B2C perspectives, previously presented business model trends like free and multilateral platforms could work well. In free model, some health app can be offered for free and customers could buy some extra features or the revenue could come from advertises. In multilateral platform perspective, the health care product would be only beneficial if there are massive amounts of users to produce the data for platform to function better. (Gorevaya & Khayrullina 2015) Both models could fit well for health care and maybe even in a combined way.

In B2B perspectives multilateral platform way may be needed for gathering enough data that can be sold to business customers. In B2B segment, models like Platform-as-a-service could be used. In a model that is based on and platform or app for customers, one benefit is that customer engagement is present. That is because customers get benefits about getting better health and in that way, they are more willing to give their information to further analyses for getting even better services. If they pay about the platform, some of the platform costs can be shifted from the organization to customers in a way to create even more effective model (Meyer Haggège et al. 2017). Still, that brings one key activity present, because health data is very sensitive and that is why data privacy needs to be taken care of.

Business models also have cost structures. Costs for data based business come mostly from infrastructure that needs to be first build and then maintained while obviously there are other costs like sales, marketing and so on. One benefit is that network effect helps in marketing. But one down side in different kind of data platforms with lots of users are that maintaining costs also grow with increasing user count. (Muhtaroglu et al. 2013)

Cloud based platforms

With cloud based platforms, or platforms in overall, there is multiple ways to get revenue out of those. One way is that revenue can be gathered with pay-per-use strategy. In that revenue model, company is offering cloud based platform where customer can store and maybe analyze their data and customer pays based on the hours they have used the service for example. (Jayaraman et al. 2017)

Another way to get money is to sell the data that users are creating. In that business model, users may use some platform for free and company gets revenue from companies that are

buying that user data from the platform. The platform usage does not have to be free but if it is, there may be much more users and in that way more companies may be willing to buy the data or readymade analyses made based on the data. (Muhtaroglu et al. 2013) That kind of multilateral platforms are identified as a trend in business models field. (Gorevaya & Khayrullina 2015)

Another value proposition with cloud based platforms are that the usage is easy, when users can access the platform from different devices and they do not need to have big data warehouses for the data (Mittal et al. 2017). Online customer service is coming common in this kind of businesses but still also traditional ways are used (Naous et al. 2017). Customer relationships are handled partly online, in a way that customers get a self-service interface where the information is available to the user and easily accessible with any device. Customers can use that interface in a way that is best suitable for their needs. Sometimes the value customers get is created with companies' co-creation. (Muhtaroglu et al. 2013) One common thing in many data based service is all the time growing need for usage requests when new customers are coming all the time. Cloud based platforms are one way to store and make data easily available in a transparent way, so increasing user amount handling is one of the key resources. (Muhtaroglu et al. 2013) And typical customer segments inside the customer company are data scientists, IT architects, Business analysts and normal business users using the data as well (Naous et al. 2017).

Lock-in is also typical benefit in cloud based platforms when customers are dependent of the data and maybe of using the platform as well (Tang 2016). Lock-in effect is usual with technology related services. That is because the more users use services it is more difficult to change service provider. (Meyer Haggège et al. 2017) For example, if you have used some service for a long time you will lose all the benefits that have come related to your data produced or related to the data from other users. In that way changing the service producer may not be easy when you can lose some important benefits and user may need to start from beginning. Also, when companies already have cloud based platforms, it would be easier to use the basics from those models and fit telco data there as a key resource.

4.3 Potential data based business models further from target company's current business

Models using location data

Thinking about location data applications, those are targeted for mass markets. That is the case with many other applications as well. Still, many of the data based services are concentrated to multiple specific segments. Targeted customer segments can be different user groups in B2C sector or some actors like manufacturers in B2B sector. Many data based services needs lots of users in the platform to get the necessary data. That tells the

fact that customer segment needs to be wide to provide the service work properly. (Muhtaroglu et al. 2013) To sum up, customer segments varies from small target groups to mass markets and those are dependent on the nature of the service.

Channels to reach people with data based business models are quite similar like with any other services. Still, many of the data based services for B2C-sector are application based services. Those applications are offered usually via Apple Store or Google Play or via web. Of course, marketing channels vary a lot but these two basic sales and marketing channels are widely used. (Muhtaroglu et al. 2013) One way to distribute channels in B2B as well in B2C is to split it into three distinct categories: traditional, virtual and combined. Virtual channel is becoming trendy because data is wanted to be shared and exploited on line and whenever wanted, as well as customer service is wanted to give online. (Gorevaya & Khayrullina 2015).

The popularity of location based services is growing all the time bigger when devices like smartphones collect enormous amounts of GPS data. With that data companies can create several types of value for their customers. For example, Foursquare app gives users possibility to rate places they have visited and then others can benefit from those rates. (Muhtaroglu et al. 2013) Another example is Google that uses GPS data for example to give drivers best route suggestions as possible by identifying traffic places with anonymous data of its users. More GPS data based services are coming all the time because that kind of data allows so many different value propositions. (Neidhardt et al. 2013)

In that way companies like Google, Foursquare, Snapchat and Twitter for example can achieve important information about customers movements and use that data to enhance the service and even to sell that data further. (Futuresight 2011) When the location platform like Google Maps is free to use, revenue models need to be cleverer and for example advertising based. All the revenues can come from data insight selling as well. That is one reason why telco data based B2C services would be difficult to create when there are competitors offering location based services for free already. But as Google and others can sell their location data, the same model can be used also with telco location data.

Google AdMob is a good example of the user targeting mobile ads that are created based on user data. AdMob can be used for example in free applications. Google AdMob gives targeted advertisements based on user's data. (Ullah et al. 2014) It is an ad platform that offers possibility to monetize mobile applications easily by integrating that feature. There are at least two different options; to give rewarded video ads to users, meaning that users get some extra features by watching an ad video or just use native ads in the application. Company gets more money from Google if more users are seeing the ads or clicking the ads. Google gets money from the advertisers when they can offer a service where advertisements are shown to targeted people based on huge data masses. (Google 2017)

Blockchain web-store

Blockchain business is also worth mentioning because that kind of concepts are really hyped at least in 2017. Blockchain based businesses have grown rapidly and shown benefits in multiple industries like manufacturing, supply chain, health care, education, finance and so on. Blockchains offer a new way to digitalize processes with decentralized model. With blockchain technology companies can offer new kind of value to its customers with safer and faster money transactions and smart contracts for example. Possibilities with blockchain businesses are wide and that has caused lots of people creating their own start-ups and cryptocurrencies and seeking funding for their business idea with ICOs. ICO comes from words Initial Coin Offering and the idea is to raise money for a startup. What is interesting in blockchains is that with it many old ideas and business models can be transferred to offer new kind of value for existing customers and to attract new customers as well. (Barnes & Burton 2017)

Blockchains show us how fast new technologies can affect and enhance to current ways of doing business. Internet of things has become common in many companies and old business models are not fitting to the new demands properly as told before. Blockchains are one possible answer to the need of new kind of business models. (Zhang & Wen 2017) In other way around, possible failures like security or scalability problems that may occur in this kind of modern technologies may force the business models to turn back to the previous ones in a fast manner as well. One critical element in blockchain based models is in revenue models, when there is no need for middleman and services can easily be offered to business customers as well as other customers with one peer-to-peer platform (Christidis & Devetsikiotis 2016). One example how blockchains could fit to telco data monetization is blockchain based web-store. That example brings additional features to model where data or insight is sold in web-store or in cloud based platform. To sum up, blockchains makes some data processes much easier and trustworthy (Christidis & Devetsikiotis 2016).

What this means for Internet of Things, is that companies can make platforms based on blockchain and smart contracts to offer marketplace and services for data sharing between devices and people. In that way people can buy and sell wanted data like they can sell and buy for example electricity with the help of proper other blockchain platform. Every transaction can happen without any middlemen. Blockchains are also a powerful tool for other data processing and analyzing purposes when networks calculation power can be used for customers tasks. (Christidis & Devetsikiotis 2016) There are multiple ways to pay for calculating power, one is to use blockchains and other is buying it from some companies offering it for a monthly subscription price for example. To sum up, blockchain-IoT platform can allow anyone to sell wanted sensor data and buy other one's data from the blockchain.

In blockchain based IoT business model, there are multiple options how to form a business model from different blocks. Regarding to Zhang & Wen (2017) in IoT business model using blockchains, business is happening between customer and decentralized autonomous organization (DAC). When the traditional version has had high supervising from government for both customer and the company and there could be also other middlemen in the process. The new way is that all transactions with money and data are made automatically based on smart contracts. In that way customer relationships can also be handled online and there are less channels needed. But in this situation companies providing blockchain applications, there is need for blockchain expertise. Earning logic is quite different than traditional ones when money goes directly from the customer to the seller and the company providing the platform earns revenue via transaction fees that are paid for the system. Company can also create revenue if it is selling their data on the platform as well. What is good is that customers pay only about what they are using and when there are no middlemen there are no need to pay for those parties. (Zhang & Wen 2017)

This kind of model would fit to telco data monetization in a way that operator or service provider maintains a web-store where they sell telco data insight to all interested buyers. They could also offer a possibility for other people to sell their data insight which could be combined with telco data insight. In that way, operator and service provider gets revenue per each transaction made as well as when their telco data insight is sold. If blockchain aspect is seen not that potential now, this model could work properly also without blockchain, so only a web-store to sell and buy data and insight.

To sum up the whole sub-chapter, when data can be gathered from services and from social media and from other that kind of platforms, the business models have also needed to change. There can be seen an increase in personal data-dependent business models that are driving the new wave of information generation and using. One common aspect of these business models is platform that connects sellers, buyers, advertisers and other users together. This kind of platforms share products, services, intangible assets and so on in a digital way. With personal data dependent businesses, EU and other policy makers plays a key role in defining proper rules for data usage. It is problematic to find out the boundary between benefits that new data processing techniques and technologies bring and what can be done based on data privacy and ethics. (Buttarelli 2015)

4.3.1 Business models in telco data based business

As can be seen from Appendix A, there is not that many researches concentrating just into telco data business model creation. Still, some researches handle those and at least many of the researches handles the business potential. As can be seen from the business areas in telco data based business, there are lots of potential business areas for multiple types of companies and other organizations. Telecommunication operators have understood that and now they are creating new kind of business models to monetize that data.

Internal process optimization and enhancement is not the only way to get revenue and data selling to other companies has become more interesting. (Calabrese et al. 2015)

Telco data mining process is better handled in the empiricism part but usually data mining processes includes three steps that can be seen in Figure 10. To start from the very beginning, data mining process starts from identifying the data source and its specialties. After that the data is collected and pre-processed in proper format. After that the data is analyzed and maybe visualized in a way that it serves the business purpose. All in all, these three steps are common but the content and scope can change. Meaning that wanted data is picked regarding to the scope and it is processed to serve that scope as well. The last box is the one that can change the most. Because analyzing depend a lot on what kind of insight, information or visualization is wanted. (Haoxi et al. 2015) These three steps are vital for telco data management and it is company's key activities to fulfill these steps properly. Still, sometimes telco company may outsource some of these blocks or leave the last block fully to customer. Business model needs other key activities of course as well but these three blocks are still the ones that creates the base.

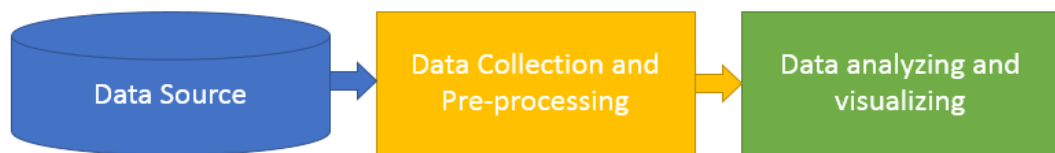


Figure 10. Data mining process (Haoxi et al. 2015)

Value proposition from business model canvas was the block that was most handled during the literature research about telco data monetization. Many times, researches were not handling business models but at least many of them showed the possible business potential and that is many times about the value proposition. One way to enhance business by using telco data is trying to understand and react for crowd movements. For example, shopping malls, retail stores and restaurants can do targeted advertising and enhance their decision making with telco data. In that way companies can create value that was before impossible to achieve. When companies can know from how far people come to their location, what kind of people are they, how long do they stay, what they do there and where do they go next, it is much easier to plan future and gain new customers. Also, telco data makes it possible to see same types of activities in competitors' locations what makes the insight even more valuable. (Wu et al. 2016)

Crowd movement analysis are not only suitable for shopping malls and restaurants for example because that insight can bring value also to other business areas that were mentioned earlier. Domains can be different but one common thing is that the value comes from analyses. What is more, analyses can be made better with additional data. Combining and comparing data to various sources like Twitter, Facebook or company's own data from other data sources. That can offer totally new kind of insight that can help making

decisions, achieving new customers and keeping existing customers for example. (Dashdorj et al. 2013)

One clear value proposition is find out insight about some specific user group like tourists. That kind of information can be valuable for many types of companies. Tourists' location data may be important for government and for police but real business value it can offer to companies which tourists use. (Sikder et al. 2016) Foreign people attractiveness is a value that company can gain with data analytics – telco data added to company's own data and maybe some other data sources as well.

The variety and possibilities in telco data monetization are wide, so it is good to remember that there is also some negative aspects and problems. As told in the data limitations chapter, telco data has multiple limitations like data privacy and data accessibility. Telco data is not available for everyone. Telecommunication operators can collect and use that data but then other companies need to get that data from operators. That is where the costs come to companies and in other way around where revenue come to the operator. (Calabrese et al. 2010)

Data accessibility is not the only problem making business model creation problematic. Data privacy causes problems as well. As mentioned before, telco data usage possibilities are various and it is good to remember that the value may not be achieved easily. The type of data is very sensitive and that is why there are lots of topics to take care of. Especially topics like laws, unwanted use and ethicality are important things to consider. (Cline et al. 2016) What makes the problems little easier, is that by anonymizing telco data, data privacy laws are not as strict. But this is the case only if the data is really fully anonymized. Meaning that anonymization technique used should be well made. In other way, differences between different countries privacy laws affect problems. (Calabrese et al. 2015)

Looking at business model canvas' block "customer segments" it can be said based on literature research that in telco data monetization, companies are customers. In other words, most of the use cases are B2B. That makes channels and customer relationships easier to handle when the focus can be only in B2B customers. That is why it is interesting topic to think how normal people (B2C) could benefit from that kind of data or service provided based on telco data.

Revenue streams in telecommunication industry are in a transition when operators are trying to find new business models to earn more money and to properly use their existing data and knowhow. Digital transformation is ongoing and huge revenues can be achieved if the opportunities are used in a right way. Telco data monetization is one way to achieve those revenues and there is no simple guideline how to get revenues from telco data. (Mittal et al. 2017) What is clear is that there are lots of opportunities and ways to get revenue like in other data related businesses has shown.

Last two blocks in business model canvas: key partners and cost structure are quite straight forward in telco data monetization when more innovative models may use more innovative ways to get revenue and reduce or transfer costs. Partners variates a lot based on the value proposition but at least operator and customer are key partners. Going deeper, there may be lawyers handling data privacy issues, technical people or companies handling data anonymization and the whole process and then other companies that may provide additional information or data. In big picture, cost for operators come at least from the anonymization, data processing, collecting, storing and analyzing and for the customer who uses the data, the cost is based on the deal how they buy the data or analyses. If operators use service providers for analyzation, cost may be shared between those parties for example.

Because business models are not so widely handled in the found literature, here is a little market research about how some big companies are using telco data and what kind of services do they offer based on the data. As can be seen from the Figure 11, there are same kind of business ideas the literature research revealed.

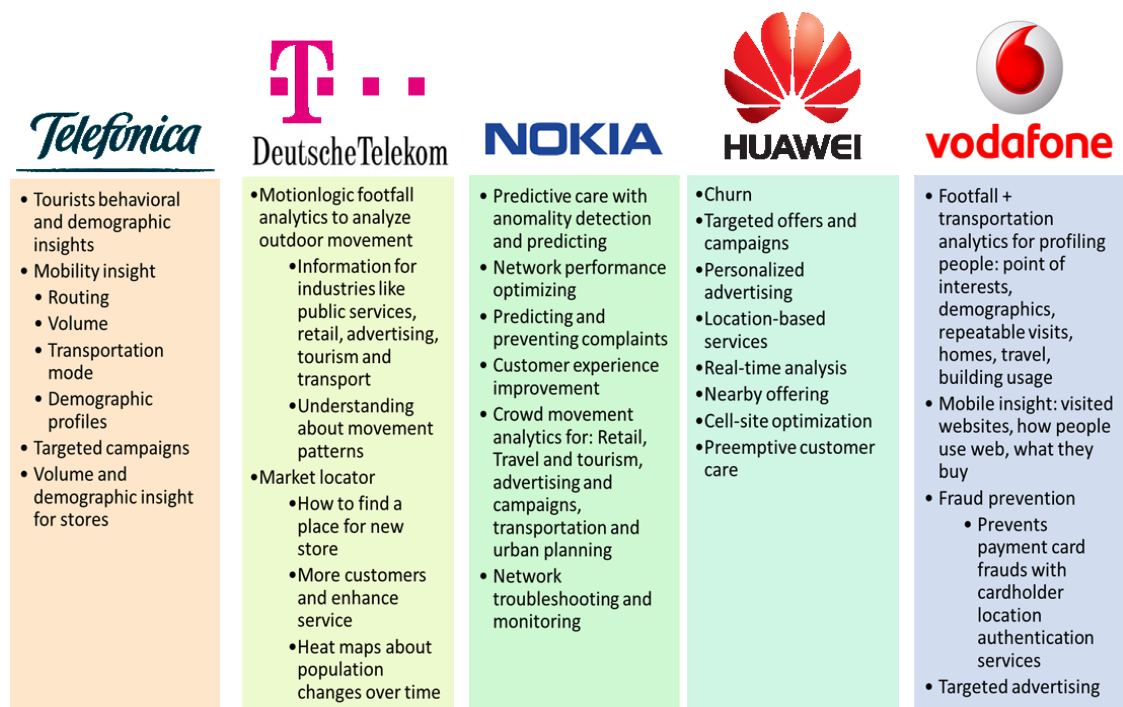


Figure 11. Telefonica's, Deutsche Telekom's, Nokia's, Huawei's and Vodafone's telco data service offerings (Banerjee 2013; Vodafone 2017; Telefonica 2017; Nokia Networks 2017; Deutsche Telekom 2017)

Figure 11 show what kind of telco data based business Telefonica, Deutsche Telekom, Nokia, Huawei and Vodafone have been developing. These five companies have been selected to show services that operators and service providers like Huawei and Nokia are offering related to telco data business. These are only examples and many other companies are playing in the telco data monetization market as well.

