Mobile Big Data: The Silver Bullet for Telcos?

MSc in Innovation and Entrepreneurship

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The changing landscape of the telecommunication industry and the potential of mobile big data

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Abstract

BACKGROUND: The telecommunication industry has been undergoing tremendous changes in recent times, with the influx of different players entering the field and various factors pitching against the industry, it is obvious that the industry is going through some kind of identity crisis at the moment. The dwindling average revenue per user of telcos is forcing them to find the next revenue stream. This study focuses on the potential of mobile big data as a resource for telco to gain competitive advantage.

OBJECTIVE: In light of the dwindling ARPU for telcos, this study aims to investigate the different forces affecting the telco industry today. Then, mobile big data is examined using the VRIO Framework (Value-Rare-Imitability-Organization) in Resources-based view (RBV) theory. Finally, this study explores the different approaches taken by the telcos to use mobile big data to gain competitive advantage.

METHOD: This study employs multiple case studies with embedded units that are exploratory which follows an inductive approach. Eisenhardt's framework of building theory from cases is being used as this study is exploratory and explanatory in nature.

RESULTS: Despite its promises, mobile big data can only provide temporary competitive advantage to the telcos. Mobile big data is valuable, rare and the telcos are organizing their other resources around it, but mobile big data is imitable and not unique. The same data can be obtained by their peers in the industry. All but one of the interview subjects came to this conclusion for mobile big data. Instead, the data collected from the interviews pointed to organizational culture as sustained competitive advantage.

CONCLUSION: In a hypercompetitive industry such as the telecommunication industry, telcos have to constantly rely on resources that can give them temporary competitive advantage; the ability to do this will ultimately be a resource itself that will give them sustained competitive advantage. Telcos have to constantly mix, match and reconfigure their different resources and capabilities to address a rapidly changing environments.

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1 Introduction

"The Only Thing That is Constant is Change"

- Heraclitus (Greek Philosopher)

"The Times They Are a-Changin'"

- Bob Dylan

With new innovations and technologies disrupting various industries today (DigitalNorway, 2017), organizations are forced to change and adapt to the new realities of their industries. This study aims to investigate how various forces are affecting the telecommunication industry today and how telcos are evaluating their resources to find their next revenue stream, with a focus on mobile big data.

The introduction begins with the background of this study and the motivation for choosing this topic (Chapter 1.1 and 1.2), shedding light on the challenges facing the telecommunication industry and arguing for the need to find the next revenue stream for the industry. Next, the objectives and research question are presented in Chapter 1.3 and 1.4 and this chapter concludes with an overview of the remaining chapters in this study.

1.1 Background

When mobile phone service was first introduced more than two decades ago, subscribers to these services were charged by the duration of the calls they made and the number of texts they sent via Short Messaging Services in a given period of time, usually on monthly basis. Eventually, with the arrival of mobile data services, subscribers were charged according to the data package they consumed.

In recent times, voice revenue for telcos has been gradually leveling off (ArthurDLittle, 2006; Funk, 2009), the landscape for the telco industry has become so competitive that subscribers pay a flat rate for all the calls and messages they make in a month (ArthurDLittle, 2007). Naturally, this leads to the subsequent decrease of ARPU for the telcos. (JuniperResearch, 2010). Today, the monthly subscription fee depends only on the amount of data in the subscriber's data package. In addition, the once lucrative mobile roaming services also come

under stiff competition. As of today, most of the telcos including Telenor and Telia in Norway are offering free roaming services to their subscribers for selected destinations (TEK.NO, 2017).

The annual reports from Telenor, (Telenor, 2016a) and Telia, (Telia, 2017b), both public listed entities in Norway and Sweden, are consistent with this trend affecting telcos all over the world. Two very good indications of how the landscape for the telcos is changing are the Average Revenue Per User (ARPU) and Average Minute Per User (AMPU). ARPU is the calculation based on mobile revenues from the company's own subscriptions, divided by the average number of subscriptions for the relevant period (Telenor, 2014b) while AMPU is traffic minutes per subscription per month based on total outgoing and incoming rated minutes from the company's own subscriptions less data only subscriptions, ignoring data-only subscriptions. This includes zero rated minutes and outgoing minutes from own subscriptions while roaming. Outgoing and incoming minutes related to inbound roaming, national roaming, service providers and mobile virtual network operators (MVNOs) are not included. (Telenor, 2014b)

The ARPU for Telenor and Telia were 339NOK and 342NOK respectively in 2003 and declined to as low as 285NOK and 248NOK respectively in 2013. That constitutes a decline of 16% in ARPU for Telenor and 17% for Telia over a decade. Figure 1.1 shows the ARPU for Telenor and Telia from 2005 to 2015.
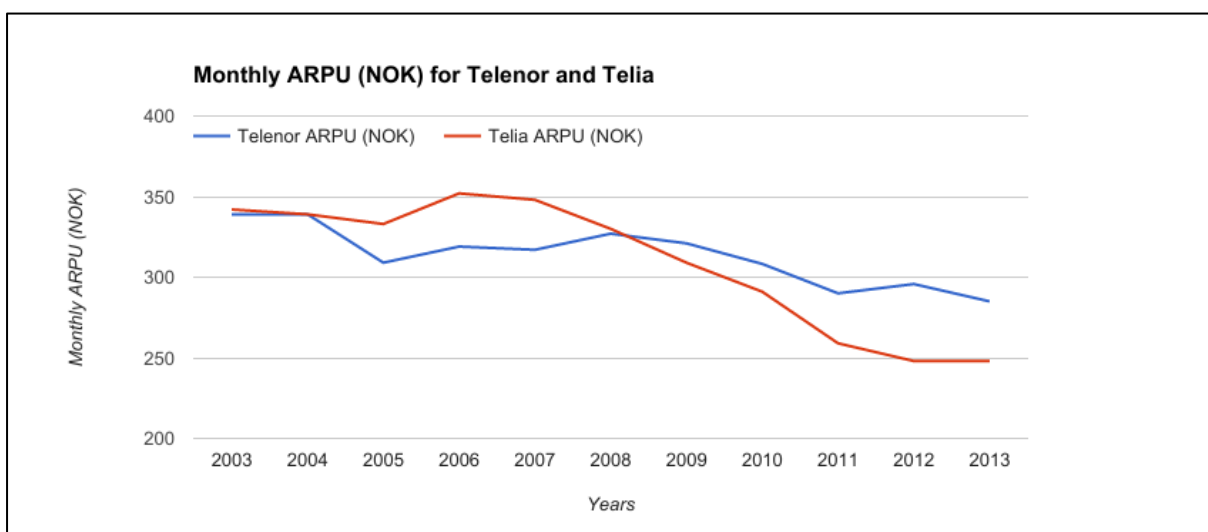
Figure 1.1: ARPU for Telenor and Telia from 2005-2015 (Source: Annual report for Telenor and Telia)

In the meantime, the AMPU for Telenor and Telia rose from 188 minutes and 164 minutes per month to 259 minutes and 302 minutes per month. (Figure 1.2). Any normal person would have to ask the question, "How can mobile subscribers spend more time talking on their mobile phone calls but paying less over the years?"
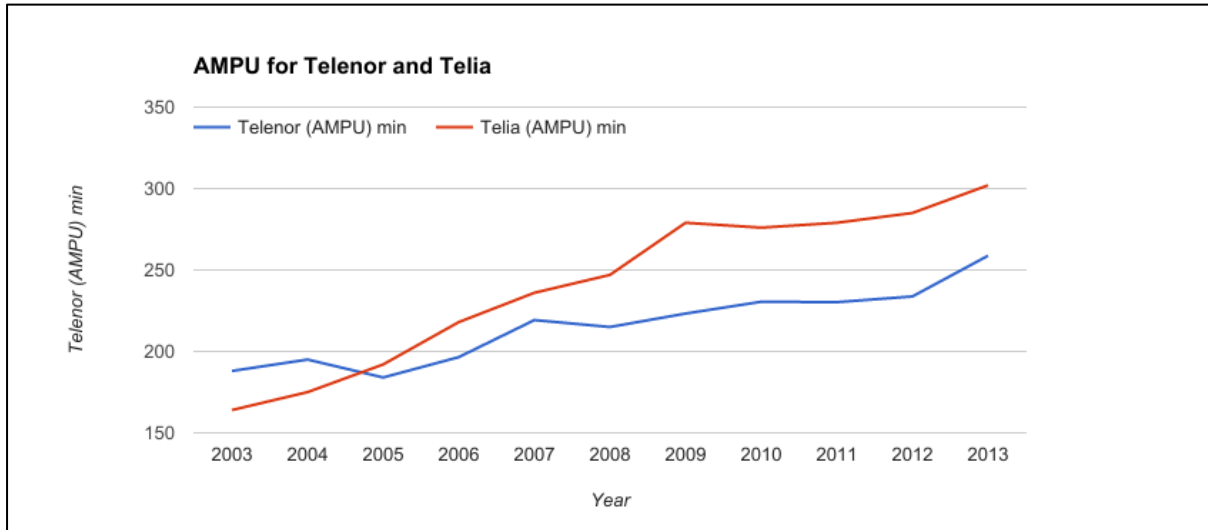
Figure 1.2: Average traffic minutes per subscription per month (AMPU) for Telenor and Telia from 2005-2015 (Source: Annual report for Telenor, (Telenor, 2016a) and Telia, (Telia, 2017b))

As if the dwindling ARPU for telcos is not enough, the emergence of smartphones in recent years is also changing the habits of consumers in very profound ways. According to (Deloitte, 2016), nine out of ten Norwegians today have smartphones, and they are becoming more popular than personal computers (PC). At the same time, more and more Norwegian consumers own several digital devices simultaneously; six out of ten Norwegians today have access to tablets, smartphones and laptops.

With smartphones playing such a central role in our daily lives, it is of no surprise when most surveyed (Deloitte, 2016) said smartphones are the first thing they check when get up in the morning and the last thing they check when they go to bed at night. Despite using their smartphones more frequently and for different types of services, as shown in Figure 1.3, Norwegians are spending less time talking on the phone. Three out of four Norwegians in age group 55-64 years use their phones to talk at least once a day, while less than half of the Norwegians in age group 18-24 do the same. Nonetheless, most Norwegians still use their phone to talk in the span of a normal week.

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In the span of two decades, the ways consumers are using their mobile phones and smartphones are changing in profound ways. Though consumers are spending more time on their phones, the ARPUs telcos are getting from their subscribers do not reflect that. This prompts the telcos to find new revenue streams in their industry.
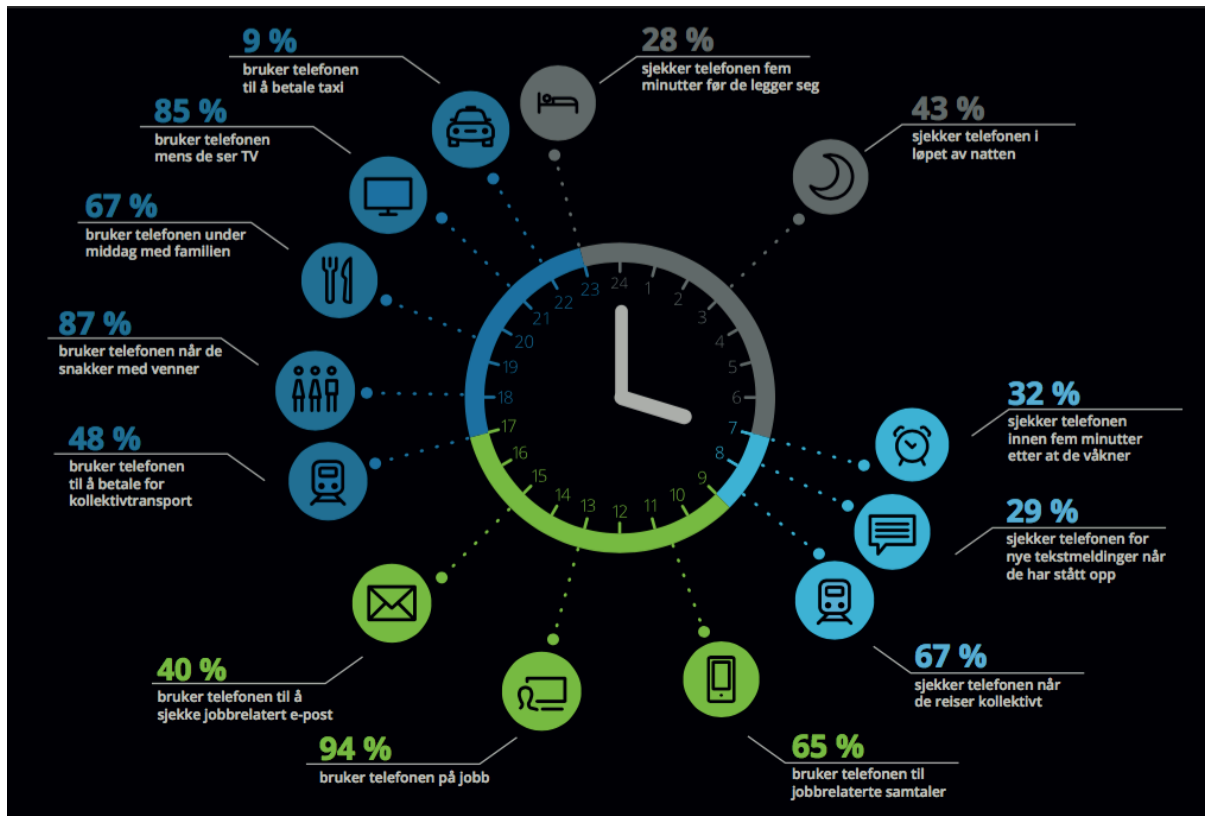
Figure 1.3: How Norwegians are using their phones today. Source: (Deloitte, 2016)

1.2 Motivation

Since I started my first practical experience for this master program at SINTEF in March 2016, I have been exposed to various data-driven innovation (DDI) projects taking place in various industries around Europe today. One of the projects I have been involved within at SINTEF is proDataMarket[1], which is a project co-financed by the European Commission under the Horizon 2020 Research & Innovation Program. proDataMarket provides a digital data marketplace for open and non-open property data, making it easier for data providers to publish and distribute their data (for free or for a fee) and for data consumers to easily access the data they need for their businesses.

