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- A case study of Telenor Norway-

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Executive summary

The telecom industry is undergoing fundamental changes. Declining revenues in traditional services, increased competition and increasingly digitized customers is putting pressure on the very existence of the industry. At the core of telco is its immense infrastructure, previously considered the true source of competitive advantage. But as market dynamics changes, the cost of running the infrastructure is becoming un-aligned with the revenues generated. Moreover, questions of whether the current infrastructure is suitable in the transition from a traditional communication services provider to the digital service provider, surfaces. From the IT industry comes the concept of virtualization, which promises not only regained flexibility and agility in the infrastructure, but also enhanced capabilities in addressing the future needs of highly digital consumers.

This thesis sets out to understand the potential of virtualization on a mobile operator's transition towards becoming a digital service provider. In an effort to provide insight on this topic, we perform a case study on Telenor Norway, a business unit of the large Norwegian telecommunications corporation Telenor Group. Built on in-depth interviews with key personnel in Telenor and academic scholars, in addition to an extensive amount of industry reports, this thesis developed and found support for three propositions relating to virtualization.

We performed three analyses to gain an understanding of the thesis topic. First, we analysed the degree of disruptive potential of virtualization to gain insight in its potential impact on mobile operators. Second, we performed a value network analysis to show the cost effects of virtualization. Third and final, we analysed how virtualization can aid the mobile operator in the transition from communication service provider towards becoming a digital service provider.

Our research found partial support for our propositions. First, we found partial support for concluding that virtualization has a high degree of disruptive potential. Virtualization had initial inferior performance, is simpler, cheaper and preferred by niche- and low-end segments, but the overall maturity of the technology at this stage of development is still of great concern for the mainstream customer.

Second, we found that virtualizing the infrastructure can lead to great cost savings in value-creating activities for the mobile operator. In particular, in terms of investments and maintenance costs which can be reduced by nearly 40 % in a five-year scenario. We did, however, find that more research needs to be provided into developing comprehensive use-cases involving hidden implementation costs such as investments in data centres and organizational change. Third and final, we found that the business model of a digital service provider is greatly aided by the presence of virtualized technology. However, we found that the successful transition is dependent on a series of other factors such as investments in data centres, organizational change and timing and hence that virtualization alone cannot ensure the success. Overall, we found that virtualization has a strong potential of aiding the transition towards becoming a digital service provider.

1.0 Introduction

Since Antonio Meucci, and later Alexander Graham Bell, invented and patented the first resemblance of a telephone, the world has become increasingly reliant on this fantastic piece of equipment. The modern telephone has experienced remarkable changes since the early days, and is today regarded as one of the most important necessities for people. Alongside the invention of the telephone grew an industry, which has completely altered the way we communicate. The technological development, from switching centrals to today's high-tech infrastructure supporting an enormous amount of data, is nothing short of remarkable. After more than two decades of tremendous growth, the telecom industry is faced with what might be its biggest challenge so far. A challenge which may threat the very existence of telecom as we know it.

In the 1990s, mobile phones were big, bulky and broadly considered a luxury item used by only a few. Similarly, Internet was a slow, chaotic and elusive thing which offered little or no interest for the average Joe. With technological development came increased interest in both mobile phones and Internet, and today we cannot imagine living without them. A study conducted by the management consulting company The Boston Consulting Group found that people were willing to give up a substantial amount of basic needs such as showering, their car, healthy food etc. before surrendering their smartphone (Boston Consulting Group 2015). Today's consumers can rely on their smartphones for virtually everything from ordering food, paying bills, applying for loan, watching TV to getting a doctor's diagnosis. However, as technology has enabled extended use of the smartphone, mobile operators are experiencing a fundamental shift in the consumers' behaviour. In today's market, willingness to pay for making calls or texting are decreasing. Mobile operators responded by including voice and texting in the subscription fee, relying on the increase in data usage to yield additional revenues. Meanwhile, the industry has witnessed a tremendous growth amongst companies offering applications and third-party services, widely known for piggybacking on the mobile operator while reaping enormous profits. Faced with new and fierce competition, the industry is forced to re-think its value proposition to become what others have termed a digital service provider.

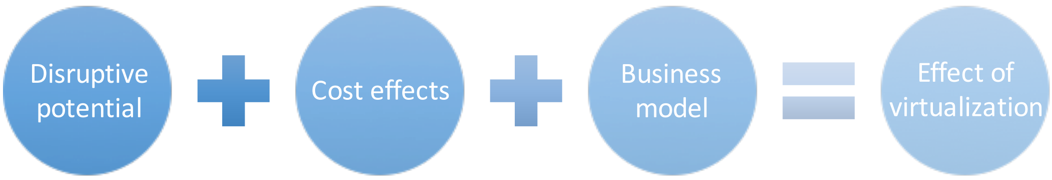
Technological infrastructure is at the core of telecom. The current infrastructure was built to support the mobile operator's role as communication service provider, but is by many regarded as unfit to facilitate the transition towards becoming a digital service provider. Adapting to new customer needs requires adding layers of new technology on older technology, making an already rigid infrastructure even more complex. The current infrastructure is filled with legacy architecture, essential in maintaining traditional services, but inherently inflexible. Painfully aware of this, telecom is directing its focus to a technology more commonly found within the IT industry. The essence of the technology, is to make physical hardware virtualized on a common computer, also referred to as virtualization. Although not a completely new phenomenon, virtualization technology has finally become of such high standards that their application in telecom is more evident. Virtualization of network infrastructure promises not only massive cost savings and regained flexibility, but also enhanced capabilities in transitioning mobile operators from a communication services provider to a digital service provider.

Fuelled by the notion of virtualization technology being part of a possible solution for the prolonged survival of telecom, we became intrigued to dig deeper and explore what potential this could have for the mobile operator. Based on this, our theme for this master thesis is:

The potential of virtualization on a mobile operator's transition towards becoming a Digital Service Provider

By adopting such a broad theme, it is important to define how we conducted our analysis. Specifically, our analysis is divided into three main elements. First, we use the literature on disruptive innovation to elaborate on the disruptive potential of virtualization technology. Does virtualization have the potential to aid the transition in the industry or is it merely a hype? Telecom is an industry subject to many innovations of different size and importance. Some turn out to be of high importance such as developments in M2M communication while others such as new switches are merely a life-cycle innovation. Second, we quantified the estimated cost effects of the technology on a specific mobile operator through a value network analysis. Our goal was to assess the potential effect of virtualization on central costs associated with value creation. Costs are difficult to assess and in an effort to simplify, we addressed the cost effects using the value network framework which allows us to see the true costs of value creating activities. Third and finally, we wanted to understand how virtualization could aid the transition towards a business model based on the role as a digital service provider. How would such a business model be comprised and will virtualization have the characteristics to ensure the success of such a change? Figure 1 summarizes the focus areas for our research.

Figure 1: Main focus areas



As the aim of this thesis is to describe strategic and economics considerations, we emphasize that many technical aspects and considerations are simplified. The reader should hence not regard the technical parts as fully exhaustive.

1.1 Propositions

As is common with a qualitative research approach, we developed a set of guiding statements for our work. We labelled these statements propositions as opposed to hypotheses. Due to the qualitative approach of our research, we cannot statically prove or invalidate our propositions. The purpose of using the propositions is to focus our research and guide us when conducting the analysis. Such a process is often referred to as analytic induction (Bryman and Bell 2011) and allows the researchers to employ propositions as guiding research questions. The propositions hence serve as template for contemplating our findings and as a preparation for the reader of what to expect answered in the paper. As is common with such an approach, we re-worded our propositions as new data and insight presented themselves. The essence of each proposition, however, remained similar throughout the course of our project. The propositions are as follows:

P1: Virtualization technology has a high degree of disruptive potential

P2: Virtualization will have a cost-reducing effect in several of the mobile operator´s value creating activities

P3: Virtualization will facilitate the business model transition towards becoming a digital service provider

P1 states that we expect the virtualization technology to show characteristics of a high degree of disruptive potential. Disruptive innovations have a history of boosting and sinking companies. Both Kodak, Intel and IBM are examples of companies where the attitude towards these innovations greatly impacted their future performance. The main reasoning behind this proposition is that virtualization technology, despite its new-found application, is a relatively familiar concept which has existed in the IT-industry for almost two decades. In recent years, complementary hardware and software has reached standards where the use can be transferred to other industries such as telecom. Overall, we expect our findings to reveal that virtualization displays characteristics compliant with the theory on disruptive innovation.

P2 states that the virtualization will have a cost effect for the implementer. Intuitively, virtualizing parts of the physical infrastructure will allow Telenor to reduce its dependence on a broad set of hardware and software. Hence, we expect virtualization to provide a significant cost reduction. As a serendipitous by-product, we expect that virtualization will enable value-creating activities to become easier and require less costs in operation.

Finally, *P3* states that virtualization will facilitate the business model transition towards becoming a digital service provider. The current business model is becoming less viable due to the structural changes in the industry and as such requires re-thinking key elements. The new business model must encapsulate new elements and we expect to find support for virtualization being a key enabler of this transition. Importantly, our proposition does not state that virtualization is the only enabler, but rather an important part.

1.2 Proposed thesis contribution

1.2.1 Contributions to the mobile operator

The proposed contributions of this thesis for the telecom industry are twofold. First, the thesis will explore a highly relevant issue for the telecom industry. Mobile operators such as Telenor are becoming increasingly anxious for future revenue streams and have begun looking at new business models to support new revenue streams. In addition, as infrastructure is at the core of mobile operations, gaining insight into the potential of virtualization of the mobile core is of high relevance for the industry. The thesis, therefore, provides a basis for telecom companies to explore the issue and invest more time and resources on the topic of virtualization. Second, the thesis proposes concrete estimates of the effect of virtualization for the mobile operator. The effects are split between cost and business model. These can be valuable for telecom industry as they again can be used as a basis for future action with regards to the technology. In addition, our thesis offers an inside-out view of the phenomenon which may provide new insights.

1.2.2 Theoretical contributions

Our thesis contributes to theory on several aspects. First, we add an empirical study on the topic of techno-economic impact. By doing so, we add to the research on the impact of technology on costs and business model. Second, we employ the value network analysis in understanding the effects of the technology. As such, we contribute to further confirming the applicability and comprehensiveness of the model in analysing companies where the value is created by mediation. Third, we add to theory on disruptive innovation by unifying and applying several theoretical contributions on identifying disruptive innovations. In doing so, we show how theory can be brought together and applied with success faced with empirical data. Finally, we add to theory on applied methods. The use of three distinct theories to highlight multiple aspects of an issue, contributes by showing how such a method can be used to yield new insight and findings.

2.0 Methodology

The next section outlines our methodological research approach. This section starts with an explanation of both the research and interview design, including the sample and interview process. Further, we explain the secondary sources used, and clarify the steps we took to ensure ethical standards and the criteria we followed to ensure high-quality research.

2.1 Research design

Our thesis follows that of a qualitative study. Contrary to the standard qualitative research approach, where words tend to be more important than numbers, our thesis includes a set of quantitative analyses adding to the research design. In doing so we have performed both qualitative interviewing as well as collecting and analysing reports and documents published by others. Following Gubrium and Holstein (1997) we maintain that our research design is most closely related to what has been termed *naturalism* meaning that we try to understand how things really are with regards to our topic area. As the nature of our thesis topic and corresponding propositions are highly applied, we chose to employ an inductive approach. Such an inductive approach allows us to generalize based on observations found in primary and secondary data which resonates well with our study of a phenomenon which is partly of the future.

Furthermore, our thesis follows a case study approach as outlined by Yin (2013). Specifically, we use Telenor Norway as the unit of analysis in applying our research. Telenor Norway is a subsidiary of Telenor Group and is the market leader in Norway. The particular case was chosen for two main reasons. First, Telenor Norway is located in Fornebu, Bærum, which is relatively close to the BI campus in Oslo. This simplified our interview efforts greatly. Second, Telenor Norway is a subsidiary which operates in a highly consolidated market with signs of stagnation in revenues, yet they manage to maintain strong margins. Hence, Telenor promised to be an interesting case study. Finally, the opportunity to gain a deeper insight into the Norwegian telecommunications industry and learn how virtualization might affect the industry, made the Norwegian market leader a natural choice (Stake 1995).

2.2 Interview design

As is common with qualitative studies, we chose to employ a semi-structured interview approach. Interviews seemed the natural choice as we wanted to explore the “grey box” that is virtualization within the boundaries of Telenor Norway. Semi-structured interviews are great tools for extracting important data from interviewees for a number of reasons (Bryman and Bell 2011). Using semi-structured interviews allows us to deviate to explore specific topics more in detail, thus revealing important data which otherwise may have been ignored in a strictly-structured interview. Additionally, in contrast to purely unstructured interviews, we wanted to keep some sort of focus in our interviews. In particular, we wanted the focal point of the interview to be either virtualization or transition from communication service provider (CSP) to digital service provider (DSP). The interview guide was thus structured into two themes focusing on either 1) the DSP strategy or 2) virtualization technology. This focus ensured quality data gathering and minimized the possibility of being overwhelmed by data, which might be of disturbance (Eisenhardt 1989). Overall, the interview design provided us with an optimal combination of focus and flexibility.

The interview guide is a common feature of the semi-structured interview style which allows the interviewer to have somewhat of a guide in ensuring that all important areas are discussed (Bryman and Bell 2011). Due to the exploratory nature of our thesis topic, we employed a subset of interview guides with fixed topics to guide our interviews. However, the template was modified accordingly as we learned more about the industry and the relevant technology. The interviews therefore served as an important arena for us to gain deeper knowledge and focus our questions. Due to our interview subjects’ different expertise, we modified the interview guide to fit each interview, but the primary goal and questions remained virtually the same for all the interviews. The interview guide template can be found in appendix 6.

2.2.1 Interview sample

Our sample was originally thought to comprise of interviewees from Telenor Norway, Academia and Management Consulting. The purpose being to obtain a diversified data from the main players influencing the perception of virtualization.

Both academia and management consultants are often in the forefront on new technology and monitor the industry closely. Hence, we believed interviews with these actors would be highly fruitful. We did, however, end up interviewing only people from Telenor Norway and Academia. Although we had interviews scheduled with major consulting firms like Accenture, Capgemini Consulting and Strategy&, the interviewees cancelled numerous times due to time constraints and sensitivity to client confidentiality. Overall, we ended up conducting 11 interviews; eight from Telenor, two from Academia and one independent consultant. Table 1 provides a full overview of these.

Table 1: Interview objects

Name	Company	Role
Frank Elter	Telenor Group	Vice President R&D
Magnus Zetterberg	Telenor Norge	Chief Technology Officer
Oliver von Gagern	Telenor Norge	Chief Strategy Officer
Per Mattiasson	Telenor Norge	Head of Digital Channels and Business Insight
Petter Aglen	Telenor Norge	Senior Engineer Mobile
Vidar Vetland	Telenor Norge	Senior Advisor Mobile
Stein Erik Bungum	Telenor Norge	Chief Information Architecture
Elisabeth Falck	Telenor Norge	Product Manager: Services, Payment & Enablers
Espen Andersen	BI Norwegian Business School	Associate Professor
Øystein D. Fjeldstad	BI Norwegian Business School	Professor Chair (Telenor)
Ellen Altenborg	Linke Invest & Management	Founding Partner

We got in touch with our first interviewee, Ellen Altenborg, through our supervisor Torger Reve. The aim of the interview with Ellen was to obtain a stronger understanding of the basic components of the industry and to focus our research theme. The interviewee had long experience in the telecom industry, and provided us with a strong basis for further exploration of the theme. Furthermore, we scheduled a meeting with Frank Elter, which proved highly useful as he provided us with key insights as to what would be an interesting area to focus on.

To get in contact with our interviewees, we sent out emails to people in the top management team in Telenor Norway. After getting in touch with the first couple of interviewees, we used the "snowball effect" to attain further interviewees, meaning that once an interview was conducted we would ask the interviewee to refer us to other people in the organisation. This method is fairly common amongst Master of Science students as most do not yet possess the necessary network to draw on. Finally, we also drew on the extensive network of Professor Torger Reve to gain access to key personnel.

Overall, we believe that our sample size is quite strong in terms of obtaining a diversified view of the topic at hand. Interviewees represent key areas of Telenor Norway and range from executive management to senior-level engineers across business areas. In addition, both of our academia interviewees are prominent in the field and have in-depth knowledge to telecom having written articles on telecom (see Andersen and Fjeldstad (2003)) together.

2.2.2 Interview process

The interviews were conducted over a period of three months, which was a deliberate strategy on our part. Such as process proved very useful for us as we were able to obtain a clearer picture of what we were searching for in our interviews. Specifically, we were able to ask more concrete follow-up questions to further dig into important areas as our knowledge expanded. We also made a point of always challenging our interviewees on their beliefs as we believed that it would trigger them to speak more freely about their personal conviction on the topics. All interviews were recorded and subsequently transcribed to ensure that any key data was captured. The interviews were summarized with regards to our guiding propositions and we then synthesized on their impact on our analysis.

2.3 Secondary sources

In addition to our primary data, we drew on an extensive amount of secondary sources. The topic of virtualization is quite hyped amongst industry analysts, consulting firms and interest groups, hence we had little difficulty in obtaining rich secondary sources. Most of the secondary sources were business cases, industry reports, concept descriptions and some semi-academic papers. When using these secondary sources, we employed a comparative view. The main reason for this is that most of the published reports are written with an agenda or with a specific purpose. In example, most of our business cases were written for a specific vendor of virtualization technology. Hence, when using the business cases, we interpreted the findings with a high degree of caution. The estimated effects could potentially be subject to a bias due to their agenda of promoting the contracted vendor. Furthermore, to account for this inherent bias, we did our best in researching secondary sources in terms of the reputation of the publisher. We only included sources of high integrity into our secondary sources data base. We also put emphasis on finding reports which was able to offer us a nuanced view. Data which had a clear agenda in either direction was, to the best of our ability, excreted. Importantly, as we applied these reports we constructed a set of assumptions. These assumptions are depicted in the appendices.

Additionally, in our analysis of the costs in Telenor, we drew on publically available data found in annual reports. Telenor Norway is a subsidiary of Telenor Group, and hence our data was somewhat limited due to the availability of numbers. We did inquire Telenor Norway for access to detailed numbers, but this was declined on the basis of sensitivity concerns. Hence, our accounts for costs are somewhat biased by the unavailability of detailed costs which resulted in the authors needing to make certain assumptions in trying to establish a cost base.

2.4 Ethical considerations

In an effort to ensure that our research was within the ethical boundaries set forward by such a format, we signed a confidentiality agreement with Telenor Norway. In doing so, we committed to treating information which may be sensitive with the utmost care. Moreover, we agreed to keeping Telenor's reputation in mind when conducting our analysis in addition to agreeing on sending a preliminary version for revision to Telenor. It is our belief that the Non-disclosure agreement (NDA) aided us in obtaining more insight and allowed for the subjects to speak more freely. Although the NDA provided us with greater flexibility and openness, we also decided that in order to allow for even greater openness in our interviews, we would anonymize our interviewees in such that we did not cite each interview, but collective cited them as Telenor Interview. We did this for all interviews with the exception of academia.

2.5 Technical considerations

The world of telecom is highly technical and filled with abbreviations which are easy to lose track of. In an effort to keep the technical lingo on a minimum, we have deliberately chosen to simplify many technical descriptions so that the paper could be read by anyone with a minimal affiliation with telecom. By doing so we chose only to include the technical parts which were critical to understanding virtualization. As a consequence of this, some technical competent readers might find our simplifications too general and that we are missing key elements, but it is our belief that the simplification does not compromise the results of this research. Moreover, we made arrangements with two engineers within Telenor to read the technical parts of our thesis and propose comments. These comments were then, if within the scope, incorporated into the text as to ensure that our technical understanding was as strong as possible.

2.6 Analysing results

The analysis of our results is greatly founded in theoretical concepts. Throughout the thesis we employ three theoretical perspectives to ensure high-quality analysis. First, we used the literature on disruptive innovations to construct a simple model for analysing virtualizations potential disruptiveness. Second, we employed a value network analysis (Stabell and Fjeldstad 1998) to analyse the cost effects on Telenor Norway's activities. Third, we drew on the business model literature to create a conceptual model where we assessed how industry and customer trends make it imminent for Telenor to change the current business model. We then proceeded to discuss our findings in light of what we learned from our interviews in an effort to draw some main implications.

2.7 Research criteria

We have throughout our research followed principles to ensure high-quality research. A rich variety of secondary sources were used in addition to conducting interviews to obtain a higher level of validity. We drew extensively on literature to create analytical generalization, i.e. generalizing to a broader set of theory as case studies are not representative for a larger population. Furthermore, we have rigorously clarified the steps and procedures of the research to ensure a higher level of reliability of the study (Yin 2003).

3.0 Theoretical foundation

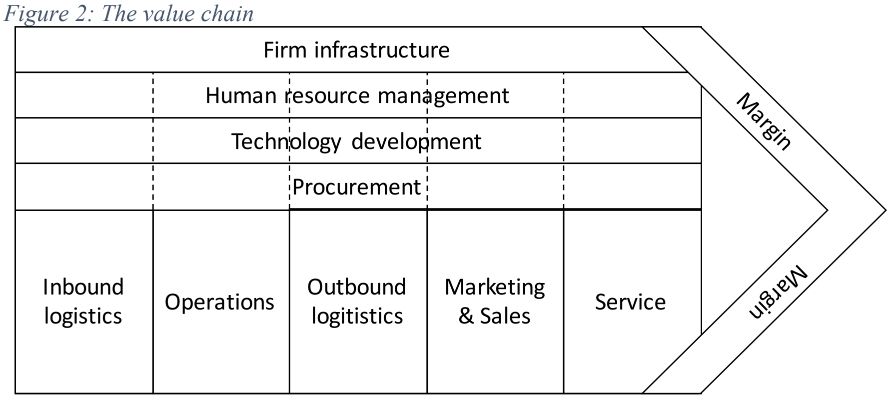
In this section we outline the theoretical foundation of our research. Due to the topic of our research we will anchor our research in the Activity-Based View

(ABV), disruptive innovation theory and literature on business models. ABV provides a comprehensive framework for assessing a company´s cost position based on its value creating activities. In addition, disruptive innovation theory is well suited for understanding the potential of new technology and finally, business model literature provides a thorough background for discussing the transition from CSP to DSP.