To sum up, many of the presented business areas are similar than the ones found in the literature research. One new example that literature research did not show was fraud prevention against payment card frauds that is a new service using cardholder's location by comparing it to the payment location (Vodafone 2017). Another interesting finding was to examine population changes and crowd movements over time (Deutsche Telekom 2017). Time is of course important aspect in telco data usage but it is good to remember that sometimes it would be good to have movement data from really long-time span. Then it is possible to analyze even the population in some area or even in some country.

Comparing telco data to other data sources there can be seen similarities. One of the biggest similarities is geo data. As mentioned before, geo data is possible to get from telco data as well as from some applications like google maps for example. What is different is the scope of business. There are lots of applications using GPS data somehow in a way that customers get benefits from that. Location services are usually tied to some other activities to create value together and that kind of applications has shown that customers are willing to pay for geo services. (Oxera 2013) While geo data is widely used also in B2C business models still telco data based geo services are not. Location based businesses in telco data side are more focused on B2B. One reason may be that data privacy is more complicated in telco data side because when data needs to be used anonymously and applications using GPS data are requesting permission to use that data making data privacy concerns easier.

5. RESEARCH METHODOLOGY

This chapter consists of three sub-chapters. This chapter also starts the empirical part of the thesis. First sub-chapter is about methodology. It includes reasons for selecting research questions and information about the used research approach and methods as well as strategy used. The idea is to give basic understanding what methods were used and why.

5.3 sub-chapter is about material collection to better understand how the materials are collected in the theoretical and empirical part. Material collection for the empirical part also includes a summary of every interview's and workshop's central themes and participants' needed areas of expertise. Last sub-chapter is a brief summary of the whole research process to give a big picture how the whole research process proceeded from start to the conclusions.

5.1 Methodology

As mentioned in the first main chapter, the main research question is: **What kind of useful and interesting models could be developed for telco data monetization?** To answer that question there was used eight sub-questions:

- Which types of business model overall trends can be identified?
- What is telco data and how can it be collected and monetized?
- What kind of and how mature business has been created based on telco data?
- What kind of business model components are essential for current telco data monetizing business models?
- How models from other business areas can be exploited?
- What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?

Chapters 2-4 are handling these questions in a theoretical and descriptive way. Material in these chapters are from literature research of this area and literature is including academic journals, books and other publications. Concept analysis and descriptive research method are used in the theoretical part. In that way theory part is providing information about what are the critical characteristics of this research, how those are connected to each other and what is the framework.

Findings from 2-4 chapters are used to give basics and understanding of the problems and current situation for the empirical part. In empirical part, the idea is as well to give answers for the research questions in different viewpoint. In that way, findings from the literature can be used to combine and compare findings from the empiricism part. Empiricism part gives different perspectives for the research questions.

It is important to understand that all researches have two different key areas to handle, which are substance and form. Substance is about the topic and area the research is about and then form is about the questions asked. Like if the sub research questions are “what”, “how”, “why” or “where”. Different research strategies need different kind of research questions and different viewpoints. So, it is possible to categorize research strategy with research questions used. For example, experiment, history and case studies are having research questions “why” and “how”. Question types like “what” can also have multiple sub categories to define the question more specifically. (Yin 2013) This thesis is mainly handling “what” and “how” questions. “What” questions in this research are answering in a descriptive way and not for example in a quantitative way. In some of the questions, more specific descriptive answers are reached with “how” questions. “Why” questions are not mainly handled in this thesis and those question would be good when thinking about further research.

Sub-research questions start with wider important topics about business models and what is telco data and data monetization. Reason for that, is to form a big picture about the whole topic. But after that questions are going more deeply into main research topic. For answering to the main question, at first it is important to understand the whole area of business and bigger things related to it, and then research how mature this business area is already, what are trends on it, how other data based business could be exploited and what kind of models are working or could be potential. In addition, what are the key elements on those models.

Approach for this thesis was inductive. Inductive approach means that research material consists qualitative data and one of the ideas is to generate understanding meanings that human add to the research context. In addition, researcher is part of the research in a subjective way and the idea is to create new understanding and find out the nature and context of key topics. When comparing to deductive approach, that is more about finding relationships from variables and about collecting quantitative data without researcher being part of the process. (Mark et al. 2009, pp. 124-127)

In addition to inductive approach, the purpose for this research is explorative. Explorative study differs from deductive study in a way that in explorative study it is important to seek and discover new insight and theories when deductive study is about testing those theories. In deductive study, the main point is about testing the validity of theories. (Woo et al. 2017) For this research, it is important to find new insight about telco data monetization but to test the insight found would need a different research.

The method for research is mono method. This research is concentrating to only qualitative data and that is why mono method is needed and quantitative data is not used (Mark et al. 2009, pp. 151-152). Qualitative data is gotten from theory material, interviews and workshops and it is handled for example with data categorizing. Also, this study is cross-sectional because telco data monetization is researched in a constraint time frame and

workshops and interviews was arranged in a short time range. Longitudinal study would have needed more time when its idea is around change and the research process needs for example results about observation over time. (Mark et al. 2009, p. 155)

Research strategy is important thing to form and research questions, as well as objectives are giving guidelines and needs for the strategy forming. Still, while objectives are one key aspect in selecting research strategy, there are also another issue to consider like resources available and existing knowledge. As there were some basic knowledge about telco data monetization and its potential use cases in the organization where the thesis is done, the idea was to seek additional information about where other companies like operators are now in this business area and how do they see current situation and what do they see to be potential.

The main purpose is to help organization to find most important things in telco data monetization field and to find how they can enhance or change their plans and create better services in that area of business what is usual in action based research (Mark et al. 2009, pp. 147-148). Therefore, this research is partly about action research because the purpose is to try help on making actions and decisions on this area of business. In turn, constructive research is about solving some specific problems with using empiricism for example (Oyegoke 2011). So, constructive research method strategies are also used because one aim for this research was to solve problems about in what business areas to concentrate and what business models to use in telco data monetization.

To answer the research questions, also information about most important themes that support the main topic are needed, like for example information about biggest constraints. The most important themes around telco data monetization has been formed to the shape of research questions. For answering these questions, qualitative theme interviews and workshops were the selected strategy.

And as theme interviews and workshops were handled in a purpose to find people's and different companies behaviors and thoughts around telco data monetization key themes, theme interviews were reasonable option. That is why interviews and workshops were semi-structured, what is a general way to find information about what is going on and for finding new kind of insight in explorative studies (Mark et al. 2009, p. 322).

Structured interviews are consisting standardized question lists that are strictly used in all interviews. Unstructured interviews are non-standardized and those are used to find general knowledge about some research area. But as the need for this research is to find answers and insight about key themes around telco data monetization, semi-structured interviews were made. In that way interviews can have basic list of key themes and some questions about the themes but the question order may change and it is usual to have additional questions. Basically, the idea is to go through main themes in a more conversation like way. (Mark et al. 2009, pp. 320-322)

For interviews and workshops participants were selected with criteria that who would have needed expertise, and existing contacts were in prior in that process because that has showed successful results in many other researches (Mark et al. 2009, p. 176). After first interviews also snowball sampling were used to find proper new candidates for next interviews because proper existing contacts were hard to find. One reason for snowball sampling is that people who are familiar with some research area may have good contacts who are also familiar with the area of research and maybe from a different perspective (Mark et al. 2009, p. 176). Reason why there was both interviews and workshops was that interviews were made in one to one basis to find out important information about key themes and unfamiliar topics. Workshops were sessions where those key themes were also handled but those were also for creating and comparing potential ways to do business together with all the participants.

To sum up, the research approach selected to support answering to the research question was inductive. Research purpose was exploratory study to find new insight and method used was qualitative mono method, so only qualitative data about a particular time period were used. Strategy was mainly about qualitative semi-structure interview study where partly constructive and action study methods were used to find interesting models and ways to enhance plans and problem areas around telco data. First interviews about data collection techniques, data security and data privacy were arranged to better understand what kind of topics would be good to handle in the theory part and to have wider understanding before going more detailed into business models. Interviews with operators and service vendors and workshops were at the end of the thesis process to better understand what kind of themes to handle in those workshops and that made it possible to mirror the answering to theory already on the sessions.

5.2 Material collection

Material collection included two parts: materials for theoretical part and materials for empiricism part. In theoretical part, materials consist different kind of academic journals, books and other publications of this research field. This material collection process is explained in 5.3.1 subchapter. 5.3.2 sub-chapter includes material collection for empiricism part and it was done with interviews and workshops.

5.2.1 Theoretical part

Theoretical part has three different chapters: business models, telco data and data monetization and business areas and models used. Literature research for these parts started with using Andor service that combines search results from multiple different databases. I also used different services like IEEE Xplore and Google Scholar for finding proper articles, books and other publishes. Material selection for this theoretical part was done

by first searching collection of literature with specific search terms. Then the final selection was done by reading the abstracts to see how well it matches to the wanted information. Also, citation values, publisher and publication years were part of the selection criteria. In the selection phase the idea was to find as new and relevant material as possible from trusted sources.

As telco data usage is the main topic of this research, all the used important telco data articles and other publishes are listed in Appendix A. That is created to better show where that part is based and what kind of researches has been done in that area of business. That Appendix also works as a short summary of researches done in that area.

5.2.2 Interviews and workshops

Empirical part consists of both interviews and workshops. Starting with interviews, interviewees are selected to be experts in the subject area to get a better understanding and new insight. Table 1 shows all the interviews including name, title, core business area of expertise, organization and central themes of the interview.

Table 1. Interviewees' names, titles, organization and interview's central theme

Name	Title	Business area of expertise (among other areas)	Organization	Central themes
Mikko Valkama	Professor	Electronics and Communications Engineering	Tampere University of Technology	What is telco data and how it can be used
Marko Helenius	Senior Research fellow	Pervasive Computing, Information Security	Tampere University of Technology	Information security
Johanna Lilja	Partner	Data Protection and Digitalization	Roschier	Data privacy laws and regulations
Juha Rontu	Head of SW Technology Modules	Network data collection and analytics	Nokia	How telco data can be collected and processed?
Imre Szucs	Director of Data and Analytics Department	Data warehousing, IT development, data science with data analytics	Telenor Hungary	Trends in telco data monetizing field, Innovative business models, location data using
David Gonzalez	Head of Big Data Analytics	Big Data and analytics	Vodafone Spain	Trends in telco data monetizing field, Innovative business models, location data using
Pedro Antonio de Alarcon	Head of Big Data for Social Good at LUCA Data-Driven decisions	Big data and analytics	Telefonica - LUCA	Trends in telco data monetizing field, Innovative business models, location data using
Anonym	Anonym	Big Data and analytics	Service provider company	Trends in telco data monetizing field, Innovative business models, location data using

First four interviews are all made with different interview questions and last four interviews are done with same questions and those key themes and questions used in the interviews can be found on Appendixes declared later. First four interviews were longer, approximately 60 minutes each and last four interviews were shorter, approximately 25 minutes each. Shortly summarizing, Mikko Valkama is a professor at Tampere University of Technology and the interview handled what is telco data and how it can be used (Appendix B). Valkama's area of expertise is communication technologies. From Valkama, I got a recommendation for the next interviewee that has expertise on information security area. So, the next interview was done with Marko Helenius who is working as a university teacher at Tampere University of Technology and has expertise on information security topics (Appendix C).

Interview with Helenius revealed that there was need for more specific interview about data privacy from the law point of view and to understand how General Data Protection Regulation (GDPR) is affecting to telco data monetizing field. That is why next interview was with Johanna Lilja. Lilja is a Partner at Roschier law firm (Appendix D). She has been 13 years in Roschier and data protection and digitalization are areas of her expertise. Now when new General Data Protection Regulation is coming, Lilja has specialized on that and is advising companies to fulfill the new regulation for example.

After these interviews, there was still some valuable information missing to properly understand the big picture of telco data monetization business models. While the network data collection and processing in a technology perspective are needed for forming business cases around telco data, more information about telco data collection were still needed. So, an interview was arranged with Juha Rontu, who is Nokia's Head of SW Technology Modules (Appendix E). Interview scope was on telco data collection and processing and about what kind of roles network vendor and operator has in that process. Rontu's area of expertise is around telco data collection and handling. These four interviews gave a view to understand important topics for a purpose to create well-functioning business model. After that, four shorter interviews were arranged to get a view about what kind of trends there are on the telco data monetizing field and in the other data based business, as well as to find out information about innovative business models, location data using and about the most vital things in telco data monetizing business models.

These interviews were arranged during Telco Data Analytics Europe conference in Madrid (October 2017), that gave a possibility to get in touch with representatives of Europe's leading operators and service providers. For this thesis, four interviews were arranged with key themes and questions that can be seen in Appendix F. Three of them were with operators and one with service provider company. One of the interviews was with Imre Szucs who is Director of Data and Analytics Department at Telenor Hungary. His main responsibilities are traditional data warehousing, IT development, recruiting and data science with data analytics. Second interview was with David Gonzalez from Vodafone Spain. He is Head of Big Data Analytics at Vodafone Group Enterprise and his job

is basically leading the work that they do related to big data. Third one was with Pedro Antonio de Alarcon, who is Head of Big Data for Social Good at LUCA Data-Driven decisions at Telefonica. He is basically doing B2B big data projects and analytics. Fourth interview was with service provider company's representative whose expertise was also on big data analytics. These four interviews were shorter as they lasted about 20 minutes each. That is why these four interviews are called short interviews in this thesis.

Empirical part also consists two workshops – one with people from operator and other one with people from possible telco data customers. First workshop was with one Finnish operator's group of four people that were investigating this telco data monetization area of business. The main target of that workshop was to get information about operators views on telco data monetization and especially to potential business models. Second workshop was about customers point of view and it was arranged with selected companies' representatives that were already familiar with telco data and its possible benefits. Attendees were Natalia Reen who is a Project Manager at Forum Virium, Heli Vainio who is a Shopping Center Manager at Hestia (Kamppi) and one attendee from outdoor advertising company. Workshops idea was to understand the needs that some of the customers have and what are the ways how those needs and problems could be solved with telco data and how these answers differ compared to operator perspectives. Vainio gave shopping center perspective, Reen public organization perspective and representative from outdoor advertising company gave advertising perspective. One thing to notice is that Reen had to leave in middle of the workshop and that is why some of the answers include only opinions from the other participants. Appendix G includes operator workshop's key themes and questions and Appendix H same things about the later workshop.

5.3 Research process

Research process started with creating rough time plan and getting familiar with the search topic and other related topics. First things were to do literature research and read found articles. After that, research questions were created to fulfill needs on this area of business and research strategies and methods were selected. After that, more specific literature research was done and process for finding proper candidates for interviews and workshops were started. With interviews, more specific knowledge about the supporting areas of the research were gotten and it was possible to arrange workshops. With workshops, it was possible to have a view about how operator's and customers' views differ.

Interviews in Telco Data Analytics Europe conference made it possible to gain even more specific information about trends in telco data field and what operators and service providers are trying to achieve in this moment and how mature is the business around telco data monetization. After that, it was time for finishing the theory part and writing results about interviews and workshops and then writing the main findings and conclusions of the whole research process.

6. RESULTS

This results part consists of three sub-chapters. First one is about the interview results to get a deeper understanding of important topics like what is telco data, security and privacy viewpoints and laws and regulations. Second subchapter is about the workshop results. There are results from two workshops: one with operator perspective and another with possible telco data customer perspective. Workshops handled innovative and valuable business models from two different perspectives above other things.

Last subchapter is about shorter interviews with selected operators and telco data service vendors from Europe to find out their thoughts about the key questions of this research. These answers do not include my own opinions. Sub research questions about “*What is telco data and how can it be collected and monetized?*”, “*What kind of and how mature business has been created based on telco data?*”, “*What kind of business model components are essential for current telco data monetizing business models?*”, “*How models from other business areas can be exploited?*” and “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*” are considered in these interviews and workshops.

6.1 Interview results

Interviews give each business lines professionals’ views to get even better understanding about what is telco data, what kind of security and privacy issues are there and how data privacy laws and regulations affect telco data monetization. These topics are difficult because there are so many aspects to take care of and some of them are not simple without background information and knowledge about those areas. The idea is to summarize some important things in these areas. Results are summarized from the interviews and each subchapter starts with a summary of key themes, key findings and what research questions those themes are answering.