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[1] http://blog.prodatamarket.eu

According to (OECD, 2013), in a data-driven socioeconomic model, data are a core asset that can create a significant competitive advantage and drive innovation, sustainable growth and development. The following five areas are identified as drivers of innovation:

- Use of data for the creation of new products (goods and services). This includes using data as a product (data products) or as a major component of a product (data-intensive products);
- Use of data to optimise or automate production or delivery processes (data-driven processes). This includes the use of data to improve the efficiency of distribution of energy resources ("smart" grids), logistics and transport ("smart" logistics and transport);
- Use of data to improve marketing, for instance by providing targeted advertisements and personalised recommendations or other types of marketing-related discrimination (data-driven marketing) as well as the use of data for experimental product design (data-driven product design) (WIRED, 2012);
- Use of data for new organisational and management approaches or for significantly improving existing practices (data-driven organisation and data-driven decision making). (Brynjolfsson, Hitt et al., 2011); and
- Use of data to enhance research and development (data-driven R&D). This includes new data-intensive methods for scientific exploration by adding a "new realm driven by mining new insights from vast, diverse data sets".

I am especially interested in the first driver of innovation, the use of data for creation of new products. The white paper from (Fraunhofer, 2016) also advocates that data be treated as an economic asset and product, thus should be considered as a viable revenue stream to many businesses as well.

In Norway, a good example of companies which make use of data to create new products is a company based in Bergen called Eiendomsprofil AS. Nabolagsprofil Premium 2.0 by Eiendomsprofil is a service which combines free open data from Statistisk Sentralbyrå (SSB) and their own data to provide insights to potential house buyers on the neighborhood they are interested in moving into. Information such as the make-up of family units, income levels of the neighborhood and accessibility of the neighborhood are available in this service. Real

estate agents subscribe to this service on a monthly subscription fee model and provide these insights to their clients.

Recent reports of use cases for mobile big data and analytics around the world published by MIT Technology Review (MIT, 2016) and in Norway by Telenor (DN, 2016a; DN, 2017c) (DN, 2017c) suggested that such initiatives, where data can be used for the creation of new products (goods and services), the first driver of innovation in (OECD, 2013), is indeed a viable option in the telco industry.

With the telcos facing declining ARPU over the years, I am motivated to explore the potential of mobile big data for the telcos in Norway. This could be relevant to practitioners as this study may reveal important findings on the potentials and challenges of mobile big data for telcos. This is especially relevant for Norway because Telenor is one of the biggest company in Norway and the two biggest telcos in Norway, Telenor and Telia employs a total of 5206 employees in Norway. (Telenor, 2016a; Telia, 2017a)

1.3   Objective of research

There are three objectives for this study:
 (i) To investigate the current state of the telco industry, identifying the various forces affecting the industry today.
 (ii) To explore the potential of mobile big data as a resource for telcos to gain competitive advantage.
(iii) To examine the approaches telcos are taking to use mobile big data as new revenue stream.

1.4   Research Question

This study seeks to contribute to the existing literature on how telcos use mobile big data in the face of a changing landscape in their industry and the approaches they are taking to use mobile big data. The following research question is posed:

How are different forces affecting the telecommunication industry today and the race to find new revenue streams? What is the potential of mobile big data?

1.5   Thesis Structure

This thesis begins with an introduction to the topic of my study and the background of the telecommunication industry today. An in-depth look on at the ARPU for telcos is provided from the financial reports of publicly listed telcos in Norway such as Telenor (Telenor, 2016a) and Telia (Telia, 2017b).

Chapter 2 begins with literature reviews and theoretical frameworks for this study. The rationale for the use of the frameworks is explained in this chapter. The Porter's Five Forces framework (Porter, 1979; Schilling, 2013) is used to examine the different forces affecting the telco industry today while a resource-based view is used to examine mobile big data as a resource for telco to gain competitive advantage. The dynamic capabilities theory is then used to examine how telcos are adopting mobile big data as potential new revenue stream. Chapter 4 explains the research design and methodology applied. Chapter 5 provides an explanation of the analysis strategy and detailed analysis itself. Chapter 6 concludes the work with final conclusions, implications of the research for professionals and academics.

2 Literature Review and Theoretical Framework

My practical experience for this master program at SINTEF exposed me various data driven innovation (DDI) projects within Norway and the European Union (EU). The various research projects and papers, which I came across during my stint at SINTEF provided a good basis for my literature review. To understand what is happening in the telco industry today, a number of frameworks and theories are looked into and examined. Below are the frameworks and theories that are applied in my thesis and the rationale of including them.

(i)   Porter's Five Forces – To examine the current state of the telco industry and the different forces affecting the attractiveness of the industry today as a whole. (Porter, 1979; Schilling, 2013; Peng, 2014)

(ii)   Resource-based View (RBV) – To examine the attractiveness of mobile big data as a potential new revenue stream for telco in light of the dwindling ARPU for telcos in Norway and around the world. (Penrose, 1959; Wernerfelt, 1984; Barney, 1991)

(iii)   Dynamic Capabilities – To examine how telcos are adapting to the changes in their industry today, it could be one of the four quadrant in the prediction and control framework, such as planning, adaptive, visionary or transformative (Wiltbank, Dew et al., 2006). Property Rights Theory is used to complement this theory to better understand the rights to resources, thus allowing telcos to sense and seize new economic opportunities. (Kim and Mahoney, 2010; Coase, 2013)

The literature review section of this study was initiated by searching for "resource-based view", "dynamic capabilities", "big data" and "dynamic organization" on Google Scholar and Oria database. The references list of these works led me to even more relevant papers in these subjects. Moreover, the "Smart Suggest" function for some sites such as Science Direct also provided some relevant papers for the topics I was interested in.

2.1 Big Data

The scope for big data is too wide, for the purpose of this study, the terminology "mobile big data" is used to limit the scope of big data to the telco industry only. But for this literature review, the terminology "big data" is used.

Despite the buzz around Big Data, most people still struggle to define what Big Data exactly means because the term big data has different meanings to different experts in the field. (Loukides, 2010) defines it as data for which "the size of the data itself becomes part of the problem" while (Beyer and Laney, 2012) defines big data as "high volume, high velocity, and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization." According to McKinsey Global Institute (Manyika, Chui et al., 2011) Big Data refers to "datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyse."

Notwithstanding the different definitions of Big Data, size is clearly the first thing that comes to mind when people talk about big data. However, other characteristics of big data are gaining significance. (Laney, 2001) suggested that Volume, Variety and Velocity (or the Three V's) are the three dimensions of challenges in data management. Over time, the Three V's framework is becoming the more acceptable definition of big data. For example, Gartner, Inc. defines big data in similar terms: "Big data is high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making." (Gartner, 2017a)

The Three V's can be described below.

Volume refers to the magnitude of data. The sizes of big data are reported to be in the multiple of terabytes and petabytes. One terabyte stores as much data as would fit 1500 CDs or 220 DVDs. One petabyte equals 1024 terabytes. (Gandomi and Haider, 2015)

Variety refers to the different forms of data being collected today. More than 4 billion hours of video are being watched on Youtube each month, around 400 million tweets are being sent per day and more than 30 billion pieces of content are being shared on Facebook each month. (IBM, 2013) This is just the data collected on social media platforms alone, imagine the amount of data collected on the public and private sectors.

Velocity refers to the rate at which data are generated and the speed at which it should be analyzed and acted upon. Different types of sensors and devices are becoming more and more ubiquitous, this prompts real-time analytics for these data and better evidence-based planning. (Gandomi and Haider, 2015)

In addition to the Three V's, other dimensions of big data has been added.
Veracity as the fourth V is coined by (IBM, 2013), which refers to the uncertainty of data. Despite of the amount of data various organizations are able to amass today, there is no guarantee that the data is precise and certain, hence the need for various tools to analyze and verify these data.

Variability (and complexity). Introduced by SAS, variability refers to the variation in the data flow rates. Often, big data velocity is not consistent and has periodic peaks and trough. Complexity refers to the fact that big data are generated through a myriad of sources. This imposes a critical challenge: the need to connect, match, cleanse and transform data received from different sources. (Gandomi and Haider, 2015)

Value. Oracle introduced Value as a defining attribute of big data. Based on Oracle's definition, big data are often characterized by relatively "low value density". That is, the data received in the original form usually has a low value relative to its volume. However, a high value can be obtained by analyzing large volumes of such data. (Gandomi and Haider, 2015)

2.2 Porter's five forces

Porter's five forces is a framework to analyze the level of competition within an industry. It draws upon five forces that determine the competition and hence the attractiveness of an industry. This framework was developed by a professor in Harvard University, Michael E. Porter in his paper "How Competitive Forces Shape Strategy" in 1979. Figure 2.1 shows Porter's Five Forces.

The five forces that determine the attractiveness of an industry are as follows:
(i) Threat of substitute – substitutes are defined as products and services that are not direct competitors, but can still fulfill a strategically equivalent role for the customers. The more potential the substitutes are, the closer they are in function to the firm's product or

service, thus posing threat of substitution. Sometimes, the substitutes may even offer superior quality to existing products or offer attractive price/performance trade-off, posing an even greater threat. The threat of substitute can often be easily overlooked in an industry. (Schilling, 2013)

(ii) Threat of entrants – the attractiveness of an industry is determined by the entry of barriers of potential competitors. The higher the entry barrier, the more attractive an industry. Entry barriers can include factors such as high start-up costs, brand loyalty, difficulty in gaining access to suppliers or distributors or raw materials, government regulations, threat of retaliation by existing competitors, and many others. (Schilling, 2013)

(iii) Rivalry among competitors – the intensity of rivalry in an industry determines the attractiveness of an industry. If an industry is experiencing slow growth and has a lot of competitors which are homogenous in size and power, the rivalry in that industry will be very intense. This makes the industry less attractive. An industry with high rivalry will cause frequent price wars, proliferation of new products, intense advertising campaigns and high-cost competitive actions and reactions. Such intense rivalry threatens firms by reducing profits. (Peng, 2014)

(iv) Bargaining power of suppliers – The number of suppliers in an industry can greatly influence the attractiveness of the industry. If there are a lot of suppliers in an industry and/or not very differentiated, a firm can be in the position to force the suppliers to bid against each other in order to get favorable pricing for their products or services. The amount the firm purchase from their supplier can also influence their bargaining power. It the firm's purchases constitute the bulk of the supplier's sales, the supplier will be reliant on the firm and this will weaken their bargaining power. (Schilling, 2013)

(v) Bargaining power of buyers – If the firm's product is highly differentiated, buyers will typically experience less bargaining power, and if the firm's product is undifferentiated, buyers till typically experience greater bargaining power. If buyers face switching costs, this is likely to lower their bargaining power, and if the firm faces switching costs to work with other buyers, this will increase the buyer's bargaining power. (Schilling, 2013)

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Figure 2.1: Porter's Five Forces Framework

2.3   Resource-based View

The resource-based view is used to probe the attractiveness of a resource within an organization. According to (Wade and Hulland, 2004), resources are defined as assets and capabilities that are available and useful in detecting and responding to market opportunities or threats. The resources and capabilities of an organization can further be categorized as tangible and intangible. Tangible resources and capabilities are assets that are observable and more easily quantified. They can be broadly divided into four categories: financial resources and capabilities, physical resources and capabilities, technology resources and capabilities and organizational resources and capabilities. Intangible resources and capabilities, by definition are harder to observe and more difficult (or sometimes impossible) to quantify. Examples of intangible resources and capabilities are human resources and capabilities, innovation resources and capabilities, and reputation resources and capabilities. (Peng, 2009) Normal applications of this are concerned with how access to specific difference resources will enable some firms to have a competitive advantage over those that lack such resources. (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993)

2.3.1   Brief history of Resource-based view

Although (Penrose, 1959) seminal work, The Theory of the Growth of the Firm, provided the foundation for the modern, resource-based theory of the firm; it was Birger Wernerfeldt's paper, A Resource-based View of the Firm (Wernerfelt, 1984), that pushed this theory to the mainstream strategic management community. Researchers found out that even in industries with high levels of competition, some firms manage to prosper and perform extraordinary well when they are not supposed to be. It was therefore suggested that an internal examination of a firm's strengths and weaknesses may explain this phenomenon.