3.1 Activity-based view

The notion of viewing the firm as a series of functions performed to design, produce, market, deliver and support a firms' product(s), was initially a view found in the management consulting industry. The concept was initially termed Business Systems (see Buaron (1981), Gluck (1980)). In his well-acclaimed work on competitive advantage, Porter (1985) redefined the view to include activities rather than functions. The main proposition of his work, showed how competitive advantage arises from the configuration and interrelationship between activities performed in the firm. He postulated that all activities inside the firm could be categorised as either primary or supporting activities. Primary activities refer to those concerned with the physical creation of the product, sales and distribution, in addition to after-sale services. Supporting activities support the primary activities by providing inputs, human resources and various firm-wide functions. The aforementioned categorizing of activities resulted in what became known as the value chain model (see Figure 2).

Figure 2: The value chain



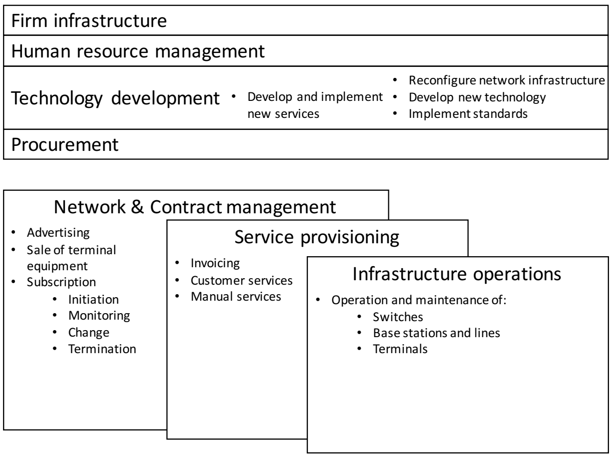
Source: Porter, Michael E. 1985. "Competitive advantage: creating and sustaining superior performance

They key in diagnosing the competitive advantage of a firm, according to Porter (1985), lies in analysing *how* each activity is performed. The way it is performed determines the subsequent cost position and differentiation effort. The diagnosing effort was termed value chain analysis and lies at the heart of the activity-based view. Porter (1985) went on to describe how linkages, or relationships between how an activity is performed and the cost or performance of another, can lead to competitive advantage in two ways: optimization and coordination. By optimizing the activities performed in such a manner that the position cannot be replicated without making significant trade-offs, allows a firm to attain sustaining competitive advantage. The ability to effectively coordinate the linkages will likely give a basis for cost reduction or differentiation and, hence, lead to competitive advantage.

A well decade later, Porter (1996) wrote his seminal article *"What is Strategy?"* which addressed a growing misconception in the utilization of the activity-based view amongst practitioners. Dating back to the 1980s when Japanese firms outcompeted Western firms, companies had started to focus on operational effectiveness rather than strategic positioning. Operational effectiveness refers to the ability to perform similar activities better, while strategic positioning refers to performing different activities than your competitors. However, choosing a strategic position is not in itself enough to guarantee a sustaining competitive advantage (Porter 1996). Competitors can easily re-position themselves to match the position, or more commonly match the position while maintaining the original position, also termed straddling. The solution is to configure the activities in such a manner that any replication or straddling efforts will demand the competitor to make certain trade-offs against other positions. The trade-offs may rise from three main reasons: inconsistency in image and reputation, the nature of the specific activities performed and, finally, limits on internal control and coordination.

As the value chain analysis framework began paving its way into businesses, business schools and journals, one in particular interesting article transformed ABV. Having observed and applied the value chain analysis framework on a variety of firms in different industries, Stabell and Fjeldstad (1998) found that the framework had clear limitations. Specifically, the framework was not applicable for all firms. The primary-category definitions of the generic value chain model proved difficult to fit with the observed activities in certain firms. Drawing on Thompson (1967) typology of long-linked, intensive and mediating technologies, they coined two additional generic models of activities in the firm. These new configurations were termed value shop and value network and were useful additions to ABV. The value shop was characterized by firms which rely on intensive (Thompson 1967) technology to solve a complex customer problem. A typical example is professional services found in law, consulting, medicine and architecture. Central to the theme of value creation in value shop, lies in the element of information asymmetry.

Figure 3: Generic value network model



Source: Porter, Michael E. 1985. "Competitive advantage: creating and sustaining superior performance

The third configuration (see Figure 3) outlined by Stabell and Fjeldstad (1998) includes firms which rely on mediating (Thompson 1967) technology to link customers who are, or wish to be, interdependent. Importantly, the value network is not a network in itself, but it rather offers networking services to its customers. Telecommunication firms, retail banks, price comparison firms and insurance companies are modern-day examples of value networks. Value creation in the value network is less obvious and often more complex to understand. However, Stabell and Fjeldstad (1998, 427) describe value networks as *"mediators [who] act as club managers"* who admits members who complement one another. The process is governed by a set of customer contracts, which commit both parties to a mutual set of obligations.

3.1.1 Value Creation Logic in Value Networks

The primary activities in the value network are divided into three main categories. First, network promotion and contract management consists of activities aimed at courting potential customers to be part of the network, selecting desirable customer and terminating contracts. Second, service provisioning includes activities which are associated with establishing, maintaining and terminating links between customers. In addition, activities, which are aimed at charging customers for value received, also fall under the service provisioning category. Third, network infrastructure operations reflect activities concerned with running and maintaining the physical and information infrastructure. Moreover, in supporting activities, network infrastructure development and service development are of particular interest. Network infrastructure developments are activities concerned with the design, development and implementation of network infrastructure, while service development involves activities associated with everything from the modification of a large set of customer contracts to developing new services.

3.1.2 Interactivity relationship logic

The relationship between activities in the respective value configurations shows different logics of interaction. In the value chain, the relationship between the primary activities follows a sequential logic. One step (activity) is performed prior to moving on to the next step in the chain. Production of a specific product is not initiated before the raw material has been transported to the location of transforming this material into a physical product. Hence, the system is a sequentially linked chain of activities. The primary activities in a value network, on the other hand, follow a different relational logic. Mediation activities are performed simultaneously at multiple levels (Stabell and Fjeldstad 1998). Figure 3 depicts this logic, through the overlapping of primary activities.

3.1.3 Interdependence between activities

The contrasting interactivity logic between the value network and value chain gives rise to other forms of interdependence between primary activities. Interdependence concerns the mutual dependence between two entities (Casciaro and Piskorski 2005) and creates a condition where these entities have to take each other into account to be able to reach their goals (Litwak and Hylton 1962). Here, an entity can be a firm or an activity within a firm. Interdependencies between various activities in a firm are dealt with through coordination (Stabell and Fjeldstad 1998). Thompson (1967) divided the construct into three different types: sequential, pooled and reciprocal interdependence. As organizational activities share common resources, all value creation technologies are characterized by pooled interdependence (Stabell and Fjeldstad 1998). In a value network, interdependencies between primary activities are reciprocal as activities are performed simultaneously. Failure to synchronize may lead to a breakdown of the system (Stabell and Fjeldstad 1998).

3.1.4 Layered Industries

In value network industries, labour is divided in a horizontally interconnected and vertically layered value system (Andersen and Fjeldstad 2003). This system is vastly different from the sequentially connected value system of value chains where the flow of a product follows a "straight-line" pattern. The value system in network industries, thus, carries a complex set of relationships where interactions follow multidirectional patterns. In network industries, competition is more complex as relationships of a network are dependent on other layers of the network. Complementing products in other layers increase the value of the service (Andersen and Fjeldstad 2003) and firms engage in relationships to coproduce value. Additionally, actors might hold different roles in relation to each other. A firm might be your competitor while at the same time being your partner in certain areas or projects (Ramírez 1999). In example, firms in the telecom industry might cooperate in arranging compatible systems or share networks. Furthermore, device manufacturers create value for mobile operators in producing handsets. Through this, actors in the industry coproduce value with, and for, each other. On the other hand, these might also compete in recruiting and retaining the same customers.

3.1.5 Drivers of cost and value

For a value network, scale and capacity utilization are the main drivers of value and cost (Stabell and Fjeldstad 1998). Value is derived from the ability to create positive network externalities, or network effects. This is also a critical determinant to achieving and sustaining competitive advantage (Katz and Shapiro 1985). The set, or network, of actors the customer is able to communicate with determines the value of a given service. This is evident from the example of a telephone service. The value to the customer is in this case clearly dependent on who else owns a phone (Stabell and Fjeldstad 1998). Because of these network externalities, a network will initially provide low value for its members. However, value increases over time as an increasing amount of actors join the network. Subsequently, firms in the industry will compete fiercely to increase network size as this increases the value for members of the network (Fjeldstad, Becerra and Narayanan 2004).

Size is, thus, vital for the creation of network externalities, which again creates value for consumers. However, size alone does not provide a full picture of network effects. The composition of actors within the network is also a factor, which determines the value for the members (Bental and Spiegel 1995). This can be easily pictured through an example: if Facebook had 1 billion members but all of these were located in China, the service would provide less value for a given customer in Norway compared to consisting of 500 of an individual's closest friends. The main product delivered is dependency among customers, and the network service creates the opportunity of exercising those dependencies (Stabell and Fjeldstad 1998). Hence, both composition and size are both critical drivers of value (Fjeldstad and Ketels 2006). Size is, in addition, a cost driver in a value network. Increased network size increases the traffic, which decreases the quality of the service. Upgrading infrastructure is, thus, required to sustain the same service level to consumers. As the number of access points then increases, so does the cost to the end customer (Domowitz 1995). Although capacity utilization affects value in terms of reducing unit cost, it might also increase the traffic in a given network (Stabell and Fjeldstad 1998). Imagine a highway. More cars on the road will increase traffic and in the end, reduce the speed in which a given car can travel. This idea can be transferred to, for example, telecommunications. A phone line where multiple actors try to reach another member of the network will ultimately reduce the speed and quality of a service.

3.1.6 Diagnosing Competitive Advantage

Through the analysis of a company's activities using a value chain framework, arose the tool from which competitive advantage could be assessed (Porter 1985). Porter (1990) additionally proclaimed that the tool was applicable in all industries, a statement which today is not without its shortcomings. Stabell and Fjeldstad (1998, 415) introduced value configuration analysis which is defined as *"an approach to the analysis of firm-level competitive advantage"*. An extension, which embraced a broader set of industries and companies, where value creation did not match the one of a prototypical manufacturing company. However, there are still inconsistencies within the strategy literature. First, scholars still analyse the telecom industry as one consisting of value chains. For example, Li and Whalley (2002) see the sum of firms in the telecommunications industry as a value network, However, on a firm level, companies are still characterized as value chains. Second, those who use the value network expression, analyse value creation on an industry level, rather than firm-level value creation. Maitland, Bauer and Westerveld (2002, 453) say, *"An industry-level value chain serves as a model of the industry whereby processes are considered independent of the firms that may or may not engage in them."* Additionally, Peppard and Rylander (2006, 134) introduce Value Network Analysis (VNA), which will *"aid in addressing the issues faced when designing strategy"*. However, it focuses on identifying actors in the industry (identify and define network entities) and defining perceived value of different actors in the network. Mobile operators have not transitioned from value chains to value networks. Rather, the complex set of actors in the industry increases the importance of external relationships. Consequently, their analysis contributes to understanding where value is located on a network level.

3.2 Disruptive Innovation

According to Hamel (2002) the most important issue for businesses is building companies where innovation is both radical and systemic. Businesses today have to manage the dualism of functioning effectively to sustain success while at the same time incorporating disruptive innovations that increase their future competitiveness (Katz and Paap 2004). Creating an ambidextrous organization with the right balance between exploration and exploitation (March 1991) or centralization and decentralization (Brown 1998) is a crucial task organizations have to manage to survive in the long run.

3.2.1 Defining disruptive innovation

An important distinction in the innovation literature is between sustaining and disruptive innovations. Most innovations are sustaining*: "What all sustaining technologies have in common is that they improve the performance of established products, along the dimensions of performance that mainstream customers in* *major markets have historically valued"* (Christensen 1997, xv). Disruptive innovations underperform relative to existing products or services. Disruptive innovations are 1) simpler and cheaper, 2) typically first commercialized in emergent or insignificant markets, and 3) unattractive to the most profitable customers of a company (Christensen 1997).

It is important to note that disruptiveness of innovations is distinctly nuanced from the radicalness or the competency-destroying dimensions of innovations (Govindarajan and Kopalle 2006). Disruptive innovations introduce a different performance package from mainstream technologies and are initially inferior to the mainstream technology. In its early development the disruptive innovation serves niche or low-end markets, before the performance level becomes satisfactory for the mainstream customers (Adner 2002). Unlike radical innovations, disruptive innovations do not necessarily involve cutting-edge new technology. It can involve the application of a relatively new technology to a new product category (Govindarajan, Kopalle and Danneels 2011). In the short run a disruptive innovation might seem non disruptive through entering the low-end market. The new product is therefore seen as non-threatening and is ignored by incumbents who end up being disrupted in the long run (Schmidt and Druehl 2008). Disruptive innovations disrupt the former key players of an industry and represent a significant change in an organization's existing practices and activities, in addition to changing social practices and how we learn (Damanpour 1996; Leifer, O'Connor and Rice 2001; Thormond and Lettice 2002).

3.2.2 Types of disruptive innovation

Originally, the term disruptive innovation included only technological innovations (Christensen 1997). However, the term was extended to including also business models and products in the book *"Innovators Solution"* (Christensen and Raynor 2003). Different types of innovations have different implications and challenges for organizations. Therefore, they cannot be treated as the same (Henderson and Clark 1990). As such, Markides (2006) divided disruptive innovation into two categories: business model innovations and radical product innovations. Business-model innovations redefine what an existing product and service is and how this service or product is provided to the customer. An example is Amazon who changed the book industry from physical to online stores with the opportunity to shop for books throughout the day. Additionally, business-model innovations require a whole new combination of activities and are therefore more difficult to imitate by incumbents (Markides 2006). Product innovation entails creating a new-to-the world product which disrupts consumer habits and behaviours. These innovations are often a result of a supply-push process because they are disruptive to both consumers and producers (Markides 2006).

3.2.3 Inhibitors of disruptive innovation

Several factors limit an organization's awareness of disruptive innovations and the literature emphasizes various inhibitors to successful adoption of these. First, the organizational structure might be constraining in relation to innovating. Hierarchical structures are favourable in stable conditions, but make an organization inflexible and unable to capitalize on disruptive innovations (Moorman and Miner 1997). To prevent structure from stifling, Tushman (1997) suggests building two fundamentally different architectures within a business unit to enable continuous improvement and exploration. Markides and Geroski (2005) argue that larger firms should let start-ups innovate as they have the flexibility and skills needed for the task. Second, due to history, past success and culture, businesses might suffer from organizational inertia. Success limits the willingness to take risks and therefore increases the probability of falling into the familiarity trap or success trap (Ahuja and Lampert 2001; Levinthal, March and Schendel 1993). An unwillingness to cannibalize your own products also inhibits introduction of disruptive innovations (Chandy and Tellis 1998). Stringer (2000) asserts that large organizations are more inert as they have invested too much to move away from the status quo. The inability to change can prove crucial as previous competencies can turn into rigidities. Organizations are unable to build the necessary skills or capabilities to engage with new technology (Leonard-Barton, Schendel and Channon 1992).

3.2.4 Evaluating disruptive innovations

Danneels (2004) argued that the lack of an appropriate measure of disruptiveness is a weak spot in the literature. Countering this weakness, Govindarajan and Kopalle (2006) performed a study on 330 senior executives of SBUs from 38

Fortune 500 companies to create a reliable and valid disruptiveness scale. Schmidt and Druehl (2008) presented a framework to assess the potential diffusion pattern and impact of an innovation to help firms determine the opportunity or threat posed by an innovation. This framework introduces three steps: 1) Identify market segments and primary attributes of the product, 2) Assess each market segment's willingness to pay for each attribute, and 3) Assess which segments will buy a given new product over time.

3.2.5 Contradictions in the theory

Many scholars have argued that large companies are less able to innovate than smaller firms and that incumbent firms often fail to realize the threat, which a disruptive innovation might pose (Stringer 2000; Tushman 1997; Belkhir 2001; Christensen 1997; Christensen and Raynor 2003) However, studies have nuanced these views. Among these are King and Tucci (1999) study on disk-drivers companies. They found that incumbents entering new markets have a higher rate of survival than new entrants and that incumbents enter new markets faster. Furthermore, Klepper, Simons and Helfat (2000) found that the US television receiver industry was dominated by actors previously in the business of radios. Chandy and Tellis (2000) performed a historical analysis of the consumer durables and office products industries and found that large firms and incumbents are more likely to introduce radical innovations than non-incumbents and small firms.

3.3 Business models

The business model concept has witnessed immense attention from both practitioners and scholars over the last years. Zott, Amit and Massa (2011) find that 1177 articles on business models was published in peer-reviewed academic journals between 1995 up until the writing of their article. In addition, business models have also been under focus in numerous practitioner-oriented studies. Scholars find business models to be potential sources of competitive advantage (Markides and Charitou 2004) and the creation of new, effective models has the potential to create superior value for firms (Morris, Schindehutte and Allen 2005). Despite these claims, there is no generally accepted definition of the term. Shafer, Smith and Linder (2005) found, in their review on the relevant literature, 12 different definitions in publications from 1998 to 2002, which contain 42 unique business model elements.

3.3.1 What is a business model?

Due to its emergence from different areas of research, various definitions of the business models concept exists. Shafer et al. (2005, 202) refers to an organization's business model as a *"representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network."* Thus, the business model is about creating and capturing value, which is crucial for any company to survive. To achieve this, however, the firm relies on a system of interdependent activities which transcends the firm's boundaries (Zott and Amit 2010). These boundary-spanning transactions with external actors are crucial aspects of the business model of a given company (Zott and Amit 2007). A business models is about an interrelated set of decision variables, which are addressed to create a sustainable competitive advantage (Morris, Schindehutte and Allen 2005). Or put differently, the business model is the result of a firm's realized strategy (Casadesus-Masanell and Ricart 2010).

3.3.2 Business model components

Even though a clear definition on the concept has yet to emerge, scholars seem to agree that business models consist of a set of variables or components, which are interdependent and interrelated (Zott and Amit 2010). Major changes in one element will affect the other elements and the whole business model (Johnson, Christensen and Kagermann 2008). As such, a business model has multiple contingencies, which a company needs to handle simultaneously. These contingencies also include the external environment through value creation with suppliers and partners (Shafer, Smith and Linder 2005; Hamel 2002).

Different scholars have made an effort to conceptualize the elements of a business model. Johnson, Christensen and Kagermann (2008) believe a business model consists of four interlocking elements: customer value proposition, profit formula, key resources and key processes. These will, taken together, create and deliver value. According to the authors, the customer value proposition is the most important. Osterwalder, Pigneur and Clark (2010) crafted a business model canvas consisting of nine interdependent building blocks: value proposition, key resources, key activities, key partners, customer relationship, customer segment, revenue streams, cost structure, channels. The canvas is designed as a pre-structured map to help easily understand the business model of an organization. Shafer et al. (2005) in their review of the literature clustered their findings into four components: strategic choices, value network, value creation and value capture, where each of these elements has several sub-components. Despite the absence of an accepted model or framework, a few common patterns are evident (Zott, Amit and Massa 2011).

3.3.3 Reinventing the business model

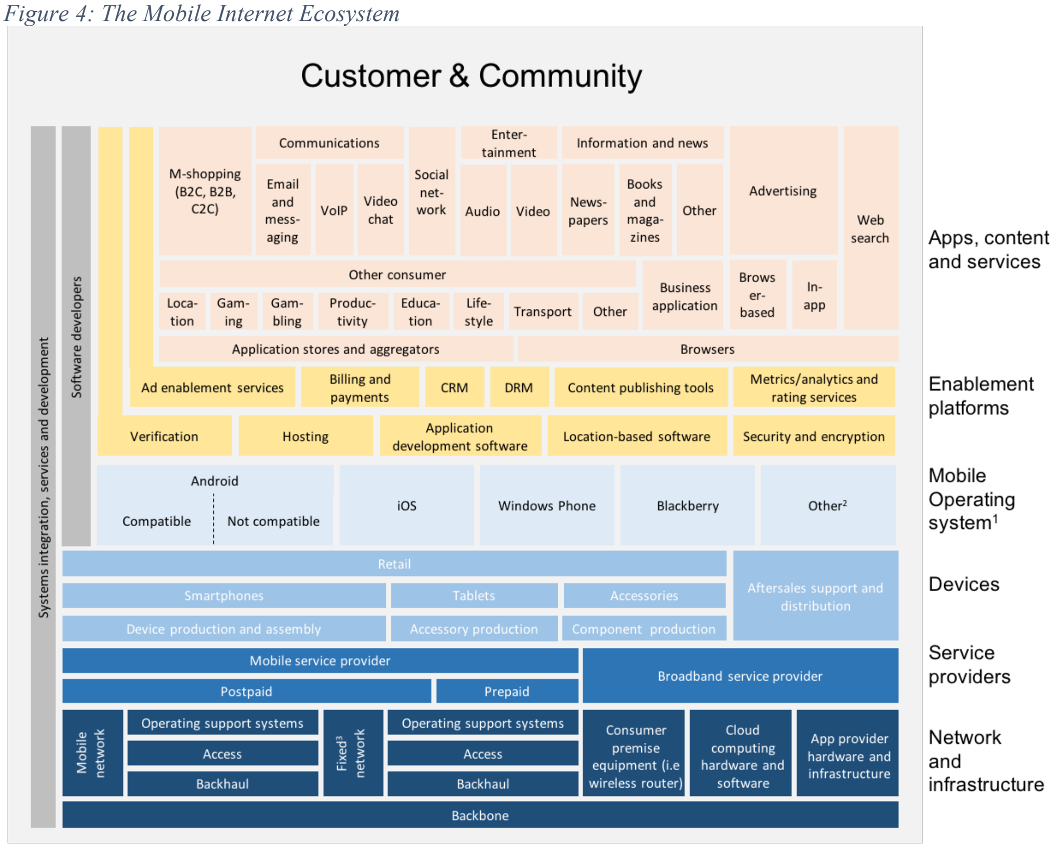
Alongside the increased interest in business model surfaced the concept of business model innovations. Due to constant shifts in market landscapes, innovating and reinventing the business model of a firm has become an important task for companies (Johnson, Christensen and Kagermann 2008). Markides (2006) proclaimed business model innovation would be beneficial in three circumstances: 1) when entering a new market where other companies have first-mover advantage, 2) when the present business model is inappropriate, and 3) when trying to introduce a new product to the mass market. Johnson, Christensen and Kagermann (2008) observed five strategic circumstances where a business model change is often required: 1) the opportunity to address the needs of large customer groups, who are currently not served, through disruptive innovation, 2) the opportunity to capitalize on a new technology by wrapping it in a new business model (e.g. Apple with iTunes), 3) when needs are unmet because incumbents focus on products rather than service, 4) when a company needs to fend off low-end disrupters, and 5) the need to respond to a shifting basis of competition.