6.1.1 Network technology expert interview

This interview with technological expert was done with professor Mikko Valkama, who is familiar with technological aspects of communication technologies. That is why two key themes of this interview were handling telco data. Key themes and key findings of this interview can be found from Table 2. First key theme was “Impacts of network technology evolution affecting telco data monetization” to see how better communication technologies are affecting the business that can be created based on that data. Other bigger theme was about “Telco data types and collecting techniques” to see what telco data really is and what kind of data it includes as well as to see how the data can be collected. First

and second themes are both answering to sub research question “*What is telco data and how can it be collected and monetized?*” and first theme is also answering partly to “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”.

Table 2. Key themes and findings from an interview with a network technology expert

Key themes	Impacts of network technology evolution affecting telco data monetization	Telco data types and collecting techniques
Key findings	<ul style="list-style-type: none"> - Network technology evolution has enabled more data types to be collected from networks. - Through 4G networks, location accuracy has become more precise (around 50-100 meters) and that kind of more accurate location data can already enable new use cases. - 5G location accuracy will be even better: around one meter - Technology evolution enable use cases around optimization and selling location data to 3rd parties 	<ul style="list-style-type: none"> - At least two bigger categories: machine to machine type of data and mobile broadband data - Examples about what kind of data can be collected: reference signals, SMS, CDR, data transfer, user phone habits - Reference signals allow continuous location tracking - Data collection is possible by combining users' data from different cell towers user has been connected

Impacts of network technology evolution affecting telco data monetization?

Valkama was very familiar with the history of networks. Therefore, here is a brief summary of what led operators to the current situation and how the information transferal through networks has evolved: After landlines, a possibility for speaking with others regardless of time and location was needed. That led to first mobile networks and that is why NMT and digital GSM networks were created. After that also the transfer of data was wanted to be transferred. One well-functioning extension for GSM to transfer also data was GPRS. After that data transferring became more common and needed and better connectivity was a key aspect that drove 3G to be developed as well as to offer internet for people's pocket. Then Valkama said that LTE was for bringing better mobile broadband and mobile internet connections. To sum up Valkama's key points, everything started from transferring speech, then text and after that all the time bigger amounts of data.

Next bigger thing coming is 5G and that is needed to support as many sensors in one location as possible. Valkama also highlighted better latency to be one of the key aspects in 5G to ensure telepresence. Reason for that is that for example in remote driving the user needs to have the feeling that if he turns the wheel, the car or other machine reacts instantly with 1ms latency for example. Interviewee also told that something like 90 % of

mobile operator's business consists of mobile broadband and the rest is from internet of things kind of topics, so at this moment the mobile broadband topics are more interesting on telco data monetization perspective but data from IoT and sensors would be monetized in the future. To sum up, network evolution has enabled bigger amounts and several types of data to be handled and also collected from the networks than before.

Valkama stated that technology development in telco data monetization perspective is an important aspect because it enables innovative ways to use the data. Speech and data has been transferred for a long time and there have been network optimization tasks done for a long time. One new thing that technology evolution has made possible, and what Valkama has also been examining is location data from telecommunication networks. That kind of data has been possible to collect in the past as well but recent technologies like 4G have made it more accurate. That kind of more accurate location data can already enable new use cases. To sum up, LTE networks makes it possible to have accuracies around 50-100 meters and 5G would probably offer even accuracies around one meter. For example, 5G would allow continuous car movement tracking with one meter accuracy.

What comes to innovative use cases, Valkama stated that location data usage would be one clear new prospect. Especially now when new technologies are making more accurate location positioning possible. However, he pointed out that data privacy is a difficult thing in that business area. But other thing he also mentioned was that peoples' attitudes about their privacy are changing all the time with different use cases because they have seen many apps that collect data from users and still they have continued to use those apps. He summarized that "when data privacy is handled well and data anonymized, it would be a potential option for operator to sell location data to 3rd party who can use the data to create new business or then the operator itself can create this kind of new business".

Telco data types and collecting techniques

Valkama stated that telco data does have at least two kind of bigger categories which are device to device type of data and mobile broadband data. He identified also smaller categories under mobile broadband like user data from calls, SMSs, internet usage, reference signals and so on. He was not sure about what kind of data operators and network vendors are really collecting but from technological perspective it would be possible to collect very specific data about users and their mobile phone usage habits. That kind of different signal data that is coming to cell towers from different mobile phones can be collected with data collection devices and software located in cell towers. But reason why all coming data may not be collected or at least used in monetization purposes are laws and regulations.

Interesting result from this theme was that location as well as other telco data from mobile devices can be collected continuously. For example, location information can be collected

continuously even if users' phones are in their pockets because of signaling going on almost all the time. Signaling is needed to make mobile networks functioning and to keep mobile phones in the network all the time. To ensure that, cell towers send reference signals and then mobile phones report back network strengths from different cells and decision to change used cell tower is made based on that. Valkama said that: "mobility is achieved with reference signals because handovers between different cell towers happen based on signal strengths".

Valkama stated that signaling is one way that makes location tracking possible because signaling can be used for other use cases as well, in addition to cell tower handovers. Some of the signals can be made specifically for positioning purposes in a way that for example there are cell id numbers to show what mobile device is connected to what cell tower and the signal strength also gives an approximation about how close to the tower the device is or time of arrival can also be used to see how long it has taken the signal to move from the cell tower to the mobile phone. When locations and coverage areas of different cell towers are known, rough location for each mobile device can be calculated. Accuracy in that kind of use cases can be over hundreds of meters and in the countryside where there are less towers even worse. Another way to do positioning that Valkama mentioned is to combine that signal strength or time of arrival information with data from direction antennas. Meaning that better accuracy can be achieved if the direction is known as well as the distance. To achieve even better accuracies, it is possible to calculate mobile phones location from different cell towers and merge these results over multiple different cell towers. Then the crossing point gives even more accurate result.

6.1.2 Information security expert interview

This interview about information security was done with Marko Helenius. As shown in Table 3, there were two bigger themes in the interview. First one was "important things about information security affecting telco data monetization" and the second theme was "Valuable information security techniques in telco data based business" that was for getting information about what kind of needs and problems there are in techniques to ensure information security. Both themes are answering the sub research question: "*What is telco data and how can it be collected and monetized?*" and especially in the part how telco data can be monetized.

Table 3. Key themes and findings from an interview with an information security expert

Key themes	Important things about information security affecting telco data monetization	Valuable information security techniques in telco data based business
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Key findings	<ul style="list-style-type: none"> - Laws and regulations, especially GDPR, needs to be considered carefully and followed - GDPR is not affecting to anonymized data usage - In data monetization anonymization is needed to ensure data privacy or permission to use the data must be obtained from users 	<ul style="list-style-type: none"> - Encrypting all the collected and used data - Securing data with basic data security techniques, like encryption and firewalls is important - One constraint for new business creation is balancing between information security costs and possible revenues - Data privacy can be protected with anonymization techniques while it may be problematic to see if the data can be still backtracked – i.e. revealing still personal data - Aggregation is a way to keep categories like age in the anonymized data to enable better business value for the data
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Important things about information security affecting telco data monetization

One clear result, that Helenius pointed out for this theme about important things concerning information security in telco data monetization field was laws. Those are the most important constraint in information security and that is because telco data includes really sensitive information. In data based business overall, it is important to understand what kind of data can be used and how. Depending on the purpose, sometimes acceptance for data collecting is needed from the user or if data is anonymized there is no need for getting acceptance. Helenius also highlighted that in international business it is important to follow all the different countries policies and laws.

From the telco data point of view, Helenius said that operators have certain commitments regarding telco data collecting and storing. Different laws and regulations give operators commitments to monitor abnormal traffic and even try to prevent it. He said that: “it is balancing between data privacy and individual freedom” and now when operators and service providers are considering totally new businesses on top of data, they must prepare for different laws that they may not have done or thought before.

Helenius pointed out that the upcoming new EU-regulation GDPR, is now the most important thing to notice what comes to data privacy laws and regulations. Reason is that GDPR makes it mandatory for all companies in EU to take care about data privacy and document what is done to make the data secured. The documentation means that every company needs to be able to prove that they have followed all the needed data privacy rules. Helenius stated that what is good in new EU-regulation is that companies do not have to prove that the data is fully secured and no one can get access to it. It is enough if the company can show that they have used required efforts to protect the data.

Helenius had couple of workable solutions that would help companies to fulfill all the regulations. One solution to fulfill data privacy rules is that companies could be partnering with law firms or hire people that are familiar with these kinds of laws. Helenius also said that: “Another typical example can be that risks are outsourced to big companies like Apple or Google who then take care of laws and possible negative effects”. One of his thoughts was that new service or product creation is about taking risks and it is obvious that companies that do not take risks can also forget the possible revenues.

Valuable information security techniques in telco data based business

Helenius stated that information security technologies include many different areas and to start with, data encryption is one important topic. That is because when data like telco data is on some server and if some hacker gets access to the server, it is important that he does not get the data straight from there. Helenius also said that in other business areas where sensitive data is handled, it has been a typical mistake to not encrypt and that has caused big data leaks.

Helenius also stated that encrypting is only one thing in data security techniques. There are also other important measures to protect the access to sensitive data. Meaning some basic data security solutions like system administration, updating, firewalls, traffic monitoring and companywide specific data security policies and rules. Technique possibilities for that kind of security solutions are very wide and it is usual that the better security is wanted the more it costs. One result from the interview was that one problem area in new service or product creation is to find out how much money to put on data security in a way to get good enough security and still make a profitable service. He summarized that “if some new business case would need very high data security but offer not so high profits, there is no reason to do that business case”.

One result for information security techniques about telco data monetization is to choose best possible technique to do anonymization when the anonymization is needed. One problem area that Helenius sees is how to ensure that the data is anonymous and it cannot be un-anonymized later - how to find the technique that ensures that. Another problem area is to see the boundary between anonymous and un-anonymous data when data aggregation is used to shape categories. That is important because categories would increase the business value of anonymized data.

6.1.3 Interview with expert of data privacy laws and regulations

This interview with Johanna Lilja from Roschier was handling how laws and regulations are affecting telco data usage. As can be seen from Table 4, there were two key themes handled during the interview. One of them was “General Data Protection Regulation (GDPR) from telco data monetization perspective” and another one was “Telco data anonymization”. Both themes are answering to the research question “*What is telco data*

and how can it be collected and monetized?” and especially to part about how telco data can be monetized.

Table 4. Key themes and findings from an interview with an expert of data privacy laws and regulations

Key themes	General Data Protection Regulation (GDPR) from telco data monetization perspective	Telco data anonymization
Key findings	<ul style="list-style-type: none"> - GDPR is an important regulation to follow because big sanctions are placed if GDPR is not followed - GDPR affects to whole lifecycle of personal data: from data collection to data deletion or anonymization - Transparency around personal data usage is one key element in GDPR - Although GDPR is coming, companies should continue searching for new business models and areas and prevent falling behind in competition with companies outside Europe 	<ul style="list-style-type: none"> - GDPR is not affecting data usage if data is fully anonymized - Aggregation can be made and it is still possible to have anonymized data but only if categories are big enough - It is difficult to compare and show how effective different anonymization techniques are

General Data Protection Regulation (GDPR) from telco data monetization perspective

What comes to data privacy, Lilja said that it has been quite fragmented even though in the background there has been a directive harmonizing things. That has been the reason why now EU has wanted to bring GDPR which is a regulation that is directly applicable in all EU member states and it is coming into effect in May 2018. Also, changes are coming to eprivacy regulations and electronic direct marketing, and the proposal is to sharpen the rules in the same way as in the data protection regulation. GDPR is a regulation that forces companies to change their habits around personal data usage. Lilja pointed out that maybe the biggest reason why GDPR has raised a lot of attention is sanctions coming with it that can be quite high in financially: 4 % of one year global sales or 20 million euros – whichever is higher.

Lilja summarized that: “GDPR is going to affect the whole data lifecycle from collecting personal data to the point when there is no need for personal data handling and the data is either deleted or anonymized”. As telco data is mostly about personal data, GDPR is going to impact it as well but if telco data is anonymized, it is not affecting. To point out some of the key aspects Lilja mentioned about GDPR, people should have more rights to check their personal data saved to different systems. Furthermore, people can demand

that their personal data is updated or deleted if there is some old or wrong data. New thing is also that it is possible to transfer personal data from one service provider to another.

Another topic Lilja stated around GDPR is that GDPR is also affecting telco data monetization in terms of agreements. Transparency is an important aspect and it needs to be clearly stated in terms if user's personal data is used. Consent language needs to be well clarified in a way that user surely knows what he/she is accepting. Hence, no hidden terms are allowed.

Lilja's opinion about GDPR was that it is good that data privacy is going to be handled better and inappropriate data usage would decrease. Still, EU is quite alone with the new regulation compared to for example America and it raises questions that would it cause companies in Europe to fall behind. Thinking more about business opportunities around telco data, Lilja stated that location data usage would be a good thing if everybody was following the same rules and if it was used to help in daily life or it was used to help controlling for example influenza spread. As a scary thing Lilja mentioned services that seem to know one's life better than oneself, like where should one be next. That raises questions whether data privacy rules are followed. But to sum up her thoughts, companies should openly research new business areas and models and at the same time take care of compliance with laws.

Telco data anonymization

One key result from the interview was that when data is fully anonymized, it can be used into any purpose and GDPR is not affecting to it anymore. Therefore, the difficulty is to know if the data really is anonymized when it is said to be. Lilja gave an example that there is some research showing that even with couple of data points about one anonym person's movements during a day, it is possible to identify the person. There are some recommendations made about anonymization techniques but Lilja still mentioned that it is problematic to know what technique is enough and suitable when costs are also taken into consideration.

Lilja stated, that aggregation is also one possible way to use anonymized data and still show some categories like age and gender. With aggregation one of the biggest problems is to select the right minimum size for the categories. If the selected category is showing only couple of people and their location for example, it is quite easy to identify who those people are and then the data is no longer anonymized.

From the telco data monetizing perspective Lilja saw a lot of problems regarding data usage. To sum up her main points, one of the first things to do when creating new business around telco data is to choose whether data is used in an anonymized way or not. If it is used, a proper way to do the anonymization is needed and if not, GDPR must be followed and approval for data usage is needed. Depending on the situation, there are at least three

ways for that: one is consent for some specific data usage purpose, other one is performance of contract and third is legitimate interest. Lilja stated it as a tricky question whether 100 % sure anonymization is possible to do and she said that: “My view that has been formed during conversations with different professionals is that it is difficult especially with telco location data but it is not impossible and expertise is needed because technology is evolving all the time.”

6.1.4 Interview with telco data collection expert

This interview with Juha Rontu from Nokia was handling telco data collection process and it included three key themes: “Telco data collecting”, “Telco data types possible to get” and “Telco data monetizing trends”. All the key themes are answering to sub research question “*What is telco data and how can it be collected and monetized?*” and the last theme about telco data monetizing trends is also answering to the question “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”. Key themes and key findings for these themes are summarized in Table 5.

Table 5. Key themes and findings from an interview with a telco data collection expert

Key themes	Telco data collection	Telco data types possible to get	Telco data monetizing trends
Key findings	<ul style="list-style-type: none"> - Telco data collection can be described with Mobile Networks Architecture that consists of software for defining differences in incoming data, network element for providing measurements to calculate KPIs and Traffica for visualization events and reports real-time - Data collection before analytics is happening in three bigger phases: data collection, data pre-processing and data transferring to applications that make analysis - One problem area in telco data collection is that multivendor arrangements cause difficulties 	<ul style="list-style-type: none"> - Call details, location, internet usage, service usage (e.g. Facebook), age, gender, network failures and so on is possible to collect from networks - It is possible to collect and analyze data in real-time - Because many types of data can be collected, ownership for different types of data needs to be declared between operator and network vendor 	<ul style="list-style-type: none"> - Two clear internal monetization trends are predictive analytics and network optimization - Geo-location data monetization is a new and potential external monetization trend - 5G and IoT are going to create sensor data monetizing trend

Telco data collection

Starting with theme about telco data collection. Rontu declared that operators have network vendors who deliver network devices to them and it is usual that an operator has several network vendors to produce its networks. Nokia is a network vendor and Rontu

was explaining Nokia's mobile network architecture for network analysis tools to give basics about the data collection process before going deeper into the data collection process itself. Mobile network architecture includes various parts like one software to transfer messages and defining needed differences in data usage. Rontu said that: "The SW collects signaling, decodes all the protocols and makes conclusions like, there were setup failures, call drops due many reasons and so on." And that software is collecting all calls in real time even including location information.

Rontu continued that according to the architecture, network element is providing measurements and counters to NetAct which aggregates network wide KPI (Key Performance Indicator) reports. So, Rontu stated that NetAct is a Nokia Network Management System. These KPI reports are important for the operator because it is a measurable way to understand the network behavior, predict possible issues in the network and react to changes. In that way NetAct is giving a possibility to do internal network enhancements. Another way to understand better how operator's networks are functioning is to follow Traffica, that collects and visualizes information about counters and reports that the network element is providing in real time. It is possible to see for example call failures from Traffica.