The three research branches that converged and shaped the resource-based view of the firm as it is understood today are: theories of distinctive competence, Ricardian economics and Edith Penrose's theory of the firm. The theory of distinctive competence refers to some characteristic of a business that it does better than its competitors. That the business is able to do something better than other businesses and has a competitive advantage over other businesses. According to (Ricardo and Fogarty, 1965), firms with access to a finite resource may use it to extract economic rent in certain market conditions. Although at that time Ricardo focused on land resources, his idea can be extended to include other type of resources. The final research branch is by Edith Penrose, which defined firm as an administrative framework that organizes bundles of productive resources and firms could gain and sustain a competitive advantage by acquiring particular resources.

Today, two main assumptions apply to resource-based view of the firm. First is the heterogenous of the resources. Skills, capabilities and other resources that firms possess differ from one company to another. If organizations would have the same amount and mix of resources, they could not employ different strategies to outcompete each other. Therefore, resource-based view assumes that firms achieve competitive advantage by using their different bundle of resources. The second assumption is the immobility of resources. Resources are not mobile and do not easily move from one firm to the other. Due to this immobility, firms cannot replicate rivals' resources and implement the same strategies. Intangible resources, such as brand equity, processes, knowledge or intellectual property are usually immobile. The key to a resource-based approach strategy formulation is understanding the relationship between resources, capabilities, competitive advantage, and profitability – in particular, an understanding of the mechanism through which competitive advantage can be sustained over time. (Grant, 1991)

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2.3.2 VRIO Framework

The VRIO (Value-Rarity-Imitability-Organization) Framework analysis was developed by (Barney, 1991) in "Firm Resources and Sustained Competitive Advantage". In this framework, a resource must possess four attributes in order to become a source of sustained competitive advantage. This framework can be thought of a series of steps to evaluate how effective a given resource's intrinsic values in providing competitive advantage to a firm.

The question of value

Value is the most fundamental question to start in this framework. (Adner and Zemsky, 2006) This question asks if a resource adds value by enabling a firm to exploit opportunities or defend against threats. If the answer is yes, then a resource is considered valuable. Resources are also valuable if they help organization to increase the perceived customer value. A resource that cannot meet this criteria, leads to competitive disadvantage. The value of a resource has to be continually reviewed due to the constant changing internal or external conditions, which will render the value of this resource less valuable or useless.

The question of rarity

Resources that can only be acquired by one or very few firms are considered rare. If a resource is valuable and rare, then a temporary competitive advantage can be granted to that resource. On the other hand, when more than a few firms have the same valuable resources, this leads to competitive parity. This is because firms can use identical resources to implement the same strategies and no organizations can achieve superior performance. Even though competitive parity is not a desired position, a firm should not neglect a resource that are valuable but common.

The question of imitability

A resource is costly to imitate if other organizations that doesn't have it can't imitate it, buy or substitute it at reasonable price. Imitation can occur in two ways, by directly imitating (duplicating) the resource or providing the comparable product / service (substituting).

A firm that has valuable, rare and costly to imitate resources can (but not necessary will) achieve sustained competitive advantage. Barney has identified three reasons why resources can be hard to imitate:

- Historical conditions: Resources that were developed due to historical events or over a long period usually are costly to imitate.

- Causal ambiguity: Firms can't identify the particular resources that are the cause of competitive advantage.

- Social complexity: The resources and capabilities that are based on the firm's cultural or interpersonal relationships.

The question of being organized to capture value

The last attributes of the framework, to achieve sustained competitive advantage, a firm needs to organize itself around a resource in order to capture value from the resource. A firm must organize its management systems, processes, policies, organizational structure and culture to be able to fully realize the potential of its valuable, rare and costly to imitate resources or capabilities. Only then, a firm can achieve sustained competitive advantage. Figure 2.2 shows the VRIO Framework to determine if a resource / capability can be a sustained competitive advantage.
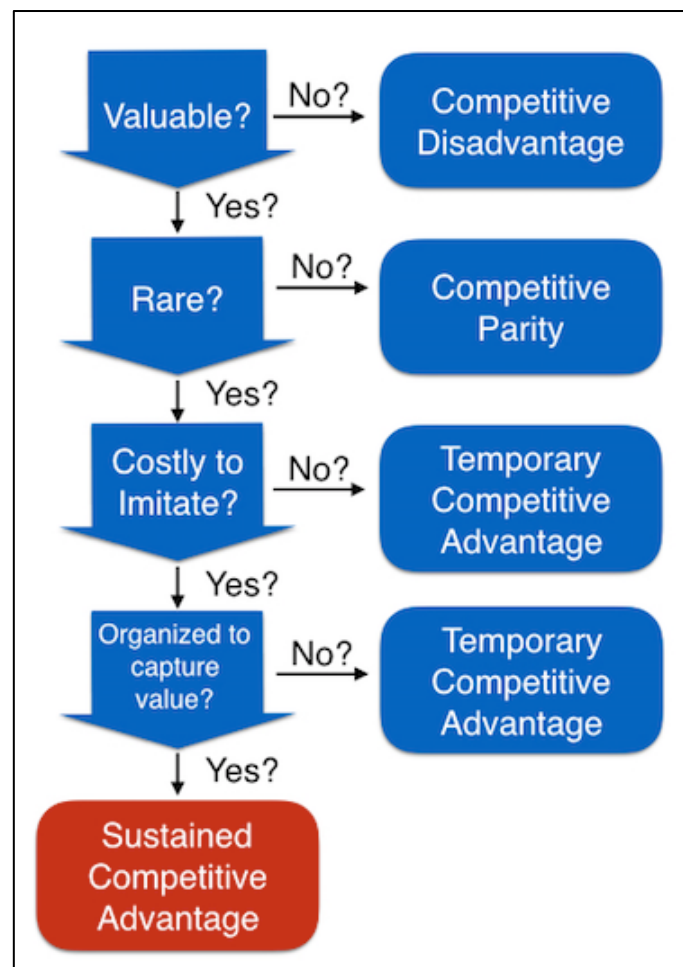
Figure 2.2: VRIO Framework (Rothaermel, 2012)

2.4 Dynamic Capabilities

Over the years, the shortcomings of resource-based view started to emerge (Priem and Butler, 2001). One critique is that a given resource may not lead to competitive advantage in a fast-changing market, even if it is valuable, rare and difficult to imitate (D'Aveni, Veliyath et al., 1996). The dynamic capabilities approach seeks to overcome the static limitations of the resource-based view (Eisenhardt and Martin, 2000) by showing how organizational processes, resource positions, and path dependencies (Argyres and Liebeskind, 1999) can lead to a stock of valuable, rare, inimitable, and organization resources—the so-called VRIN criteria (Barney, 1991).

Dynamic capabilities theory is widely accepted as an extension of the resource-based view and can be described as the firm's ability to integrate, build and reconfigure internal and external competences to address a rapidly changing environments. (Teece, Pisano et al., 1997). A firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die. (Eisenhardt and Martin, 2000)

Dynamic capabilities exist in contrast to substantive capabilities. A substantive capability may be intrinsically valuable, rare and difficult to imitate, but if it cannot evolve over time, it is of limited long term value. Firms with dynamic capabilities therefore have the higher-order to evolve, substitute and rearrange their substantive capabilities in response to market conditions (Zahra, Sapienza et al., 2006). Dynamic capabilities are the antecedent organizational and strategies routines by which managers alter their resource base - acquire and shed resources, integrate them together, and recombine them - to generate new value-creating strategies. (Grant, 1996)

2.4.1 Framework of Prediction and Control

With the amount of changes taking place in the telco industry today, the prediction and control framework from (Wiltbank, Dew et al., 2006) provides a very structured view of how the telcos are positioning themselves to the future with the use of mobile big data as a

potential revenue stream. The left hand side (LHS) of the quadrant, Positioning, shows if a telco emphasis on planning or adaptive to position themselves to the future. Although both the planning and adaptive schools have low emphasis on control, the planning school has high emphasis on prediction while the adaptive school has low emphasis on prediction. The right hand side (RHS) of the quadrant, Construction, assume either the non-existence of key elements of the environment (presenting opportunities for constructing them), or the organization's ability to affect the evolution of those elements in significant ways. (Wiltbank, Dew et al., 2006)

The rational planning view predicts that as uncertainty increases, organizations that work more diligently to analyze and predict more accurately the changing situation in which they operate will outperform those that do not (Wiltbank, Dew et al., 2006). The learning school, as opposed to the planning school, suggests organizations learn what to do next by minimizing the use of predictive rationality, and instead experimenting and moving quickly to capture new opportunities (Mosakowski, 1997). Learning, which enables adaptation, comes at prediction from the opposite direction, avoiding it as much as possible. Adaptation argues that, in changing environments, moving faster to adapt will lead organizations forward more effectively than trying harder to predict (Wiltbank, Dew et al., 2006). Adaptation research argues that in dynamic and uncertain situations, planning slows adaptation and that comprehensive planning actually blind the organization to important changes in its environment. (Mintzberg, 1990; Schoemaker, 1993)

On the RHS, the visionary approaches emphasizes constructing an organization and its environment by imagining future possibilities and proactively bringing them to fruition. This approach simultaneously emphasis high control and high prediction. The future that comes to exist does so in large part simply because visionary leaders chose to create it. (Wiltbank, Dew et al., 2006) The second quadrant in the RHS, the transformative approaches, is both non-predictive and non-visionary. The primary model for this quadrant comes from (Sarasvathy, 2001) and (Sarasvathy and Dew, 2005) which worked out a model of effectuation. Figure 2.3 shows the Framework of prediction and control.
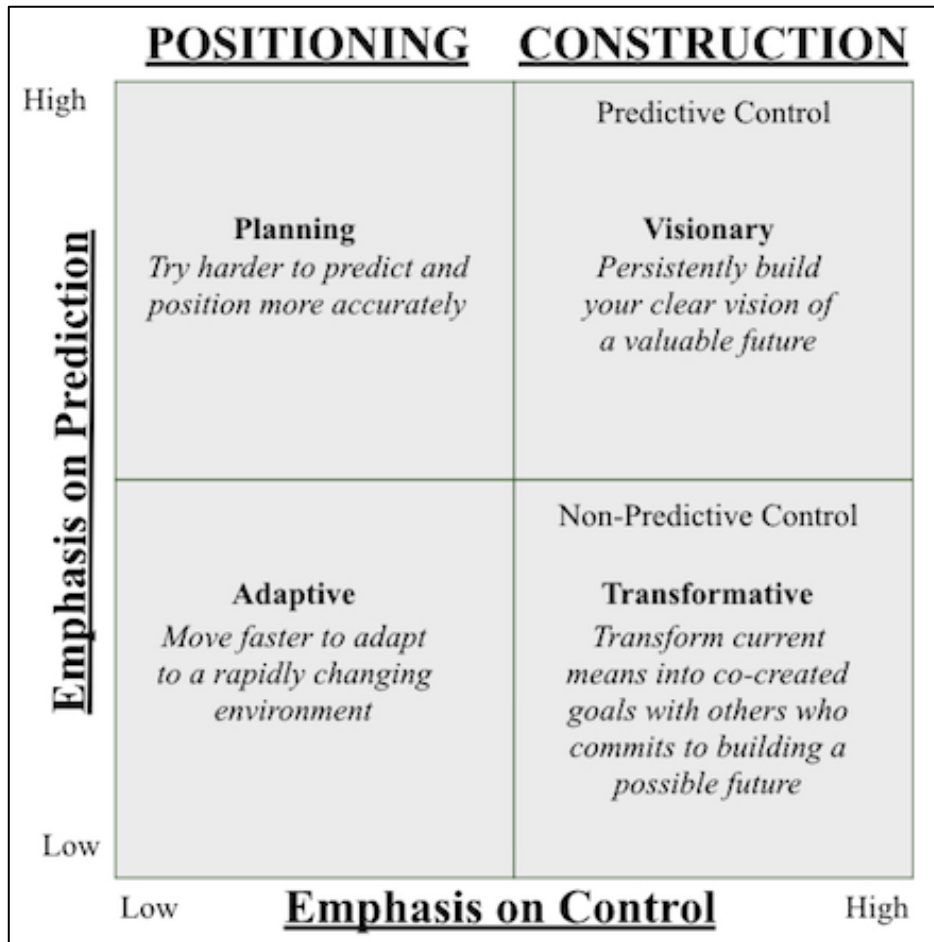
Figure 2.3: Framework of prediction and control

2.5 Property Rights Theory

Just as the resource-based view, dynamic capabilities are not without its critiques. Dynamic capabilities are criticized for being conceptually unclear and tautological (Williamson, 1999). To address this shortcoming, the property rights theory is being used to complement dynamic capabilities. Property rights theory was first proposed by Ronald Coase in 1960. Coase declared that if each firm had property rights to a certain resource and the firms could not co-exist, then the firm producing more benefits from the resource in question should be the firm to retain property rights (Coase, 2013). From these beginnings, property rights theory has evolved into a more complex theory addressing legal property rights as well as the social institutions in which these rights exist (Libecap, 1989). (Coase, 2013) stated that property rights should be reserved for those who could create the most benefit. Scholars today are still expanding property theory according to this assumption. Property rights theory defines resources and capabilities as bundles of property rights. Thus, developing and renewing dynamic capabilities can be regarded as a process of bundling (and rebundling) resource

combinations (Kim and Mahoney, 2010). By combining insights from dynamic capabilities and property rights, (Kim and Mahoney, 2010) defines the firm as a nexus of incomplete contracts. The idea of a nexus of complete contracts (Fama, 1980) is rightly discarded in the dynamic capabilities approach (Teece, Pisano et al., 1997) because it rules out competitive advantage, which requires market frictions. Hence, the firm is defined as a nexus of incomplete contracts, which enables the possibility of entrepreneurial alertness and ingenuity (Kim and Mahoney, 2010).