4.0 Understanding Telecom

4.1 The mobile ecosystem

Telecommunication (telco) is an old industry which has witnessed a tremendous development in the recent decades (Wolfgang Bock et al. 2015). The industry is complex and although it is easy to name a company or two which are part of the industry, a comprehensive review quickly reveals a more complex set of actors involved. The International Telecommunication Union defines telecommunication as "*Any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems (CS)"* (International Telecommonunication Union 2012, P. 7). Although the definition captures the technological core of telco, it does bypass several important features. For instance, is Facebook a part of telco? Surely, you need access to internet to use it, but at the same time you wouldn´t need a smartphone which is regarded as central in telco. How about buying clothes? These days many buy their clothes online and/or via a smartphone, but does that mean that because the store relies on telecommunications it should be regarded as part of the industry? Probably not. But the examples greatly illustrate the need for a comprehensive overview of what telco is and how the industry is built. In an effort to de-mystify telco we rely on a multi-layered model of the industry, a central feature of industries which rely on mediation technology (Stabell and Fjeldstad 1998). The term "multi-layered" refers to a model commonly used within network engineering coined "stacks", which point to software and hardware that work together to drive a computer or other device. Such a model is very useful for its ability to structurally display the different layers. A layer in this context can best be described as a parallel, yet interacting set of products and services which brought together with other layers collectively allows for telco to happen (Wolfgang Bock et al. 2015). The interaction and competition between layers allows the industry to evolve and innovate and is the main reason for its value. Put even simpler, without the presence of the layers, you as a consumer would not be able to use your smartphone to buy apps. Figure 4 represents the full model. In the following sections we describe the different layers of the model in order to obtain a richer view of how the telco business is knitted together.

Figure 4: The Mobile Internet Ecosystem



Source: BCG Analysis; Team Analysis
Note: Box sizes are not meant to represent relative size and importance
[1] Includes software preinstalled by operating-system providers
[2] Others include Symbian, Series 40 and Firefox
[3] Mobile and fixed networks may share core and backhaul elements

4.1.1 Network and infrastructure

The bottom layer termed "Network and infrastructure" encapsulates what we term infrastructure (i.e. the core technology facilitating telecommunications). In this layer we find the actors providing and operating hardware and software aimed at facilitating the transmission of data. In addition, we also have hardware and software providers which offer connectivity directly to the infrastructure such as cloud computing and consumer premise equipment.

4.1.2 Service providers

The second layer comprises of what is termed service providers. In essence, these are the actors who provide you with traditional services such as SMS, MMS, voice and access to Internet via a subscription. Some of these service providers may own their own infrastructure and is present on the previous layer as well, while others operate as what is known as MVNO or Mobile Virtual Network Operator. The MVNOs buy access directly from the owners of physical infrastructure and leverage this towards their customers. Finally, this layer also contains actors which offer mobile broadband services using the same infrastructure.

4.1.3 Devices

The third layer termed devices refers to OEM or Original Equipment Manufacturer part of the industry. Broadly speaking, this layer provides the customer with devices such as smartphones and tablets. Such devices are necessary for enjoying access to the services and are important in enabling technology developments.

4.1.4 Mobile operating system

The fourth layer is in many ways an extension of the third layer, but carries with it specific differences which are important. The layer operates and develops operating systems such as Android, iOS, Windows phone and Blackberry and provide software which enables services to work properly on the selected devices. Finally, the specific operating system act as important key enablers and barriers for both upstream and downstream layers in terms of standardization.

4.1.5 Enablement platforms

The enablement platform layer can be seen as a necessity to connect the sixth layer with layer one through four. The actors provide software with the ability to facilitate billing, ads, analytics etc. for apps, content and services.

4.1.6 Apps, content and services

The final layer consists of apps, social networks, advertising and other third-party services and products. This layer is probably the one most frequently encountered by digital customers. The number of different actors here are numerous and this layer is often characterized by huge profit, low entry barriers and high competition. For the remainder of the paper, we refer to actors in this layer as Over-The-Top (OTT) suppliers.

4.1.7 Consumer and community

At each layer of the stack, we find a set of customers interacting with the particular layer. In Network and Infrastructure, we find customers buying original equipment and cloud computing software as well as actors from higher layers buying input for their products. It is important to note that although the model provides the impression of a chain of layers, this is erroneous. Each of the layers interact with a subset of customers as well as with the vertical layers totalling to what we previously spoke of as interdependency in value networks. Overall, the model provides us with a useful tool of visualising the telco industry and its complexity in a timely and educational manner.

4.2 The Global Mobile Operator Industry

Telco is a multi-billion-dollar industry with a large impact on the economy both on a global and national level. In the following section we describe the impact of the industry on a global level with a focus on describing the fiscal parts.

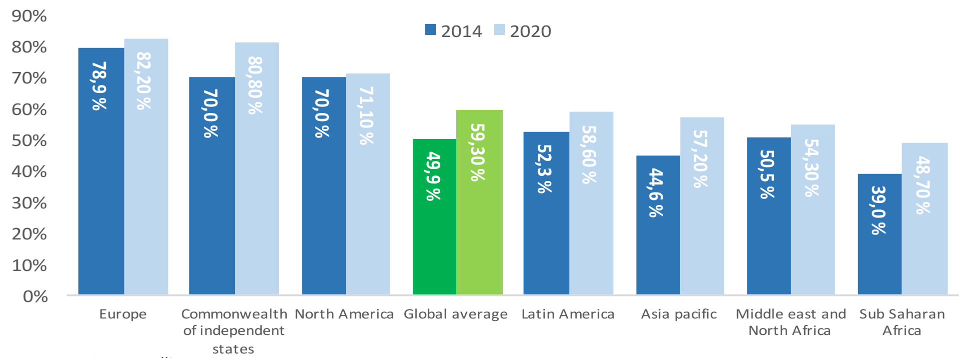
In 2014 alone, the mobile operators of the industry netted an incredible 1.15 Trillion US Dollars. By 2020, the revenues are expected to exceed 1.4 trillion equivalent to a Compound Annual Growth Rate (CAGR) of 3.1 % (GSMA Intelligence 2015). Telco has traditionally been claimed to be a high-margin business. While margins still remain high, the global industry has witnessed a drop from 36.9 % in 2009 to 33.5 % in 2014, mainly caused by increased competition and regulations. Fuelling this future growth requires investing heavily in infrastructure and hence CAPex is an important signal for industry growth and sustainability. Annual growth in CAPex from 2014 to 2020 is expected to average at about 2.5 % and is significantly lower than growth up until 2014 which equalled 9 % (GSMA Intelligence 2015). Although such a drop in investments can be interpreted as a slowdown in the industry, much of the earlier investment level is due to the implementation of 3G/4G infrastructure.

The mobile industry is a truly global industry with major impacts on the global economy as well. In 2014, mobile operators contributed with 3.0 Trillion US Dollar to GDP, constituting 3.8 % of global GDP. By 2020, industry experts expect the contribution to be closer to 3.9 Trillion US Dollar or 4.2 % of global GDP. In some regions such as Africa, future GDP contribution from Mobile operations is expected to increase to as much as 10 % up from a mere 1 %. The main bulk of this contribution comes from network operators, operators providing access to the physical network, which contribute 0.99 % of global GDP or 26 %

of GDP contribution directly into the economy. In comparison, handset manufacturers contribute just above 0.12 % of global GDP. Moreover, mobile operations contribute greatly to creating new jobs. In 2020, more than 15 million people will work within the industry, up from 13 million in 2014 constituting an annual growth in jobs of 1.8 % adjusted for population growth. The global mobile ecosystem did, directly and indirectly through related industries, contribute with close to 24.8 million jobs in 2014 and an expected 28.7 million in 2020.

On the consumer side, increasing globalization remains one of the most prominent drivers for fuelled growth. In 2014, roughly 2.6 billion smartphones exist worldwide. By 2020, estimates project the number to be closer to 5.9 billion constituting a CAGR of 18 %. This rapid increase is largely owed to a development of cheaper mass-market smartphones and an overall more efficient mobile ecosystem. In 2014, mobile internet penetrations amounted to 33 % worldwide. By 2020, this is expected to increase to a whopping 49 % with an annual growth of 6.81 %. It is easy, however, to argue that an increasing mobile penetration and the number of smartphones does not necessarily equal increased globalization. Rather, the number of unique subscribers display a more realistic picture.

Figure 5: Unique subscribers penetration per region



Source: GSMA Intelligence

As of 2014, 3.6 billion unique subscribers owned one or more subscription which constitutes roughly 50 % of the world´s population. The number is expected to increase to 4.6 billion or 59 % within 2020 which constitutes a CAGR of 4 %, thus showing a clear trend towards increased global connectivity (GSMA Intelligence 2015). The overall picture is however fragmented (see Figure 5). The high growth in global average is mainly driven by Asia Pacific, Commonwealth of independent states and Sub-Saharan Africa. In comparison, highly-developed economies such as North-America and Europe display a more moderate increase indicating lesser growth potential in such markets.

4.3 The Norwegian Mobile Operator industry

4.3.1 A brief history

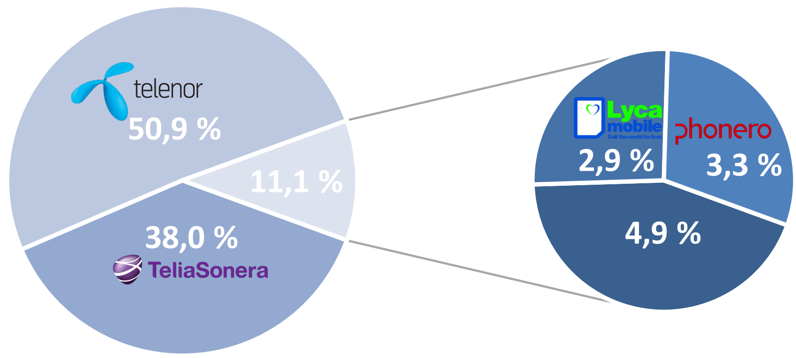
The evolution of the modern telco industry in Norway is often said to have started in 1988. This was the year when the Norwegian telco industry was opened for competition and the long-running monopoly ended. It would however take another decade for the last remnants to be removed. Up until 1988, the Norwegian market had been dominated by the state-run Televerket, a nationalization process which started in 1899 and completed in 1974. In 1991, what would later become NetCom, acquired a GSM license and launched the first private network in 1991 and in 1999 NetCom became the first private company to launch commercial services in Norway. In 1994, Televerket was transformed to Telenor which in 2000, became partially privatized. Telenor, Netcom, and later ice.net (previously Network Norway) constitute the three providers of commercial physical infrastructure in Norway (Vinje and Nordkvelde 2011).

The decade from 2000 to 2010 became a technological race where new innovations dominated the industry. In the early 2000s Telenor started offering leasing of access lines in the fixed network, which provided new competitors with direct access to Telenor´s fixed-line subscribers. A year later, Netcom launched GPRS (general packet radio service) which provided mobile users with access to internet with increased speed. Between 2004 and 2007, both 2G (enhanced data rates for GSM evolution) and 3G (third generation) internet access was introduced to customers and internet access speed was revolutionized. In 2009, 4G (fourth generation) internet access was introduced in Norway. At that point, Netcom was the world´s first operator to launch the technology and in 2012, Telenor became the first operator in Norway to offer 4G services to cellular phone users (Vinje and Nordkvelde 2011).

4.1.2 Norwegian mobile operations in numbers

The Norwegian mobile operators market is highly concentrated. As of 2014, the two main players have a combined market share of nearly 90 % of private and corporate subscriptions (see Figure 6).

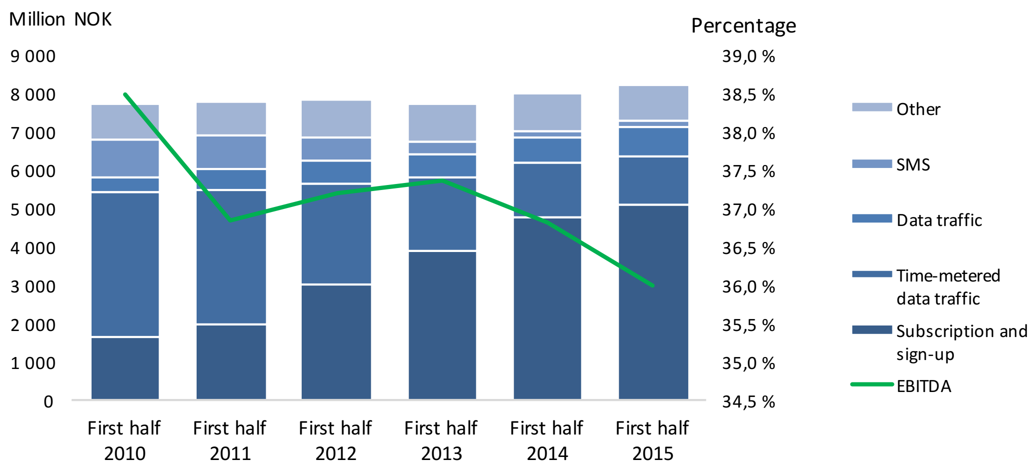
Figure 6: Market share based on subscription



Source: Norwegian Communication Authority

Together, the players collected revenues of nearly 15.000 million NOK in 2015 with year-over-year growth of 0.29 %. Traditional telco-related revenue streams for Norwegian mobile operators have remained quite stable in the last years in the proximity of 8.000 million NOK (Norwegian Communication Authority 2015). Figure 7 displays telco-related revenues and captures the transition from time-metered data and voice traffic to a single fixed-fee subscription. Annual growth (CAGR) in the period 2010-2015 was, however, a mere 1.22 %, well below the global average of 4.5 % for the same period (GSMA Intelligence 2015).

Figure 7: Revenue streams and EBITDA margin mobile services Norway

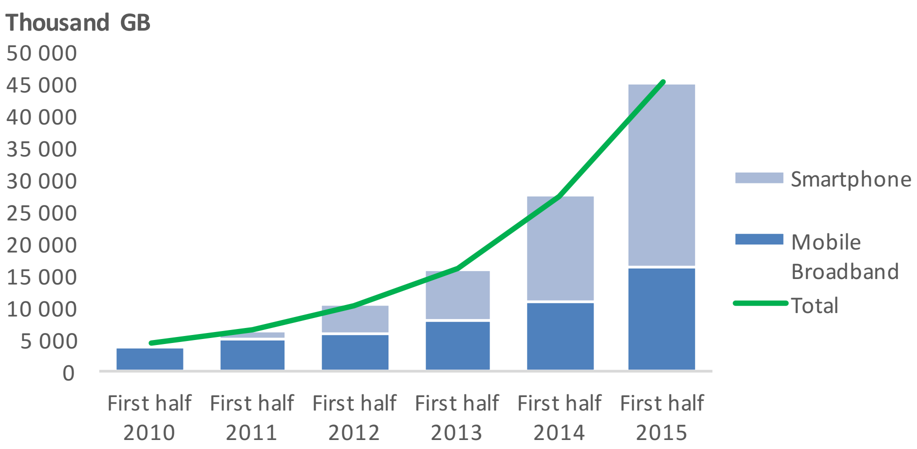


Source: Norwegian Communication Authority; Telenor; TeliaSonera

Margins have, however, declined from 38.5 % in 2010 to 36 % in 2015, bearing witness to decreasing profit margin in traditional revenue streams. The profit margins do in fact vary heavily amongst Telenor and TeliaSonera. While Telenor maintain higher margins, well above 40 % in the last five years, TeliaSonera has seen a decline from 35.6 % in 2010 to 30 % in 2015 (Telenor Group 2016b; TeliaSonera 2016).

On the consumer side, Norway remains one of the countries in the world with highest penetration of mobile users. As of 2015, more than 80 % of all inhabitants possess a smartphone (Medienorge 2016a) putting it well above the global average of 49.9 % and slightly above the European average of 78.9 % (see Figure 5). As smartphone penetration has continued in a steady pace, it has fundamentally transformed the way we access the internet.

Figure 8: Data traffic share



Source: Norwegian Communication Authority

In 2010, smartphone constituted a meagre 12 % of total data traffic while in the first half of 2015, data traffic from smartphone had risen to a staggering 64 %. The annual growth was a staggering 123 %. Subscriptions including 1GB of data usage increased from 2 million units in 2013 to 2,87 million units in 2014 at a 43,5 % annual growth. Mobile subscriptions including 5GB data traffic or more per month represented 10 % of mobile subscriptions by the end of 2014. In addition, data traffic increased from 36 800 TB (36,8 million gigabyte) to 63 600 TB in 2014. This amounts for approximately a 73 % annual increase in data traffic (Norwegian Communication Authority 2015). This trend is expected to continue to strengthen in the upcoming years as both corporate- and private arenas become increasingly digital. In summary, the Norwegian Telco industry display many of the same symptoms found in the global markets. Revenue growth is declining, while margins remain strong and customers are becoming increasingly digital and hence access to digital services are increasingly demanded.

4.4 Key challenges and customer trends

In spite of strong forecasts in the digitization of consumers, telco operators face great challenges. Most noticeable, traditional revenue streams such as Voice, SMS/MMS and Data are declining in value, while the costs of running the infrastructure is rising (Friedrich, Hall and El-Darwiche 2015). Conversely, the digitization of customers and increased competition bring with them a new set of challenges for telco operator.

4.4.1 Data traffic

Faced with a rapid increase in expected demand for data in the upcoming years, the mobile operator is faced with a challenge of reducing costs and avoiding becoming marginalized in to what has be labelled “dumb pipe”. Globally and domestically, the trend shows that mobile data usage is increasing rapidly. Numbers from GSMA (2015) suggest an explosion of data traffic usage, with volumes forecast to grow at a CAGR of 57 % towards 2019. This amounts for almost a tenfold increase in data traffic, with video being a key driver to this growth. In Norway, mobile phones including 1GB internet in the subscription increased from 2 million in 2013 to 2,87 million in 2014. This is a 43,5 % increase. Mobile subscriptions including 5 GB data traffic or more per month represented 10 % of mobile subscriptions by the end of 2014. In addition, data traffic in Norway grew from 36 800 TB (36,8 million gigabyte) to 63 600 TB in 2014. This amounts for approximately a 73 % increase in data traffic (Norwegian Communication Authority 2015). Deloitte predicts that 26 % of smartphone users in developed markets, will not make any traditional phone calls in a given week in 2016. These “data exclusives” made up 11 per cent of smartphone users in 2011. Usage of smartphones has become more data-intensive with non-voice activity increasing considerably, trebling in mature markets such as the UK and the US (Sallomi and Lee 2016). If Norwegian data traffic follows global demand, we estimate that we will see an accumulated increase in data usage of in total 508 % over the next four years. In summary, data traffic is set to become a volume driven challenge for both revenue streams as well as for the infrastructure.

4.4.2 M2M/IoT

In the end of December 2014 there were 243 million cellular M2M connections globally, and the growth is set to accelerate over the next few years. GSMA predict the number of cellular M2M connection to grow at a CAGR of 26 % between 2014 and 2020 (GSMA Intelligence 2015). This will amount to almost 1 billion connections, representing 10 % of all mobile connections (EY 2015). In addition to the many benefits, several challenges must be addressed for IoT to reach its full potential. Among these is the strain on the existing communications infrastructure put forward by the growing number of devices and the need for common standards of communication to enable these devices to communicate with one another (Bezerra et al. 2015). M2M is set to become a growing concern for the infrastructure providers

4.4,3 Competitive pressure

The telco industry has come to a point of saturated markets, stagnant growth and competitors moving from other industries attempting to take a share of operators' traditional businesses (Friedrich, Péladeau and Toumi 2014). The app economy has soared since the introduction of platforms such as Apple's iOS and Google's Android. In 2013, apps were downloaded 102 billion times globally, a 60 % increase from 2012 (Wolfgang Bock et al. 2015). In 2015 alone, global voice operators lost 8 % of its voice minutes to over-the-top (OTT) competitors. In addition, OTTs are increasing their share of industry revenues with 10 % in just a few years. Incumbent mobile operators see OTTs as the most likely disruptive force in altering future customer demands. In addition, the regulatory environment is highly favourable for the OTTs (EY 2015). While telcos face strict regulatory environments, OTTs are subject to lesser. Telcos are experiencing stagnating revenues in competition with OTT communication providers, such as Facebook and Skype. Because of this competition, it is crucial for mobile operators to differentiate by creating valuable service and quickly introducing these services to market (ACG Research 2015b).

4.4.4 Customer trends

Another great challenge is the perceived distance between end-users and telco. Consumers are the at the heart of a digital transformation driving up demand for digital services. In adjacent industries such as media and entertainment, actors have maintained a close relationship with end-users by offering consumer-driven and innovative products which has digitized the customer (Friedrich, Péladeau and Toumi 2014). To ensure high-quality customer experience, two elements must be addressed 1) new service development and 2) personalising the customer journey. In the global communications study performed by EY (2015), 68 % of industry executives highlight customer experience management as the number one strategic priority with greater service personalisation seen as a critical driver. One executive stated: "*if you are customer-centric and provide value, keep your customers happy and anticipate their future needs, you will thrive. If you can't do that, you will become a dumb, wholesale connectivity provider"* (EY 2015, 18). New service development was the second number one strategic priority mentioned by senior executives. This shows the importance in capturing new digital opportunities for growth by expanding service portfolios. Furthermore, 34 % of respondents deem service personalisation as the number on customer centricity initiative, higher than any other category (EY 2015).