Now moving nearer to data collection, Rontu stated that there can be identified Data Collection and Analytics architecture that includes three clear parts. Rontu said that data is coming from 2G, 3G or LTE and then message collection platform/layer collects that data, makes some filtering and moves it to the next part which is message analysis platform where data pre-processing is done. Collection and pre-processing is done in different servers and for example in USA there can be hundreds of different servers. Last thing is to transfer the data to applications and services that can be found from the service layer where data can be used to make analytics. What comes to information security of telco data, it is important that the data is encrypted. Rontu also identified one clear problem with transferring data, which is that it is not possible to move data outside of America for example without first scrambling it into anonymized form.

Rontu mentioned that in the collection process there are many different purposes and targets. Some processes need capability to do collection in real-time and some do not. For example, one way to use data coming from the systems is to use triggers. As an example, if a call fails the trigger is activated and data regarding that call is sent to the operator. One possible outcome for that kind of service is like Rontu said: "By using these real-time or close to real-time data collection and analysis solutions it is possible to find the issues in the network really fast and assist the operator even before they have noticed the problem."

One difficult area Rontu mentioned in this telco data collection process is the fact that operators have multiple vendors to provide network equipment and one reason to have multiple vendors is competitive tendering. That means that it is more difficult for network vendors to understand all the things in the networks when there are unfamiliar devices as

well. Rontu also sees enhancements in that difficulty area when companies have started to create multivendor competency and for example co-operatively created common specs to make the entire process easier.

Telco data types possible to get

Rontu stated that at first Nokia's idea was to collect all possible data but afterwards it was realized to be a bad idea and now they are collecting only data that would be useful later for some purposes. Rontu mentioned some of the important data types that are collected, like data about calls including things like how long was that call and in what place was it done and so on. Then it is possible to get data about internet usage and even what types of service people are using, like if they are using Facebook. Furthermore, data about people's location during the day is possible to get. Not only where they have been but also how long have they stayed in some specific locations and how fast they are moving. This kind of data can be combined to subscription data like gender and age and so on.

Answering the questions regarding what types of telco data is it possible to collect, Rontu stated that it is also important to understand that from telco data monetization perspective, one important element is the time competency. Meaning that some analytics needs real-time or almost real-time data when other use cases do not. Rontu mentioned that Nokia is doing software that is working in real-time (less than a second) but it is usual that when the data is provided to operator and operator does different things like analytics with it, the data is not anymore real-time. Reasons to lose the real-time aspect can be multiple, like transferring the data to a cloud server. Rontu has also understood that new services created need to be working in real-time or it is almost no use at all to do that service nowadays.

Rontu mentioned that another important thing about different types of telco data is the ownership of data. He summarized that basically operators own the data but that is not always the situation because of laws. Reason for that is that even though the operator owns the data it cannot use that for every purpose it wants. Also, sometimes Nokia can collect some types of data and use it. But in these kinds of situations it is important to make a contract that clearly shows for example that Nokia is using some part of the collected data in some specific purposes and to declare what those purposes are. Another example Rontu mentioned was emergency situations when the data is needed as fast as possible. There is no time to think who owns the data.

Telco data monetizing trends

Telco data monetizing from the network vendor perspective is a little different because they can sell devices for operators as well as related services to enhance the products. One possibility Rontu stated was that the network vendor can sell information about operator's capacity to the operator, for example to show that in some specific area capacity will be

going out in a brief time range. From the internal monetization perspective, also predictive analytics about the devices themselves are used. Network vendors can sell that kind of analytics bundled to the devices to operators as well.

From the perspective of telco data based services that can be sold externally, Rontu stated one clear trend which is location data. Reason for that opinion was that there are lots of use cases and need for using geolocation information existing already. For example, heat maps and crowd movement patterns in some certain area to show how people move and where they spend time. Rontu also mentioned that it is also possible to use roaming data to understand what tourists do and where. Like for example if in some location there are lots of Japanese people, the place can be identified and information explored to find out that they are for example playing golf a lot in Finland.

One other way to use location data is to make customers mobile experience better by enhancing better handovers between cell towers. One example about that is that if people are always going directly in some intersection, the network could learn to handle its handovers better. Meaning that bad handover decision is not done when network is predicting where people are most likely going next.

There are lots of use cases for location data but Rontu said that in most of the cases privacy is becoming an issue. So, there would be lots of need for personal location data while it just cannot be sold. Another big trend that Rontu mentioned to be coming is 5G and IoT. He said that those are going to be big trends in telco data monetizing field in the future. One obvious reason for that is that companies are already trying to figure out how that kind of sensor data can be used and monetized.

6.2 Workshop results

This chapter is about workshop results. First sub-chapter is about workshop with operator and the other subchapter is about workshop with potential telco data service customers. Subchapters start with information about key themes that each workshop was handling. They also include information what research questions those key themes are answering.

6.2.1 Workshop with an operator

Workshop with an operator included three bigger themes that are shown in Table 6. Workshop started with theme “Business models in general level and in telco data monetizing”. That theme is answering to sub research questions “*How models from other business areas can be exploited?*” and to question “*What kind of and how mature business has been created based on telco data?*”. That workshop was with Finnish operator experts; therefore the answers are from Finnish operator perspectives. Next bigger theme was handling “Potential business models based on telco data” and the last key theme was “Important elements in telco data based business models - business model generation from scratch

with business model canvas”. Both are answering to research question about “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”. The main idea of this workshop was to see operators views about business model trends, how far they are in telco data monetizing field and to see what kind of business model would be potential in telco data monetization.

Table 6. *Key themes and findings from the workshop with operator*

Key themes	Business trends in general level and telco data based business maturity	Potential business models based on telco data	Important elements in telco data based business models - business model generation from scratch with business model canvas
Key findings	<ul style="list-style-type: none"> - Important trends identified were: Business transformation that has led to new business creation and especially to service creation on top of data - Telco data based business maturity is in a new idea creation and piloting phase. Also, problem areas like data privacy are considered and explored 	<ul style="list-style-type: none"> - Analytics-as-a-Service way of offering insight services based on telco data is potential - Scalable business models with help of partnerships are tried to be developed for creating more profitable models - Web-shop is one potential scalable way for offering telco data based services like insight - B2C is an interesting option and it could consist of a platform where some personal data is combined with other data sources, but B2B is easier to create and that is why B2B would be also more potential 	<ul style="list-style-type: none"> - Geolocation insight is an important way to create value for B2B customers - In business model selection, it is important to compare revenue and value created - Revenue share is a key element in telco data based business models - Well selected technology partners are important asset for operators in telco data monetization

Business trends in general and telco data based business maturity

Starting with the first key theme, one clear result was that operator representatives could identify that business transformation is ongoing in different companies and almost every company is trying to identify some new ways to do business and for that they are trying to model new kind of business models as well. The trend now is to plan and create services on top of data for example. Operator’s view was that new kind of service creation is ongoing almost everywhere including their own business. That is why services on top of data that companies already have and collect is one logical answer.

Workshop participants were saying that business is already created using telco data but the existing business is about network optimizing and churn preventing for example and

those areas can be included into internal monetizing business models. But in external monetizing processes operator does not have published business and now they are searching for options what they could do. On the network optimizing and churn preventing side, that are parts of internal monetizing, there are already different kind of business models used and some ideas for external monetization can also be used from there. With internal monetization perspective operator means that data is used to support its current business and get cost savings with that. For example, operator has a tool for optimizing and configuring networks every night.

Participants summarized that there are already a lot of internal activities done based on telco data but a new trend now is to consider external monetization purposes like anonymized geolocation insight selling. They are trying to seek different kind of options how to monetize the data that they already have in a way that it can be sold externally. One of the main questions is to find out what kind of insight it is possible to get out of the telco data and to understand what kind of services customers would need.

Participants stated that their target is to make totally new services or products. One clear topic they raised up was data privacy that has to be taken into account in development work. Their view was that telco companies have been quite cautious with this telco data monetizing and one of the biggest questions is that how to create real value for customers. One interesting way to solve that problem was that operator could use outsider panel to see what kind of business models and ideas are going over customer limits or are violating customers and what kind of models are worth continuing further. Another important thing mentioned was GDPR that is going to effect as well in 2018. To sum up, in external telco data monetization maturity level operator is trying to find and pilot new business ideas and models and at the same time trying to find and overcome possible problem areas like data privacy. Participants also mentioned that their data usage is quite spalled in this moment and that is one reason why new kind of models are needed.

Potential business models based on telco data

One outcome of that theme about potential business models based on telco data was that really innovative idea may not be the main target and one good way to approach this is to start looking what kind of services customers may want. Participants were seeing it as a good option to find some already working models from other data based business areas. Analytics-as-a-Service is one model that could fit but its benefits are dependent on the use case. Reason for it is that some of the use cases are on one time basis, like analytics for where to build a new shop. After analytics are done, there is no use for more same kind of analytics. Data-as-a-Service were also thought during the workshop but main outcome was that it would not fit properly because at least bigger operators are not willing to sell data itself. Reason is that operators want to keep data with themselves.

Another model handled from other business areas models was blockchain based data web-store. Operators saw blockchain itself as a new and interesting way but it would have needed more time to more deeply think the benefits and problem areas of it. But they thought that web-shop way of selling analytics would work well because it is a scalable way to do business. Web-shop could be a place from where different companies could buy analytics and insight in Analytics-as-a-Service way.

To sum up, if we are thinking new models starting from problem solving, there is three points needed to figure out. One is what customers want and at the same time operator needs to have enough revenue in return. Problematic thing there is market size. In Finland where the operator is operating, is about 5 million people and roughly 2000 companies willing to buy for this kind of new products. So, market is quite small and if there is needed a lot of revenue coming from a business in case that it is clever to do, it is difficult and the service cannot be very cheap. Second important thing that was possible to identify was that services should be scalable and the usage needs to be continuous. That is why couple single tailored use cases are not enough. Third important element are partnerships. Partnerships are important in new service creation because then there is no need to start from a scratch while of course operator needs to first decide if it could or want to do that new business by itself.

Participants were also interested in thinking what would be innovative enough in B2C. Operator's view was that B2B is the direction they are moving forwards but B2C is also seen as an interesting area of business. They have been looking through ideas like combining location with other data sources. The key thing there is to find out some service or platform that individual persons would be willing to buy. To sum up, in B2C business important element would be data that user has created with its own actions combined with other kinds of data.

Important elements in telco data business models - business model generation from scratch with business model canvas

This theme is about business model creation from scratch and it was done with help of business model canvas tool. Results of this process are around what is a potential model based on telco data and what are the most important elements in external telco data monetizing business models. All participants decided easily that they want to create a model around location data usage while they found also 5G and IoT use cases interesting but those areas would be more interesting in the future and not at this moment. Reason why location data usage was selected was that it has shown its potential already and while it may not be the most innovative way of business, the market is quite new and there should be room for this kind of services.

Unique value proposition was decided to be around crowd analytics, meaning anonym and segmented crowd movement patterns and insight. Segments was decided to be age

and gender. This data aggregating and segmenting were seen as a way that make the crowd movement analytics even more beneficial. Real-time data is difficult to get in this moment, so the target of this model would be to offer both near-real-time data and historical data about how people are moving and where they spend time in some specific locations. The value is created with different kind of visualizations giving insight to some specific areas people's movements in certain time. Especially with information about bigger changes on the movement patterns. Figure 12 summarizes the business model created.

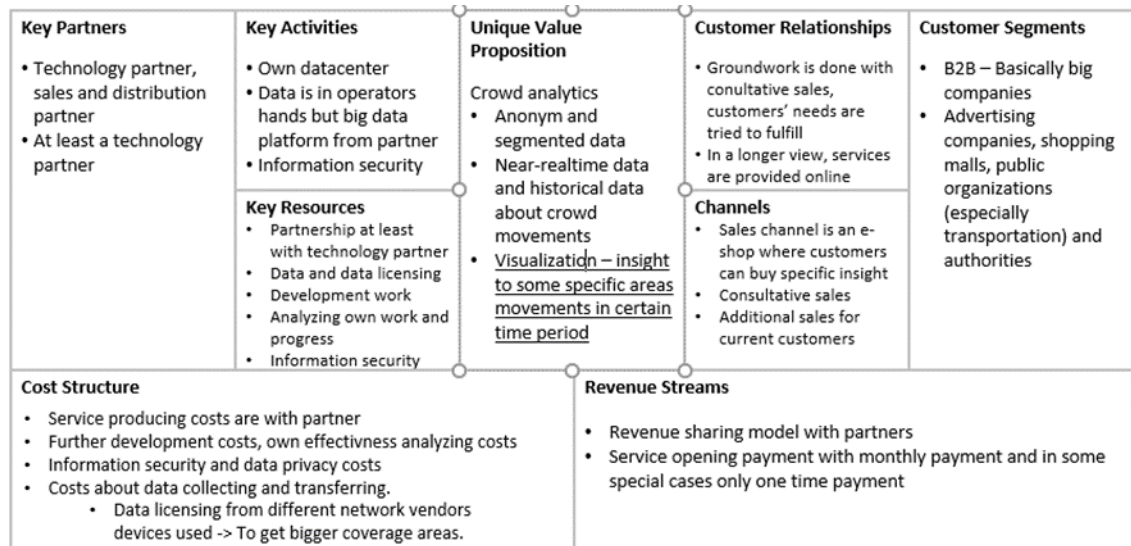


Figure 12. Crowd analytics - interesting business model based on telco data

In channels perspective, e-shop was selected to be the main sales channel. Meaning that there could be a portal where customers can select what kind of insight they want to buy by themselves without sales person. But participants stated that at first consultative sales are needed to get customers but after that the idea is to only give a portal for customer to buy more. For reaching customers, additional sales for current customers is one straightforward way. Furthermore, in customer relationships point of view operators stated it to be important to first create good relationships with consultative sales and then slowly change services online.

This business model is targeting to B2B and more specifically for bigger companies. One reason for this kind of model is that it can be sold to many kinds of companies like advertising companies, shopping malls, public organizations and different kind of authorities and so on. There is no need to target into one kind of organizations. Participants were still properly aware that when this kind of scalable business is created those services needs to be giving insight that is vital in multiple industries, so customer perspective is still crucial. Authorities as a customer was seen especially as a potential option because they would leverage of knowing for example that in some place there is 10 000 people moving past when normally there is something like 500 people passing. Different kind of events and traffic spots can also be identified easily with these crowd movement analysis and movements around some specific organizations like shopping malls for example.

Key partners were a block that rose most attention. There were many opinions against partners and then again in favor of partners, especially technology partners. One of the biggest problems that came up about partners is that in co-operation it can be that way that the vendor is giving the idea how to use telco data and then operator has just go with the idea and operator cannot affect to the outcome. Also, it was thought that operator could do the technological part by itself. But that idea was also seen problematic when everything should be started from scratch. Another option was that operator is only selling the data to service provider. That idea had multiple different opinions. Some of the participants said that it is not a thing that operator is looking for either because operator is not wanting to be only a data broker. Reason for that opinion was that in some cases that would be a good opinion but in this new market area it would be good to try first different ways to do business than selling only data. Another view that came up was that why not to settle for monthly payment or some percentage partition of the service's revenue and leave the risks and costs of creating new business for the partner. Finally, the result was to create a business where operator has a technology and sales partner in a way that partner is taking care of e-shop and analytics and then operator is providing the data and participating in insight idea creation.

Participants thought that in that case the revenue share could be one option for revenue model. One summarizing comment why revenue sharing would be good was: "This kind of business would need partners almost in every case – technology partner and maybe sales and distribution partners. Selling only data to service provider may not be option at all because service providers may not have as much money as needed at the beginning when no revenues are coming."

Other ideas related to revenue streams were to sell the service with a monthly subscription and one time starting price. In some specific cases there could be also option for one time payments. Pay-per-use model was also considered. Participants thought that it would be functioning with authorities but in other cases it only makes customers budgeting more difficult and that is why they did not want to use that.

As can be seen from the Figure 12, key activities are highly around data. Participants stated that it is clear that this business model needs a proper information security activities to see that this model follows laws and regulations as well as that the data is secured. One clear statement here was that operator must have own datacenter. Big data platform would not be own but at least operator must have own datacenter, so the raw data is on their own hands. Key resources were also obvious starting with mentioning partnerships and information security once again. Then new thoughts were around own process analyzing to see if model fills targets. Then another key resource is to continue developing to be ready for changes. Participants also saw data as a key resource as well and when operator needs to get data for example from whole Finland, there might be need for getting data from multiple network vendors' devices. In that case, data licensing is also needed.

Moving to cost structure, participants added that data licensing needs investments. Costs are also coming from data collecting and transferring as well as from information security and data privacy. Own effectiveness research and development are costs as well. Positive side that operator representatives summarized to be in this model created is that service producing costs can be left for the partner.

To sum up, operators view about key elements in telco data monetization and in business model selection are costs compared to the value created and revenue possible to achieve. To understand the value and revenue parts better, pilots are needed to see if customers are interested and willing to pay. One reason for that, is that this market is quite new and there is not much mature business created for location data using. Another key element in their perspective is to create good partnerships and find just the right partners with right capabilities.

6.2.2 Workshop with potential telco data service customers

Customer workshop included three key themes that can be seen on Table 7. Table also summarizes the key findings for each theme. First theme was “How services based on telco data could fulfill customer needs” and that theme is answering to sub research question “*What kind of and how mature business has been created based on telco data?*”. The idea was to find out what kind of pilots there could be in that area and to see how far have customers thought about this kind of service opportunities. Next theme was “Telco data monetization business models from customers perspective” and it was for finding critical elements for business model creation and last theme was “Innovative business models in telco data monetization”. The reason for selecting these themes was to see how customers’ views differ from operators views about telco data business models. Another reason was to see what kind of business models from other business areas could fit well to telco data monetization. These themes are answering mainly to the sub research question: “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*” and partly to “*How models from other business areas can be exploited?*”.