3 Methodology

3.1 Research Design

3.1.1 Choice of Research Design

According to (Yin, 2014), there are three conditions that determine the type of research methods for a study. They are (a) the type of research question posed, (b) the extent of control a researcher has over actual behavioral events, and (c) the degree of focus on contemporary as opposed to entirely historical events. Table 3.1 below shows relevant situations for different Research Methods.

Table 3.1: Relevant situations for different Research Methods

Method	(1) Form of Research Question	(2) Requires Control of Behavioral Events?	(3) Focuses on Contemporary Events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case Study	How, why?	No	Yes

Based on the table above from Yin (2014), a case study design is the most obvious choice for my research for the following criterias:

(a)   The purpose of the study is to answer a "how" and "why" questions

The question for my research is a "how" question that aims to find out how different forces are affecting the telco industry today, how attractive mobile big data as a new revenue stream to the telcos and how the telcos are approaching to embrace this new resource.

(b)   The investigator cannot manipulate the behavior of the events or those involved in the study

The changes sweeping through the telco industry today are far reaching and as an investigator, I am independent of the industry and is unable to influence the behavior of the actors or events happening in the industry. For example, the emergence of telecommunication vendors from Asia has lowered the barrier to enter the telco market, these new breed of telcos are aggressive in their pricing plan to gain market shares and the bigger / incumbent telcos have to react and find new ways to stay competitive.

(c)   Contextual conditions are relevant to the phenomenon under the study

Telcos are not only under attack from new telcos in their home region, they are also under facing stiff competition from newer breed of competitors which are stealing away their customers, such as Whatsapp and Skype. Hence, Telenor launched their video conferencing service in 2014 called Appear.In. (Telenor, 2014a)

(d)   The question may require in-depth investigation of a social phenomenon.

This study investigates the use of mobile big data as potential revenue stream for the telcos, this has far-reaching consequences to the public in general and the privacy issues surrounding this.

With the above, I designed my case study as multiple case study, a case study organized around two or more cases, with embedded units that is inductive. I chose to do a multiple case study based on (Yin, 2014) reasoning that a multiple case study provides a more robust conclusion than a single case study due to the fact that one will get a richer data from multiple sources. By doing a multiple case study, and collecting data from multiple sources, I am improving the reliability and internal validity of my study. (Yin, 2014).

3.1.2 Conceptual Framework

Although there are different frameworks found in the literature for conducting case study research, the framework presented by (Eisenhardt, 1989a) provides the most appropriate framework for developing theories from case studies. (Eisenhardt, 1989a) approach is

particularly relevant to exploratory studies that research a new topic area. The different steps in this framework is illustrated in Figure 3.1 below.
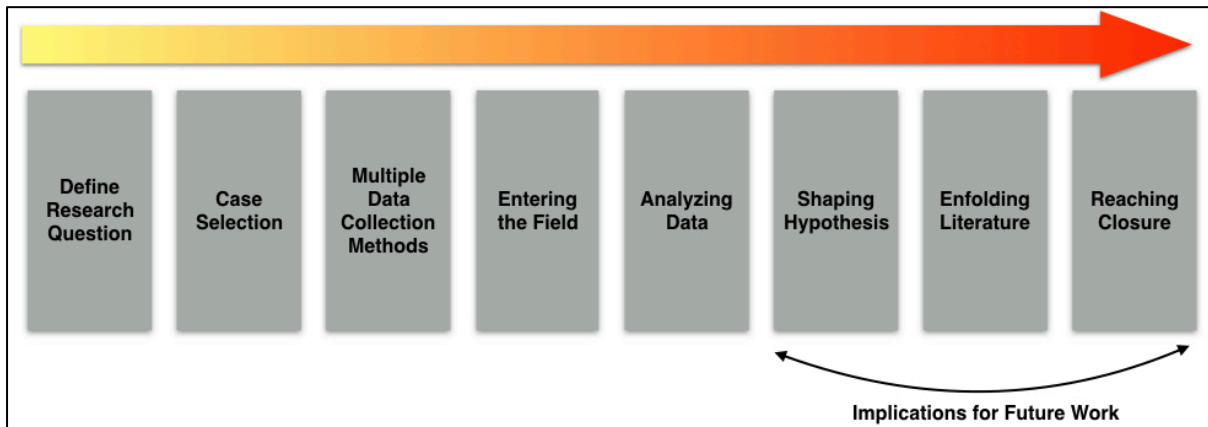
Figure 3.1: Eisenhardt (1989) conceptual framework for inducting theory

I decided to use (Eisenhardt, 1989a) as the framework to guide my case study research. In this type of case study research, the researcher has not formulate any propositions after completing the literature review. The last three stages of the framework will be considered in the section of Implications for Future Work since the scope of this research does not include developing new hypothesis.

With my research question formulation and a selection of the case and unit of analysis made in the previous sections, the application of the other parts of the (Eisenhardt, 1989a) framework is described in the following sections.

3.1.3 Unit of Analysis

To help me determine the unit of analysis for my study, references were made to (Wilson, 2014; Yin, 2014) and (Baxter and Jack, 2008). To revisit my research question:

How are different forces affecting the telecommunication industry today and the race to find new revenue streams? What is the potential of mobile big data?

The more time I spent interviewing my subjects during the course of this study, the more theories and frameworks that can be tied together to shed some light on what is happening in the telco industry today and what the telcos are trying to do to remain relevant and competitive.

However, according to (Yin, 2014) and (Stake, 1995), boundaries need to be defined in order to prevent the thesis from becoming too broad due to the time constraints imposed in the thesis. These boundaries can be: (a) by time and place (Creswell, 2014); (b) by time and activity (Stake, 1995); and (c) by definition and context. (Miles and Huberman, 1994). Binding the case will ensure that the study remains reasonable in scope. For these reasons, I limited my scope to the telco industry and mobile big data as the resource to investigate as potential sustained competitive advantage to the telcos.

This study is based on multiple case study, with holistic view of the entire telecommunication industry. For the holistic view of the entire telecommunication industry, the subunit of analysis is the different forces affecting the telco industry while for the embedded unit of analysis, the subunit of analysis is the telcos itself.

3.1.4 Type of Case Study

According to (Wilson, 2014), there are three types of research study, they are exploratory research, descriptive research and causal research. Wilson (2014) also differentiate single case designs and multiple case designs; in addition there are holistics analysis and embedded analysis. (Wilson, 2014) describes exploratory research as a type of research that follows an inductive approach. In this type of research, the researcher conducts research into a research problem where there currently exists very little, if any, earlier work to refer to. Hence, where there is lack of published research and a lack of knowledge about a given topic, then exploratory research is a viable research design. The aim of this type of research is to develop a better insight into a particular topic, leading to the development of a set of hypothesis. This set of hypothesis can be tested at a later date.

For the purpose of this research, it is a well known fact in the telco industry that the ARPU for telcos are declining over the years but very little published research is found on the potential mobile big data play for telcos in gaining sustained competitive advantage. Hence, an **explanatory case study** to investigate the forces affecting the telco, **exploratory case study** to investigate the attractiveness of mobile big data as a resource and how telcos are adapting fit very well as the most suitable research type of case study for this thesis.

3.2 Data Collection

3.2.1 Timelines

The idea for this thesis was hatched in the autumn of 2016 under the ENT4210 - Practical Innovation Management class. During my summer job at SINTEF, contacts have already been made with one of the major telco in Norway on the possibility of project utilizing mobile big data. The first face-to-face interview with a Data Scientist working in the Data Science Lab of the telco in Norway was conducted in December 2016. The interview confirmed that there is indeed a lot of interests in mobile big data and various initiatives to monetize it by telcos in Norway and abroad. Further literature review and refinement of research questions were carried out in the period between October 2016 and February 2017. All interviewees were sent introductory write-up of the thesis to enable them to have some ideas on the topics of my master thesis, but interview questions were not sent in advance to the interviewees. Secondary data was collected from the internet and university library throughout the whole period of writing. All seven interviews were conducted and transcribed in March 2017 while certain sections of the thesis were written in parallel to the data gathering activities. The report was consolidated in the last weeks of April and early May 2017.

3.2.2 Data Collection Methods

The nature of this study encourages a combination of multiple data collection methods, through interviews, white papers and archival sources. However, inductive researchers are not confined to these methods. The rationals are the same as hypothesis-testing research, that triangulation made possible by multiple data collection methods provides stronger substantiation of constructs and hypothesis. (Eisenhardt, 1989a)

Primary Data Collection

Semi-structured interviews with various actors in the telco industry in Norway were the primary method of data collection. In a semi-structured interview, the researcher has a list of questions for fairly specific topics to be covered, often referred to as interview guide, but the interviewee has a great deal of leeway in how to reply. (Bryman and Bell, 2015) In my interview guide, in addition to the main questions to be covered during the interview, further questions which act as probes were included to get in-depth information from the interviewees. (Appendix A)

A total of seven interviews were conducted for my case study, six interviews were conducted face-to-face in Oslo while one interview was done via Skype due to geographical reason (the interviewee was working on a project in Asia at that time). To improve validity, (Yin, 2014) advocates the use of triangulation: finding multiple sources which support a given finding. For this purpose, I was able to interview seven subjects working in telcos (four from Telenor, one each from Telia, Ice.net and Telio) while two subjects working on the telco software and hardware vendor side (Alpha Entrance and Nokia) of the industry. The supervisor of my thesis, Dr. Dumitru Roman, was with me in two of the interviews as observatory role due to his interests in this area as well. The mix of different roles in my interview subjects, both from the commercial and technical sides of the industry also provided a very interesting insights into the telco industry today. Although their different background may be biased, their different views also shed a very interesting light on the potential of big data as a potential revenue, including the pros and cons of mobile big data.

This study also used a multiple case design that allowed a replication logic, that is, a series of cases is treated as a series of experiments, each case serving to confirm or disconfirm the inferences drawn from the others (Yin, 2014). Replication approach to data gathering also means that I select interview subjects that I expect to either give very similar results *(literal replication)*, or that I expect to give opposing results for anticipatable reasons *(theoretical replication)* (Yin, 2014). Table 3.2 below shows the subjects being interviewed.

Table 3.2: Interview Subjects

No.	Interview Date	Company Names	Roles
1.	06.03.2017	Telenor	1. Lead Business Development 2. Lead Developer 3. Network Consultant
2.	09.03.2017	Telia	1. Chief Data Officer (CDO)
3.	18.03.2017	Ice.net (Netcome Global Partners)	1. Technical / Engineering
4.	19.03.2017	Nokia	1. Customer Solution Manager
5.	21.03.2017	Alpha Entrance	1. Technical Manager
6.	23.03.2017	Telenor	1. Senior Data Scientist
7.	28.03.2017	Telio	1. Project Manager

In the span of one month, a total of 4.5 hours of audio recordings were collected from seven interviews with 52 pages of transcription. I consider the data collected in my primary data collection provided the most valuable source of data.