4.5 From CSP to DSP

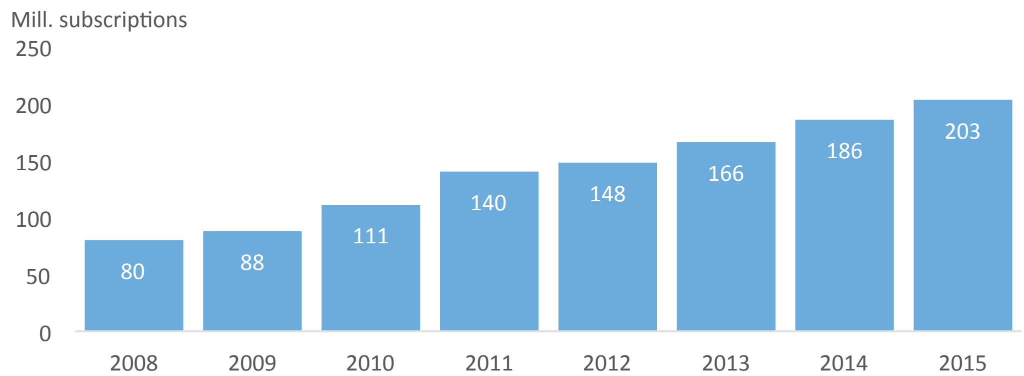
As the aforementioned customer trends and challenges arise, a fundamental shift in business forces its way forwards. While the traditional mobile operator relied on traditional communication services or what has been termed a communication service provider (CSP), the new reality suggests that becoming a digital service provider (DSP) is inevitable. A DSP is a service provider with delivery architecture, which is integrated, seamless, intelligent, automated and in real-time. Moreover, a DSP provides digital services with a focus on driving most interactions online and across devices. Conversely, the CSP offers traditional, core, telecom services. Contrary to a CSP where the primary service delivered is connectivity, a DSP focuses on delivering a broader set of services such as content and apps. As such, DSPs separate themselves from traditional CSPs by becoming more than utility providers, but as genuine digital competitors (Behan 2014).

5.0 Telenor

5.1 Telenor Group financials

Telenor Group is a Norwegian publicly noted telecommunications corporation headquartered in Fornebu, Norway. The company is present in 13 markets worldwide with an additional 14 markets through its ownership stake in Vimpelcom Ltd. In 2015, Telenor Group reported revenues of 128 billion NOK, making it the second largest company in Norway (Telenor Group 2016a). The margins are sound and constitute a healthy 34.5 % in 2015, close to one per cent higher than the global average. On the customer side, as of the 1st quarter of 2016, Telenor Group was the tenth largest mobile operator in terms of mobile connections worldwide (Statista 2016). By the end of 2015, they had 203 million telephone subscriptions worldwide (Telenor 2016b). Their customer base has increased steadily and in 2015, they reached the milestone of 200 million subscribers (See Figure 9). Additionally, Telenor is among the world's 500 largest companies in terms of market value (Financial Times 2014).

Figure 9: No. of subscriptions



Source: Telenor Group

5.2 Strategy

Telenor Group´s long-term strategy is characterized by the changing market dynamics. The overall ambition is to become the customer´s favourite partner through delivering a broad range of relevant, personalized and engaging digital services. In an effort to concretize these visions, four key strategic ambitions have been designed (Telenor 2016c):

5.2.1 Loved by customers

Most of the traditional markets are becoming saturated and subscription growth is coming to a halt. In an effort to achieve above-industry growth in the future, Telenor aims to become the superior choice for customers through a combination of delivering the best network experience and digitized and automated customer journey

5.2.2 Engaging digital products

Consumers are spending less time in Telenor´s core services. In an effort to reverse this, Telenor plans to strengthen their end-user position through leveraging new and engaging digital products within specific internet service categories and in digital verticals

5.2.3 Winning team

In order to facilitate the shift from traditional telco to customer partner, significant changes in capabilities and culture must be present.

5.2.4 Most Efficient Operator

While traditional revenue streams are decreasing, a need to operate more efficiently and smart is imminent. Accelerating technology and process simplification is key towards achieving this.

The strategic ambitions are the results of an incremental shift for Telenor. While emerging markets continue to provide steady revenues, more and more markets are showing signs of saturation and stagnation as previously stated. Hence, the strategy focuses more on providing the customer with digital solutions which promises to become a far bigger part of the foreseeable future. As stated in their annual report of 2014*: "Telenor is transforming itself into something more than a provider of connectivity"* (Telenor 2015, 1). Offering services which allow for closer interaction with end-users on several layers of the mobile ecosystem is becoming more and more important for future strategic position. Telenor wants to become the customers' favourite partner in the digital sphere (Telenor 2016c).

Operationally, Telenor expects adjacent and existing verticals to become strategically important in ensuring future growth. Investing in innovation where

Telenor lacks an apparent ability to compete is a vital part of the new strategic direction. Subsequently, Telenor pursues a strategy of acquiring companies to induce capabilities, which can help them sustain their market position. Most recently was the acquisition of Tapad, a New York-based start-up founded in 2010 which promises to enrich Telenor`s position in the ad market. Finally, Telenor merged its Strategy and Digital units in 2014, to bring digital development even closer to its core (Telenor 2015).

5.3 Digital Services

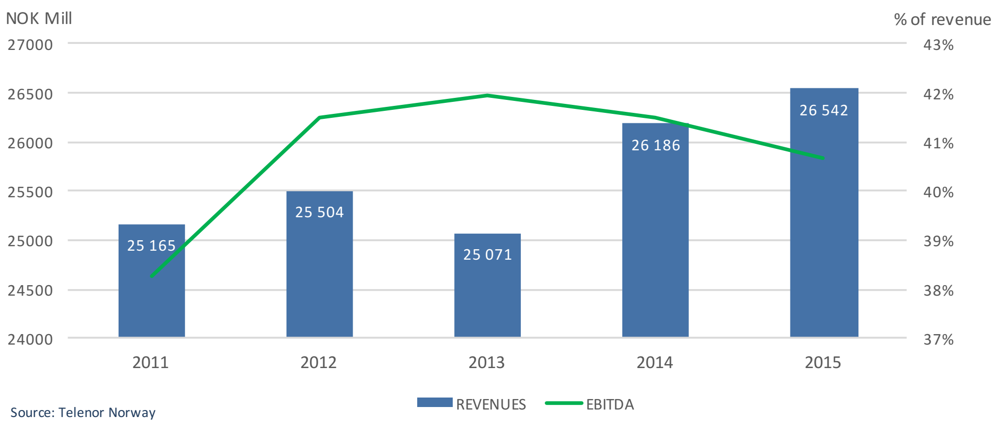
As digital development becomes a greater part of Telenor's core business, changes are being implemented in their service offering. Historically, Telenor has successfully managed to conquer digital positions in international markets. Financial Technology, Machine-to-Machine, Communication and Storage services are future service areas where they aim to claim a stronger position. Some of these efforts have already manifested themselves into concrete action. In 2009, Telenor Pakistan acquired a 51 % stake in the micro finance bank Tameer Bank. Through this acquisition, Easypaisa was launched to seize the opportunity for mobile money in a market with only 15 % bank penetration in 2008 (Nenova, Niang and Ahmad 2009). Easypaisa introduced branchless banking in Pakistan and enabled easy and secure payment of bills, money transfers and opening of a mobile bank account (Telenor 2013). Through this partnership, Telenor successfully captured a digital position in the Asian market. By the end of 2012 the service had processed over 100 million transactions and was identified as a 2012 GSMA Mobile Money Sprinter – one of the 14 most successful mobile services (McCarty and Bjærum 2013). In Serbia, Telenor introduced its first wholly-owned financial institution, Telenor Banka, in September 2014. Through a customer-centric model, the service enjoyed instant success (Telenor 2016a). The online bank was the first in the Serbian market to offer services such as multicurrency accounts, contactless withdrawal of dinar or euro at ATMs and ability to send money to e-mails and mobile phones (Telenor 2016e). Finally, Telenor developed Telenor Music in co-op with Tidal/WiMP in an effort to capture customer's willingness to pay for music streaming.

Central to the digital shift in more mature markets, is the realization that Telenor does not necessarily have the capabilities to develop new services internally. As a response, Telenor recently launched an incubator program aimed at helping start-ups and accelerate the process of innovation. Ignite Incubator is a program where employees of Telenor, regardless of position or geographical location, get an opportunity to develop their ideas into minimal viable products (MVP) or testable prototypes (Telenor 2016f). Even more recently, Telenor announced that it plans to let their employees become full-time entrepreneurs for up to three months to develop new services for the future (DN.no 2016).

5.4 Telenor Norway

The Norwegian market accounts for one fifth of Telenor's total revenues during the fourth quarter of 2015 (Telenor 2016d). Norway remains highly important for Telenor Group, contributing with a very strong EBITDA margin and overall strong performance.

Figure 10: Financial information Telenor Norway

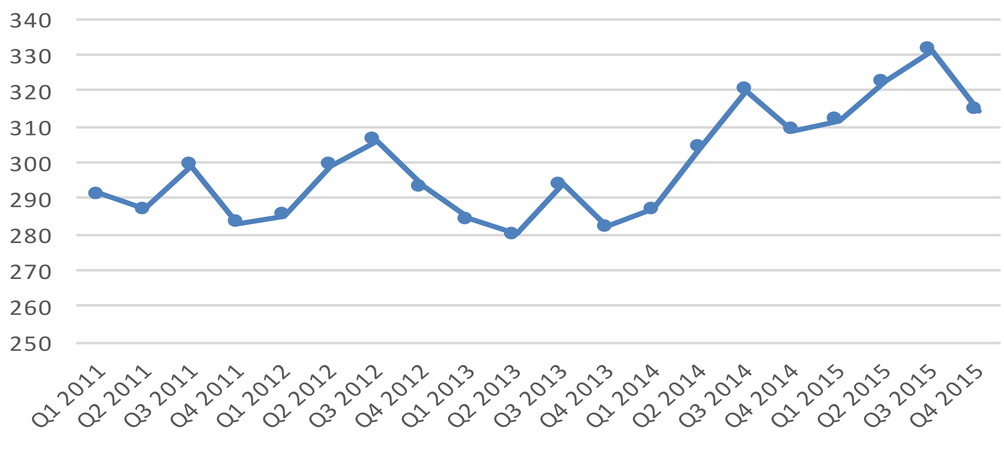


In recent years, growth has slowed and the overall CAGR for 2011-2015 remains a mere 1 %, significantly less than the Group CAGR of 5,5 %. This key number is consistent with Telenor's notion of diminishing telco revenues in mature markets and displays the need for new sources of revenue. Average Revenue per Subscription per Month (ARPU) is a common used measure for the profitability of consumers and Figure 11 summarizes the ARPU for the mobile division for the last five years. While revenues remained stagnant between 2011-2013, recent years has seen rise in revenues consistent with overall revenue for Telenor. Compared against main rival TeliaSonera, Telenor maintains a premium of almost

30 %, a testimony to a strong revenue position in Norway(Telenor Group 2016b; TeliaSonera 2016).

In terms of investment, Telenor Norway invested roughly 4 billion NOK in 2015, a record number in the last five-year period. In general, heavy investments are often considered a measure of renewed faith in the market, but in Telenor´s case it is likely related to the final implementation of 4G technology (Telenor Group 2016a). Historically, CAPex have been close to 15 % of revenues.

Figure 11: ARPU for mobile



Source: Telenor Group

5.4.1 Strategy

Being part of the global group means that group strategy put forward makes for the overall strategy pursued. Hence, we do not spend any time on explaining the strategy for Telenor Norway and refer you to section 5.2

5.4.2 Digital Services

Digital services play an important role in the Norwegian market and Telenor has launched several new services in the last five years with varying results. In 2014, Valyou was launched in an effort to capture customers from the growing market of mobile payment solutions. The service drew on near-field communication (NFC) technology, a technology employed by some device manufacturers, but not common to all (Digi 2014). The service was less successful and was terminated at the end of 2015 (E24 2015). In 2010, Telenor launched the music streaming platform WiMP in Norway and Denmark. WiMP was a greater success and highly appreciated by both customers and tech journalists who claimed it to be superior to the more renowned Spotify (Verdens Gang 2010). In early 2010, Telenor launched Telenor Fusion, a portal where Telenor leverages its own services and services of third-party providers. Third-party providers can access interfaces to Telenor's core services such as messaging services, user location, payment solutions, M2M/IoT and click-to-call. Telenor Fusion is comprised of a set of common Application Program Interfaces (APIs) which enables easier connection to third party providers and speeds up the process of innovation and collaboration (Telenor Fusion 2016b). API is a fairly new concept, aimed at bringing other layers of the mobile ecosystem closer to Telenor. Finally, Telenor has enjoyed great success in offering television for customers using their existing network. The Telenor-owned Canal Digital claims nearly 50 % of the Norwegian market for TV-distribution (Medienorge 2016b). Leveraging their extensive infrastructure and bundling services has proved a successful and profitable recipe.

5.4.3 Telenor Norway´s strategic position

As previously stated, Telenor enjoys extremely high margins in the Norwegian Market suggesting that high prices or significantly lower costs. Based on their market share it would not be surprising if most of this margin stems from being a price-setter, but as prices on subscriptions in Norway are quite competitive, we are lead to believe that the company enjoys a cost position due to high efficiency and cost control. Most of their revenue comes from traditional telco revenue stream, founded in a high ARPU on both prepaid and contract subscriptions. Subsequently we are lead to conclude that Telenor currently possesses a strong strategic position based on a high consumer base as well as a strong cost position.

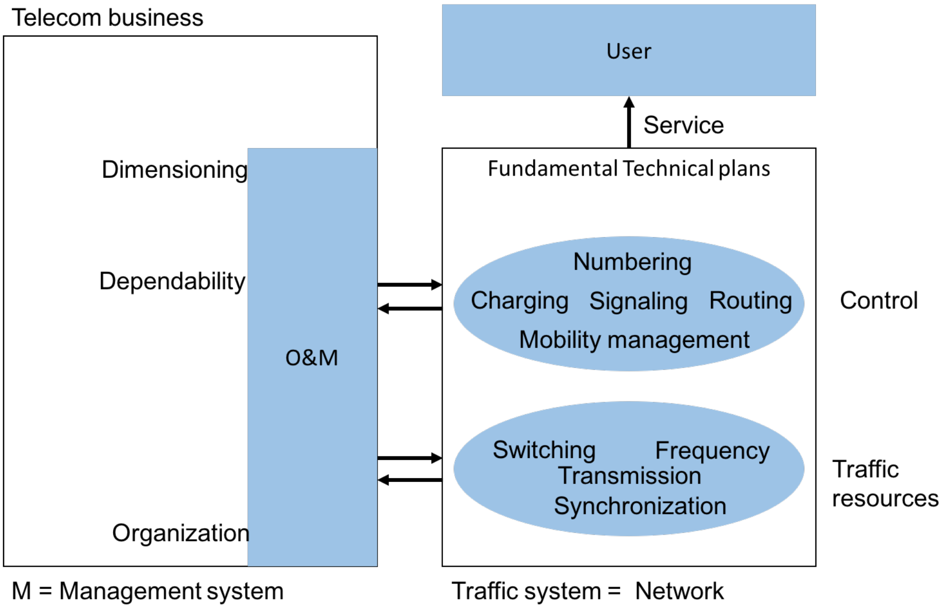
6.0 Technology overview

The aim of this section is to provide a basic understanding of the technology involved in operating a mobile network. In order to understand the potential of the technology, one must first understand the basic technological functions needed to operate a network. Although telco is a technology-intense industry, we make an effort to keep the reading light and understandable for the average economist. It is important to note that our description of technical aspects is simplified, and hence the experienced reader will notice that some aspects of the technology are left out. In the following section we will outline the basics of how technology works in telco in four subsections. First, we introduce BSS and OSS to establish a basic technical understanding. We then move on to describe the traditional mobile network to establish a base of understanding before finally describing virtualization technology and its impact.

6.1 Business Support System and Operation Support System

The network and infrastructure and service provider layer of the mobile ecosystem is divided into two separate, yet intertwined sets of operations: a) the management part or Business Support Systems (BSS) and b) the traffic or Operations Support Systems (OSS) (Olsson 2005). Figure 12 presents a simplified overview of the two main systems with their respective stacks of plans.

Figure 12: Main systems of telecom



Source: Anders Olsson (2004) "Understanding changing telecommunications", Wiley and Sons

The traffic system or Operations Support System (OSS) is the operational system used to deliver services to end-users. Put simply, the OSS is the physical network which allows for connectivity. This system serves the end-user with services such as data, voice and messaging. On a technical note, the system is characterized by two main body of functions; traffic resources and resource control. Traffic resources refers to signals, data, voice etc. travelling through lines and wireless communication. Moreover, it includes the physical structure commonly found in cellular towers. In this plane we find important function such as switching, frequency, transmission and synchronization. The detailed explanation of how these specific functions work and interact is beyond the scope of this paper, but it is important to understand that connecting requires a complex set of techniques and resources. Resource control refers to the programmable control of how these data packets pass through the systems and examples include numbering, charging, signalling and routing (Olsson 2005). Put simply, resource control optimizes the flow of resources in such a manner that both efficiency and customer needs are met. Conversely, BSS is the business end of telco. In these systems we find customer management, service provisioning and data warehousing (Big Data, Analytics etc.). Managing subscriptions, billing customers, developing and maintaining services and meeting customer needs are some of the important function encapsulated in BSS. The system provides crucial commercialization of the OSS and ways of monetizing the connectivity provided by the network. Together these systems constitute day-to-day operations for Telecom Service Providers (TSP). It is important to note that in today's telco the stacks are even larger and encompasses several additional planes, however the main essence remain fairly similar. Finally, we note that an important feature of the two systems is the presence of technological legacy. By technological legacy, we refer to the presence of previous technology which cannot easily be removed due to its interdependence with key services. This feature is particularly evident in Norway, where the network bears the signs of the technological evolution. In example, although 2G and GSM are older technologies, they are still found within both the OSS and BSS as they still provide services. Newly developed networks in emerging markets are free of this legacy as newer technology generations encapsulates these features.

6.3 The traditional mobile network architecture

Although BSS and OSS are handy simplifications of the technological complexity of telco, we need to dig deeper into the realm of mobile technology to fully understand how mobile operations function. In particular, we look closer at how a mobile network is operated. Operating a mobile wireless network involves three main parts: a) terminals b) cell towers or base station and c) backbone. Terminals refers to hardware used to connect to the cell tower and can either be stationary such as router or mobile such as smartphone. Each time you use your smartphone, the signal is routed to cell towers in proximity to you. Inside these cell towers we find a complex set of devices such as transceiver, combiner, multiplexer, antenna and the whole core-network, commonly termed backbone (Maruyama, Tanahashi and Higuchi 2002). Each of these devices has a distinctive role in ensuring that the customer has a seamless experience when using his or her terminal. Again, it´s easy to dig into the technical specificities of each of these devices, but we settle by summarizing that each of these devices contain two primary level; the application plan and the control plane. In addition, each device is comprised of a hardware and a software part. The hardware part does the physical distribution of information and data while the software prescribes the rule to which the hardware does its job. Importantly, these devices are proprietary, meaning the producer owns both the hardware and software and any changes to either of these must subsequently be carried out by the producer. This praxis has created a very attractive business for producers of such devices as the network cannot easily function without them. For the mobile operators such a praxis has allowed them to outsource maintenance to suppliers and hence created a strong interdependence which has been both profitable and symbiotic. As previously stated, the mobile network has what has been termed a backbone. The primary function of the backbone is to tie together the different pieces of network so that the overall connectivity functions. Put even simpler, the backbone ensures that each cell tower is connected to the overall network and hence connects the cabled network with the wireless networks. In example, all cell towers in Oslo are connected together via a local backbone, while all of Telenor's customers are connected together via a global backbone.

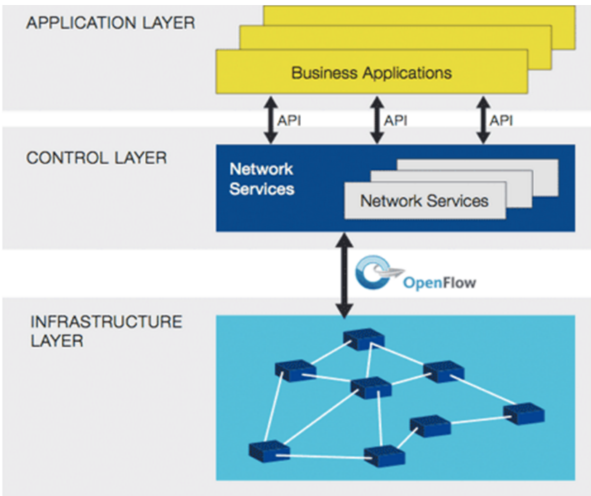
6.3 Virtualization technology

Virtualization is a phenomenon originating from IT industry and describes the process of creating virtual objects based on an identical physical object. A more accurate description describes virtualization as being the creation of a virtual resource such as a server, desktop, operating system, file, storage or network (Techopedia 2016). For telco, virtualization refers to taking physical hardware in the infrastructure such as switches, balance loaders etc. and create them in a virtual operating system. The two technologies enabling virtualization in telco have been labelled Software Defined Network (SDN) and Network Function Virtualization (NFV). For the remainder of this paper we refer to these two technologies collectively as virtualization.