Table 7. Key themes and findings from the workshop with customer experts

Key themes	How services based on telco data could fulfill customer needs?	Potential telco data monetization business models from customers perspective	Innovative business models in telco data monetization

Key findings	<ul style="list-style-type: none"> - Each participant told examples how their organization could benefit from telco data insight: Helsinki – Crowd movements in Jätkäsaari, Kamppi – lunchtime movement analysis in shopping mall and Outdoor advertising company – advertising optimization. - Examples showed that selected possible telco data customers are quite far in planning how they could use telco data insight 	<ul style="list-style-type: none"> - In revenue model perspective, paying for services (analytics-as-a-service) with once a year subscription payment was seen as a potential model. Also value based payment model was seen potential. - Partnerships were also seen as only a positive thing if communication is not going to be more difficult - When comparing scalable and tailored services, customers mentioned tailored services to be more potential from their perspective 	<ul style="list-style-type: none"> - Innovativeness was seen to be in relationships with the customer, customer needs to be the number one priority - One innovative new model to offer insight services would be free-trial model where customer could play with the data first before buying. - Another important thing related to innovativeness is to find boundaries and push limits.
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How services based on telco data could fulfill customer needs?

As all the participants were familiar with telco data possibilities, they all had different kinds of ideas how to use telco data services and mainly services based on geolocation data. Table 8 shows a summary of three different kind of use cases. Starting with Helsinki municipality, there were multiple different ideas like defining clever routes for busses, planning parking spaces, ensuring safest route for kids to go to school or planning context based advertising.

Table 8. Summary of use cases from customer expert workshop

Organization	Helsinki municipality	Kamppi, Shopping mall	Outdoor advertising company
Potential use case	Crowd movements in Jätkäsaari	Enhancing services fo lunch customers	Advertising optimization
Problem areas to solve	Where do people come to Jätkäsaari, with what vechicle, how long do they stay and where do they go next.	Where do people come to Kamppi and when, how long do they stay there, how do they move inside Kamppi, where do they go next and in what time. And especially how lunchtime is affecting to these patterns, also how time of week or time of month is affecting.	Who is seeing the add, so who is passing the advertisement in some spesific place. And in what segments does those persons belong. How to profile people passing their advertisement boards
Customer need	To enhance Jätkäsaari infrastructure and public transportation to make crowd movement flow better and reduce traffic peaks.	To understand their customers for developing services in Kamppi to better fulfill customers needs and make Kamppi's lunch services more attractive.	Modeling and categorising peoples movements for giving better services for people who are buying advertisement space from them.

To explain one use case better, Reen from Helsinki municipality stated that a harbor area called Jätkäsaari was an interesting use case to investigate. Especially from the traffic

point of view, there are lots of people going in and out. One interesting aspect would be to see who are people working there and who are coming or going out with ships or by car for example. Furthermore, how long people stay Jätkäsaari and where they go next and so on. Anonymized crowd movements collected from telco data would give Helsinki city valuable information how to enhance the infrastructure and public transportation in Jätkäsaari for reducing traffic peaks.

From the Kamppi shopping mall point of view, there are also lots of interesting ways to use telco data analytics. Especially when there is a bus terminal as well in Kamppi. But one clear need from Kamppi, that telco data services would fulfill was lunch customer investigation. Vainio stated that telco data analytics, especially anonymized crowd movements would show important aspects like from where do people come to Kamppi, when, how long do they stay there, how they move inside Kamppi, where do they go next and in what time. In that use case, the target is to monitor the lunch time. Therefore, crowd movement analysis could be made to look especially lunch time and how it differs from other times and how week day or time of month is affecting to these patterns. Kamppi's need in that use case would be to better serve their visitors and offer better and more attractive lunch services. As well as to show companies why Kamppi is or would be a good place to locate a shop. Another interesting use case that Vainio mentioned was how new Helsinki metro extension called Western Metro (Länsimetro) is going to affect Kamppi visitors' movements.

Representative from outdoor advertising company stated that their interest is always in specific places where outdoor advertisements are located and people are passing that place. Representative mentioned that there are thousands of interesting questions that need to be answered like who and where. Who, or what kind of people segments are passing a billboard in some time span for example. Outdoor advertising has not used data for a long time in past but now they are trying to do profiling for example. That outdoor advertising company has identified that findings from data are recurring, so historical data usage would be enough but real-time analytics is also an interesting option. One interesting use case in their perspective would be to sell advertising services in a way that the purchaser can select audience for the advertisement. But the main idea how they could leverage telco data services is to model and categorize people's movements to give better services for companies buying advertisement space. To sum up, all the use cases are well thought through which is showing that companies have used time for understanding telco data usage possibilities and they are able to see its benefits.

Telco data monetization business models from customers perspective

In customer point of view, value proposition is one of the most important areas in telco data monetization business. All the participants thought that one important thing for operators and service providers is to understand customer needs and try to fulfill those. Furthermore, when customers are making decisions to buy some data based services, one

important element is seller's credibility. Process behind analytics should be transparent and one key element is to know where the data is from and how good is the quality. To sum up, sellers expertise and transparency are important to understand.

In customer perspective, also revenue models were an attractive theme. Vainio from Kamppi was thinking that buying for service is a way that have worked in other business areas and it would fit to this use case as well, like Analytics-as-as-Service. The reason was that it is an easy and effective way to buy analytics when there is no need to have all the analytical capabilities inside the company. She also saw that additional payments could be coming when tailoring is needed. Representatives from outdoor advertising company and Kamppi were both thinking that revenue sharing between them and operator/service provider is not an option. Reason was that they want to keep all the revenues in their company. Other thing that they both agreed was that paying should be in once a year basis. In their point of views, it is psychologically easier to pay smaller sum once a month but budgeting is much easier when the price tag is for entire year. Even though monthly paying can be combined to the entire year they still like more to have only one price tag for the whole year. They declared that with multiple monthly services taken from different companies the combined price tag can easily go too big without notice. Helsinki city point of view, there was also pointed out that value based model would be suitable. They would like to pay in according to the value they get out of the data analytics when they use them. In that way, they can ensure that they are not paying about anything that they do not use or not get value from.

Partnerships was also one view that was went through during the workshop. Figure 13 shows benefits and problem areas of partnerships in telco data services in customer perspective. One clear outcome was that for customers it is only a positive thing if operators have partners like service providers offering new kind of expertise.

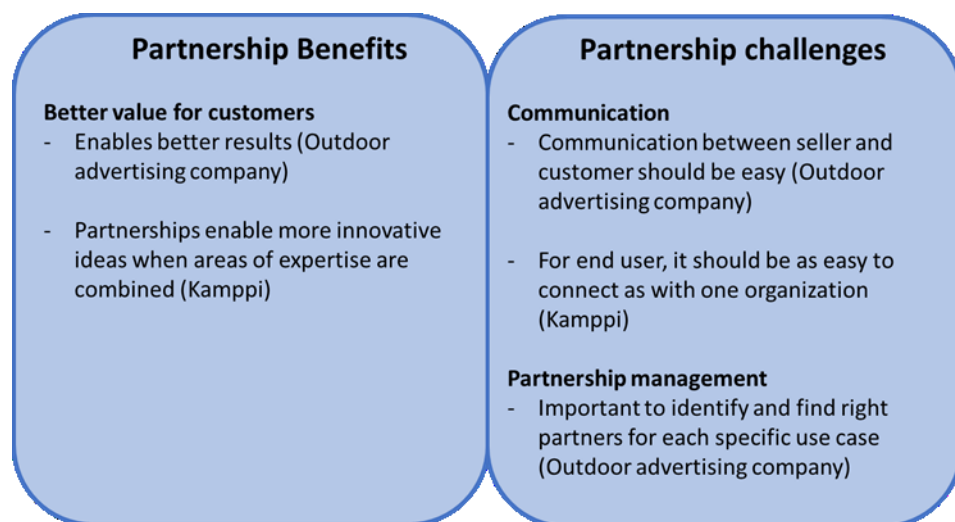


Figure 13. Telco data monetizing services' partnership benefits and problem areas in customer experts point of view

One result was that one wider category for Partnerships' benefits can be identified and it is better value for customers. Vainio from Kamppi stated that partners are enabling more innovative ideas when expertise from different areas can be combined. Also, representative from Outdoor advertising company summarized it in a way that partners are enabling better results in most of the use cases.

In problem side, communication and partnership management were bigger categories that came up. Outdoor advertising company sees that only negative side when operators have partners is that the communication between seller and customer could become more challenging. Representative also mentioned that it is important to identify and find right partners for each use case and handle these co-operations properly. It should be clear for everyone that who are communicating with whom and who are doing what. Management cannot be forgotten. Vainio also agreed with that opinion and added that there should not be any difficulties to connect with seller because communication problems may reduce customers even if the service would be good.

Then in a perspective of tailored versus scalable, results were that customers want to have tailored services (Figure 14). They understand it is important from operator and service provider point of view to make scalable solutions but customers want services made just for them. One reason for that was coming from Outdoor advertising company: "It is hard to create a scalable solution fitting for everyone's needs and what we want is data based planning solutions that can be integrated to our own systems". They do not see that other companies would have same kind of needs than they do and especially services that are possible to integrate with their systems would need tailoring.

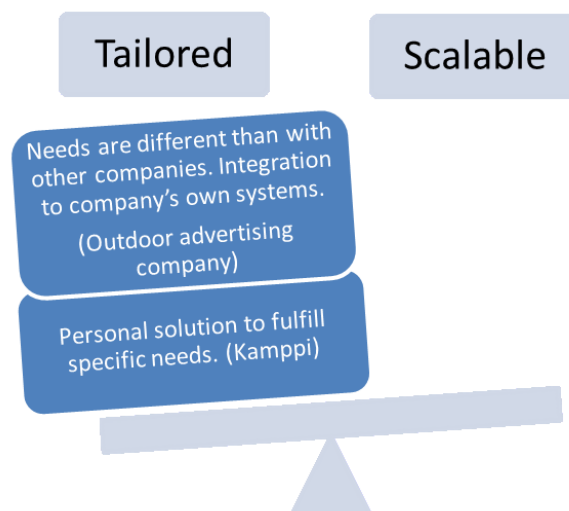


Figure 14. Opinions about scalable and tailored telco data monetization in telco data customer experts point of view

Vainio was seeing that question in a business area mature way, meaning that this kind of telco data based services are learning from everyone in this moment. That is why it would

be good to look potential business models in a tailored way at this moment at least. But still Vainio also sees that their needs are kind of special and they would also prefer tailored way of working.

Innovative business models in telco data monetization

Innovative business ideas were quite difficult topic for the participants. One clear innovative way is location data using in overall but other more specific ideas were difficult to find out and easier was to say what kind of value the business model should give. But most of the ideas in that theme were around fulfilling customer needs. For example, Vainio stated that it is a benefit if operator and its business partners and customer are all involved in an idea and service creation to make a win-win solution. Idea or service should be something that makes it possible to create own innovations with that as well and make better decisions based on that service.

Outdoor advertising company saw free-try possibility as an innovative way of this kind of business models. Representative continued that location data using is quite new for companies and that is why people may would like to play with the data at a map before buying the service. Representative also said that examples about this kind of free trial models are many but one example is Google who is making it possible to play with Google search data for free with Google Trends tool. With free-try options companies could better understand the value coming out of the service and then later buying decision would be easier to make. One view about GDPR also came up. Outdoor advertising company's representative as well as Vainio stated GDPR to be a right direction to go but companies should not be too afraid of it. New and innovative ideas can come if people are pushing limits and finding boundaries to make better services to others. One way to do that is to hire law department to look through what can be done. Another thing about this kind of data privacy topic that Vainio mentioned was that if services using anonymized telco data would be used, information about that needs to be openly shared. She said that "there is no reason to hide that and it gives a better picture for others to show that openly".

6.3 Results from short interviews with operators and service provider experts

These interviews were all made with the same structure that can be seen in Appendix H. Interviews are handling the main topics of this thesis and key themes as well as key findings can be seen in *Table 9*. First theme about "Trends and problem areas in data based and telco data based businesses" is answering to sub research question about "*How models from other business areas can be exploited?*".

Table 9. Key themes and findings in short interviews with operators and service provider experts

Key themes	6.3.1 Trends and problem areas in telco data based business and other business areas	6.3.2 Important elements in telco data monetizing business models	6.3.3 Innovative business models in telco data monetization
Key findings	<ul style="list-style-type: none"> - Business transformation is an ongoing trend that has forced companies to seek new kinds of business models and to move to new business areas - Big data analytics is a trend that is ongoing in almost all business areas as well in telco data based business and it means that companies have started to use and monetize more and more data - Co-operation and partnering are trends that have showed lots of benefits and new business combinations - Data privacy is a problem area that causes difficulties in every business area using data, and especially when personal data is used 	<ul style="list-style-type: none"> - Partnerships, especially technological partners, are important for business that is based on telco data - Scalability is an element that companies try to achieve for creating more profitable business models - B2B is a way towards which most companies are going 	<ul style="list-style-type: none"> - Value and insight creation based on location data analytics - Sponsorship and sponsoring are totally new and innovative business models created based on telco data - Big data-as-a-service (Platform-as-a-service) are innovative ways to create business and serve value - Revenue sharing is an innovative business model that makes partnering and whole business models more profitable

Second theme is about important elements in telco data monetizing business models and there are results for sub research question about “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*” and about “*What kind of business model components are essential for current telco data monetizing business models?*”. After trends, difficulties and important elements are handled, the last theme is about innovative business models in telco data monetization and that is also answering to the same two sub research questions. Each theme is handled in its own sub-chapter starting with 6.3.1.

6.3.1 Trends and problem areas in telco data based business and other business areas

There were four clear categories for trends that the interview participants identified. Those are business transformation, big data analytics and co-operation & partnering. There were also some problems identified that are affecting a lot to these trends. All the identified difficulties are under data privacy category. Figure 15 is a summary about the key trends and challenges found.

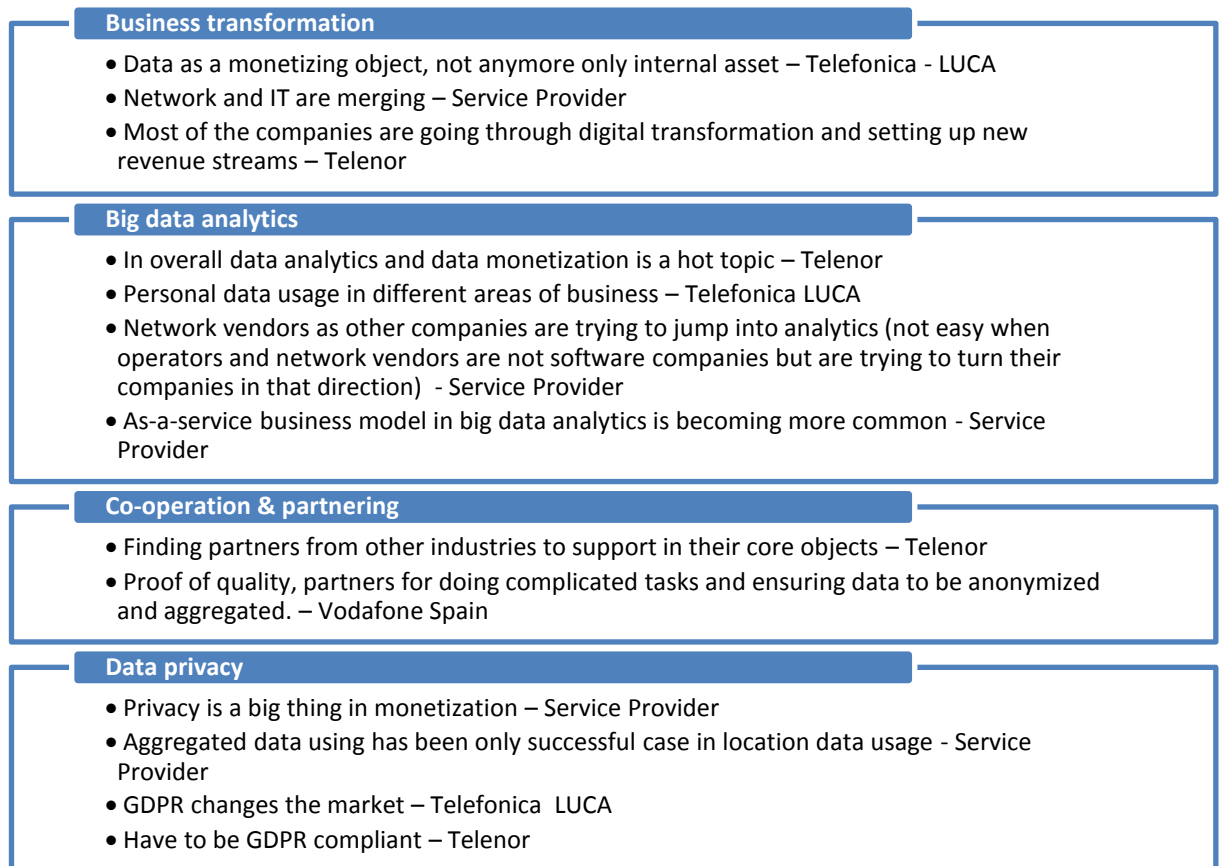


Figure 15. Trends and problem areas that can be found both on telco data based business and other business areas

First trend category was business transformation that is ongoing in multiple industries including telecommunication companies. Alarcon from Telefonica mentioned that previous trend was internal data but now data has starting to be monetized. He said that: “All telcos have started digital transformation projects and one part of that process is generating new products in digital way from a scratch”. To sum up Alarcon’s view, one clear trend in operator companies is to generate value on top of telco data that was not previously useful in companies.