Interview Guidelines

Prior to my interview, with the assistance from my supervisor at SINTEF, I was very fortunate to obtain the help of Human Computer Interaction (HCI) expert at SINTEF to review my interview question sets. The feedback from the HCI expert were later incorporated into the initial question sets:

(i)   Setting up of key research questions / research goals, then list up the particular questions in the interview guides that are going to shed light on the different research questions / goals. Linking each question to the research aims. (Appendix A)

(ii)   Be sure of the purpose of each question and how they can help you to understand the research goals. Else, there will be a lot of back and forth, regretting why some questions are not being asked.

(iii)   For my case study, the interview should have more questions concerning "Why". For the purpose of multicase study, have questions to reflect on the differences and similarities between the telcos and compare them.

In addition, a book on interview by (Kvale, 1996), was obtained from the HCI expert and shaped the interviews I conducted. For example, during the interviews, the first few minutes were the most critical. The subject will want to have a grasp of the interviewer before they allow themselves to talk freely, exposing their experiences and feelings to stranger. A good contact is established by attentive listening, with the interviewer showing interest, understanding, and respect for what the subject says, at the same time, the interviewer is at ease and clear about what he or she wants to know.

A pilot interview was conducted early March and the questions were further refined to ease the flow of interview for the subsequent interviews. The interview subjects were first contacted on email with write-ups on the topic of my case study. Summaries of the main theories which I would like to investigate such as the Porter's Five Forces, VRIO framework

in resource-based view (RBV) and dynamic capabilities were provided in the email to help the interviewees to have a good grasp of the topics.

Secondary Data Collection

To have a better grasp on the latest trends and state of the telco industry today, I spent considerable amount of time gleaning through the financial reports for the major telcos in Norway and Sweden since early 2000 (Telenor and Telia are publicly traded entities and are listed on the Norwegian and Swedish stock exchange in). The ARPUs for the telco showed steady reduction from that time to recent years and were shown in section 1.4, Background in Chapter 1, Introduction. Industry reports and white papers on telcos were examined as available. In addition, the social media channels for the telcos (LinkedIn and Twitter) were followed to get the latest news and announcements on them. The other source of evidences listed under (Yin, 2014) such as direct observation, participant observation, physical artifacts, etc., are not relevant and were not considered for this case study.

3.3   Entering the Field

The idea for this case study was first hatched during my practical training at SINTEF when I was involved in various Data-Driven Innovation (DDI) projects, for example proDataMarket project, taking place in Europe Union business area. The reports of telcos losing their ARPU on a year-by-year basis led me to believe that data-driven initiatives can be applied in the telco industry as well. Hence, the most obvious choice of interviewees for this case study are experts working in the data science labs of the telcos or business development executives at the telcos who are responsible of finding new revenue streams for telcos.

A key feature of theory-building case research is the freedom to make adjustment during the data collection process. These adjustments can be the addition of cases to probe particular themes that emerge. (Eisenhardt, 1989a) I found this to be particular true for my case study, in my pursue of finding out new revenue streams for the telcos in the form of mobile big data, I was led to investigate the causes of dwindling ARPUs for the telco from different angles, through the angles of mobile equipment vendors who work very closely with the telcos to deploy their mobile networks to business development managers who work with finding new revenue streams with mobile big data. This completely adhered to (Eisenhardt, 1989a), if a new data collection opportunity arises or if a new line of thinking emerges during the

research, it makes sense to take advantage by altering data collection. This flexibility is controlled opportunism in which researchers take advantage of the uniqueness of specific case and the emergence of new themes to improve resultant theory.

3.4 Data Reliability

To improve data reliability of a case study, (Yin, 2014) proposed the following four principles:

1. *Use multiple sources of evidence*. The primary unit of analysis was the telcos itself. To increase the reliability of data, seven interviews were conducted for this study with four telcos (managers from Telenor were interviewed twice in separate sessions) and two vendors (software and hardware) which provide services to the telco. To achieve triangulation of data, a careful selection of one hardware vendor and one software vendor were interviewed as well.

2. *Case study database*. After every interviews, the recordings were transcribed immediately while the memory of the interviews were still fresh in the mind. They were categorized by topic and relevance.

3. *Maintain a chain of evidence*. This is achieved in my research by allowing an external observer to follow the derivation of any evidence from initial research question to the ultimate case study conclusion.

4. *Exercise care when using data from electronic sources*. For my research, I limited the usage of Wikipedia. In the event that I access it, I cross-checked information from Wikipedia with other sources which are more trustworthy and verifiable.

3.5 Ethics

Prior to the interview, permissions were secured for the interviews to be recorded. However, to protect the confidentiality of the information that were provided during the interview, which may be sensitive information pertaining to the telcos, the entire transcripts of the interviews were not included as part of the thesis. The interviewees were informed that the interviews will be transcribed, analyzed and some of the conversations would be quoted in its original form. The interviewees were also given the discretion to not answer the questions if they were deemed to be too sensitive.

4 Data Findings and Analysis

4.1 Data Analysis Strategy

According to (Yin, 2014), there are four strategies in analyzing case studies. They are (1) relying on theoretical propositions, (2) working your data from the "group up", (3) developing a case description and (4) examining plausible rival explanation. This case study is inductive and exploratory in nature with no fixed theoretical propositions, hence the first strategy is inappropriate. The second strategy does not present a good match either because this case study does not have any quantitative data while the fourth strategy of examining rival explanation works in combination with all of the other three strategies. Hence, only the third strategy, developing a case description is the most relevant strategy.

Once the strategies for analyzing the case study has been finalized, there are five techniques to analyze the case study: pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis. Of these, explanation building technique is the most relevant to this exploratory case study.

4.1.1 Overview of Companies

There are a total of six companies interviewed in this study, four of them are telcos which have operations in Norway (Telenor, Telia, Ice.net and Telio) while two of them are hardware vendor (Nokia) and software vendor (Alpha Entrance). Nokia and Alpha Entrance were included in this study to increase reliability in the study, by using multiple source of data with triangulation of data source. (Yin, 2014)

Telenor

Telenor Norway has the largest market share (56,4%) for mobile telephony and mobile broadband services for the first half of 2016 based on sales revenue. (Nkom, 2016) Telenor Group is one of the world's major mobile operators, with reported revenues of NOK131 billion in 2016. (Telenor, 2016a) Telenor has 214 million mobile subscribers connected in 13 markets across Scandinavia, Central Eastern Europe, and Asia. Recognizing the shifting power in the telco industry, Telenor has been investing heavily in the next big thing in technology, such as the recent establishment of AI Lab in collaboration with NTNU (Telenor, 2017a) in Trondheim. Despite the size of the entire organization, Telenor placed great

importance in empowering its employees and has been organizing innovation and entrepreneurship programs called Ignite to incubate innovative ideas internally from their employees across the globe. (Telenor, 2016b) One of the winner of this intrapreneurship program is Telco Open Data, a delivery platform for Mobility Analytics that enables customers to do analytics on a self-service basis. (Telenor, 2016b)

Telia

Telia Norway has the second largest market share for mobile telephony and mobile broadband service in Norway with 33,0%. Telia Norway is owned by Telia Company AB (changed from TeliaSonera AB in 2016) in Sweden and has operations in other countries in Northern and Eastern Europe, Central Asia and South Asia with a total of 24 million mobile subscribers. The group reported a total of SEK84 billion in 2016 (Telia, 2017a). Similar to Telenor, Telia is putting a lot of resources on the next wave of technology coming into the telco market with the establishment of Telia Next in late 2016. Telia Next is the innovation unit of Telia where new businesses are being developed in the areas of Internet of Things (IoT) and Machine Learning (ML). In April 2017, Telia was given the greenlight to purchase Phonero, the third largest telco in Norway. (Digi.no, 2017)

Ice.net

Ice.net has the fourth largest market share for mobile telephony and mobile broadband service in Norway. (Nkom, 2016) Originally a provider of fixed-line and broadband service to the cabin in remote areas in Norway, Ice.net went into the mobile operator market in 2015 and is slowly winning subscribers in Norway with its aggressive pricing plan.

Telio

Telio is the fifth largest mobile telephony and mobile broadband service provider in Norway (Nkom, 2016). Telio is a mobile virtual network operator (MVNO) which leases network infrastructure from Telia. MVNO is a type of telco which does not own any mobile network infrastructure but lease it from other bigger telco. Telio was established in 2004 and is a pioneer in Norwegian VoIP market with operations in Denmark, Switzerland and the Netherlands. In 2013, Telio acquired NextGenTel, which provides broadband services in Norway. (NexGenTel, 2017)

Nokia

After Microsoft acquired Nokia's mobile hardware division in 2013, (BusinessInsider, 2017) Nokia has been focusing on the network equipment and mobile telecommunication infrastructure market today. They count communications service providers (telcos), large enterprises and consumers around the world as their customers today. Recently, Nokia has been acquiring a number of companies, among them Alcatel-Lucent (Nokia, 2016a) and Whitings, (Nokia, 2016b) this signals the transition to new technologies such as 5G, the Internet of Things, cloud technology, digital health and wellbeing.

Alpha Entrance

A relatively young mobile service startup based in Oslo with engineering team in Argentina. By collaboration with other telco in Norway, Alpha Entrance uses real-time location data for targeted mobile marketing and location-based service for concerts and events. Currently conducting a proof-of-concept (POC) project with a telco in Norway.

4.2 Cross-analyses across sub-units and synthesizing results

4.2.1 Porter's Five Forces

Porter's five forces shed a very interesting light on the current state of the telco industry.

Threat of substitutes

From the interviews, it is apparent that the telco industry is facing tremendous threats of substitutes. According to the manager at Ice.net, *the traditional voice and SMS services which telcos offer are becoming more and more like commodities. If the users are using applications like Whatsapp, Skype or whatever, they are just going through those applications only, not in the voice anymore.*

When a user is using Whatsapp and Skype, they are using services offered by different players in the industry which are not from the traditional telcos. Thus, totally bypassing the traditional voice and SMS services offered by the telcos. Though these newer type of services still run on the data package which are offered by the telcos, the telcos do not make as much money from these services as voice or SMS from before. The manager at Nokia agreed. This is t*he typical scenario, suddenly with the smartphones, or vertical players, suddenly you see*

that you are competing with the global players like Google and Apple, Facebook. You are not competing with the traditional players in their own countries anymore.

The data scientist at Telenor sums up very nicely on the threat of substitutes, he stated that *during the last 10 years, there have been so many newcomers, Facetime, Skype, all these services deliver voice or even video. It's a better service than just using voice. Snapchat and all sort of instant messaging services, given that all the customers are really indeed different, the ones that are price sensitive will start hunting down and using the free services.* All these substitutes offer similar or superior services to existing services by the telcos, often times at no costs, thus posing even greater threat to the telcos.

This is consistent with (Feng and Whalley, 2002), the traditional telecommunications value chain is deconstructing into a complex and rapidly changing value network. Within the value network a multitude of market entry points exist, where a variety of companies can enter the market through several possible routes. Many powerful new players from other industries can now enter the telecommunications value network. The exit point is the point where the company interacts with its chosen end customers and this differs significantly depending on the business model adopted by the different stakeholders.

With smartphone penetration of around 70 percent in Western Europe by the end of 2016 (Ericsson, 2016b), the different services consumers access on their smartphone are being "dis-entangled" from the telcos. Companies such as Whatsapp, Skype and Snapchat are benefitting from this and entering the telco value network, thus substituting the services offered by telcos.

Threat of new entrants

As for the threat of new entrants, telcos are facing threats from multiple fronts. Gone are the days when a country only has one or two telcos monopolizing the market. The telco market is fast becoming a crowded field. The manger at Ice.net rationalized that *one reason that the newcomers can do it as well is because all the prices for network and telecom equipment has decreased a lot since 2000. Most of the network he work with recently, except the one in Norway, are all Huawei and ZTE. The price for building network has decreased dramatically over the past 5-10 years. Now it's very very cheap.* In addition to that, *those that are building their network now, they can have the latest technology where the equipment is much cheaper*

and much easier to maintain. They don't need that many people to maintain the network. They can do a lot of things that are application based, where the subscribers are able to access and modify the subscription settings directly without the need to call customer service. The team to maintain the network is much smaller where new people enter the market, compared to those old companies who are there from before. With cheaper network equipment coming in from Chinese equipment maker, the entry barrier for telcos is coming down significantly, thus allowing more players to come into the market and eating up the profit margin of the existing telcos. The manager at Ice.net adds, *those big, big companies like Telenor and Telia in Norway, or Orange and SFO in France, who were there before, they could afford to have a lot of people to charge for whatever, there is a newcomer arriving, they cannot do that anymore.*

Rivalry among competitors

With new telco players coming into the telco market, this naturally increase the rivalry among the competitors, especially the new telcos who are aggressive and eager to gain market share. The manager at Ice.net reflected that *in France, they introduce Force Mobile Operators free, when the new one arrive, if you want to be successful, you have to be very, very disruptive and has to attack a lot on the prices, meaning those guys that were here before, a bit fat, because they could charge a bit higher prices because the competition were less, that suddenly they can't do this anymore.* Apart from the monthly subscription fee which is coming down on a year-to-year basis, telcos are under the pressure to offer new and innovative services as well. Recently, one of the telco in Norway offered data-rollover service, which is a service that allows your unused data package to be included in the following month's data package. When one of the telco started offering this service, others have no choice but to follow suit. This is confirmed by the senior data scientist at Telenor, he added that *Talkmore was the first to do this and we (Telenor) has to follow.*

Bargaining power of suppliers

The same rivalry that happens in the telecommunication market is happening in the vendor market for the telcos as well, which is, for a change, a good thing for the telcos.