6.3.1 Software Defined Network (SDN)

The main difference between a traditional network and a software defined network lies in that SDN virtually separates the network control plane from the resources plane (Open Network Foundation 2016). In a traditional network, these two layers are intertwined. Moreover, SDN enables the consolidation of multiple control planes, while still maintaining an appearance of multiple control planes for the resource control plane. Such a feature is highly important as it allows for control over multiple planes through a singular control function. Although the technical side of this is quite complex, from a business perspective this separation and consolidation allows the company to dynamically adjust routines as they see fit. In example, if customer needs warrants that traffic should be shifted in a particular way, such a procedure is coded and executed more readily. In addition, SDN inherently centralizes network intelligence such that controllers maintain a global view of the network rather than the traditional local view (ACG Research 2015a). The implication of this is highly dependent on the discussion of private vs. public cloud, but the technical complexity of such a discussion is outside the scope of this research. Nonetheless, business-wise the global view gives the operator greater control and centralized administration of the network while, to the rest of the business applications, it still appears as one single, logical switch. More importantly, SDN allows for the managers to quickly re-program, re-route and in general optimize network resources as they see fit due to SDN not being reliant on proprietary software updates and re-configurations. This feature promises to dramatically reduce costs. Finally, SDN enables and simplifies network design and operation because SDN provides instructions rather than a complex subset of proprietary and vendor-specific protocols. Figure 13 displays a SDN network. In summary, comparing with the traditional mobile network architecture, SDN provides greater flexibility and control to the mobile operators by separating the control plane from

Figure 13: Model of SDN

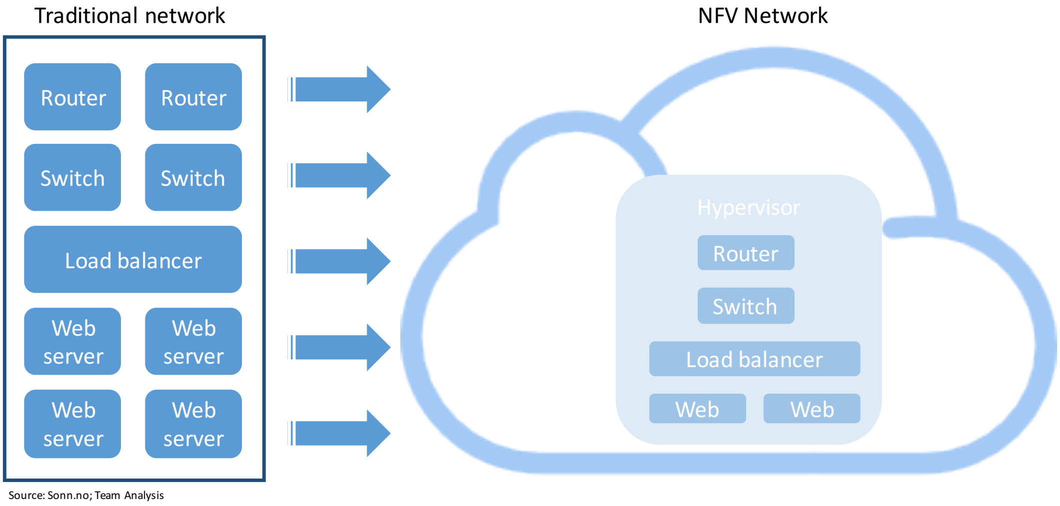


the resource plane and centralizing the function thus expanding the technical capability.

6.3.2 Network Function Virtualization (NFV)

While SDN provides greater flexibility and control, Network Function Virtualization (NFV) brings forward a new set of opportunities. In traditional networks, data is routed through a complex set of proprietary devices, which allow the data to reach its destination. These devices are often numerous and in particular in networks which have a lot of technological legacy. As previously mentioned, Norwegian cell towers not only have to operate recent 4G technology, but also older 3G, 2G and GSM technology which adds to the number of devices needed to control data traffic. Put simply, NFV takes all these devices and virtualizes them in a common off-the-shelf (COTS) x86 server. Specifically, it virtualizes several devices and runs them in a cloud, based on an operating system such as Hypervisor and promises to completely virtualize most of the infrastructure needed in networks (See Figure 14) (SDXCentral 2016b).

Figure 14: Traditional vs NFV Network



For the business end of telco, such a technological advance promises to dramatically reduce both operational expenditure as well as capital expenditures. In addition, NFV is expected to reduce time-to-market of deployment of new services as it does not require physical changes in the network. Moreover, the overall risk of adding new services is lowered due to NFV´s ability to provide the operator with easy process for optimizing the services in a trial and error process. Finally, one of the most important features of NFV is its ability to scale. Due to the virtualization of hardware, a NFV-based network is fully scalable without adding any new costly hardware. In summary, NFV promises to provide cost benefits as well as agility flexibility with regards to scale and service development to meet changing needs (SDXCentral 2016b).

6.3.3 Limitations and challenges

Although NFV and SDN promises to solve many of the aforementioned challenges for Telco, there are of course limitations and challenges associated with the technology. First and foremost, standardization of technology is hugely important for the adaption in telco. Standardization is important for several reasons, but most importantly due to the need for technology to work across networks, systems and devices. Hence, vendors such as Nokia, Huawei, Ericsson, VMWare etc. are currently racing in the efforts to write the standards for these solutions and the full specifics of virtualization remain to be standardized. Second, much uncertainty is still tied up to the application of virtualization. More specifically, does the technology apply to both legacy and new network technology? Most studies are conducted on LTE/4G networks and a study which assumed combined networks (GSM/3G/LTE) found that effects of the technology are somewhat lower for these networks combinations (PA Consulting 2015). Overall, much remains to be seen in terms of the application for different types of network. Finally, the last challenge for virtualization is related to security. Many mobile operators are heavily dependent on the security of the data. Companies with a high degree of secure objects of national importance are sceptic towards allowing the data to flow through cloud services as history has proved the security of such services to be more vulnerable (Telenor Interview 2016). Moreover, security is important for the overall value proposition in B2B markets and strong legislation and regulations are often high and can potentially act as barriers for adopting the technology. Norway, in particular, employs strict rules both in terms of data storage for telco which acts as a natural barrier for a first-mover in adopting new technologies (Samferdselsdepartementet 2003).

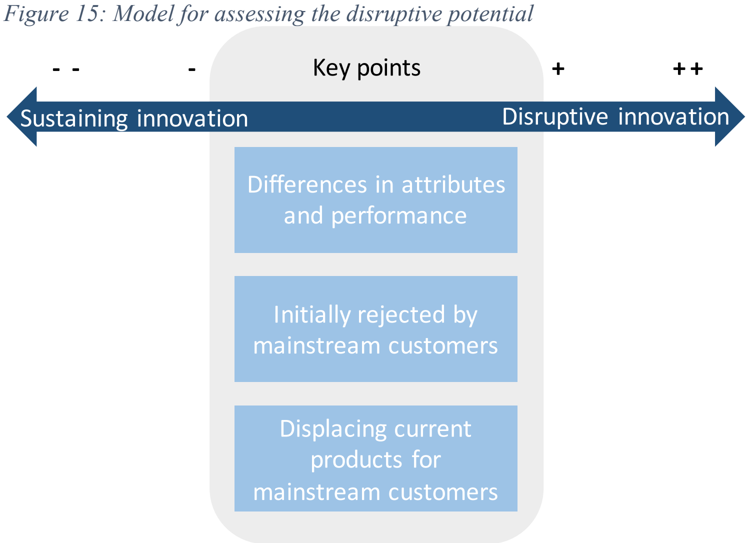
7.0 Technology Analysis

The purpose of the following analysis is to explore the disruptive potential of SDN and NFV. In doing so, we hope to add weight to our proposition of virtualization having a high degree of disruptive potential. Our data background is for the main part based on rich secondary sources such as previous analyses and descriptive papers outlining the attributes of NFV and SDN in addition to interviews.

7.1 Disruptive potential analysis

In an effort to create a common basis for characterizing disruptive innovations, Govindarajan and Kopalle (2006) constructed a model for assessing the disruptiveness of an innovation. Based on the previous findings of several innovation scholars, the model seeks to provide a scale for the characteristics of disruptive innovation. In addition, (Schmidt and Druehl 2008) provided us with the encroachment framework for assessing whether an innovation is disruptive or sustaining. The term encroachment refers to the product taking away sales from the older product, and it is proposed that disruptive innovations will take a low-end encroachment route. Specifically, the innovation will diffuse through the market more incrementally if disruptive, and at first embraced by low-end customers before diffusing upwards. In high-end encroachment, the high-end part of the market embraces the product first, before diffusing downwards towards low-end users. Although both models were developed to assess consumer products, their implications and underlying rationale can be easily transferred to technologies as well. Based on the literature found in both these sections and in the theoretical foundation, we developed a simple model for assessing the disruptive potential of virtualization technology. Due to the differences in characteristics, we assess each technology separately. In the following section we analysed virtualization through combining these two frameworks. We focused in particular on a) differences in attributes and performance measures, b) whether the initial product was embraced by low-end customers and rejected by mainstream customers and finally c) whether the development of the product eventually displaced current products for mainstreams customers. The greater the technology fits these three statements, the higher the degree of disruptiveness. Figure 15 displays our model for assessing the disruptive potential.

Figure 15: Model for assessing the disruptive potential



7.1.1 Differences in attributes and performance

Following Christensen and Bower (1996) and Adner (2002) amongst others, we evaluated whether SDN and NFV introduced a different set of features and had performance attributes differing from mainstream products while being offered at a lower price. In particular, we expect disruptive innovations to show signs of greater simplicity, be cheaper and lesser performance compared to current products (Huesig, Hipp and Michael Dowling 2005). In many ways SDN is similar to the standardized devices found in the traditional networks in terms of performance. However, at the introduction of SDN, the technology performance was considered inferior to mainstream products. The inferior performance of the supporting x86 servers played an important role in this lesser performance due to their immaturity. Conversely, the separation of the two planes are broadly considered as highly performance enhancing (Open Network Foundation 2016). The possibility of consolidating and centralizing multiple control planes into a common control function is expected to become important for improved performance while creating greater simplicity for the user. For NFV, we see a similar pattern. Virtualizing the numerous devices promises not only greater flexibility and agility, but is overall linked to better performance. The shift from physical devices and boxes to virtual switches found inside a server is a major change in attribute. Importantly, the NFV technology is still at immature stages and is broadly considered to be inferior to mainstream solutions (Telenor Interview 2016). Finally, both SDN and NFV are considered overall much cheaper than traditional technology (ACG Research 2015b, 2015a; Adner 2002;

Alcaltel Lucent 2014). Overall, we assess that both technologies fit the criterion of being significantly different from existing products in terms of attributes and performance. In addition, touching on one of Christensen's (1997) criteria, both NFV and SDN are simpler and cheaper. Specifically, both SDN and NFV simplify the traditional approach to networking through separation (and consolidation) and virtualization. SDN and NFV also promise to greatly reduce CAPex and OPex, thus fuelling our argument of being cheaper than traditional technology (ACG Research 2015b).

7.1.2 Initially rejected by mainstream customers – appreciated by low-end

In their article on disruptive innovation, Schmidt and Druehl (2008) describe how a disruptive innovation will follow a low-end encroachment diffusion. The key understanding in the model is that innovations are primarily either sustaining or disruptive. If SDN and NFV are to be disruptive in nature, then we would expect them to follow a low-end encroachment trajectory. SDN was first introduced as a concept more than twenty years ago. In fact, SDN re-visits old ideas from the early telephony networks in the mid 90´s where the control and application plane were separate (Feamster, Rexford and Zegura 2014). At that point, the term SDN was not yet coined and the industry referred to the technology as active networking. The basic product lacked a clear use and deployment path for the mainstream user and hence was only adopted by a few low-end customers (Feamster, Rexford and Zegura 2014). In the years to come, as computer technology became better and more suitable, SDN was re-developed to resemble the technology known today. Based on these historical descriptions, we are lead to believe that SDN was initially rejected by mainstream customers but appreciated by low-end customers to a great extent.

For NFV, the story is somewhat different. The concept of network function virtualization was first introduced in October 2012 by a group of leading telecom operators (European Telecommunication Standards Institute 2016). Compared to SDN, NFV became more popular for mainstream and high-end customers quite rapidly and telecom giants such as Deutsche Telekom, AT&T, China Telecommunications Corporations, Vodafone and Swisscom were rapid adopters (SDXCentral 2016a). However, our interviews revealed that many of the top telecom operators are not necessarily as eager to jump on the NFV train as they consider the technology to be still immature (Telenor Interview 2016). Thus, the promise of NFV remains to prove its full usefulness for mainstream customers. Hence, we are lead to believe that NFV did not follow a similar low-end encroachment patterns as SDN, but rather a niche encroachment pattern. Such a niche encroachment pattern is mentioned by Christensen (1997) and Schmidt and Druehl (2008) as an alternative route for some disruptive innovations. Overall, we find indications of SDN following a low-end encroachment trajectory while NFV is showing symptoms of a niche-segment encroachment confirming a high degree of disruptive potential.

7.1.3 Displacing mainstream products

Both SDN and NFV are in adolescent stages of development, but are showing great potential for displacing mainstream products. More recently, AT&T announced that it will replace its customer facing applications with NFV and SDN equipment by 2020 (Wall Street Journal 2016). Additionally, China Mobile has also begun experimenting with virtualization technology (Open Daylight 2015). Conversely, Telenor has experimented with proprietary NFV technology in Myanmar (Telenor Interview 2016), following Christensen (1997) who argues that incumbents will test innovations in emerging markets. We have not yet reached the peak of SDN and NFV and hence we cannot give a definite answer to whether NFV and SDN have displaced mainstream products but we are observing definite indications to giant vendors displacing mainstream products to a greater extent. The pace and scale of the displacement is however incremental, as should be expected with new technology. Much of the future potential displacement relies on the industry efforts towards standardizing the solutions.

7.2 The disruptive potential of virtualization

Table 2: Summarized findings disruptive potential

	Differences in attributes and performance	Initially rejected by mainstream customers	Displacing mainstream products
NFV	**Disruptive ++**	**Disruptive /Sustaining**	**Disruptive +**
SDN	**Disruptive ++**	**Disruptive ++**	**Disruptive +**
Virtualization	**Disruptive ++**	**Disruptive +**	**Disruptive +**

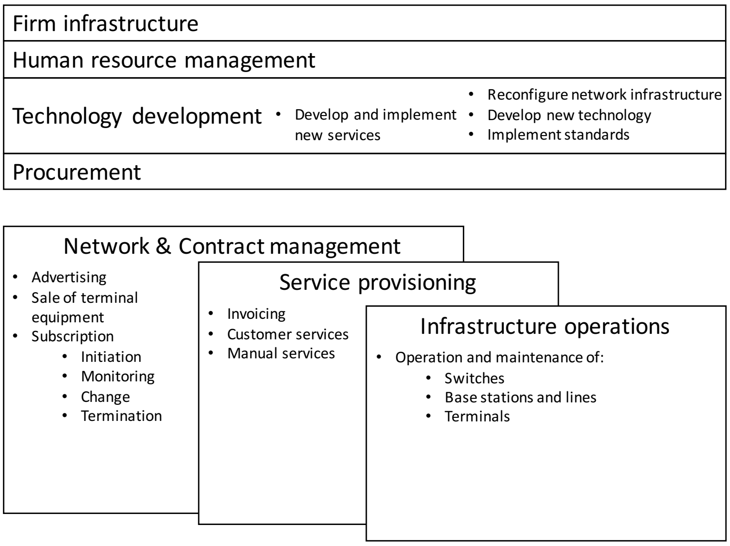
Both technologies show strong indications of having a disruptive potential (see Table 2). The encroachment trajectory is however slightly different. While SDN followed the traditional disruptive low-end encroachment, NFV is embraced earlier in its infancy by some mainstream customers possibly constituting a niche-segment. Both innovations display highly different attributes and superior performance to mainstream products through years of developments. Following Schmidt and Druehl (2008) and Govindarajan and Kopalle (2006) we are urged to conclude that virtualization has a strong disruptive potential. Importantly however, a fundamental question one needs to ask when assessing the disruptive potential is who the technology is disruptive for (Andersen 2016). In the case of virtualization, we believe that the technology is for the most part only disruptive for the suppliers of traditional infrastructure components as opposed to the mobile operators. We did, additionally, find indications that telco is not as convinced of the disruptive power of NFV yet, mainly due to its current inferiority and simplicity in terms of replacing current infrastructure (Telenor Interview 2016).

Following Govindarajan and Kopalle (2006), there are (at least) two main nuances closely linked to disruptive innovations; radical and competency destroying innovations. Radical innovations are characterized as minor or major advancements of current technology that are difficult to replace with older technology. Competency destroying technology build on prior technological skills, while at the same time destroying or making this experience base obsolete (Govindarajan and Kopalle 2006). Our analysis of virtualization revealed that NFV does not necessarily fit all criterions for disruptive innovations, and we are lead to believe that NFV may in fact be radical or competency destroying. It is not in the scope of this research to elaborate on this possible finding.

8.0 Value network analysis

In this section we go on to analysing Telenor Norway's value creating activities drawing on the framework of the value network (Stabell and Fjeldstad 1998). In doing so, we analyse the costs associated with activity categories associated with value creation. Our methodical approach bears resemblance to a study previously conducted on the insurance industry (Fjeldstad and Ketels 2006). The first step in such an analysis is to identify the different activities associated with value creation. Several previous papers have done so, and our final model is developed in part by Andersen and Fjeldstad (2003) whom conducted a similar study on mobile operators (see Figure 16). In our further analysis, we will primarily focus on Network & Contract management, Services provisioning, Infrastructure operations and Technology development.

Figure 16: Value network of Telenor Norway Mobile Operations

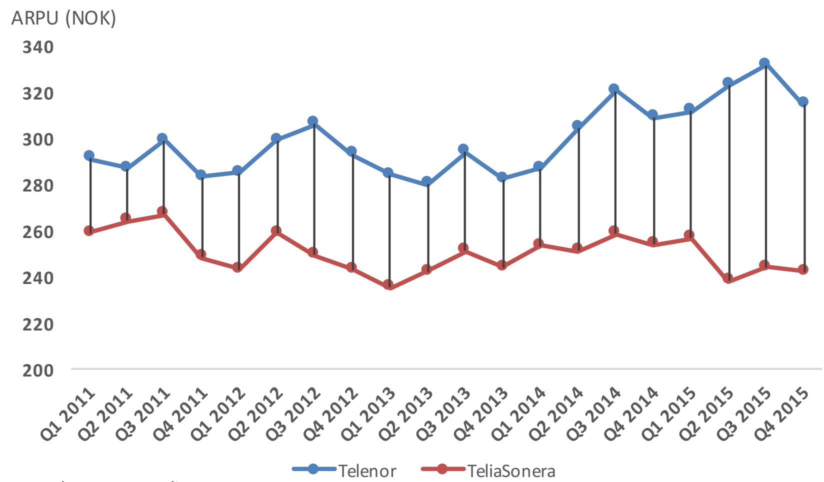


The overall aim of this analysis is to determine whether or not the activities associated with creating value are efficient in doing so. As noted by Porter (1996) operational efficiency is key in gaining strategic position (but not the same as) and hence we evaluate the cost of each activity to address this issue. We start off by doing a simple external analysis to establish the overall performance of Telenor Norway in the Norwegian market. Such an analysis is valuable in determining the overall position for Telenor. We then move on to conduct an internal costs analysis to look at each set of activities, as previously mentioned. Finally, we show how virtualization affect the cost activities.

8.1 External cost and revenue analysis

Before analysing the specific activities, we look at the overall performance of Telenor Norway. In doing so, we employ the concept of Average Revenue per Subscription per month (ARPU), a common and comparable industry measurement of the relative performance. When comparing, we use TeliaSonera as they are relatively close to Telenor in terms of operating and owning a network infrastructure as well as in size. Figure 17 depicts our comparison.

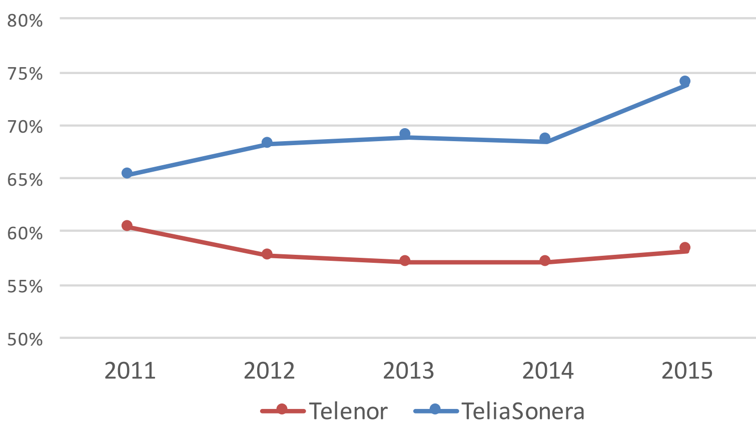
Figure 17: Historical ARPU Mobile Operations



Source: Telenor Group; TeliaSonera

We observe that overall Telenor Norway enjoys higher ARPU than its main competitor TeliaSonera. Compared to TeliaSonera, Telenor enjoys an additional CAGR of 3,1 % over the five-year period. In recent years, this difference has become even more evident and suggests that Telenor delivers greater value to customers relative to TeliaSonera. Hence, we can conclude that in the Norwegian market, Telenor activities deliver greater value than those of TeliaSonera. Just as important as the value creation, is the costs associated with creating such values. In an effort to establish Telenor's´ relative cost position, we compare the Operational Expenses (OPex) between Telenor and TeliaSonera and Figure 18 depicts this as % of revenues. From the graph, we see that while Telenor has managed to secure a relatively stable cost base, TeliaSonera is experiencing growing operational costs, resulting in lowered profit margins.