Interviewee from service provider company stated that network and IT are merging and in that way new kind of services can be made. Szucs from Telenor Hungary was also thinking same way. His opinion was that most of the operator companies are having digital transformation ongoing and at the same time those are creating new revenue streams, services and business models.

Next category identified from the interviews is big data analytics. Continuing with Telenor Hungary interview, he was seeing data analytics and data monetization as a thing that lots of people are talking about and trying to benefit from it somehow. Alarcon from Telefonica LUCA said that especially for telco companies that do have 4G services, video services, and whole connectivity plans like TV and so on, there is a trend to create services

out of the personal data. He said that: “Everything is about combining and analyzing market needs and user needs with data that is already in the company”. Service provider also said that even it is hard for network vendors and operators without lots of software knowledge to jump into analytics, they are trying. Another view from service provider was that as-a-service types of models are a trend now in big data analytics area as well. For example, there are lots of platform-as-a-service models on top of data.

Co-operation and partnering is a next trend category identified. Szucs from Telenor Hungary mentioned partnering as a way to do business together in a way that operators can find partners from other industries like banking for example. That kind of new way to do business enables business that is supporting in partners core objects or even better if it can support each other. Gonzalez from Vodafone Spain saw partnering also as a trend and his opinion was that it is like a proof of quality. With proof of quality he meant that in telco data services it is important to ensure data to be anonymized and aggregated, so operators need partners for doing complicated tasks to ensure quality.

Moving to data privacy category, there were lots of concerns and opinions about that. All the interviewees mentioned data privacy as a thing that needs to be taken care of properly. For example, service provider was mentioning data privacy as an important thing in monetization field. He has seen that privacy concerns have blocked many projects and different companies are afraid about negative news concerning data usage. In location data usage, only successful way he has seen has been when customer data is aggregated.

Many of the interviewees raised up GDPR and personal data problems. For example, Alarcon said that “GDPR is a challenge in operator companies and companies are trying to find a way for creative data monetization without colliding with regulations”. Szucs view was also same kind and he was highlighting that companies should ensure that they do not reveal any personal data about customers or partners without acceptance that is really difficult to get. To sum up interview results about data privacy, when companies are using sensitive data, even if it would be used in anonymized way, some people can be afraid that is everything done as it should. That is why reputation risk is also one thing pointed out many times during these interviews.

6.3.2 Important elements in telco data monetizing business models

Next theme was about important elements in telco data monetizing business models and one thing that many of the interviewees raised up was partnerships. Figure 16 summarizes findings and also combines answers from workshops that are already introduced and those answers are with black text color. On the left side, there is benefits and on the right-side difficulties. All the four interviewees were saying that partnerships are one of the most important elements in telco data monetizing business models and as can be seen from the Figure 16 all the opinions were about benefits. There were two bigger categories that

could be identified during the interviews. Those were business unions and better value creation for customers. Szucs mentioned business units to be one of the critical elements mainly because operators are starting to step into other businesses.

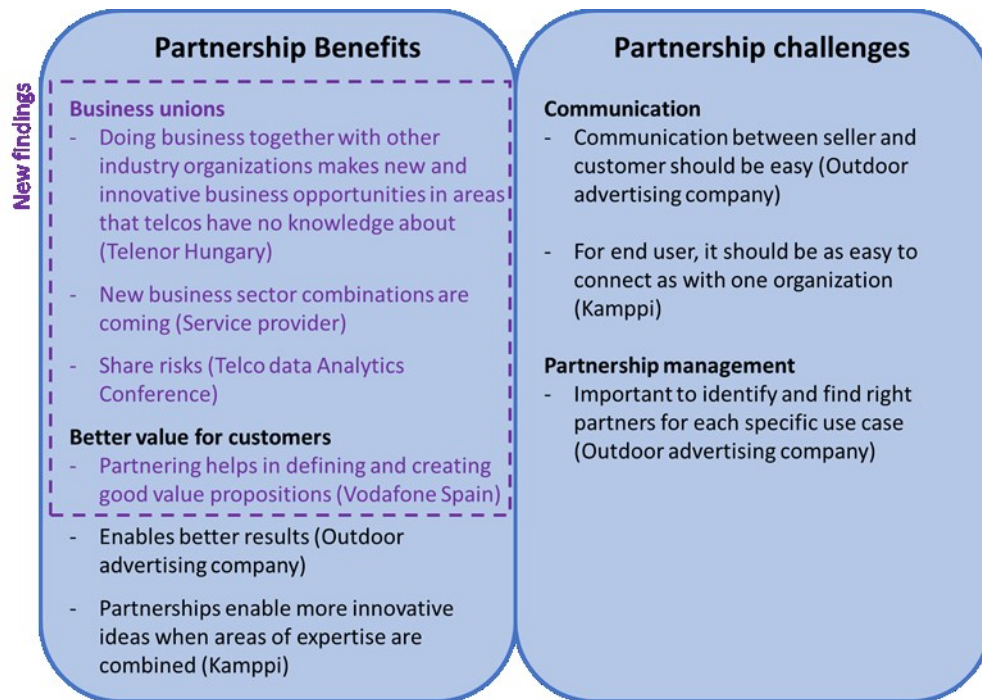


Figure 16. *New findings about partnership benefits and challenges – written with violet color. Previous findings are also combined to the figure – written with black color.*

Representative from service provider was also bringing partnerships up to be one of the critical elements. He said that companies have OTT threat and new kind of services are needed and one way is to have partnerships and create new kind of business area combinations. To sum up the whole Telco data Analytics event where also these interviews was managed, one vision there was that partnerships are also good for purpose to share risks that are sometimes quite high in this kind of businesses.

Another category in benefits side is Better value for customers. Gonzalez said that “telcos are now trying to be more like digital telcos who are still offering connectivity but at the same time operators should be digital service enablers to design new concepts”. He continued that there is two ways to do that. First is to create own knowledge and other way to do that is partnering.

Second critical element that raised different kind of views was the way how telco data monetization projects should be done. There were two kinds of opinions: scalable and tailored. Figure 17 show comments for each category and blue boxes show comments from workshops that that have been already introduced and violet boxes are new findings. Most of the interviewees was saying that scalable solutions are the way to move on. That was one clear message coming from many presentations done during the Telco Data Analytics conference as well.

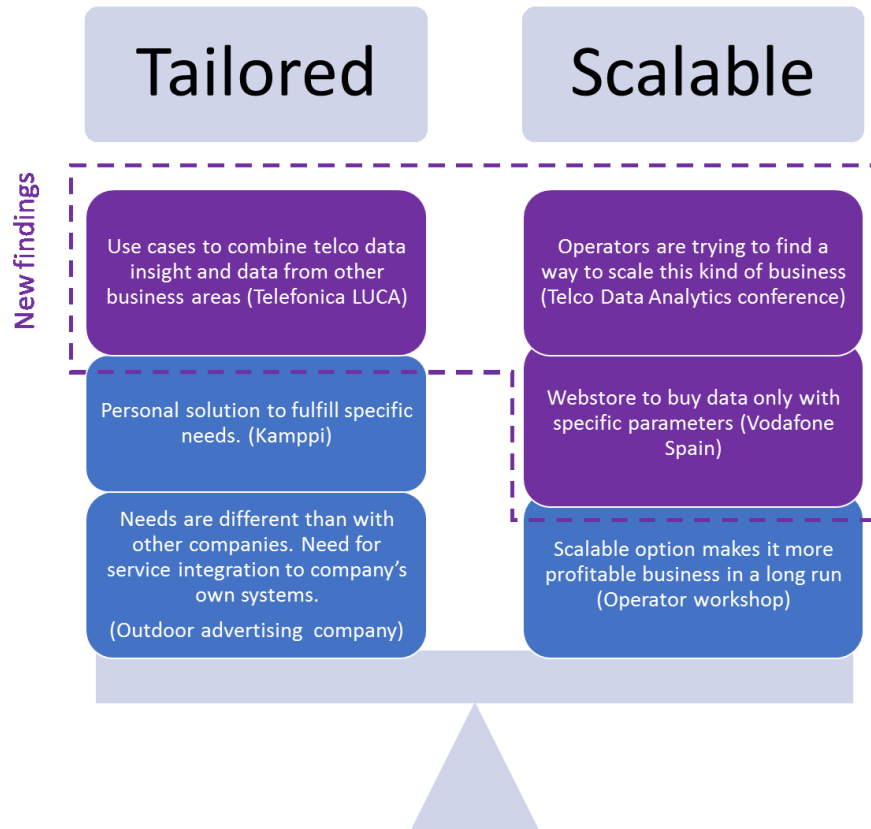


Figure 17. Opinions about scalable and tailored telco data monetization. Violet boxes show new findings and blue boxes combine previously presented findings.

Gonzalez from Vodafone Spain also said that one way to scale this kind of business is to have webstore from where companies can buy insights about crowd location data for example with specific parameters. Alarcon from Telefonica LUCA was only one of these four interviewees that mentioned also tailored services as a one important element. He said that they have had use cases to combine data insight and other business area data but he was not saying that it is the only or best option. But in that way customer can get more value out of the service because company's own data is also used for example and customer needs can be fulfilled better.

Last important element category was about customer segments (Figure 18). One clear result was that all the interviewees were thinking that B2B is the primary target in telco data monetization. Alarcon said that telcos can sell aggregated data as a value to business customers and in the B2B side there are much more ways for monetizing data analytics. Gonzalez stated that companies are moving towards improving people's lives through partnerships with companies. This kind of new way – business to business to customer is a way for selling services. To sum up, he mentioned end customer understanding as a key asset here even though the primary target is to serve business. Representative from service provider has seen that B2B is a direction that almost all telcos are moving towards and B2C to telcos are slowly going down. Szucs was also having same kind of opinions that in business revenue point of view B2B is worth to do.

<p>B2B</p> <p>Primary target for making revenue with telco data</p> <ul style="list-style-type: none"> - B2B is full of opportunities (Telefonica LUCA) - B2B2C, improving peoples lives through partnerships with companies (Vodafone Spain) - B2B is the way that most telcos are moving towards (Service provider) - In business revenue point of view B2B is clearly worth to do and has a lots of potential (Telenor Hungary) 	<p>B2C</p> <p>Indirect revenue</p> <ul style="list-style-type: none"> - Analytics for customers can make customer loyalty better (Telefonica LUCA) - More trust from customers -> positive impact to churn (Telenor Hungary) <p>Difficult and problematic</p> <ul style="list-style-type: none"> - Interesting area of business but difficult because of OTT players like Google are offering free services (Telefonica LUCA)
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Figure 18. Summary about opinions on B2B and B2C

B2B is more about revenue but in B2C side telco data using can be seen in trust point of view. Meaning that customers can trust more into services if they have better understanding about usage of products for example and that can affect to revenue as well. One of the categories in B2C side is indirect revenue. Another comment about indirect revenue was from Alarcon who was also mentioning that making analytics to customers can make customer loyalty better, better churn, better evaluation and so on.

Other identified bigger category in business to customer side was the difficult and problematic nature of the business. Alarcon brought up that one reason why it is difficult is that OTT players like Google are offering free services with location data for example. To sum up, interviewees were seeing B2C as an interesting field but it is hard to find a proper service that customers would like to pay. That is one of the biggest reasons why operators and service providers are focusing more into business to business.

6.3.3 New and innovative business models in telco data monetization

This theme about new and innovative business models in telco data monetization was clearly the toughest one for interviewees. But it was possible to find out one main category that many of the interviewees mentioned - location data. Gonzalez thought that business around geolocation data is one new and innovative way. He said that there are multiple request coming from different customers about doing business together in a way that those customers would leverage about Vodafone's location data. But Vodafone is not going to sell their raw data but that shows that there are lots of action ongoing around location data. Alarcon also said that location data is coming and it is not only operators, many other companies as well are trying to put value on top of telco data. There was still a little different opinion from service provider interview. Their representative was thinking that location data is a potential business case but privacy concerns are making it difficult. With difficulties, he meant that they have had problems for creating any model that

is able to provide enough value that customers would like to buy it and at the same time that data privacy regulations are fulfilled.

One important finding was coming from Alarcon who introduced sponsorship way of doing business. It was an innovative approach to use telco data and to combine it to other data sources like personal data. He also mentioned that this proprietary information can be other thing than personal data as well and it can enable a new way to do business. He summarized well the main problem about pricing data based models: “It is hard to put a price tag for data because it is many times coming for free during other tasks. Interesting topic would be to find out a price for one person’s data, like is it 50 cents or one euro or what is the actual revenue. In a way like it was in news some time ago that hackers pricing for different data was revealed.”

With that hackers’ pricing, he meant that there was a list published with different prices for peoples’ personal information like for example visa card number cost x euros, Facebook password cost x euros and personal health records were most expensive. What Alarcon meant with this pricing topic was that models where people donate data is also a model worth considering – data for sponsorship way of business. In that way customer can donate his/her data and in return the customer can get more minutes or more megabytes for continuity. Alarcon said that it is a business model that is working in some of the companies. It is working especially for young people who do not have that much money to pay for the contract.

Another innovative business model with telco data usage, also from Alarcon was sponsoring. In that way company can support for example biking team and help them with doing analytics about how they individually perform and how they perform in a team. This data can be used to help the team to do personal and team strategies. What is more, with telco data they can find out the audience of competitions. In that way, the company can see how many people sees their brand logos and so on but the main stakeholder for the telco data is competition organizers who are interested in knowing what is the actual audience on the events like Tour de France and so on. In that way organizers can adjust their advertising revenue streams accordingly for example. In that model, better strategies for biking team can affect in a way that company can get its brand better, see how many people sees their sponsor tags and in that way, get value back in a unique way. That is a model that is a win-win situation – when the team success better the company gets more value. It is a model that shows how value can be achieved in other additional ways than direct revenue as well.

Service provider was mentioning Big-data-as-a-Service as well as Platform-as-a-Service to be innovative business models at this moment. Because platform environments in telco data monetizing has showed to be processing well as those are showed to be working in other business areas as well. Szucs also stated that real innovative ideas are hard to find but what is useful and potential in his opinion are partnering and revenue share

7. DISCUSSION AND CONCLUSIONS

This chapter combines all the findings from the research and compares the results to the research targets and research questions. First subchapter is about interpreting the findings and putting them in a bigger picture. That subchapter is distributed into three smaller sub chapters that describe more widely all the most important topics to answer for the main research questions. Then in the conclusion part there is a brief summary about the key findings for all the research questions. After that is a subchapter about research process evaluation and lastly subchapter about possible further research areas near to this thesis.

7.1 Discussion

Discussion chapter consists three subchapters that are "Business maturity and current telco data monetization in different business areas", "How to evaluate telco data monetization business model's attractiveness" and "Innovative ways of doing business based on telco data". To answer properly to the main question about "What kind of useful and interesting models could be developed for telco data monetization?" more specific answers for these three themes are important. First theme is about business maturity and current telco data monetization in different business areas. Telco data fit to many business areas, so the idea of that chapter is to show the findings about what has been created and how mature are those businesses and business area evaluation.

Second theme combines findings about most important business model components that came up in empirical part. Idea is also to combine theory part findings about business model evaluation. Third theme is about innovative existent and novel models. There is couple of findings about most innovative models from theory and empirical part and then a summary what is common between those examples. This chapter includes most interesting findings from the research combined to writer's own thoughts raised during the research process.

7.1.1 Business maturity and current telco data monetization in different business areas

This subchapter is answering mainly for sub-research question "*What kind of and how mature business has been created based on telco data?*". In this theme, there were two most interesting findings. First interesting finding was that there are no clear telco data business area that is above others even though empirical part showed that health care and tourism are interesting and potential areas. Second main finding for this theme was that many of the current external telco data monetizing projects are on piloting phase and no mature business models were found.

Starting with the first key finding, literature research showed that insight from telco data can be valuable for multiple business areas and there are also many use cases tested. Result from empirical part was also that operators and service providers are testing telco data in multiple business areas and no one could declare one business area that is above others. Still, health care was missing from found literature while some of the interviewees stated it to be interesting. Health data is one of the most valuable personal data existing and in that area, there could be lots of use cases like to collect anonymized health data from health sensors, combine it with location data and sell insight for example to insurance companies. Tourism was another business area identified many times but that does not have many proper use cases yet. Tourism movement patterns are possible to get from roaming data and it would give lots of important information to different companies as well as to customers who want to know where tourists move and visit. Google like many others are already offering their users location data for free what makes it more difficult for operators and service providers to access the B2C markets.

Other empirical part finding was that new kind of expertise is needed when telco companies are trying to start solving problems from different business areas. One found solution for that are partnerships and sector combinations to achieve needed expertise and needed external data. Trying to combine these findings, it could be clever for smaller companies to concentrate only to couple of business areas. Because smaller companies may not have enough resources to collect data and expertise from multiple business areas.