According to the manager at Ice.net, *in the early 1990s, the telecommunication equipment market was not that intense and the vendors were able to keep high prices. The vendors have huge R&D cost to develop the new product lines for 2G, 2.5G, 3G and 4G. Then with the*

combination of internet bubble and the emergence of Chinese vendors such as Huawei and ZTE, the prices have been coming down. This resulted in the consolidation of the vendors, those with the smallest market share had to give up (Nortel) or was absorbed (Siemens), or merged with others (Alcatel, Lucent). Nokia (NASDAQ, 2016) later acquired Alcatel-Lucent in 2016.

He added that *the telco equipment market remains intense today mainly due to the lower prices of Chinese suppliers and the products became more standardized, like commodities. No vendor today differentiates really based on products / features compared with others.*

The two factors above which diluted the bargaining power of suppliers are consistent to (Peng, 2014). First, the supplier industry is no longer dominated by a few firms when the Chinese vendors came into the market. Second, when the suppliers' products ceased to be unique and cannot be differentiated from one another.

The manager at Nokia made the same observation with regards to the bargaining power of suppliers. With the number of competition in the telco suppliers market today, *telcos have the bargaining power with their suppliers (telecommunication equipment vendors), it is the buyer's market out there. In addition to the price, the telcos can ask for terms and conditions that favours them with their purchases.*

Bargaining power of buyers

With the number of telcos in the market today and the different type of services available to the consumers, it is apparent that the consumers (buyers) yield a great deal of power when it comes to deciding who their mobile service providers should be. The fact that consumers can keep (port) their phone numbers when they change providers does not help the telcos. Before government authority implement number portability onto the telcos, telcos use this as a leverage to lock in subscribers because changing telco providers mean changing their mobile phone numbers, which is a big hassle for the consumers. The project manager at Telio adds, *more and more people are looking at prices and they compare. What I get here and what I get there, and as porting number is quite easy nowadays. When they (consumers) get a better offer, they will take the better offer.* When the subscribers (buyers) do not face any switching cost, this increase their bargaining power. In addition, mobile services provided by telcos are undifferentiated, thus giving buyers greater bargaining power. (Schilling, 2013)

4.2.2 Resource-based view

The Question of Value

Since the early days of the mobile telecommunication industry, telcos have been using the data generated within their network to optimize their mobile infrastructures, such as assessing the mobile usage patterns of their subscribers to plan their next network equipment upgrade or fiber backbone upgrade. In the very competitive mobile service industry, this type of data is vital in providing satisfying service to their subscribers, reducing churn-rate and increasing subscriber retention rate.

In recent years, mobile big data is inevitably coming into the play. The different type of analytics such as customer profiles, device data, network data, customer usage patterns, location data, apps download and clickstream data are very attractive to various businesses who want to get better analytics from their mobile big data. The CDO at *Telia believes it's really valuable data. It is relatively unique in terms of seeing mobility. How people move around. Just as long as people bring the devices with them, all the time. We (the telcos) have the chance to understand a lot by how people actually move. We definitely believe there is a revenue potential there.*

In the VRIO framework, value is the most fundamental question to start. (Adner and Zemsky, 2006). The mobile big data generated by mobile subscribers certainly add value to telcos, both internally for network planning and externally for other type of businesses to gain better marketing insights, hence mobile big data can lead to competitive advantage for telcos.

The Question of Rarity

Although there are many types of data being generated in various industries, telcos are in an unique position with the type of data they are able to generate. Apart from the geolocations of their subscribers, mobile operators are also in the possession of demographics, network usage, device, application usage, preferences etc data or their subscribers. Telcos are starting to mine, model, aggregate and anonymize these datasets to create powerful analytics that can add significant value to other type of businesses and verticals. For example, retailers are particularly interested in customer foot traffic analytics which is helping them to decipher who is visiting their retail stores.

The managers at Telenor agree that mobile analytics and big data is rare. *In many countries, there are two to three operators. Does it make it rare? If three companies provide similar product. It's rare in the context that, you know, the alternative is extremely complicated.* The manager started to relate to a use case in Copenhagen where the public transport authority measure the passenger load in public transport to gauge the availability load capacity of public transport. *When they talk about the bus passengers that travel in the city. Of course, if you have 50 people that goes out in the morning in blue jackets and start questioning people. Excuse me, where did you travel from this morning. You get some sorta insights. But you only do that as many days as you can afford these people in blue jackets in the morning. You can do it like, configure it once and do it every morning. So, I think it's rare.*

With this, the data are considered to be valuable and rare, thus providing temporary advantage to mobile operators.

The Question of Imitability

Further down the VRIO framework is imitability, a resource can be of competitive advantage only if competitors have a difficult time imitating the resource. (Peng, 2014) When it comes to a resource's imitability, a tangible resource such as factory is much easier to imitate than intangible resources such as tacit knowledge, culture, leadership and talents. (Ethiraj, Kale et al., 2005)

Although the richness of the mobile big data generated by telcos is valuable and rare compared to other type of data generated by other industries, they do however face competitions from the data generated by their fellow competitors in the same vertical / industry.

This is confirmed by both Telia and Telenor. According to Telia, *since they are not the single player in our market, then it's copiable, to a large extent. So they think it is more in how you execute. They think it is possible to bring some extra value, but it's copiable, definitely. Telia does not think they have any different data than Telenor, there could be some differences in hardware and infrastructure which can give access to other type of data.* While Telenor added, *at the end of the data, is the data that the telco is collecting unique enough? That it will differentiate us from data collected by other players? They don't think so.*

Hence, valuable and rare but imitable resources and capabilities may give telcos some temporary competitive advantage, leading to above-average performance for some period of time. However, such advantage is not likely to be sustainable. Only valuable, rare and hard-to-imitate resources / capabilities can provide a firm a sustained competitive advantage. (Peng, 2014)

The Question of Organizational

To sustain competitive advantage from their resource, not only that resources has to be valuable, rare and hard-to-imitate, that resource needs to be properly organized as well. (Peng, 2014)

While working on my master thesis at SINTEF and talking to various telcos, it is apparent the telcos that I have been in touch with are organizing their operations around their big data department. Most of these operators have a department called Data Science Lab where their data scientists and business development managers work with various tools for data modelling and retrieving meaningful insights from their streaming transactional data. It is apparent that the operators we have been co-operating with are putting in significant effort in their data science labs and getting other departments within their organization to capitalize their subscribers' datasets to generate the next revenue stream.

According to the CDO at Telia, a*bout two years ago, Telia did not do anything in the big data area. Some in network and monitoring etc. But nothing to use it in a more forward looking way. Telia is going to increase this and as the Artificial Intelligence (AI) and Machine Learning (ML) becomes more and more mature. It's going to be easier to find good use cases for big data.*

Just as Telia, Telenor is investing a lot of resources to their mobile big data initiative. According to the senior data scientist at Telenor, organizations *in Telenor Norway have been changed to reflect the need for a big data analytics group. That group is in charge of mobility analytics. You need to have a group, a set of people that is responsible for having the necessary infrastructure to process and compute on these datasets. Deliver the output, anonymize, that you can share with third party. They are setting up dedicated units to do the job. That is where they are really taking the bold steps in the right direction of changing the*

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organization. You get an organization that is tailored made for the purpose. The Business Development Manager at Telenor reflects the same initiative in his department as well. He adds that *Telenor is putting more resources into the Product Management and Innovation (PMI) department to pursue the opportunities in big data and mobile analytics.*

4.3 Summary of Findings

4.3.1 Porter's Five Forces Analysis on Telecommunication Industry

Porter's Five Forces analysis of the telco industry today from the interviews paints a rather grim outlook for the telco industry. Apart from the bargaining power of the suppliers which favours the telcos, giving the telcos great bargaining power, the other four factors are against the telcos. The data scientist at a Telenor sums it up nicely when he commented that, *the business model of the telco is changing radically, the competitors are changing radically, the technology is changing, so you have a lot of things happening at the same time.*

The different forces that are working against the telco industry today set the race for telcos to find the next big thing, the next new revenue stream. Mobile big data has been getting much attention from the telcos and is seen to have a lot of potentials. Figure 4.1 below shows the different forces affecting the telco industry today.
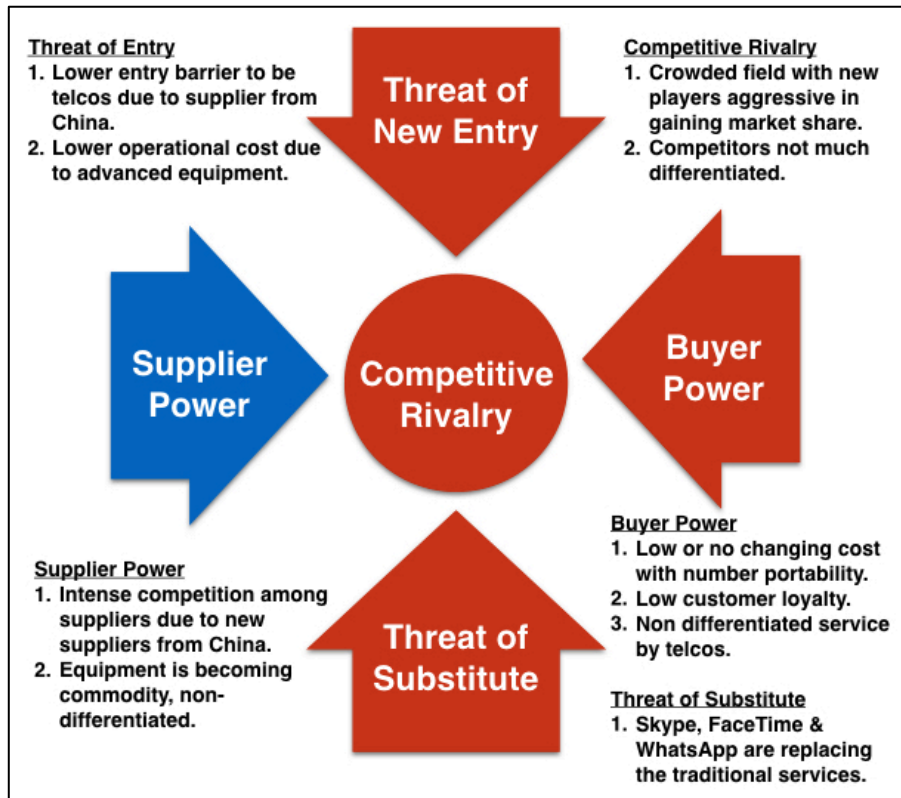
Figure 4.1: Forces affecting telcos today

4.3.2 VRIO Framework on Mobile Big Data

The managers from Telenor and Telia came to the conclusion that mobile big data is Valuable, Rare and their organizations are organized around it, but mobile big data is imitable, making it not unique. Thus mobile big data is providing telcos temporary competitive advantage only. The only anomaly in this is the manager at Alpha Entrance who does not even think mobile analytics is a temporary competitive advantage to the telcos. According to him, *a lot of organizations are doing the same kind of analytics, for instance, Google and Apple know exactly the same thing, you carry your iPhone and Android devices*. The managers at Ice.net, Telio and Nokia are not able to provide any conclusive opinion on the potential of mobile big data because they do not have mobile big data strategy at the time of interview, nor in the near future (6-12 months), hence they are not included. Table 3 shows the opinions of the manager from Telenor and Telia on mobile big data based on VRIO Framework is in Table 4.1 below.

Table 4.1: Comparison of VRIO Framework for Telenor and Telia

	Value	Rare	Imitability	Organized
Telenor	Yes	Yes	No	Yes
Telia	Yes	Yes	No	Yes

The fact that mobile big data is only a temporary competitive advantage to telcos would necessary not be a bad thing after all. The dynamic capabilities literature argues that increasingly there is no such thing as sustained competitive advantage (Day, 2014), even more so in a dynamic market such as the telco industry (D'Aveni, Veliyath et al., 1996), but rather ever-emerging waves of opportunities that are best exploited by firms that either predict their emergence, or catch them early on, and that realize when the wave has run its course, withdraw, and move on to find the next wave. In order to be a firm that can do this in a successful manner, it is imperative to not tie up resources in analyzing and planning for sustainable competitive advantages, but rather continually scan and prepare for new, short-lived opportunities by building capabilities within "specific and identifiable processes such as product development, strategic decision making, and alliancing" for dynamic markets (Eisenhardt and Martin, 2000).