Figure 18: OPex Telenor vs TeliaSonera as percentage of revenue



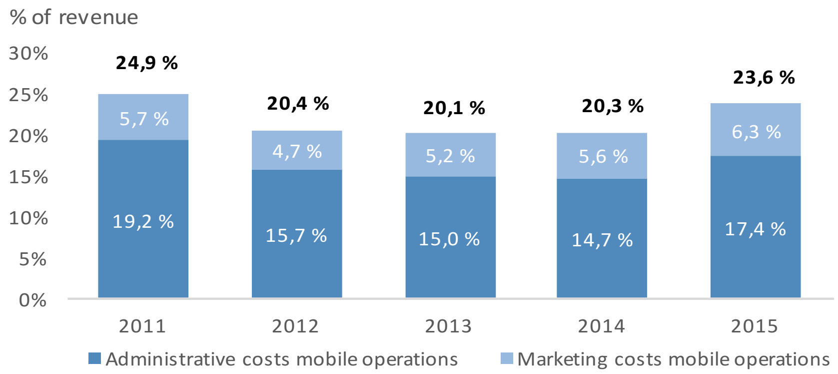
Source: Telenor Group; TeliaSonera

Based on this, it is easy to establish that Telenor Norway maintains a cost leadership in the Norwegian market place relative to its competitors. We confirm our intuition of Telenor being an efficient operations enjoying strong revenues and cost leadership. Having conducted a simple external analysis, confirming the strong competitive position Telenor enjoys in Norway, we move on to our internal analysis. In the following section we analyse the costs associated with previously mentioned value creation.

8.2 Network Promotion and Contract Management (NPCM)

Network promotion and contract management refers to activities associated with attracting, selecting and retaining customers (Stabell and Fjeldstad 1998).
Our model states that Telenor perform two distinctive set of activities with regards to this: Marketing and Contract management (Andersen and Fjeldstad 2003). Marketing refers to activities associated with advertising, sponsoring and sales efforts aimed at attracting the right customer. Contract management activities are associated with selecting and retaining the customer, and consists of activities in initiating, changing, monitoring and terminating customer contracts (Stabell and Fjeldstad 1998). Figure 19 depicts our cost analysis in this category and a full set of calculations and assumptions can be found in appendix 1.

Figure 19: Network promotion and contract management costs



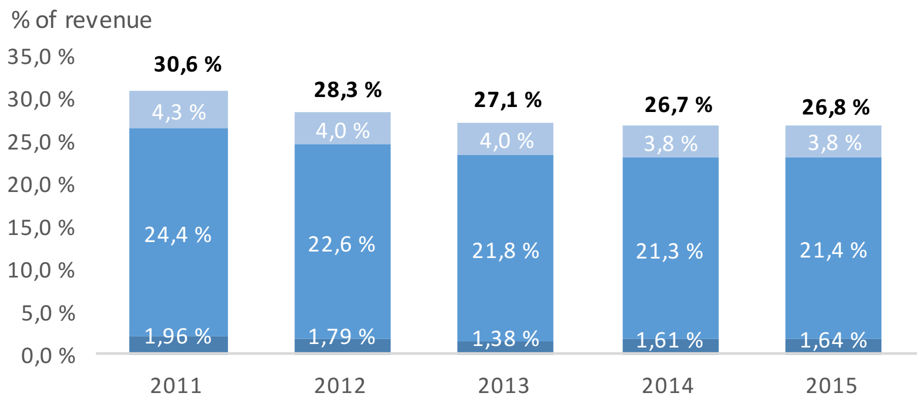
Source: Telenor;Team Analysis

With the exception of 2015, we see that Telenor Norway has maintained a steady decrease in costs related to NPCM and we can hence deduct that these activities are efficient. However, we see that marketing costs have risen in the recent years suggesting that activities associated with attracting new customers are becoming less efficient and that Telenor is experiencing difficulties in attracting the right set of customers. This can become potentially problematic as size and composition of the network are important drivers of value.

8.3 Service Provisioning (SP)

The second activity category is service provisioning or activities associated with initiating, maintaining and terminating links between customers (Stabell and Fjeldstad 1998). Put even simpler, the activities performed with relation to the customers use of services. Mobile operators provide their customers with access to their network and create value for the customer through this interconnectivity. In addition, mobile operators offer a series of complementary services which aim at improving the customer experience and usability of the network. In order to create value, one of the most important aspects of service provisioning activities is billing the customer for use of services and network (Andersen and Fjeldstad 2003). During his use of the network, the customer may have questions or experience irregularities which affects his value of the network or he may want to buy extra services or equipment. Subsequently, an important activity performed is customer services (Andersen and Fjeldstad 2003). Finally, some services may call for the use of manual services. A customer may need to install a specific set of equipment to make use of services or he is experiencing difficulties with usage of said mentioned equipment. Hence, providing manual services is our final activity associated with service provisioning (Andersen and Fjeldstad 2003). Figure 20 depicts our time-series analysis of the costs related to service provisioning. A full set of assumptions and calculations can be found in appendix 2.

Figure 20: Service provisioning costs



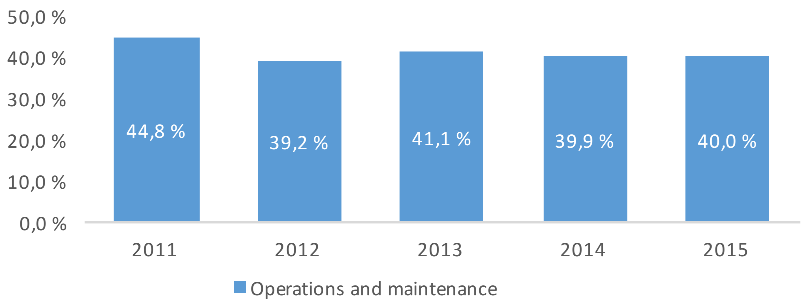
Source: Telenor;Team Analysis

Our analysis finds that customer services constitutes a significant portion of costs incurred. This is rather unsurprising as telco relies heavily on maintaining customer links and hence customer loyalty. The overall cost trend amongst these activities suggest that operational efficiency is high. Costs in each category is are declining, suggesting that the relative contribution of service provisioning adds more value than the costs associated with maintaining it.

8.4 Infrastructure Operations (IO)

Infrastructure operations refers to activities associated with *"...maintaining and running a physical and information infrastructure. The activities keep the network in an alert status, ready to service customer requests"* (Stabell and Fjeldstad 1998, 429). In other words, activities performed to ensure that the customer experiences a seamless use of network and that the physical infrastructure supporting the network is optimized. Intuitively, our model finds that most of the activities associated with infrastructure operations are found within operations and maintenance. Central to the mobile operator is the physical network and subsequently we found that activities performed within this category are cost linked with Operations and maintenance of a) base stations, b) switches and lines, and c) terminals (Andersen and Fjeldstad 2003). For Telenor Norway, this set of activities constitute major operational and investments costs due to the relative size of the network in Norway. In particular, the existence of technological legacy entails great costs as maintenance is required on several sets of supporting technology. From Stabell and Fjeldstad (1998) we know that one of the most important drivers of costs is scale and capacity utilization. Figure 21 depicts our cost analysis of activities associated with infrastructure operations. A full set of assumptions and calculations can be found in appendix 3. Overall, we find that although costs tend to fluctuate more in this category it is broadly due to capital investments in technology and hardware. This is not surprising as Telenor Norway has invested a lot in the operation of the LTE network. However, we observe that costs are still relatively stable. Telenor Norway appears to maintain a very healthy focus on costs and an increase in costs seems to pay off in increased revenues.

Figure 21: Infrastructure operation costs

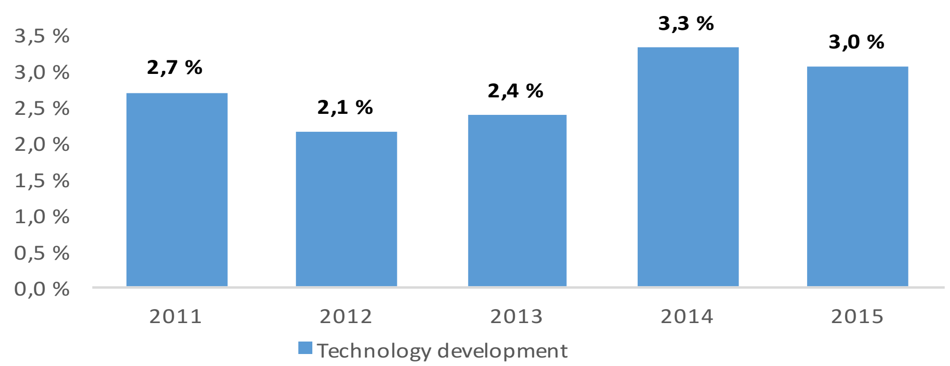


Source: Telenor; Team Analysis

8.5 Technology development

Technology development are part of the supporting activities. These are activities which "*enable and improve the performance of the primary activities*", but cannot be directly linked to a specific primary activity (Stabell and Fjeldstad 1998, 417). Although technology development is considered a supporting activity, it is closely linked to innovation and hence highly important for value creation and competitive advantage. We find that Telenor Norway conducts four activities related to technological development (Andersen and Fjeldstad 2003). First, developing and implementing new services is a crucial activity closely related to service provisioning. In the last five years, Telenor Norway has launched and implemented services such as "Min Sky", "Mitt Telenor" and "Min Be drift" and the development and implementation of such services are important in terms of value creation and revenues. Second, ensuring that the network is configured in such a way that it facilitates information exchange and new services is important. Reconfiguring the network to accommodate changing customer needs, is a vital technological development activity. Developing new technologies to further optimize the network constitute our third activity set. In particular, activities associated with the design, development and implementation of new switches, base station, lines and terminal are important. They allow for higher efficiency in the respective primary activities and are also inherently a source for strategic position. Finally, our last set of activities revolve around implementing standards. Implementing standards are vital towards ensuring that new services can function properly across the different layers in the mobile ecosystem. In particular standards for traffic technology such as 3G, 4G and 5G allow for interactions between layers and is a necessity for technology to be implemented.

Figure 22: Technology development costs



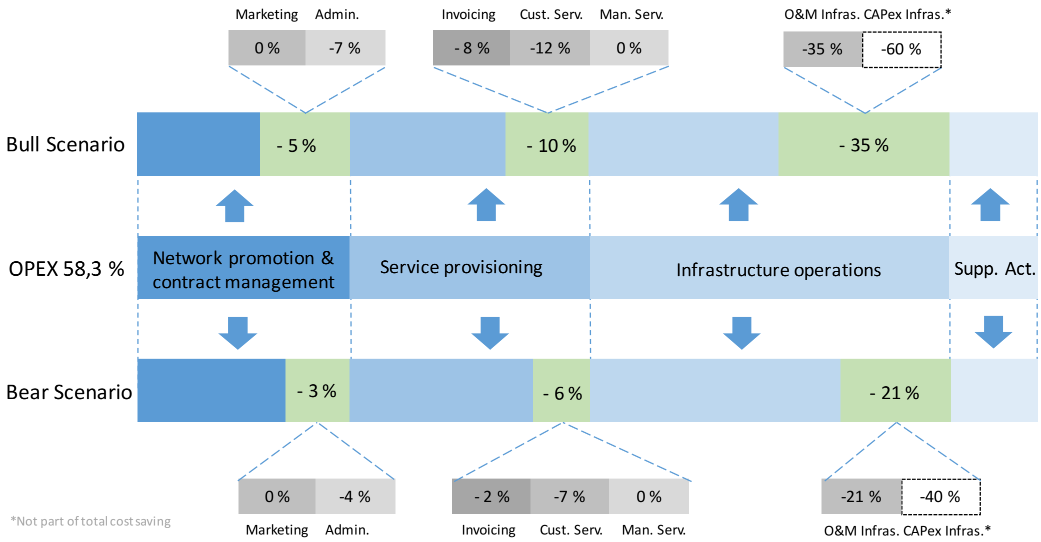
Source: Team Analysis

Figure 22 displays the costs associated with technology development in Telenor Norway (see appendix 4). Comparing to preceding categories, we see that the trend is somewhat different for this category. In fact, costs associated with Technology Development appear to increase as percentage of revenue, signalling that these activities are less efficient. This finding is well in-line with the previous depicted challenge facing telco of being unable to develop new and innovative services thus confirming the need to make these costs count for more.

8.6 Cost effects of SDN and NFV in the Value Network

In an effort to determine the quantitative effects of SDN and NFV on costs in Telenor Norway, we used available research on cost-effects of virtualization to determine what effects we could expect on primary activities (See appendix 5). The most common approach is employing a Total Cost of Ownership (TCO) model which compares cumulative costs. We then proceeded to break down costs and assign them to the appropriate primary activity to indicate where we expected cost savings to appear. In our efforts to be prudent, we used conservative estimates bearing in mind that Telenor has put several cost-saving initiative into action the last five years (Telenor Group 2016a). Moreover, our model assumes full virtualization of the 4G/LTE network. The main body of research conducted so far assumes this, and hence there was no readily available data supporting partial implementation. Importantly, we depicted both a best case (bull) scenario as well as worst case (bear) scenario. Figure 23 displays our cost reduction estimates.

Figure 23: Cost reductions allocated to activities



8.6.1 Network promotion and contract management

For network promotion and contract management we find cumulative cost savings in the range of 3-5 % over a five-year period. The main source of this reduction is tied to SDN technology and the possibility of moving subscription management on to a self-service platform. A TCO analysis conducted by ACG Research (2015a) found that such a service would allow vendors to reduce its effort in contract management and create a self-sustaining subscriber platform which would free up some operational capacity. Such an effort coincides well with the need to further digitize the end-user. The effect of such a possibility is estimated to range between 34 % and 54 % overall, yet we estimate the effect to be much lower for Telenor as they are already well in route towards digitizing the end-user. In addition, our previous assessment revealed that Telenor's efforts in administration are quite lean. Finally, we are unable to estimate any effect for marketing activities, but suggest that the overall implementation may potentially have clear spill over effects. In particular, such an enhanced self-subscription platform may indeed increase customer loyalty and hence reduce the effort in marketing.

8.6.2 Service provisioning

For Service provisioning activities we find greater cost savings in the range of 6-10 %. The main bulk of this is due to the implementation of SDN. The separation and centralization of the control layer allows customer services to further enhance customer experience through greater network analytics (ACG Research 2015a). SDN promises to deliver greater analytics in terms of network diagnosing which, if utilized properly, may yield reduced costs with customer services and higher customer satisfaction. In addition, NFV promises to reduce the down-time of the network, which is a great source of headache for customer services (Alcaltel Lucent 2014). Finally, the cost reduction is enhanced by the sheer reduction in physical hardware although this effect is somewhat moderated through an already large present of virtualized hardware (ACG Research 2015b, 2015a; Alcaltel Lucent 2014; ACG Research 2014). We find that this reduction is likely to impact both invoicing and customer services activities. Manual services might also be reduced as a by-product of stronger network analytics, but we are unable to estimate the range of this savings due to insufficient data.

8.6.3 Infrastructure operations

The biggest cost reduction effect we find is linked to the largest contributor of costs; Operation and maintenance of infrastructure and investments in infrastructure. The virtualization (NFV) of the infrastructure promises great savings in both OPex and CAPex. One of the most central costs in operation and maintenance of infrastructure, is environmental costs. This primarily due to the fact that as the number of legacy boxes found inside the base stations and data centres increase, so does the costs associated with maintaining them. Interviews revealed that most costs associated with infrastructure stems from such costs. Our research suggests that reduction in environmental costs such as floor space, cooling and power costs can be reduced by as much as 70-90 % (ACG Research 2015b). It is important to note that we did discover research which pointed to the opposite effect, as the NFV technology is currently too immature and may actually increase environmental costs. We did, however, not find very much support for this and assume that our estimates are that of a mature technology. Moreover, the virtualization process allows for much cheaper software upgrades and a lowered maintenance costs of hardware as well. On study found that software upgrades might be reduced by as much as 83 % (Alcaltel Lucent 2014). On the investment side, NFV can reduce up to 68 % of CAPex due to the lessened reliance of proprietary hardware and software. With COTS x86 servers and hypervisors, investments are significantly lower than traditional hardware (ACG Research 2014, 2015b). The mere reductions of the number of boxes needed to operate the network is the clearest and most evident reductions we find. Overall, we find that OPEX infrastructure operations can achieve cost-reduction to the tune of 21-35 % while CAPex range from 40-60 %. Importantly, our research did not include the costs associated with building of datacentres, as we assume that this cost is a one-off cost which can be financed through the selling of old equipment. Our conservatism in the estimations of costs related to infrastructure is due to a great deal of uncertainty in terms of what parts of the infrastructure that may be suitable for virtualization. Specifically, we expect the legacy infrastructure to still be a source of great costs and most current research assumes that costs savings relate primarily to LTE and 3G networks.

8.7 The cost effects of virtualization

Our analysis of the cost position of Telenor, in terms of activities performed in creating value for the customer revealed that primary activities are currently highly efficient and provide a level of value well in-line with revenues. Support activity technology development showed signs of operational inefficiency as costs relative to revenue had increased in recent years, and although the relative weight of these activities are low, we believe that their relative importance is high as they are a source of great competitive advantage in the future. Our findings are broadly as expected, as we know that Telenor enjoys good margins, but faces challenges in developing new services and technology aimed at creating new revenue streams. Our analysis of the cost-effects of virtualization reveal that the cost reductions of implementing such a technology are significant, well in line with *P2*. Most noteworthy, SDN reduces costs associated with Contract management and Customer Services which has positive effects for Telenor. First, reducing these costs presents a pristine opportunity to gain even greater operational efficiency and establish a stronger cost-leadership position. Second, cost incurred with selecting, retaining, changing and terminating contracts is reduced through a potential empowerment of the subscriber through a self-service. This self-service system can potentially create greater customer loyalty through reducing bureaucracy in customer facing applications and hence enhance the customer journey, an important strategic goal for Telenor (Telenor Interview 2016). Third, virtualization offers greater flexibility in customer services enabling greater control over network diagnosing and control. Customers experiencing issues are able to obtain a quicker solution to their problem and customer service employees control tools better aimed at providing network diagnosis. Finally, in infrastructure, the reduced costs in both OPex and CAPex presents huge cost savings and freeing of capital for other efforts. Reduced spending on expensive proprietary hardware and software and reduced environmental costs provides Telenor with greater flexibility in spending towards achieving a stronger strategic position as a DSP.

9.0 Business Model

In this section, we analyse and suggest how a business model, focused on becoming a DSP, should be constructed. We start off by re-visiting current industry trends and how they the force change in the way telcos do business. Second, we analyse how the mobile operators' business model is likely to be impacted by these changes. Third, we suggest a viable business model aimed at tackling these challenges. Finally, we show how virtualization can be a strong aid in the successfulness of the suggested business model in addition to describing other key elements in a successful transition towards becoming a DSP.

9.1 The changing telecommunications industry

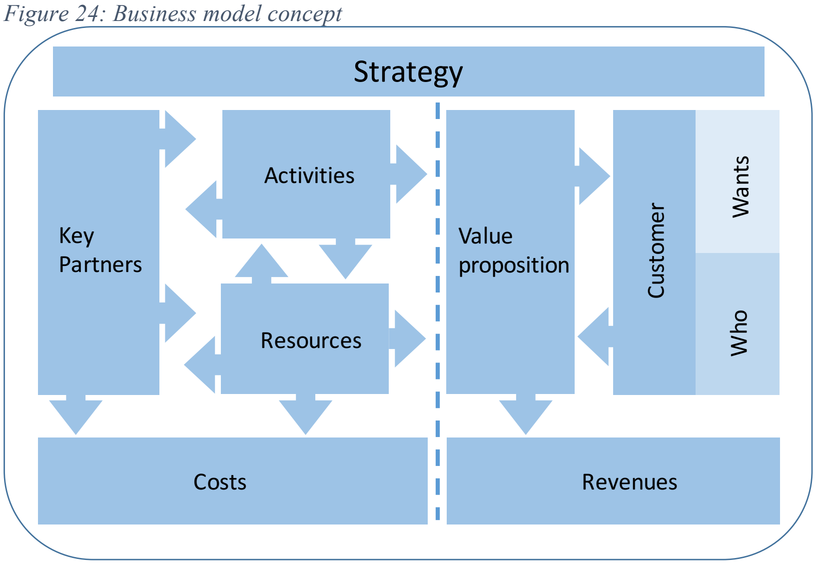
As previously described, the industry is faced with a series of challenges which put pressure on them: First, data traffic usage increases explosively with volumes forecast to grow at CAGR of 57 % towards 2019 (GSMA Intelligence 2015). This is evident both globally and in Norway. Second, M2M/IoT growth is set to accelerate over the next few years. GSMA predict the number of cellular M2M connection to grow at a CAGR of 26 % between 2014 and 2020 (GSMA Intelligence 2015). Third, OTTs are becoming fiercer competitors. In 2015 alone, global voice operators lost 8 % of its voice minutes to over-the-top (OTT) competitors. In addition, OTTs have increased their share of industry revenues with 10 % in just a few years. Fourth, customer experience is becoming increasingly important. 68 % of industry executives highlight customer experience management as the number one strategic priority with greater service personalization as a critical driver (EY 2015). To ensure continued survival, telcos must ensure that business models are congruent with these challenges.

9.2 Re-inventing the business model of a digital service provider

Based on the above discussion on industry challenges, several reasons for changing the current business model, in line with Johnson, Christensen and Kagermann (2008) and Markides (2006), become apparent. First, there is a need to respond to the shift in basis of competition. Second, with the possibility of virtualizing the network, presents the opportunity of wrapping the technology in a new business model. Third and finally, the business model of a traditional telco seems to become less appropriate in handling all of the challenges.

To build a new business model we first need to define the constructs, which are to be considered. Based on the literature as well as applied research, we have created a conceptual model with the following characteristics: strategy, key partners, key resources, key activities, value proposition and customers. These elements affect revenues and costs to the firm. Figure 24 summarizes our model.

Figure 24: Business model concept



Following Casadesus-Masanell and Ricart (2010), we postulate that the business model is a direct consequence of the realized strategy. The choice of strategy hence directs choice of key partners, activities and the use of resources. Moreover, the value proposition is in direct relation to the customers wants and needs, thus as these changes so must the value proposition. Overall, we believe our model is well-suited for discussing business model change.

9.2.1 Strategy

The overall strategy of the DSP rests on two main missions: First, to create revenues through offering a broader set of services aimed to meet the digital needs of the consumer. Second, to offer these service based on an omni-channel approach which assumes a highly digitized end consumer. Such a strategy must also be true to the fact that while consumers still value traditional services found in the CSP business model, the CSP model is not equipped to handle the needs of the digitized customer. Nonetheless, the overall focus of a DSP does not intend to compromise the CSP position, but rather shift the strategic focus to gaining a stronger digital position. The following business model is hence a product of this strategy.