Surprising second key finding was the maturity level of external telco data monetization. Literature about telco data monetization maturity was not found and researches about telco data monetization showed that business models were handled through the value proposition perspective and other important relationships like revenue models were not handled. Still, lots of telco data monetization research and pilots were found which shows that this area of business is coming. Also, all the operator interviews said that they are working on this area and some of them are piloting on this area of business. Still, no participant was mentioning mature business models that would have been properly tested and functioning. Internal monetization has been ongoing for a long time and ideas around it are enhancing as technology enhances.

7.1.2 How to evaluate telco data monetization business model's attractiveness

This chapter is combining findings for three of the sub research questions: “*What kind of business model components are essential for current telco data monetizing business models?*”, “*Which types of business model overall trends can be identified?*” and partly to “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”. First main finding for this research area were novel linkages between key activities to fulfill customer needs

and create lock-in effect with low costs. Second main finding was a potential example business model about external telco location data web-store and reasons behind the business component selection. That model can be used to help evaluating new business models by comparing selections and reasons.

To start with the first one about novel linkages, there was no clear need for totally novel business models found neither from literature or from empirical part. Because telco data monetization has same kind of characteristics as other data monetization businesses. One conclusion based on that would be that existing and well-functioning data based business models and business model trends can be used in telco data monetization as well. One key aspect for evaluating would be to find out how some business model parts work in other data based business and try to link those properly to each other and to telco data monetization in overall.

Amit and Zott (2012) described that important parts for business model performance evaluating are lock-in, novelty, complementarities and efficiency. Important evaluating criterias are how to get customers to keep using offered services, how services satisfy customers' needs and are links between business model activities innovative and create as much value as possible. Efficiency can be evaluated also by testing if costs are saved with clever linkages between different activities. In turn, Meyer Haggège et al. (2017) pointed out same kind of performance drivers like customer engagement, external linkage configuration and internal process optimization that can be used in evaluation process. To combine findings in business model evaluation, important thing is to understand value transactions between different participants in the business model and to see if all of participants can capture value and get benefits from the model. Appendix I show one example about possible value transactions that is formed based on workshops. Key partners in that model are operator, customer, network product vendors and sometimes service provider. Network product vendor could be also service provider that makes key activities simpler. Key value transactions include money, telco data, customer data and expertise.

Second key finding was a potential business model that is formed based on the short interviews and both workshops. In that model, evaluation criterias like customer need compared to value proposition and costs compared to revenues and risks are used. Those two evaluation criterias came up during interviews and workshops when participants tried to find out most important things in telco data monetization business models. Figure 19 is formed by comparing solutions that most of the operator's saw potential for creating profitable business model. One critical finding from the empirical part and theory part was that external monetization is having lots of attention and almost all of the potential external use cases were using anonymized and maybe aggregated location data for business customers in a way that risks about data security are extra carefully handled. Difficulty is to find out how location insight fits to different business areas and that is why one key resource is to use telco data combined with other data.

Key Partners With technology partner	Key Activities <ul style="list-style-type: none"> • Data security • Data privacy • Data collecting + anonymization/aggregation + analytics 	Unique Value Proposition <ul style="list-style-type: none"> • External monetization • Location insight • Ongoing service (as-a-service) + one time services • Scalable 	Customer Relationships Online + offline	Customer Segments <ul style="list-style-type: none"> • B2B • Big companies + small companies
	Key Resources Telco data combined to other data		Channels <ul style="list-style-type: none"> • Web-shop + consultative 	
Cost Structure Costs vs revenue + risk		Revenue Streams <ul style="list-style-type: none"> • Revenue share • Subscription based 		

Figure 19. Important elements for telco data monetization from operator perspective

Two ways for saving costs were identified and especially operator interviews showed that operators try to find ways to scale services and use channels like web-shops to do that. Other cost saving way that most of the participants mentioned were to have partners with revenue share model to help at least with analytics part. In that way costs from at least one key activity: data analytics, can be transferred to partner and if that partner is also network product vendor, more profitable linkages between key activities can be made. Revenue models like subscription model added to as-a-service model with free-trial period is a way to easily get customers involved and part of the services for a long time. Workshop with operator showed that even though scalability and online customer relationships are important, also consultative way of selling services are needed to keep customers more engaged to ongoing services.

7.1.3 Innovative ways of doing business based on telco data

This subchapter answers to two sub research questions: “*How models from other business areas can be exploited?*” and “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”. Three key findings in this research area can be seen above others and first one is two examples about innovative telco data monetization business models: sponsoring and sponsorship. Second finding was that those innovative models has similarities that are innovative ways to create value transactions between key members in the business model. Third innovative way of doing business was web-shop as a scalable option.

To start with the two examples that came up in operator interviews, sponsoring and sponsorship. In the sponsoring model, value is moving to multiple directions (Figure 20). The basic idea with sponsoring is that multiple data sources are used and offered to different people and organizations. Telco data collected by network product vendor is used to analyze audience in sport events and then data about individual team members is used to

create strategies for each team member and for the whole team. In that way operator and/or service provider gets value also in other ways than money and from multiple directions. In that model value can be achieved via better brand awareness as well as with revenue from competition organizers who may buy telco data about audiences.

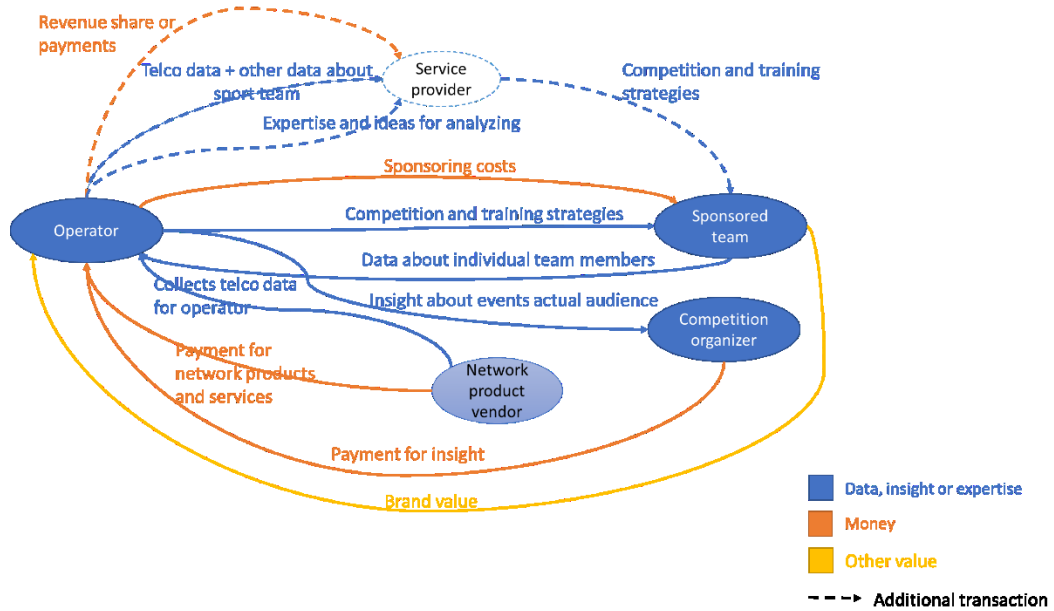


Figure 20. Sponsoring - value transactions in sponsoring business model.

Other innovative finding from short interviews was sponsorship and its value transactions can be seen in Figure 21. In that model, all the basic transactions are same, meaning that network product vendor collects data for operator and then operator does business either without technology partner or with technology partner who produces the service. But in both ways the idea is to get additional personal data from network customers in return for contract discounts.

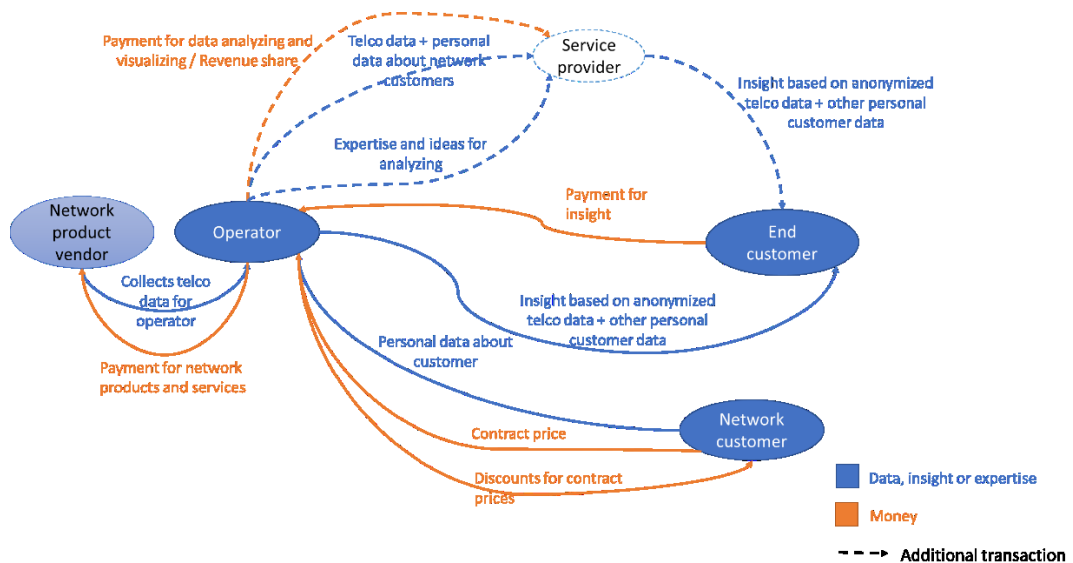


Figure 21. Sponsorship - value transactions in sponsorship business model.

In that model, network customer can get cheaper contract if he accepts to give his/her personal data. That business model gives operator and/or service provider a great opportunity to create more accurate insight for end customers buying that kind of insight. That model shows how additional data can be obtained without paying for it directly in a win-win way. To sum up, at least one big similarity between those models can be identified and it is novel and innovative value transactions. Those transactions are creating different types of value to different partners and value can also be different type than direct money. Sector combinations are one solution how to achieve that kind of novel value transactions. In theory part, there were especially one that kind of innovative model from Vodafone where payment card frauds are prevented comparing payment location to cardholder's location (Vodafone 2017).

Third key finding was web-shop or some other online-based analytics. For example, Naous et al. (2017) explained that as-a-service models are one trend in data based business models and that is one reason why it could fit to telco data as well. Operator interviews and operator workshops showed also how potential scalable web-shop or another online based platform would be. To create even more innovative model, blockchain elements could be added on that model. As Zhang & Wen (2017) stated, blockchain based web-shop would enable secure way to share insight not only from operator to customers but also to combine customers' data with other customers' data. In that way, also telco data could be combined to other data sources. By creating a service where it is possible to sell and buy all kinds of insight without middlemen.

7.2 Conclusions

Conclusions part is distributed into four subchapters and the first three are handling the main themes of this thesis and last one is summarizing the whole research and answering to the main research question "*What kind of useful and interesting models could be developed for telco data monetization?*". First main theme handled is "Business model trends in general". That trend is answering to research questions "*Which types of business model overall trends can be identified?*" and "*How models from other business areas can be exploited?*".

Next bigger trend is about important things related to telco data, so it is "Telco data collection, monetization and constraints". It is answering to question "*What is telco data and how can it be collected and monetized?*". Third bigger theme was about "Telco data business". So, important things around telco data business models were handled. That trend chapter is answering to questions "*What kind of and how mature business has been created based on telco data?*", "*What kind of business model components are essential for current telco data monetizing business models?*" and "*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*"

7.2.1 Business model trends in general

To answer the sub research question “*Which types of business model overall trends can be identified?*”, theory research was crucial while that was also handled in the empirical part. In big picture, business model is an explanation how organization works towards achieving its targets and goals. Business models give a big picture about what are the most important elements in the business and there are multiple different tools to help in creating business models. One widely used model is business model canvas. From the business model trends perspective, revenue models like paidmium, freemium, subscription based and pay-per-use are popular in business model development. Other trends that were identified during the literature research are as-a-service models, bait-hook, separation, long tail, multilateral platforms, free and open business models. In the empirical part, as-a-service models were also identified as a trend, especially big data- and analytics-as-a-service. All in all, new business model creation is ongoing as a part of business transformation and companies are trying to create all the time more services on top of data.

Answer to the research question “*How models from other business areas can be exploited?*” can also be divided to answers coming from the theory and from the empirical part. Starting with the theory, as-a-service models were identified as trends generally in data monetization and that is why those models could fit properly also to telco data monetization that has same kind of characteristics as other data types. To summarize different as-a-service models found in literature, analytics-as-a-service, data-as-a-service and platform-as-a-service could be best fitting because those can be focused to only data and insight creation. Then, blockchain based web-shop was another interesting model from literature that would have many benefits like scalability and more secure platform without middlemen. B2C platforms has shown their benefits as well in the other business areas and that is why those could also fit to telco data monetizing models. From the empirical point of view, analytics-as-a-service was identified as a potential model but data-as-a-service not because operators may not want to share or sell their data. Other potential ideas were revenue models like revenue share and subscription based models. All in all, the results from the theory part and from the empirical part are similar.

7.2.2 Telco data collection, monetization and constraints

The research question “*What is telco data and how can it be collected and monetized?*” is answered from both theory and empirical perspectives. From the theory point of view telecommunications industry is enabling people to use internet and make calls and send text messages with mobile networks regardless of location. These networks also include machine-to-machine connections like sensor connections. All the data from those networks is telco data including SMSs, calls, signaling, location, phone model, subscription details like age and gender, internet usage and app usage. That data can be used to produce

different kind of insight about crowd and new technologies makes it possible to have quite accurate crowd location details as well. Empirical part supported those findings and it was concentrating more into the collection part, where it is important to understand that operators have networks vendors from where they buy network elements. Network vendor has software that enables network operations and at the same time collect all the data coming in and out from the network devices. After collection data is pre-processed and saved to servers and also moved to different applications like for data analyzing. Transferring to applications that use the data needs to be done carefully because many times data needs to be anonymized to fulfill data privacy rules.

In theory perspective, data monetization means that a company is trying to use their data in a way that it creates revenue directly or indirectly either in internal or external way. Telco data like big data includes three important elements: volume, variety and velocity. In internal telco data monetization, data is used to enhance and optimize networks to give better service for customers and get indirect revenue. In external monetization, the data is used to sell insight about crowd analytics to other companies or to individual persons. Either in empirical part or in theory part, there were not many use cases about sensor data, phone app usage data, phone call data or internet usage data and most of the found use cases were handling categorized location data with age and gender information. In maturity perspective location data is used much further than other telco data like for example app usage data. Empirical part supported findings from theory part and fulfilled it with more specific information about constraints in telco data monetization. Telco data is sensitive and that is why data privacy and anonymization techniques are the biggest constraints in this area. To fulfill data privacy regulations especially GDPR, telco data needs to be anonymized or permission asked from each person whose data is used. Other constraints that came up from both theory and empirics parts were location accuracy, reputation risk and market size, which is at least in Finland a big boundary.

7.2.3 Telco data business

First question regarding telco data business was *“What kind of and how mature business has been created based on telco data?”*. From the theory perspective, lots of different use cases, researches and pilots were done but no clearly functioning use case was found. Use cases both in theory and empirical part were handling business areas around traffic/transportation, safety, marketing, urban planning, travel, retail and shops in external monetization. Internal monetization cases were around network analyzing, optimizing, predictive maintenance and churn. Many kind of use cases are already existing but operator interviews showed that companies are all the time searching for new possibilities and business. It was also clearly pointed out, that companies are concentrating into B2B cases or B2B2C. B2C is still potential but there is not much done yet on that area and main reason is that B2C business is much more difficult. What comes to maturity, most of the operators are piloting their business models around external telco data monetization, so

there was no mature business found in that area yet. Empirical part strengthened finding from theory part that internal telco data monetization has been ongoing for a long time. In addition, companies see both internal and external monetization categories important.

Next question was about “*What kind of business model components are essential for current telco data monetizing business models?*”. From the theory part, it was possible to identify two common essential findings. First, location insight as a value proposition is one of the essential components. It was used in most of the external use cases and optimizing as a value proposition in internal cases. Second finding was that in customers segment perspective, B2B is more common because it is easier business area.

In empirical part, three essential business model component additions were found. First, all the interviewees were mentioning data privacy as a key activity and risk factor. Second finding was the importance of partnerships to create more innovative services with low costs using revenue share model. From operator perspective, at least technology partner is important. Third finding was channels to achieve scalability and cost savings. To sum up, value transactions are also important things when connecting components together and what companies want is to offer insight as a value, not data. Most innovative business models were including novel key activity linkages and more value transactions between different parties than typical example about just between buyer company and operator. But innovative ideas were not found to be the most important thing because the business area is new and there is room for quite simple services as well.

Last question was about “*What kind of existent and novel models based on telco data are most interesting and potential for the perspectives of an operator and a service provider?*”. To start with the widest business models, interviews and workshops showed that B2B based models were most potential and used option while also B2C had interest if novel idea is created. Furthermore, almost all the example use cases in literature were based on B2B. To think more about the future, IoT would be a potential option for both operators and service providers but at this moment, models where telco location data has been combined with other data sources are seen potential as well as location data usage in overall. One of the most innovative models that could be potential is sponsorship, where company is sponsoring some sports team for example and supports that team with different kinds of data and also uses telco data to show competition organizers the actual audience in the events and at the same time company can know how many persons saw their logo on the event. Another potential and innovative way is sponsoring, where operator company gives discounts for subscription fees in return for customers’ personal data. In that way telco data and other personal data can be combined and used. Another potential model that came up were bait-hook, meaning that customers can get free trial to play with the data before buying and another one was revenue model called pay-per-value to offer services that are totally based on the value that the company gets.