On the question if mobile big data can be a sustained competitive advantage to the telcos, all the managers interviewed at Telenor and Telia gave a resounding no. The CDO at Telia *thinks it is more on how your execute your big data and mobile analytics projects that can be a sustained competitive advantage* while the Senior Data Scientist at Telenor *thinks it boils down to how good you are and how fast you are. To do things more efficiently with the problems that you are trying to solve.* The statements from the CDO at Telia and the Senior Data Scientist seems to concur with (Barney, 1986), that organizational culture can be a sustained competitive advantage.

The VRIO Framework on mobile big data is also consistent with (Barney, 1991) seminal work, Firm Resources and Sustained Competitive Advantage, because these firms all implement the same strategies, they all will improve their efficiency and effectiveness in the same way, and to the same extend. Thus, in this kind of industry, it is not possible for firms to enjoy a sustained competitive advantage. Firms in this type of industry have to find other type of resources as their sustained competitive advantage.

Challenges of Monetizing Mobile Big Data

Despite the promises of mobile big data, the business model for monetization of mobile big data is still not fully developed at this point. The senior data scientist at Telenor warns that *the telcos have to be careful that you try to monetize the data. It's a different ballgame,*

playing the data game is different. We come from a very regulated world, where we are charged by the minute and by the gigabyte for so many years. And charging for services is very different. Then you really have to look at how you gonna solve the problems of our customers. Even though the telcos are sitting on vast amount of data, the data scientists think that *just throwing a lot of data at researchers or whomever, is not going to solve anything. Unless you really have a good idea for problems that you are trying to solve. That is what people tend to miss, if you are really going to make a sustainable business on data analysis, then you really need to solve somebody's problem.*

The CDO at Telia is also working on the ideal business model for monetizing mobile big data. She adds that *the customer data is probably the most challenging when it comes to using mobile big data as revenue stream. We (Telia) can't just test and experiment and do whatever we want, we need to be careful both not to do something we are not allowed. And the perception of what we are doing with customer data. Like the headline for Telenor. "Telenor vil ha dine data".* (DN, 2017c) *People feel it can be intrusive, you don't want to make a lot of headlines like that. It may limit your ability to do good stuff.*

Even today, Telia is still experimenting with the price-points for their NB-IoT business, a type of service related to mobile big data and analytics. The CDO adds, *many would be tracking very valuable things and it is like a insurance, when you have tracking, you know where the things are. And it's less likely that it's going to be stolen or damaged. But the willingness to pay for the connectivity itself is very, very low, because it is perceived as there is not where you get the value. So, that is the only test we made. So, up until you really need the trigger of the data, it's really not worth anything. It's that one valuable trigger that you are waiting for. But may be you need to have the whole series, so that you get the insights, like you get the Geofence, someone moving in out, in out. And then suddenly, the only trigger you want to act upon, as if they have not been inside for a week, for example. That is the only one you need to act upon, but you still need to collect all the other data. So, I think may be the transaction needs to be really low, probably per transaction. But we haven't really dig deep into that.*

4.3.3 Dynamic Capabilities and Framework of Prediction and Control

When it comes to making mobile big data as their new revenue stream and adapting to the new realities of their industry. Telenor and Telia falls into the Adaptive quadrant of the prediction and control framework (Wiltbank, Dew et al., 2006) with Telenor seems to leaning towards the Transformative quadrant, as shown in Figure 4.2 below. Ice.net and Telio have no clear mobile big data initiatives and are not included in this part of the study.
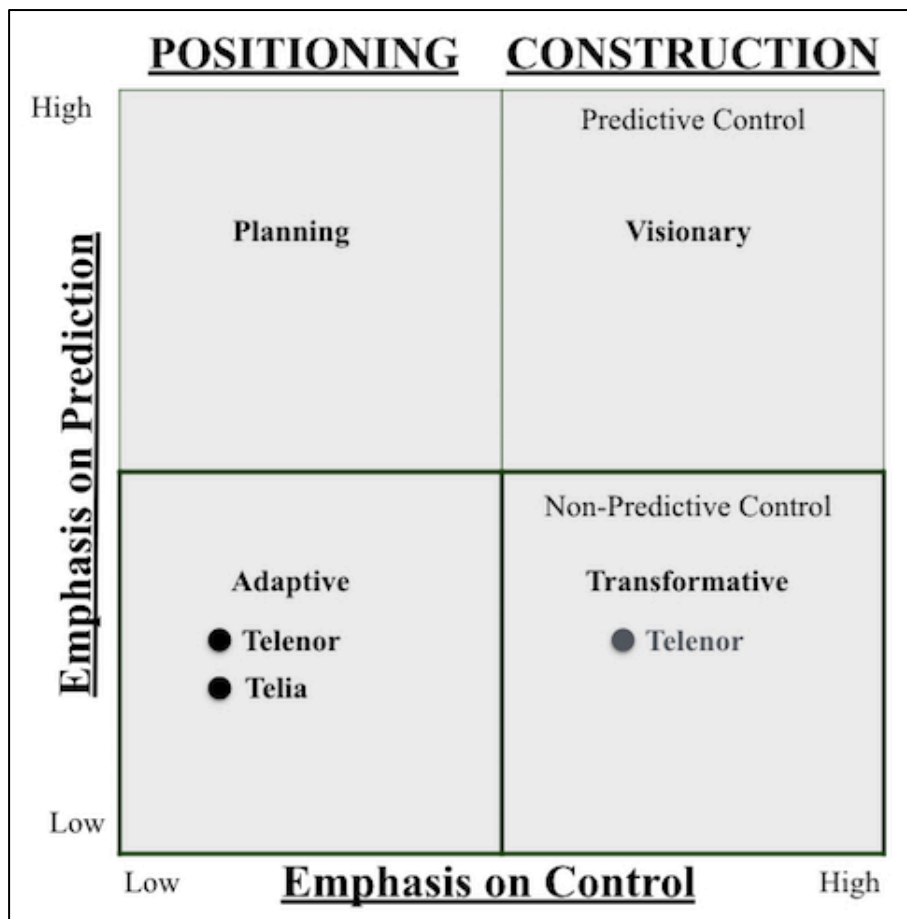
Figure 4.2: Telenor and Telia on Prediction and Control Framework

With all the factors affecting the telco industry today, all the interview subjects agreed that telcos have to change and adapt to the new landscape. According to the senior data scientist at Telenor, *telcos have to change in a way that they are constantly searching for new revenues. To be the engine in the hunt for new revenues. The hardest transformation Telenor is going through right now is the organization and trying to turn the organization to data driven, to become data driven. For so many years, it has been hierarchical / command lines, you have a task and you just have to do it. But if you gonna be truly data analytical, you have to become data driven. That means you have to question data, ask questions.* He also added, *in order to succeed in the future, Telenor organization has to become data driven. That is a*

prerequisite, you have to be able to understand the world of data, and digital information. And analytics and Artificial Intelligence is only about automation, finding patterns from data. Learning from these patterns. It all fits very nicely together. We have to turn to data driven to succeed in the future.

Despite of its size, Telenor under the helm of its new CEO, Sigve Brekke, is behaving almost as if it is a startup, nimble and quick to try something and see if it works. According to the Software Developer at Telenor, *they want to create new products, fail fast, that is needed. They want to fail fast if there is nothing to go for, but if they hit the gold mine, they got to scale behind to back it up and roll it up.* This is consistent with one of the digital service venture Telenor launched a few years ago called Comoyo. Comoyo was launched to compete with Netflix in 2012, but Telenor stopped the service in 2014 when they realized the service did not get the traction they were looking for. This resonates very well with (Sitkin, 1992), mistakes play a role in the evolution of dynamic capabilities. Small losses, more than either major successes or major failures, contribute to effective learning as it provides the greatest motivation to learn. Such failures cause individuals to pay greater attention to the process, but do not create defensiveness that impedes learning.

In rapidly changing environments, there is obviously value in the ability to sense the need to reconfigure the firm's asset structure, and to accomplish the necessary internal and external transformation (Teece and Pisano, 1994). With the full support of their management, Telenor launched various initiatives to rejuvenate their organization, such as their intrapreneurship program called Ignite, where their employees got the opportunity to pitch their ideas to a panel and the winners were given one year to work on the idea. (Telenor, 2016b) If Telenor does not own the skill-sets or the technology they want, they would acquire the startup, just as they did with the acquisition of Tapad, a marketing technology startup founded in 2010 (Telenor, 2016c) or partner with universities for cutting-edge technologies (Telenor, 2017a).

(Teece, 2007) advocated that firms will need sensing, seizing, and transformational / reconfiguring capabilities to be simultaneously developed and applied for it to build and maintain competitive advantage. Telenor seems to realize that being in the transformative quadrant is to be in continuous temporary competitive advantage. The various programs they have in place for their organizations suggested that they want to inculcate a dynamic and flexible culture. This constant exercise of bundling (and rebundling) resource combinations

internally and externally is also consistent with property rights theory (Kim and Mahoney, 2010), which defines firms as a nexus of incomplete contracts that enables the possibility of alertness and ingenuity.

When it comes to dealing with the changes in their industry, Telia (Norway) seems to behave more like startup compared to their counterpart in Sweden. The CDO at Telia thinks *the Norwegian approach is more iterative, startup like while their Swedish headquarter approach is, sort of planning and then executing. The way we develop towards our POC, for example, we get some sorta incoming needs and we start solving, testing based on some stuff we already done as well for other cases. And then we try to create that in a generic way so that we can solve similar cases for other customers later and scale it into product.* Although the CDO disclosed that Telia acquired a crowd analytics startup to enable them to gain new technologies, there is no evidence of employees intrapreneurship program such as Ignite at Telenor or strategic partnerships with top universities such as NTNU.

5 Conclusion

Consistent with (Eisenhardt, 1989a), this study follows a theory-building approach which is both explanatory and exploratory (Yin, 2014). This study explains the different forces that come into play in the telco industry today. This study then explores the potential of mobile big data as sustained competitive advantage to telcos and telcos' approaches in adopting this resource as potential revenue stream, as well the challenges.

Porter's five forces was used to understand the different forces affecting the telco industry today. The findings for each of the force in this framework on telco are:

Threat of Substitutes: Although people still need mobile service from telcos, when it comes to the traditional SMS and voice services, there have never been more substitutes than it is today. With the emergence of smartphone and different apps that run on them, the border for new apps and services coming into the local market of the telcos is completely blurred. Services like Whatsapp, Skype and Facetime are competing head-on with the the services provided by telcos and even replacing them, causing telcos to lose their revenues;

Threat of New Entrants: As if the threat of substitutes is not enough, telcos today are facing the threat of new telcos in their home turf as well. The influx of telecommunication equipment maker from China such as Huawei and ZTE is lowering the barrier for new telcos to come into the market because the cost of setting up a mobile network is just a fraction of what it used to cost with these Chinese vendors. In addition, these new equipment has lower operational cost, thus requiring smaller team to maintain and they require less customer service because the mobile subscribers are able to access and modify the subscription settings directly;

Rivalry among Competitors: With the number of new telcos coming into the market today, it is only natural for the rivalry in the market to intensify. Apart from the monthly subscription fee which is coming under heavy price war, telcos have to compete on new and innovative service as well. Recently when one of the telco in Norway started offering data-rollover service, other telcos have no choice but to follow suit;

Bargaining power of suppliers: The same rivalry happens on the vendor side, which means the telcos have better negotiation power with their suppliers and can negotiate better deals for themselves. In addition to getting better pricing for pitching the suppliers against each other, the telcos get very favourable terms and conditions in procuring their network equipment as well;

Bargaining power of buyers: The intense rivalry among the competitors (telcos) and the lower entry barrier to become a telco only mean the buyers (subscribers) are spoilt for choices when it comes to choosing who they want as their telco providers. The low switching cost for buyers certainly does not help the telcos as well. With number portability, buyers can switch to a different telco provider without much hassle. Customer loyalty is rather low in the telco industry, buyers have no qualms switching to a different telcos if the subscription fee is lower. In addition, mobile connectivity which is the main service provided by telcos is highly undifferentiated, hence buyers have greater bargaining power.

The conclusion from Porter's Five Forces is, apart from the bargaining power of suppliers, all the four forces in this theory are not in favour of the telcos, hence the telco industry is not as attractive as an industry as it used to be.

By applying VRIO Framework on mobile big data as a resource, it can be concluded that mobile big data can only provide temporary competitive advantage to telcos. However, it is interesting to note that the manager at Alpha Entrance does not even think mobile big data can provide temporary advantage to the telcos.

On the question of **Value**, it is very apparent mobile big data is valuable to the telcos. The data generated by telcos is being used both internally, to do network planning; and externally, in gaining insights from the movement of people for different use cases such as crowd management during special events.