9.2.2 Customer:

Who is the customer and what does the customer value? (Magretta 2002). This question is vital in crafting a business model. For years, telco has been able to target both private and corporate segments. Through the physical SIM-cards, telcos have enjoyed great customer loyalty and close interaction with the customer. Today, this reality has changed. The imminent introduction of E-SIM-cards pose a great challenge in maintaining this type of customer loyalty. Hence, retaining customer loyalty requires rethinking what customer segments to target. In terms of value for customer, the DSP business model must take into account the continued presence of OTTs. Regardless, connecting with the end-customer remains highly important to remain competitive in all segments, and finding new ways in doing so is critical. A possible way of doing so, is through the indirect B2B2C route. Telenor Fusion is a platform which greatly facilitates this (Telenor Interview 2016). Payment services, analytics and user location services aim to offer greater convenience and flexibility for corporate customers. An illustrative example is the payment service Strew, which enables and handles SMS payment for its corporate customers, regardless of which mobile operator the users are connected to. Strex allows Telenor to maintain a relationship with the end-user through the corporate customer (Telenor Fusion 2016a). Such an indirect route appears to be a good response to maintain customer loyalty.

The second question involves what creates value for customers. Both corporate and private customers value convenience (Telenor Interview 2016). Today's service offering cannot be delivered in silos and business models must be of a higher complexity, emphasising bundling (Telenor Interview 2016). Customers expect a holistic service offer catering to all their needs. Telenor Fusion is such a platform. By creating services which offer convenience for both corporate customer and end-user, Telenor can continue to create value, while earning revenues on both customer segments. Bundling these services together, creates a lock-in effect which is highly desirable. Creating a customer reliance on more than one product increases the switching costs for users, and will aid the transition towards DSP without the loss of customer base.

9.2.3 Value proposition:

In order to meet these customer needs, the value proposition for the mobile operator must evolve. Herein lie the questions: "What value do we deliver to the customer?" and "Which customer needs are we satisfying?" (Osterwalder, Pigneur and Clark 2010). Traditionally, the primary source of value came from mere access to the network, a function of composition and size. While customers chose Telenor based on the mere size and composition of the customer base, today's OTTs can offer much greater size and composition in their networks, thus reducing this competitive edge. Hence, the value proposition must encapsulate other value driving aspects. Part of this includes promoting attributes of the service offerings which cannot be matched by OTTs. Security is a pristine example. Large corporate customers value security and rely on this to be relevant to their customers. Compared to OTTs, a mobile operator follows stricter regulations in the securitization and utilization of customer data. While OTTs value security, they are still renowned for their efforts in obtaining analytics through accessing users metadata, and corporate customers may disprove of this. Second, a continued key value delivered is accessibility. Previously, customer wanted access to other customer, while today´s corporate customers want access to data about the network. Allowing for greater convenience and accessibility, while maintaining a strong sense of security is key in the value proposition for the DSP. Moreover, such a position can be claimed through innovating and developing new APIs which aim at delivering just that. Third, private and corporate subscribers still maintain a connection with Telenor. Capitalizing on this connection through offering analytics, without compromising privacy and security, is key. Through API integration with Telenor, the corporate customers can gain access to analytics of great value. Such a service adds value for the corporate customer through providing greater insight about customer behaviour not captured by internal customer management systems. Finally, integrating with the mobile operator's API can greatly reduce costs on activities for the corporate customer. The lessened need in investing and developing internal systems must surely be valuable for the customer and hence a key part of the value proposition.

9.2.4 Key partnerships:

Traditionally, mobile operators have had few horizontal partnerships while vertical partnerships were more common. However, faced with a high degree of vertical integration forces the mobile operators to rethink this. Horizontal partnerships may both reduce collective costs while creating stronger services for corporate customers through pooling of resources. Telenor therefore focus on, in addition to delivering own services, being a good partner for both vertical and horizontal key partners (Telenor Interview 2016). In example, Strex is a product of this new type of horizontal partnership which relies on the notion of pooling together resources to create a superior product which greatly simplifies the customer's challenges. In the past, cooperation between TeliaSonera and Telenor in the Norwegian market has been virtually non-existing. Today, the patterns of partnering are changing. The speeding pace of innovation renders collaboration with others critical. Keeping that in mind, mobile operators must consider radical options such as shared network models. A shared network model may not only allow the organization to focus on digital services, but also ensure a greater cost efficiency in the network through consolidation. Such a cooperation may also be a solution towards handling the projected increase in data usage from customers as well as M2M/IoT. Moreover, focusing on a horizontal open innovation model may results in greater value and the prolonged survival for the whole industry. Finally, vertical cooperation with adjacent OTTs is also an important part for future business models. BankID, an online signature platform, which allows users to easily sign official documents online, has been a major success for Telenor and is a product of vertical cooperation (Telenor Interview 2016). Such co-operations may reduce the "piggybacking" commonly found amongst OTTs as well as ensure greater value creation. Overall, both horizontal and vertical cooperation allows for greater scalability and increase in network dimensions which is of high importance for corporate customers. The group-level project Incubator Ignite is one the initiatives aimed at just that. Through connecting with OTT start-ups, Telenor offers acceleration in product-fit processes and partnerships which may results in increased revenues and an overall stronger position in the OTT market.

9.2.5 Key resources:

There are three main resources vital to Telenor's competitive advantage: the physical infrastructure, customer base and human capital. Traditionally, infrastructure has proved a tremendous resource for Telenor. In the 1990s, network coverage separated Telenor from its competitors and contributed to competitive advantage (Telenor Interview 2016). Today, network coverage provides only a slight comparative advantage, at best. In today´s innovation race, infrastructure, although still central, has become a source of major costs and investments. Creating a flexible infrastructure supporting the new range of digital services, is key in the prolonged viability of telcos. In particular, the forecasted increase in data usage from both private consumption and the future of M2M will continue to demand high scale in infrastructure. Moreover, the current state of the infrastructure results in mobile operators having to create additional application layers in order to integrate new services, thus creating a greater sense of complexity. The traditional infrastructure also yields a long time-to-market for new services due to the extensive configuration needed to run trial-and-error on newly developed services. In order for physical infrastructure to continue to be a key resource, rather than an obstacle, change needs to be implemented in the capability of networks. A second vital resource for Telenor is the customer base. This is what attracts customers and partners to Telenor. In the example of Telenor Fusion, the ability to connect to the large Norwegian customer base that Telenor maintains, is one of the primary incentives. Last but not least, to be able to create the innovative services demanded, the employees in the organization are crucial. Their innovative capability sets the stage for extending the service offering. Aligning the organisation with new capabilities and industrial challenges may pose as a significant obstacle in the transition.

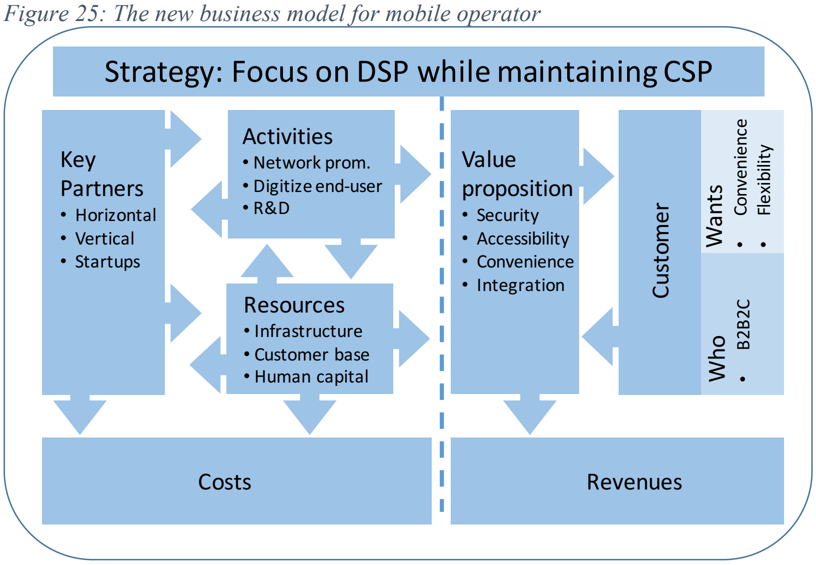
9.2.6 Key activities:

The DSP business model has to deliver amongst a dimension of four key activities. First, network promotion activities must become more yielding in order to maintain and grow customer bases. Highlighting the value propositions and services offered remain at the core of continued growth. Moving into the digital era entails more focus on service development and creating holistic customer journeys, however, without sacrificing the core telco operations (Telenor

Interview 2016). Importantly, the current hybrid CSP/DSP business model is evolving in this direction. Second, service provisioning activities such as billing, customer services and manual services must follow an omni-channel approach allowing for greater customer experiences across platforms and channels. Corporate customer must become even more digitized end-users. Customer experience still remains at the heart of continued loyalty, hence greater analytics and network diagnosis remains key. Third, infrastructure operations are key activities in determining future competitiveness. Transforming the infrastructure to become an agile, flexible and cost-efficient resource, demands re-addressing the main purpose of the infrastructure. Finally, because of a larger focus on services, supporting activities such as technology and service development, are becoming increasingly important. Innovation is still at the core of growth, and ensuring value-adding activities is a vital part of the DSP model.

In summary, the DSP business model for Telenor Norway has to undergo fundamental changes from its traditional CSP model. Importantly, we still maintain that the CSP model continues to be of high importance for Telenor Norway in the future, yet a shift in focus is imminent. The increased commoditization of traditional services may force a renewed focus on customer segments and we find B2B2C to be of high promise. The value proposition must focus on the convenience, accessibility and security Telenor can provide through offering services and key is the simplification of the customer journey. Strategic partnering with both horizontals and verticals is an interesting effect which may prove highly yielding if executed properly. Moreover, key resources must be reconfigured to support the new business environment and support the new revenue streams. Last, the key activities must aim at further digitizing the end-user through automated customer services and a greater focus on R&D efforts both through acceleration programs as well as through strategic partnerships. Figure 25 summarizes our key findings.

Figure 25: The new business model for mobile operator



9.3 Virtualization as facilitator of transition towards DSP

In previous sections, we found that virtualization provides telcos with great potential for cost savings. Our final proposition *P3* states that virtualization will aid in the business model transition towards becoming a DSP. In this last section, we explore this more in detail.

As previously stated, the traditional infrastructure is becoming increasingly inflexible which inhibits the creation of new services greatly. With a virtual approach[1], reports have found the that the time-to-market for new services can be reduced from 15 to six months due to a much faster deployment and automated trial-and-error procedures (ACG Research 2015b). For the mobile operator, such a reduction can aid the life-cycle of the product and hence translate into increased revenues. Based on this, the cost of failure will also be much lower in a virtualized setting than the traditional setting (ACG Research 2014). Traditional infrastructure adds to capacity in step-by-step manner, thus resulting in lost revenues when over/under capacity is present. A virtualized approach will allow the mobile operator to dynamically scale network capacity, thus capturing previously lost revenues. The use of virtualization is hence highly applicable for meeting the future increased demand in data usage in a more efficient way, ensuring no loss of revenue while at the same time ensuring strong margins (ACG Research 2015b). The same report found this to be true for M2M capacity as well.

[1] Assumes full virtualization of the mobile EPC. The EPC is of the referred to as the core, and hence a virtualization of the core is risky.

Importantly, we do not find any data supporting virtualization being able to handle increased data usage more efficiently than traditional telco infrastructure. However, virtualization allows for a geo-independence of network resources. Such a geo-independence is highly valuable for distributing resources to peak areas without the loss of revenues due to time constraints, thus allowing for virtualization to help mobile operators in peak times (ACG Research 2015b).

Another benefit of virtualization is the ability to easily obtain stronger network diagnosis and customer analytics which may facilitate the continued end-user digitization. The centralization and separation of the control and application plane allows the mobile operator to achieve increased revenues in less downtime in the network, in addition to a strengthened customer services offering. We found indications that mobile operators not necessarily hold this to be true, and caution should be taken we reflecting on this. Current infrastructure vendors are quite familiar with the traditional infrastructure and hence they possess greater insights into maintenance needs. Finally, a report from the management consulting company PA Consulting (2015) estimated the effects of virtualization in the context of shared infrastructure. In this context, the effects of virtualization are expected to be even greater, amounting to more than 60 % in OPex savings, assuming full virtualization. Importantly, virtualization may be of great benefit in the traditional CSP business model, although we have not analysed the potential for this.

9.4 Key elements of a successful transition

Although the prospects of virtualization as a key facilitator in the transition from CSP to DSP are strong, we still find that there are several other elements which need to be taken into account for the transition to be fully successful. A fundamental change in the value proposition for Telenor would require change in the whole organisation, starting at the group level and ending with key partners. This part of the transition promises to be the most difficult one, as it requires reconfiguring both the culture, practises and mind set of a rather large organization. As the industry expects the marketplace to continue to grow fiercer, many telco giants also expect that the industry will consolidate as a direct consequence of this (Telenor Interview 2016). Such a change may become a pristine opportunity to reshape the organization to adapt to the new reality and hence aiding this part of the transition.

The successfulness of the transition is also highly reliant on timing. Although all major mobile operators are aware of the current reality, only a few have taken concrete steps towards adapting in a more radical manner. As history has proven repeatedly, those who jump before or after the train do not survive. The key is devising a strategy, incorporating it with the different business units and ensuring that organization is on board with the change. Successful mobile operators will recognise that making such fundamental change is an incremental process starting with the strategy and ending with a new business model. However, many of the global giants including Telenor have a rather large organisation making them more susceptible to missing the train. A key element is hence to acknowledge that change is necessary and preparing the organisation for change in an incremental yet rapid manner.

Finally, a key success factor is the willingness to re-think the competitive environment and how they operate. Leaving behind conventional truths about the industry and embracing the new reality require telcos going unconventional ways. A study performed by PA Consulting revealed that a shared (virtualized) network solution between two mobile operators would increase the cost-benefit effects dramatically (PA Consulting 2015). For many telcos such a thought would previously be unheard of, but the new reality will require such efforts. Realizing that the challenge is industry-wide and co-operating in adapting, is key in successfully transitioning towards a DSP role.

Overall, we find support for our proposition *P3* stating that virtualization will aid in facilitating the business model transition towards becoming a DSP. We do however find that the facilitation is currently only related the physical infrastructure and that much analysis remains in terms of providing use cases for the organizational use. In addition, we find indications that although the transition may be aided by virtualization, the potential success of the transition is dependent on a wide range of factors. While virtualization may prove a useful tool in regaining flexibility and innovation in the organization, a successful transition will have to incorporate both technological as well as organisational changes on all hierarchical levels.

10.0 Discussion

When we started this report, we set out to explore the potential of virtualization on mobile operators´ transition towards becoming a digital service provider. We proposed that the potential of virtualization would materialize in three parts. First, that virtualization technology followed the trajectory of a disruptive innovation as described by Christensen (1997). Second, that virtualization would have a clear impact on the costs by reducing OPex and CAPex. Third and final, we proposed that virtualization would aid in facilitating the business model transition towards becoming a DSP.

10.1 The importance of virtualization technology

Our first order of business was to determine the degree of disruptiveness in virtualization. In doing so, we constructed a simple model to assess the disruptive potential. The analysis found that virtualization had a high disruptive potential. The concept of disruptive innovation is closely linked to competitive advantage and hence our finding should fuel the notion of virtualization being an important technology for telecom. In our interviews, we found support for this notion, although a lack of practical use-cases is critical in assessing the full potential (Telenor Interview 2016). Overall, we find that although our analysis suggests that the technology is of high importance, mobile operators remain quite laid back in terms of implementation. This is not a surprising finding, as standardization is key before a technology is implemented. It is our intuition, that the overall industry remains confident that virtualization technology will be implemented at some point in time, but are still on the fence to what degree and pace this will happen. We found indications that virtualization is more likely to be implemented incrementally starting at the less critical edges of the network and then gradually towards the core (Telenor Interview 2016). Moreover, we found that an additional concern with virtualization, is the current legislation with regards to securing the privacy of users (Telenor Interview 2016). Norwegian legislation is quite strict in terms of the degree of freedom telco companies are allowed to assume, and hence the regulatory concern is of major importance. Finally, Telenor expressed concern in terms of how their customers would react to their data being "in the cloud" (Telenor Interview 2016). Security is of major concern for Telco and consumers, and any full scale implementation must ensure that all security-related aspects are fulfilled. Security, being a vital part of the value proposition, is hence a vital part of the future success of virtualization. In summary, although we found support for initial proposition *P1* regarding the importance of virtualization, the reality is that the disruptive potential of the technology is not necessarily synonymous with adaptation. A range of factors such as legislation, security, lack of standardization and use cases are strong current barriers to implementation which may pose as an inhibitor.

10.2 The cost effects of virtualization

Following our technology importance study, we sought out to determine whether there were any cost effects associated with virtualization. Our stated proposition *P2* guided us to believing that this was the case, and through a comprehensive review of reports and white papers we found that virtualization could lead to major cost savings. Our analysis found that Telenor Norway enjoys a very strong cost leadership position in Norway compared to its greatest competitor TeliaSonera. We also found that the average revenue per customer is significantly higher at Telenor Norway, thus suggesting that the global decline in revenues is not as evident in the Norwegian market place. Furthermore, all primary activities showed clear signs of high operational efficiency thus adding to our notion of Telenor Norway being an outperformer in terms of delivering and creating value. Having established the cost status in Telenor Norway, we proceeded to analyse where the cost effects of virtualization would materialize. Drawing on an extensive set of reports on the TCO effects of virtualization on different parts of the network infrastructure, we found that virtualization would cut costs greatly in all primary activity categories. Importantly, the effect was estimated to be the biggest in activities concerning operation and maintenance with cost reduction ranging from 24-40 % over a five-year period. Conversely, our interviews revealed that for a high-margin company such as Telenor, the potential cost savings were of inferior value. Having had a strong focus on cutting costs in recent years, the cost-cutting side of virtualization appeared to be viewed as a serendipitous by-product. This effect is most likely somewhat idiosyncratic for our case company, and we expect the broader industry to accepts this more favourably. We believe that other mobile operators, struggling with declining margins and revenues might enjoy such cost-saving to a greater extent. Well in line with our own notions, Telenor confirmed that they had reservations to whether the real cost associated with virtualization could be estimated due to the complexity of implementation (Telenor Interview 2016). In particular, the existence of legacy architecture could potentially complicate the cost savings. Having to invest heavily in data centres to facilitate the transition, potentially increasing the costs of migration. It is our belief that many major operators do not currently maintain the necessary infrastructure to support a complete migration to a virtualized solution, and that implementation would follow naturally as older infrastructure is replaced. In addition, due to the criticality of keeping the network running, indirect cost of shutting the network down for the migration could potentially ruin any short-term savings. Although virtualization promises more than mere cost savings, it could end up being just that, rather than an enhancement of the capabilities of the infrastructure. In summary, we find that virtualization has the potential to generate great cost savings for Telenor across all value creating activity categories. The cost savings are generally related to replacing hardware with cheaper COTS and software which relieves the current infrastructure and minimalizes environmental costs. However, there are great uncertainty regarding the actual cost-effects of virtualization, particularly in terms of the real value of virtualization. Infrastructure with a great deal of legacy architecture, may prove difficult to migrate and costly to virtualize and may hence be less suited for such. In addition, we find that cost savings in themselves are not necessarily a good enough reason for virtualizing. Overall, we find support for our proposition *P2*, but also note that previous studies on the cost effects have yet to acknowledge the presence of additional cost-driving factors such as migration- and other hidden costs.

10.3 The transition to DSP

The third and final, analysis set out to highlight how a business model supporting the DSP role would look. We evaluated this in light of the changes in the telecommunications industry and looked at how virtualization can aid this transition. In doing so, we created a conceptual model based on the most important characteristics of business models from the strategy literature.

Based on our analysis, we found that a DSP business model must be significantly different from that of a pure CSP. The imminent introduction of the E-SIM poses a highly real challenge for retained customer loyalty in all customer segments. At the same time, consumers are becoming increasingly digitized and demanding, shifting their willingness to pay towards services offered by an increasingly high-earning OTT industry. In a DSP business model, a clear segmentation of customers is necessary and our analysis that the B2B2C market would be a pristine opportunity to reach both segments. The corporate segment values convenience, flexibility and security, which can become a strong differentiator for the telco industry. A more holistic service offering could potentially create an increased loyalty to Telenor and lead to a lock-in effect of customers. Moreover, we found that the DSP business model must comprise of both horizontal and vertical partnerships. For instance, partnerships with strategically important OTTs could yield promising new revenue streams while horizontal partnerships with competing operators on traditional CSP operations may become a solutions well-suited for the DSP business model. To meet the needs of an increasingly demanding customer base, mobile operator must 1) be a good partner for third-party providers, and 2) change the normal partnering patterns. Telenor is already following these paths and must continue to increase the efforts in such. Finally, we found that key resources such as the infrastructure supporting the network needs to become more flexible to support a wide range of new services. While the current infrastructure is highly applicable for the CSP, the new business model requires new approaches to the architecture of the infrastructure. We proposed that virtualization could aid the business model transition towards becoming a DSP and found support for this. Specifically, virtualization can aid the transition by providing greater flexibility in the infrastructure, thus supporting new service development as well as regained control. A shorter deployment time of new services will decrease time-to-market for innovative services, thereby increasing the potential time for these services to yield revenue. This is vital as a slow introduction of new services might result in someone else introducing a similar service faster and have the time to recruit a critical mass. This can be devastating for potential revenue creation. Furthermore, creating services through software reduces the cost of failure and eases the process of creating new services as the codes can be reused in subsequent service migration. These aspects in themselves reduce costs. Some argue that virtualization is not a necessity for DSP, as the services can be added to the core network using additional layers well-suited for handling the new services with great success. Although they might be right, we argue that such a frame of mind can be illusive and hence lead to cognitive inertia within the organization.