7.2.4 Useful and interesting new models for telco data monetization

To answer the main research question “*What kind of useful and interesting models could be developed for telco data monetization?*”, there is important information both in the theory part and in the empirical part. One outcome was, that there were no different views between the theory and the empiricism. In internal telco data monetization perspective, one interesting model is to use predictive optimization to keep the networks effective. In the external monetization, there were more new business models found and piloted. As the market is kind of new, there is no direct need for creating new and innovative models and other data based business models can be reused. Furthermore, free trial would be an effective way to get people familiar with this kind of new data insight. One main problem to overcome is to create value without colliding with data privacy regulations. In telco data monetization, partnerships were seen as a key factor and from operators’ perspective especially technological partnership.

To sum up, the main finding was location data insight selling. It was clear, that it is the way operators and telco data service providers are seeking. Most interesting models were using multiple data sources instead of only telco data and that is one reason why business sector combinations were seen interesting. When some personal data can be combined to telco data, outcome can produce much more value for different users. To make the location insight business profitable, scalable models are needed and one potential solution for that is web-shops. Other model seen as interesting one was analytics-as-a-service which has already shown reliable results in telco data monetization and has shown also good results in other data based business areas and it can easily be used with web-shops as well. Useful models in location data usage are based on B2B but new B2C models are also seen interesting and some possible business area for that could be tourism for example.

One target business area that were found from the literature research and also short interviews showed its value was health data. Especially if sport trackers and other health sensors will become more common, there would be lots of new use cases in that area. To sum up, basic models with location insight sold to the customer with the operator and the service provider sharing the profits are seen useful. But more interesting models may be the ones where there are more value transactions and value capture going on.

7.3 Research process evaluation

Research process started with literature research and continued with empirical research. Literature research showed that there is only a few researches that are concentrating to telco data monetization business models. That is one reason why literature about other data based business models were needed while of course in all situations it would have been a good viewpoint as well. There were many researches about telco data monetization

in overall but researches where also business potential would have been gone through were harder to find. One of the biggest difficulties was to figure out a way to find and combine important literature that can be used in a purpose to create new business. In other way around, that is one reason why this research is important in this area of business.

When there was no direct literature about telco data monetization business models, it may cause lack of some important perspectives. Still, that can be seen to be a positive thing when there were no specific opinions formed during the literature research that would have influenced on workshops and interviews. That was also one of the research targets, to find new information about this area.

Validity and reliability are important things to estimate in different research processes. In reliability perspective, it is important to try to form research and after research try to estimate these aspects. In reliability, it is important to estimate that would some other researcher got same kind of results or would the results be same kind if the occasions would be different. It is also important to find out is there transparency between results and data. (Mark et al. 2009, p. 156)

Most of the results are such that they would most probably appear in other same kind of researches as well. Still some results about innovative business models for example would be different kind if interviewers or interviewees were different. Even though operators and service providers were speaking openly about their business, they may not want to reveal some new and innovative model before they publish it. But the big picture about potential models' problems and benefits are not very specific, so there is high chance that same kind of research would result in same kind of findings.

Reliability and possible biases that may cause lack of it were tried to minimize during the process. For example, participant bias means that interviewees or workshop participants may say something what their bosses want them to say (Mark et al. 2009, p. 156). One used way to minimize this was to make some of the interviews anonym. In that way, the participants could speak more freely but in other interviews and workshops there is a possibility for participant bias. Another reliability threat is participant error that were tried to minimize by arranging interviews and workshops in various times of week and also in different times of months and year. Participant error means that results may be different depending on the time of the week when interview is arranged (Mark et al. 2009, pp. 156-157). One way to make better reliability was to have semi-structured theme interviews where participants could speak more freely without tight guidance.

Validity is about is the results really what they are understood to be (Mark et al. 2009, p. 156). One used way to ensure this is to compare results from theory to results from empiricism part and big differences were not found. Also results from workshops and interviews were in big picture in line with each other. These are reasons why results can be seen valid. But to ensure the validity even more, more interviews would have been

needed. To sum up, results can be seen reliable and valid for this kind of research that tries to form new kind of information and insight that were not available in the literature.

7.4 Further research

This research revealed many research areas that would be potential for further research. Interviews about information security and data privacy showed that there would be need for at least different anonymization and aggregation technique research. That kind of research could include technical examination about how anonymity can be ensured and what are the weaknesses of each technique and results could be mirrored to the data privacy regulations. Not only in general level but also to really test different techniques and try to find ways if those anonymizations could be un-anonymized.

One need that came from short interviews was data pricing. In this thesis, data pricing has been mentioned but there was no vision how it can really be done and it is something that companies are trying to figure out at the moment. Interesting elements would be to know how much for example one person's data like location data would cost. One difficulty is to put price tag onto something that has come as a byproduct. To sum up, it would be interesting to see if it is possible to calculate price for one person's data and is it dependent on the whole sampling crowd size for example.

To answer more specifically to researches sub question about potential business models, one further research topic would be to select some potential models and really test and compare those. That kind of case research would include testing the whole model in action and to find out problems and benefits and to see how profitable it could be, how could it be enhanced and what would be suitable price for it. Next steps for this thesis in Nokia would be to use this thesis for creating and testing new business model around telco data.

As telco data includes also data about machine to machine connections like sensor connections, there would be a whole new research area about how sensor data could be monetized. Sensor data monetization was a topic that many of the interviewees pointed out. Especially, in that area interesting would be to know what kind of value sensor data could bring. IoT and 5G would bring lots of new sensors in the future and that is why it would be good area to research how those massive amounts of devices could be benefitted. For example, fitness trackers are more common all the time, there could be lots of use cases to collect data from that kind of devices and monetize it.

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APPENDIX A: LITERATURE ABOUT TELCO DATA USAGE

Headline	What	Data	Additional information	Business or just research
Visualizations-based Analysis of Telco Data for Business Intelligence	BI Dashboard with visualizations about 3 business measures/indices	Call detail records		Business (Business intelligence)
Using On-the-move Mining for Mobile Crowdsensing	Mobile crowdsensing	Mobile device sensors (Accelerometer, Proximitysensor, Magnetix field, Temperature, Light sensor, Gyroscope and pressure)	Not precisely telco data because used Android based module for data collection	?
Urban Sensing Using Mobile Phone Network Data: A Survey of Research	Urban sensing: human activities and urban dynamics. Mobility patterns, urban space usage, travel demand during different events, geographical dispersal of mobile communications, social networks structure, consumption like energy, waste and water and environmental impact like noise and pollution	Mobile phone network dataset	Research with good quality and lots of examples	Business including business models
Traffic Analysis Zone Based Urban Activity Study with Aggregate Mobile Network Data	Urban activities from spatiotemporal (location+time) data	Real-time mobile network data	With mobile data it is possible to overcome problems like lag, high cost and low user counts	Research
Toward a Route Detection Method base on Detail Call Records	Automatic route extraction from CDR data. This location information gives possibility to study different things like traffic jams, origin-destination and transportation systems	Location data from CDR data. Telco operator provided Call Detail Records in 2014	Used two different datasets: small with 1.7 million events of 17 500 subscribers and medium with 69 million events of 48 000 subscribers	Research
The Spark-based framework for mobile network data and cluster analysis on mobile users' behaviours	Processing and analyzing mobile network data with spark based framework. Showing clusters about what users are doing (searchin what in internet, listening music, watching videos, SMS etc.). In addition timestamps and device brands.	Real mobile network data	Is focusing more into the technical side using spark-base framework.	Research, but they implemented CURE algorithm for analyzing mpbile users' behaviours.
TelCoVis: Visual Exploration of Co-occurrence in Urban Human Mobility Based on Telco Data	Urban human mobility research and visualization techniques to better understand urban planning, BI, social behaviour and contagious diseases. Urban human mobility analyzes can be used also to understand co-occurencies between people from different regions.	Large-scale telco data	Case studies and business opportunities of telco data using	Business
TelcoFlow: Visual Exploration of Collective Behaviours Based on Telco Data	Collective behaviours in small resolution of large coverage areas. Visual analytics system is used in different purposes	Spatio-temporal data (telco data)	Case studies about real datasets used	Business with multiple use cases
SOMOBIL - improving public transport planning through mobile phone data analysis	Public transportation planning. For example traffic hours, transportation types (individual/public) and user-groups were identified.	Austrian nationwide mobile network data	With traffic flow visualization it was possible to see even total number of users trips overlapping	Research

Semantic Enrichment of Mobile Phone Data Records	They created a model to find out what kind of activities are likely happening in different locations	Mobile network data combined to georeferenced information from OpenStreetMap and other similar services	They created model to find out exceptional events from telco data and find out tasks that are probably to happen in certain places with certain people group like tourists in certain time of the day and year	Research + identified business areas
OAISIS: an Ontological-based Approach for Interlinking CrowdSensing Information Systems	Crowdsensing with data from smartphones, sensors and wearable devices.	Sensors like noise, wind, pollution, luminosity, blood sugar, heart rate, humidity, outdoor temperature and mobile phone apps	Solution model to manage data in Crowdsensing systems and give recommendations. No telco data used	?
NIM: Scalable Distributed Stream Process System on Mobile Network Data	Real-time decision making with help of raw 3G network data set. Created a user behaviour model that can help in creating customized services, network optimization and to give recommendations.	Data from customers and from operators network devices	More about the technical side and furthermore about business possibilities	Business including business models
Network Heavy Traffic Modeling Using α -Stable Self-Similar Processes	Not telco data	Not telco data	Not telco data	Not telco data
Implicit Social Networking for Mobile Users: Data Monetization for Telcos through Context-Aware Services	New way to get information about how to upgrade existing or develop new social networking services	Telco Data	Social networking mobile platform for mobile users. Users get personalized recommendations for about movies or tickets or some offers for example.	Business
Home and Work Place Prediction for Urban Planning Using Mobile Network Data	Urban planning based on mobile network data. Urban planning is done by predicting home and work place from the data	Telco data	Method used in this research is showing 25 % better accuracy in home and work place predictions than existing methods.	Research
Digital Transformation Initiative, Telecommunications Industry	Information about telecommunications industry and about its future. Lots of usecases including telco data monetization	Telco data + lots of other example data sources	Good use cases	Business
Dengue Propagation Prediction using Human Mobility	Dengue virus spread prediction. Dengue can propagate between people, so human mobility from mobile network and epidemiological data is used to predict the propagation	Mobile network data and epidemiological data	Data analytics used to do predictive models about dengue propagation	Research
Big Data Analytics for User-Activity Analysis and User-Anomaly Detection in Mobile Wireless Network	Different clustering techniques used to analyze and detect anomalous behaviour of mobile network (call record data)	Mobile network data (call record data)	High traffic demands in some certain location were identified to anomalies. Neural networks were used in the prediction models. That kind of information can be used for example to allocate resources and for creating fault avoidance solutions	Research with some business usecases identified

Analysis for Large Passenger Flow Area and Monitoring Technology	Internet of things sensing techniques are used to make analysis about passenger flows to enhance public safety.	Video analysis, mobile network data, social data	Created an early warning system to enhance emergency plan and public safety.	Research, but business possibilities identified and multiple datasets combined
An Interactive Analytics Tool for Understanding Location Semantics and Mobility of Users Using Mobile Network Data	Home and workplace prediction to make urban development easier	Mobile Network Data		Research
An Efficient Approach of Identifying Tourist by Call Detail Record Analysis	With the help of call detail record, tourists approximate locations were tracked	Call detail record (telco data)	This anonymous data about tourists can be used in multiple use cases like to give tourists SMS based help, give emergency information or for police etc. And for tourist organizations as well	Research but benefits of this research for business purposes are also handled
A multi-objective clustering approach for the detection of abnormal behaviours in mobile networks	Visualizations about users behavioral similarities	Mobile networks (Call detail record and signaling data)		Research
Understanding individual human mobility patterns	Different models to understand and compare human mobility and individual travel patterns	data collected six months from 100 000 anonymized mobile users	Interesting finding is repeatable patterns can be found from individual human mobility patterns	Research but those findings have some business opportunities
The geography of taste: analyzing cell-phone mobility and social events	Human mobility during social events	1 million cell-phone traces + event details	Places where people come to events and event type are correlated	Research
Structure and tie strengths in mobile communication networks	Study about global and local society-wide communication networks	Mobile phone log data		Research
Geographical dispersal of mobile communication networks	Models created based on mobile communication dispersal	850 millions of communications from 2.5 million customers collected in six months. Communications include phone calls and text messages.		Research
Cellular Census: Explorations in Urban Data Collection	Research about urban behaviours	Mobile network data from Rome (Telecom Italia provided data)		Research

APPENDIX B: KEY THEMES AND QUESTIONS IN NETWORK TECHNOLOGY EXPERT INTERVIEW

Impacts of network technology evolution affecting to telco data monetization

- How different network technologies (like 2G, 3G, LTE) differ from each other?
- How location data is possible to collect and how network technology effects to that?
- What are accuracy differences between different network technologies?

Telco data types and collecting techniques

- What kinds of telco data is it possible to collect?
- Who owns telco data?
- How data privacy effects to telco data collecting and using?

APPENDIX C: KEY THEMES AND QUESTIONS IN INFORMATION SECURITY EXPERT INTERVIEW

Important things about information security effecting to telco data monetization

- What is important in telco data monetization from information security perspective?
- How telco data differs from other data sources in privacy aspects differ from different data privacy perspective?
- What kind of laws effect to data privacy in Finland? And how those laws effect?
- How data anonymization effects to laws?

Valuable information security techniques in telco data based business

- What kind of different information security techniques are needed?
- How companies can ensure that their raw data is secured?
- Can there be 100 % sure data anonymization techniques?
- Is it possible to sell anonymized telco data that still has some bigger categories about people?

APPENDIX D: KEY THEMES AND QUESTIONS IN INTERVIEW WITH EXPERT OF DATA PRIVACY LAWS AND REGULATIONS

General Data Protection Regulation (GDPR) in telco data monetization perspective

- What is important in data privacy?
- How new General Data Protection Regulation is going to effect?
- How Finnish laws are lined with EU regulations?
- How regulations are effecting to telco data usage?

Telco data anonymization

- Is it possible to have fully anonymized data that cannot be unanonymized?
- In law point of view, who is defining what anonymization techniques are good enough?
- Is there some way to evaluate different techniques?
- Are data aggregation techniques possible to use and still keep the data anonymized? Where is the boundary between anonymized and personal data?

APPENDIX E: KEY THEMES AND QUESTIONS IN INTERVIEW WITH TELCO DATA COLLECTION EXPERT

Telco data collecting

- How telco data can be collected and what is network vendor's like Nokia's role in that process?
- If one operator has multiple network vendors, how all the data can be combined?
- What kind of steps and elements is there between telco data collection and telco data analyzing

Telco data types possible to get

- What kind of telco data is possible to collect?

Telco data monetizing trends

- Have you identified some trends in telco data monetization?
- What kind of potential use cases you see for telco data monetization
- What kind of business model components are most vital in telco data monetization?

APPENDIX F: KEY THEMES AND QUESTIONS IN SHORT INTERVIEWS WITH OPERATOR'S AND SERVICE PROVIDER EXPERTS

Trends and problem areas in telco data based business and other business areas

- What kind of trends do you see now in different business areas?
- What kind of trends do you see now in telco data based business?

Important elements in telco data monetizing business models

- How do you see location data using in telco data monetization business?
- Have you already used location data in some business models?
- What are the most important components to estimate different business models?

Innovative business models in telco data monetization

- What kind of innovative business models have you seen used in telco data monetization?
- What kind of innovative business models could work well?

APPENDIX G: KEY THEMES AND QUESTIONS IN WORKSHOP WITH OPERATOR

Business trends in general level and telco data based business maturity

- What kind of business trends is there in general level?
- What are interesting areas in business model creation?
- What kind of tools you use to design business models?
- How are you creating telco data monetization business models? And have you published some telco data monetization businesses?

Important elements in telco data based business models - business model generation from scratch with business model canvas

- How AaaS, DaaS or blockchain based webstore could fit to telco data monetization?
- What kind of other innovative and potential ideas about telco data monetization business models you have?
- What kind of elements one potential telco data based business model would have? Form a model with Business Model Canvas.

Criteria for comparing different telco data business models

- How to compare different kind of business models?
- What are most important elements in telco data based business in operator perspective?
- What are the biggest constraints?

APPENDIX H: KEY THEMES AND QUESTIONS IN WORKSHOP WITH POTENTIAL TELCO DATA SERVICE CUSTOMERS

Customer needs

- What kind of needs do you have and how telco data could be used to fulfill those needs?
- What kind of other options than telco data there is to fulfill those needs?
- What kind of risks do you see in telco data usage?

Potential telco data monetization business models from customers perspective

- What kind of business model components do you see important in telco data monetization and why? (channels, revenue model, partners, value proposition...)

Innovative business models in telco data monetization

- What kind of business model parts you pay most attention if comparing telco data based business models?
- If you would be working in some operator or service provider company and was responsible for creating new business based on telco data:
 - What kind of priorities you would have?
 - What kind of innovative models would you try to create?

APPENDIX I: VALUE TRANSACTIONS IN BASIC TELCO DATA MONETIZATION BUSINESS MODEL