On the question of **Rarity**, the mobile big data generated by telco is considered to be rare, when combined with other types of data that telcos already have, such as the demographics of their subscribers, the data can be considered is rare.

On the question of **Imitability**, since there are more than one telco in each country, the data collected is not unique, thus it is imitable. Telco faces competition from their peers when it comes to the data they manage to collect.

On the question of **Organizational**, all the telcos I interviewed have very clear initiative to exploit the data generated in their network and allocating resources around their mobile big data. Telenor and Telia both have data science lab and research division to work on their mobile big data.

In a hypercompetitive market such as the telecommunication industry that we know today, the fact that mobile big data can only provide temporary competitive advantage to telcos should not come as a complete surprise. (Day, 2014) even argued that increasingly there is no such thing as sustained competitive advantage. Hypercompetitive conditions ultimately result in all positions of competitive advantage being eroded by imitative or innovative competition. Hence, maintaining superior performance ultimately requires the continual renewal of competitive advantages through innovation and the development of new capabilities. (Grant, 1996) Although the study started with exploring mobile big data as a resource for telco to gain sustained competitive advantage, the data collected from the interviews pointed towards organizational culture as sustained competitive advantage, which is consistent with (Barney, 1986).

When it comes to adopting mobile big data as a new revenue stream and adapting to the future, it is obvious that Telenor and Telia belong in the Adaptive quadrant of the prediction and control framework (Wiltbank, Dew et al., 2006). But Telenor's various initiatives such as their Ignite Intrapreneurship program (Telenor, 2016b), NTNU-Telenor Partnership (Telenor, 2017a) and Tapad acquisition (Telenor, 2016c) are quintessential effectuation principles by (Sarasvathy, 2001; Sarasvathy and Dew, 2005). This indicated that Telenor is leaning towards the transformative quadrant. These initiatives are also very good example of how big organizations adhering to the Property Right Theory (Kim and Mahoney, 2010), bundling and rebundling property rights (resources) to create new products and services, or even to acquire new capabilities. Property Rights Theory also defines firm as a nexus of incomplete contracts that enables the possibility of alertness and ingenuity, thus this contracting process is a form of entrepreneurial discovery process enabling firms to sense and seize new economic opportunities.

(Teece, 2007) advocated that firms will need sensing, seizing, and transformational / reconfiguring capabilities to be simultaneously developed and applied for it to build and maintain competitive advantage. Telenor seems to realize that being in the transformative quadrant is to be in continuous temporary competitive advantage. The various initiatives they have in place for their organizations indicated that they want to inculcate a dynamic and flexible culture. It is interesting to note that, in a rapidly changing environments, there is obviously value in the ability to sense the need to reconfigure the firm's asset structure, and to accomplish the necessary internal and external transformation. (Amit and Schoemaker, 1993; Langlois, 1994) Telia will stand to lose out to Telenor if they remain in the Adaptive quadrant.

Finally, it is important to highlight the aspects of internal validity and external validity (Yin, 2014). The interview results were cross-analyzed with literature and secondary research to build internal validity. For external validity and generalization of this research, it is important to understand that the research is limited to the the telco industry. The Porter's Five Factor frameworks used to analyze the data collected from the interviews to determine the attractiveness of the telecommunication industry, the VRIO Framework used to analyze if a resource / capability can be a sustainable competitive advantage while the Prediction and Control Framework is used to determine the approaches telcos are taking to embrace mobile big data. For the holistic view of the entire telo industry, the sub-unit of analysis is the different forces affecting the telco industry while for the embedded unit of analysis, the sub-units of analysis is the telcos itself.

The subjects of my interviews provide a varied of backgrounds, Telenor and Telia are both major telcos owning their own infrastructures with operations in Europe and Asia while Telio is a mobile virtual network operator (MVNO) riding on Telia's infrastructure to provide mobile services to their subscribers. The views provided by Telenor and Telia on the state of the telco industry, mobile big data and their approaches to embrace mobile big data are quite similar while Telio and Ice.net have yet to put much effort in mobile big data. The managers from Nokia and Ice.net reinforced the views provided by the managers from Telenor and Telia on the current state of the telco industry today, if not making the data on this topic richer and depth. The data collected from the manager at Alpha Entrance is radically different from those in Telenor and Telia.

5.1 Implications for Future Work

This study has a number for implications which can lay a good groundwork for future research.

5.1.1 Business Implications

This study managed to gather some very interesting insights on how mobile big data can be used as revenue stream for the telcos. Although the various use-cases presented by mobile big data are very promising, they are not without its challenges. Below are some of the challenges that can be further researched for future work:-

(i) Data ownership – One of the most debated issue in data science. In the traditional physical world, if you buy a piece of canvas and paint on it, the final artwork belongs to the painters. However, this is not quite the case in the data science world. Once the data are being manipulated and worked on, the comparison between the material world and the immaterial data world shows that the legal terms defining ownership and possession should apply analogically. (Bauer, 2016)

(ii) Business model for mobile big data – During the course of my interviews, many of the subjects came to the conclusion that the business model for telcos are undergoing seismic change, especially when it comes to monetizing mobile big data of their subscribers. For many, the monetization of mobile big data is still a nascent market with some grey areas. (Kijl, Bouwman et al., 2005; Osterwalder, Pigneur et al., 2005) research on business models can provide a very good basis to form a potential business model for mobile big data; (Kijl, Bouwman et al., 2005) propose a dynamic business model framework for emerging mobile services because of the rapidly evolving market and technologies; while (Feng and Whalley, 2002) can be used to understand how the telecommunications value chain has evolved into a value network.

5.1.2 Institutional Implications

Although this study focus on the attractiveness of the telco industry through the lense of Porter's Five Forces (Porter, 1979), through the interviews, it is interesting to note that the number of policies that affect the telco industry, both the formal and informal institutions.

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Telecommunication industry is very much regulated by government in their home turf or regional authorities, such as the European Commission (EC). These policies are effectively affecting the attractiveness of the industry and the telcos' competitive advantage.

For example, the ease of porting to a new telco without the need to change to a new mobile number in Norway in 2001 (Number Portability) and the General Data Protection Regulation (GDPR) which will come into force in May 2018 (DN, 2017b). With GDPR, EC aims to give European Union (EU) citizens back control of their personal data and to simplify the regulatory environment for international business by unifying the regulations within the EU. Norway will, as a European Economic Area (EEA) member, also implement this regulation. (Bade, 2016) Another regulation which will come into force much sooner by EC is the "Roam like at Home" regulation. By 15th June 2017, telcos have to end roaming surcharges for people who travel periodically in the EU, where customers pay domestics prices, irrespective of where they are traveling in the EU. (EuropeanCommision, 2016)

A research into the institutional framework together with Porter's Five Forces can provide a much better overview of the industry as a whole and how this is affecting the telco industry and their customers. For example, the "Roam like at Home" regulations already change how consumers are using their mobile phones when they are traveling abroad. Both Telenor and Telia reported that the data usage of their subscribers increased by ten times when they are abroad. (DN, 2017a)

5.1.3 Social Implications

There have been some failed attempts by big organizations to capitalize on big data for social good and there are lessons to be learned from these missteps. For example, Google's attempt to predict flu outbreak with their data (WIRED, 2015). One potential solution is to engage domain expert in every domain where mobile big data is going to be applied. In the area of public health, data scientists need to collaborate closely with medical doctors to gain the insights needed to fight a disease. Previous projects failed because it was only data scientists that were involved only. This can be further studied and explored for future work so that best practices for utilizing big data for social good can be put in place.

5.1.4 Organizational Culture as Sustained Competitive Advantage

The way each telco is approaching their internal resources to gain sustained competitive advantage is very interesting. Due to the scope of this study where four telcos were being studied and all of them work in data science and business development departments, I feel that I am just scratching the surface when it comes to finding out how these telcos operate, especially on finding out their organizational culture. Future work could study the telcos and interview various personnel across different departments / business units in the telcos, such as those working in human resources, operations and executive office to understand more of the organizational culture of the telco.

5.2 Final Words

5.2.1 Big Data and Privacy

Our data has enormous value when we put it all together. Our movement records help with urban planning. Our financial records enable the police to detect and prevent fraud and money laundering. Our posts and tweets help researchers understand how we tick as a society. There are all sorts of creative and interesting uses for personal data, uses that give birth to new knowledge and make all our lives better. Schneier (2015)

With the amount of digital tracks left behind today and the potential of these data can bring to the business world, it is not difficult to understand that certain groups are calling for greater protection for users privacy. But I think this will be the new reality of our modern society, we need time to adjust to this new reality and the trade-off of getting the services that we want from the digital tracks that we left behind. When Google Gmail was launched more than 10 years ago, users were up in arms protesting when they found out that their emails will be read by bots and algorithms so that Google can sell ads that are relevant to the users based on the content of their emails. Today, hardly anyone bother much about it and Gmail is the most popular free email service by far.

Over time, the general public will become more comfortable with the data various organizations are collecting about them and the new revenue streams that can be generated from these data. I think we live in a very interesting time of computing evolution.

5.2.2 Thoughts on Theory Building from Cases

The journey of writing a master thesis is not an easy one, nor it is a difficult one.

In the early phase on my study, I struggled to find the methodology which was really right for the way I want to approach my study; i.e. to investigate the state of the telco industry, to explore the attractiveness of mobile big data as new revenue stream for telcos and the way the telcos are adapting to the changes sweeping through their industry. In addition, the propositions I want to make for my case study were not forthcoming.

When I came across (Eisenhardt, 1989a)'s methodology of theory building from cases late February 2017, I managed to fill the gaps that were previously missing in my study with ease. My experience in writing this study is consistent with the methodology, the process is very iterative which involves constant iteration backward and forward between steps. Often times, I had to move from cross-case comparison, back to redefinition of the research question, and out to the field to gather new evidence on additional case. Also, the process is alive with tension between divergence into new ways of understanding the data and convergence onto a single theoretical framework.

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Appendix A – Interview Guide

All interviews needs to be recorded

Introduction

Thanks for your participation.

The research question for my master thesis is how telcos innovate and adapt to the changing landscape of their industry. With the dwindling average revenue per user (ARPU) for telco over the past decade, this thesis aims to investigate the state of the telco industry today and how telcos identify internal resources to gain competitive advantage. Mobile analytics is analyzed as potential revenue stream for the telcos. This project also aims to investigate the approaches telcos are taking to monetize their mobile analytics and the challenges in achieving this.

Privacy

It's important to know that you can withdraw from the interview at any time and that you are also free not to answer questions. If you have questions about the investigation please contact me.

We will ask you if it's okay for you to record the interview for transcription later. These will only be used for research. We will delete footage and transcripts as soon as the report is published (21.05.2017). Before anonymity, footage will be treated strictly confidential.

Thank you for participating.

Data Information

When did you do the interview?

Where did you do the interview?

Background info

- Age?
- Gender?
- Position/work?
- How long in your position?

Questions

Q1.   The ARPUs for telcos in Norway have been declining for the past decade, what do you think is happening in the industry today?

Q2.   What are the most important business challenges for the telco industry with the declining ARPU? Why?

Q3.   Where do you think the new revenue stream for telco is going to come from in the next 5 years? Why?

Q4.   How is mobile big data changing the telco industry today? Why?

Q5.   How important is mobile big data as potential revenue stream for your telco? Is this different from other telcos? Why?

Q6.   Do you think mobile big data can be a sustained competitive advantage to telcos? (Further probe: if it's not, what can be the sustained competitive advantage?)

Q7.   How do you think telco can monetize their mobile big data?

Q8.   What approach(es) your telco is taking to make mobile analytics as new revenue stream?

Q9.   What are the challenges of making mobile big data as new revenue stream for Telia?

Q10.   What do you think of other telcos' strategies when it comes to monetization of their mobile analytics?

Q11.   What are the social implications of applying mobile big data in the telco industry?

Q12.   How do your organization plan to solve the privacy issues surrounding the monetization of mobile big data? Is there any ethical concerns you can think of?

Q13.   There has been a reorganization in Telia recently, can you explain the rational behind the reorganization?

Q14.   Can you tell me how the department you are in today, functions or in decision making, in comparison to other departments within Telia, say Operation or Finance? Why is it different?

Research Goals:

1. Finding out the state of the telco industry today and the motivation to find new revenue streams. (Q1, Q2)

2. How the industry is changing now. (Q3, Q4, Q5)

3. The attractivesness of mobile big data as revenue stream. (Q6)

4. Investigate the strategies to monetize mobile big data. (Q7)

5. How the telco is moving from A to B to make mobile analytics as their new revenue stream. (Q8)

6. To understand the challenges of using mobile big data. (Q9)

7. To probe that they are aware of what their peers / competitiors are doing. (Q10)

8. To find out the social implications of applying mobile big data. (Q11)

9. To find how the telco is addressing the privacy issues in mobile big data. (Q12)

10. Is the data science lab or department dealing with mobile big data operates differently from other department in the telco. (Q13, Q14)