Through our interviews we became aware of varying perceptions with regards to the aiding power of virtualization. A common perception was that the needed change would originate from a mere re-focusing of efforts, emphasizing delivery of new quality services, analytics and personalization for the customer (Telenor Interview 2016). Others continue to claim that the traditional CSP business model would only require some tweaking to face the new challenges, and that the revenue of the future would still origin from traditional telco services. Such division of perception may become a barrier for change. It is not difficult to agree to such perceptions, as Telenor still enjoys above-industry margins from their traditional telco operations fuelling the argument for a continued focus on CSP. But it might lead to a sentiment of content or belief that one is doing exactly the right thing – the so-called success trap (Levinthal, March and Schendel 1993). We do however recognise that completely leaving the CSP business model behind is both unfeasible and unwise. Finally, we outlined some additional factors which are important for the transition towards becoming a DSP. Telco are highly aware of these, and our interviews suggest that telcos believe these to be the greatest hurdle on the road towards DSP (Telenor Interview 2016). Well in-line with our descriptions, Telenor Norway believes that the transition is a function of organizational development, timing and incremental business model change, and less dependent on virtualization. This might be true, as all those factors are crucial in transitioning, however we believe that virtualization is a strong aid as it enables many of the network functions supporting the new business model and should not be written off as a mere technology development.

11.0 Implications

In light of the nature of our findings, we have not made any definitive conclusions. Nevertheless, our findings reveal a series of important implications with regards to the potential of virtualization on the transition towards becoming a digital service provider. The implications are threefold and relate to telco, theory and method. In the following section we outline these implications.

11.1 Implications for mobile operators

In analysing the disruptive potential of virtualization, we found indications that overall, virtualization has a high disruptive potential. The implication for the mobile operators, is that virtualization technology is unquestionably part of the future, and not to be marginalized. Mobile operators need to continue to monitor the development of these two technologies in order to remain at the forefront of innovation. Virtualization is set to become a major competitive advantage of the future, yet the question remains as to when the correct timing for adoption is. Mobile operators should continue to take an even more active part in developing comprehensive use cases, in particular for mature markets where traditional revenue streams are drying up. Use-cases remain central for any infrastructure-wide implementation and in particular for valuing the true contribution. Currently, telco is gaining access to more and more use-cases, but we believe that operators would benefit from testing and developing their own.

A common approach for disruptive innovation, as previously mentioned, is to test on less critical markets, which could become a valuable lesson. Mobile operators should consider experimenting with incremental virtualization, thus virtualizing less important parts of the infrastructure and evaluating the results. In terms of costs, efforts should be made towards estimating the cost-benefit effects of both partial and complete virtualization from an internal perspective. Our cost analysis, based on available reports, revealed that there are significant cost reductions in implementing virtualization. Previous reports on the subject are, however, often contracted by suppliers of virtualization technology and are hence subject to an inherent bias. An internally developed analysis could reveal the true cost-benefit relationship of virtualization and provide a stronger basis for action. In particular, most of our empirical data suggests that many hidden costs are not included in the estimations. Hence, a true cost-benefit study must include hidden costs such as organisational change, CAPex investments in data centres and training costs. Moreover, mobile operators should also try to quantify the measurable benefit from virtualization. Few public available reports have done this so far, but estimates place the value up to 300 % of current cost savings. Quantifying the benefits is critical for telco if virtualization is to become more than just a cost saving measure. In particular, mobile operators need to quantify these while keeping in mind what the current network is capable of as an alternative benefit/cost.

The business model transformation from CSP to DSP is bound to include virtualized infrastructure. To what degree remains to be seen and is to a large extent dependent on the standardization of virtualization technology. The mobile operator should take a strong position in co-developing the standard for these technologies to ensure that their needs are met. The strong competition from OTTs and third-party developers requires radical change in value propositions. Delivering new sources of value requires re-thinking core elements of the current business model. In particular, telcos must embrace the fact that OTTs will continue to increase the distance between telco and the customer. However, this does not simply imply that telco should become a passive dumb pipe. Conversely, they should develop new and strong business models which aim to re-connect with the customer via for example a B2B2C route. Switching to such a route will solve two major problems. First, it will counter the trend of OTTs drawing on telco for access only and second, it will allow for greater loyalty from customers although in a more indirect way. The transition is not easy, far from it. It includes great organisational change, starting with the people and ending at the value proposition. A possible solution to aid this transition, is continued and strengthened focus on partnering with other telcos in service development and offerings and a clear implication of the transition is an increased emphasis on this. The challenges facing the telcos are a collective problem, and hence such strategic partnerships are beneficial for the industry as a whole. Virtualization promises to aid in this transition. As infrastructure becomes incrementally virtualized, telcos should consider partnering up with competitors in parts related to the CSP business model in an effort to reduce costs. Although controversial, such a model illustrates the key changes which are required for telcos to successfully transitioning towards a DSP. Furthermore, telco should not delay the implementation of a business model change. Adapting to the new competitive environment is key. Moreover, although virtualization is important in the transition, we acknowledge that it is not the sole contributor to the success. Hence, the DSP journey should be accompanied by great organizational change encompassing all levels of the hierarchy.

11.2 Implications for theory

Although this paper for the most part offers practical implications for telcos, there are some valuable implications for theory. This research focused on three main branches of strategy theory; disruptive innovation, activity-based view and business models.

In our efforts to ensure a robust analysis of the technologies, we brought together three widely-cited articles (Schmidt and Druehl 2008; Govindarajan, Kopalle and Danneels 2011; Christensen 1997) to develop a model for measuring the degree of disruptiveness for an innovation. In doing so, we believe that theory could benefit from more research on the topic of degree of disruptiveness. Specifically, theory is missing concrete tools for the assessment of disruptiveness *ex ante*, as most of the theoretical contributions on disruptiveness characteristics as are done *ex post* and hence become less applicable in anticipating future disruptiveness. Hence, an implication for future theoretical endeavours, is to further develop a measurability of disruptiveness which can be utilized both *ex ante* and *ex post*.

For the theory of the activity-based view, we applied Stabell and Fjeldstad's (1998) value network analysis on an empirical example. We thereby extend the use of the analysis, which has previously been applied, in example, on the life insurance industry (Fjeldstad and Ketels 2006). Similar to the findings of that study, our research confirms the universal applicability of the analysis on companies which create value through mediation. Applying the theory on an empirical example proved highly useful in dissecting the costs in a pragmatic and theoretically founded manner. Hence, even 18 years after the introduction of the analysis, our research shows that the value network analysis still is a complete and comprehensive, yet logical, tool for understanding, analysing and evaluating the value creation logic of a company.

The theory on business models is, as previously mentioned in the literature review, fuzzy and highly extensive. Keeping that in mind, our research adds to theory by taking a highly practical approach to the theory. Using broadly acknowledged theories, we extend the list of empirical examples on the use of business model theory in explaining business model transition and development. Furthermore, we apply the theories to relevant examples, which allows for readers to understand the concept of business models more easily. We do not, however, extend the understanding of the concept of business models, as is not the aim of this research.

11.3 Implications for method

In addition to implications for telco and theory, there are a few implications for method as well. First and foremost, future researchers on the topic should test our findings and propositions in a statistical manner. Assigning proper hypotheses and operational measures and testing whether our propositions holds for the greater populations would be of high interest. Nevertheless, our results imply that the propositions have support, to the very least within the context of a case study.

Moreover, future research designs should focus on a tighter incorporation of, and cooperation with, the chosen case company. The authors, although highly grateful for access to great data and interviewees, feel that the method would benefit from even greater access to data, which remained unavailable for us. One should however note, that such a close relationship with the case company requires strong focus on maintaining an unbiased view of the research.

12.0 Limitations

The most obvious limitation in this thesis, is its technical simplifications. Virtualization technology is highly complex and its proposed application is difficult to assess for business students. The authors have tried, to the best of their ability, to ensure a minimum, yet sufficient, level of technicality which some may find to be to superficial. Nevertheless, this simplification has required us to make certain trade-offs with regards to the potential of virtualization. In particular, potentially important discussion on choices related to the implication of virtualization are left out. Such discussions include, but are not limited to, private versus public cloud, the time frame of implementation and degree of implementation. Hence, our findings should be reflected on, bearing this in mind.

Second, although virtualization is a popular subject, most publically available reports are of a highly technical character. In an effort to keep the report relevant for the scope, we had to make assumptions. A clear limitation is hence our use of assumptions as they may be built on misunderstandings or may be just plain wrongful. As a countermeasure to this, we employed a large number of rich secondary sources to ensure that this effect was minimised.

Third, although the NDA provided us with greater access to information, it may also have impaired our ability to discuss as critically as we might have wanted to.

Finally, our research design invokes some clear limitations. By doing a single case study, the generalizability of our findings are limited. We do however argue that the challenges facing telco are systemic and hence that some generalization are in order. Moreover, the phenomena of virtualization is not yet fully conceptualised and hence our findings carry with them an inherent degree of uncertainty.

13.0 Appendices

Appendix 1: Basis for calculation of Network Promotion and Contract Management costs

Mill NOK	2011	2012	2013	2014	2015
	Telenor Group				
Telenor Group Revenue*	98 516	101 718	104 027	111 443	128 175
Opex*	15 192	14 702	14 313	14 931	15 454
Adminstrative costs*	7 743	6 703	6 220	6 610	8 183
Marketing costs*	2 312	2 011	2 142	2 523	2 949
	Telenor Norway				
Telenor Norway Revenue*	25 165	25 504	25 071	26 186	26 542
Telenor Norway revenue mobile operations*	12 903	13 639	13 308	14 426	15 082
% of Total Telenor Norway revenue	51 %	53 %	53 %	55 %	57 %
Adminstrative costs[1e]	3 097	2 681	2 488	2 644	3 273
Marketing costs[2e]	925	804	857	1 009	1 180
	Telenor Norway - Mobile operations				
Administrative costs[3e]	2 478	2 145	1 990	2 115	2 619
Marketing costs[4e]	740	644	685	807	944
Administrative costs mobile operations	19,2 %	15,7 %	15,0 %	14,7 %	17,4 %
Marketing costs mobile operations	5,7 %	4,7 %	5,2 %	5,6 %	6,3 %

* Numbers retrieved from Telenor Group Annual Report 2012, 2013, 2014, 2015

e) Estimated numbers

ASSUMPTIONS	
1) Administrative costs related to Norway	We assume that costs associated with contract management and sales of customer equipment are within the range of **30-40%** of overall administrative costs. We base this on the notion that salary costs are overall higher in Norway and hence bigger than for other parts of the world.
2) Marketing costs related to Norway	Due to the higher cost-levels and relative importance of Norway, we assume that **30-40 %** of group marketing costs can be assigned to the Norwegian part of the operation.
3) Administrative costs associated with mobile operations	Mobile operations constitue 50-60 % of overall revenue in Telenor Norway. As previously mentioned, we assume that costs associated with contract management are similar across markets. However, we do appreciate that since Norway employs a greater part of these functions, the cummulative effect of these activities are greater than revenue contribution should warrant. We therefore assume that **80 %** of administrative costs are related to mobile operations.
4) Marketing costs associated with mobile operations	Mobile operations constitue 50-60 % of overall revenue in Telenor Norway. We believe that most of the money spent on marketing is related to promoting mobile operations, and that the latter is spent on Canal Digital. We therefore assume that marketing costs are slightly higher than mobile revenue contribution should indicate and hence we assign **70-80 %** of marketing costs are related to mobile operations

Appendix 2: Basis for calculation of Service Provision costs

Mill NOK		2011	2012	2013	2014	2015
Telenor Norway Revenue*		25 165	25 504	25 071	26 186	26 542
Revenue mobile operations*		12 903	13 639	13 308	14 426	15 082
% of Total revenue		51 %	53 %	53 %	55 %	57 %
Salary costs Group*		10775	10683	10755	11375	12406
No. Of employees Group*		32 030	32 900	34 000	35 000	38 000
No. Of employees Norway*		6760	6770	6460	6209	6047
Estimated salary costs Norway	e	5 507	5 403	5 270	5 430	5 696
% working in Customer services	e	50 %	50 %	50 %	50 %	50 %
% working in Manual services	e	10 %	10 %	10 %	10 %	10 %
Acquired software	e	1 316	1 265	877	1 191	1 265
		Telenor Norway				
Invoicing	1	252	244	184	233	247
Customer services	2	3 148	3 081	2 898	3 073	3 227
Manual services	3	551	540	527	543	570
		Telenor Norway - Mobile operations				
Invoicing		252	244	184	233	247
Customer services		3 148	3 081	2 898	3 073	3 227
Manual services		551	540	527	543	570
Invoicing		1,96 %	1,79 %	1,38 %	1,61 %	1,64 %
Customer services		24,4 %	22,6 %	21,8 %	21,3 %	21,4 %
Manual services		4,3 %	4,0 %	4,0 %	3,8 %	3,8 %

* Numbers retrieved from Telenor Group Annual Report 2012, 2013, 2014, 2015

e) Estimated numbers

ASSUMPTIONS	
1) = Invoicing	Invoicing is not as extensive work as it used to be. Based on this, we assume that no more **1 %** of the workforce carry invoicing activities. In addition, costs associated with software licenses and sever usage is assumed to constitute **15%** of yearly software acquisitions.
2) = Customer services	We assume that customer services is one of the biggest sources of costs for Telenor. We know that Telenor operated 8-15 customer service centers in Norway, each with more than 100 employees. Based on this, we assume that **50% of the workforce** work with customer services including retail personnel and dedicated customer service personnel. Finally, we know that IT and software is highly important in customer services and hence we assume that **20-30%** of acqusitions of software are related to Customer services
3) = Manual services	Manual services refers to services which are provided to the customer as mean to facilitate use of the network and are to a large extent unspecified. We assume that this is not a service which is performed in a wide scale, and hence we believe that no more than **5%** of the workforce is involved in

Appendix 3: Basis for calculation of Infrastructure Operations costs

Mill NOK	2011	2012	2013	2014	2015
Telenor Norway Revenue	25 165	25 504	25 071	26 186	26 542
Revenue mobile operations	12 903	13 639	13 308	14 426	15 082
% of Total revenue	51 %	53 %	53 %	55 %	57 %
Operation and maintenance Group[1]	4 983	5 111	5 271	5 830	7 046
% of O&M related to Norway[2]	50 %	50 %	45 %	40 %	35 %
	Telenor Norway				
Operation and maintenance Norway	2 492	2 556	2 372	2 332	2 466
Depreciations	3 291	2 792	3 095	3 423	3 565
	Telenor Norway - Mobile operations				
Operation and maintenance Norway	5 782	5 347	5 467	5 755	6 031
Operations and maintenance	44,8 %	39,2 %	41,1 %	39,9 %	40,0 %

ASSUMPTIONS	
1) = Operation and maintenance group	We assume that operation and maintenance costs encapsulate both switches, base stations and lines, and terminals. We also assume that all costs are related to mobile operations, supported by indications found in our interviews with key Telenor Norway people.
2) = % of O&M related to Norway	From our interviews we learned that operating a mobile network in Norway costs approximately 2,4 Bill NOK yearly. Based on this finding and a general assumption of costs remaining relatively stable, we assum the **% of O&M related to Norway was 35-50% between 2011-2015.**
3) = Investments in infrastructure Norway	Overall CAPex for Telenor Norway was found in annual report. We assume the **90%** of these relate to the mobile operations business while the remaining allocates to fixed line infrastructure.

Appendix 4:Basis for calculations of Technology Development costs

Mill NOK	2011	2012	2013	2014	2015
Telenor Norway Revenue	25 165	25 504	25 071	26 186	26 542
Revenue mobile operations	12 903	13 639	13 308	14 426	15 082
% of Total revenue	51 %	53 %	53 %	55 %	57 %
R&D Group[1]	387	325	351	530	511
% of R&D related to Norway[2]	90 %	90 %	90 %	90 %	90 %
	Telenor Norway				
R&D in Norway	348	293	316	477	460
	Telenor Norway - Mobile operations				
Operation and maintenance Norway	348	293	316	477	460
Technology development	2,7 %	2,1 %	2,4 %	3,3 %	3,0 %

1) = R&D group level	We assume that R&D costs involve all costs related to the category of Technology Development. Finding these costs based on the particular set of subactivities has proved impossible given our access to data
2) = % of R&D related to Norway	R&D efforts are usually geographically neutral. Technological and service developments are aimed at functioning across all markets. Hence, we assume that **90%** of costs related to R&D can be assumed in Telenor Norway.

Appendix 5: Basis for calculations of Cost Effects Virtualization

Activities performed	Current cost	Five-year cummulative cost effects		Future costs[e]	
		Bear case	Bull case	Bear	Bull
Marketing activities	6,3 %	0,0 %	0,0 %	6,3 %	6,3 %
Contract management acitivies	17,4 %	4 %	7 %	16,7 %	16,2 %
Netvork promotion and Contract management	**23,6 %**	**3 %**	**5 %**	**22,9 %**	**22,4 %**
Invoicing	1,6 %	2 %	8 %	1,6 %	1,5 %
Customer services	21,4 %	7 %	12 %	19,8 %	18,9 %
Manual services	3,8 %	0 %	0 %	3,8 %	3,8 %
Service provisioning	**26,8 %**	**6 %**	**10 %**	**25,2 %**	**24,1 %**
O&M Infrastructure	40,0 %	21 %	35 %	31,6 %	26,0 %
Infrastructure Operation & Maintenance	**40,0 %**	**21 %**	**35 %**	**32 %**	**26 %**
CAPex Infrastructure[1]	16,4 %	40 %	60 %	9,8 %	6,6 %
TOTAL COST OF OWNERSHIP SAVINGS		**30 %**	**50 %**		

[e] Estimated future cost based on assumptions

Assumptions		
1) CAPex infrastructure	Infrastructure CAPex is assumed to be **90%** of all infrastructure investments in Telenor Norway and is calculated based on numbers in Telenor Group Annual Report	
Nature of cost	**Savings estimate**	**Source**
Aggregated OPEX Aggregated CAPEX	67 % 68 %	ACG Research (2015) "Total Cost of Ownership Study Virtualizing the Mobile Core"
Aggregated OPEX Aggregated CAPEX	37 % 48 %	ACG Research (2015) "Business Case for Brocade Network Analytics for Mobile Network Operators"
Aggregated OPEX Aggregated CAPEX	40-45% 19-30%	ACG Research (2015) "Business Case for a Common NFV Platform"
Aggregated OPEX Aggregated CAPEX	67 % 44 %	Alcatel Lucent (2014) "Business case for moving DNS to the cloud"
Aggregated OPEX Aggregated CAPEX	27 % 35 %	ACG Research (2015) "Business Case for NFV/SDN Programmable Networks"
Aggregated OPEX Aggregated CAPEX	20-30% 20-35%	Doyle Research (2016) "https://www.sdxcentral.com/cisco/service-provider/info/analysis/building-nfv-business-benefits"

Appendix 6: Intervie guide template

Interview guide

Topic 1: DSP

- How important is technological advandcements for an increased role as a digital service provider?
- How will Telenor take a bigger part in the role as a digital service provider?
- How do you plan to remain attractive as a network provider?
- How do you gain the capabilities and resources capable of enabling the transition to a DSP?
- How do you plan to maintain your unique position in Norway?
- How do you see Telenor changing in a telco industry which is becoming increasingly IT-based?
- What are your plans for tackling the competition from other industries entering the telco industry?
- How will virtualization enable the transition to a digital service provider?

Topic 2: Virtualization

- How do you assess the impact of NFV and SDN?
- What impact have these technologies had on the industry up until today?
- How do you assess their future impact?
- What impact will their implementation have on Telenor Norway?
- In which pace will these be implemented?
- How will these technologies affect Telenor's service offering?
- What are the risks with implementing/not implementing NVF and SDN?

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Preliminary Thesis Report

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-A Case study of Telenor-

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Table of Contents

1.0 Introduction

1.1 Introduction and research topic

In our master thesis we have chosen to study how the digital development impacts the business model of the telecommunications company Telenor. More specifically, we intend to focus our research on exploring how Telenor's business model is transformed through recent technological advancements. The study aims not to generate new theory on the topic, but rather to apply an empirical analysis. The topic is of particular interest as the telecom industry has been, and is subject to, intense digital development, which continuously shifts the characteristics of the industry. This again, we believe, forces the industry to adopt its business models to fit the new environment. Hence, the need for a viable and competitive business model is of the essence for incumbent firms. To limit our research, we have chosen to focus on Telenor Norge and the Norwegian market. Our working research question(RQ) is:

How can Telenor develop its business model to adapt to the digital development in the telecommunications industry in Norway?

Such a research question does not come without a set of assumptions underpinning it. First, our RQ implies that there is an on-going digital development within the industry. The telecom industry has witnessed remarkable digital developments over the last decade. The industry has evolved from focusing on basic connectivity infrastructure to delivering broadband with immense capacity. The technological advancements are continuous and will continue to shape the industry. Second, the RQ asserts that the digital development requires Telenor to develop their business model. As the industry changes, so do the need of consumers. While new technology facilitates new service and infrastructure development, the need for a business model suited to meet the opportunities is pressing.

1.2 Hypotheses

To guide our efforts, we have constructed a set of hypotheses.
H1: Telenor's current business model is configured in such a way that it reflects the desired current position in the market.

H2: Telenor's current business model must be configured in such a way that it is capable of absorbing future emerging digital developments.

The aforementioned hypotheses represent the authors' statement for what we expect to find. Hypothesis 1 states that Telenor's current business model reflects their assessment of the current position they intend to have. It should hence be a product of their strategy to claim the desired position in the industry and should be reflected in the activities performed. Importantly, such a hypothesis subsequently assumes that current digital developments are presently mirrored in the business model. Our efforts towards "proving" H1 will be done in an analysis of the current business model, its activities and strategy. Hypothesis 2 speaks of the ability to develop a business model well-suited to tackle the future emerging digital trends. It assumes that a viable strategy and hence business models must reflect Telenor`s aspirations for the future as well. This hypothesis will create some leverage for the authors as to speculate and formulate recommendations on how such a business model should be configured.
Importantly, as our research is quite explorative in nature, our hypothesis cannot be fully confirmed or discarded, as is not our intent either. However, they serve us well as guidelines for directing our research. They will also be subject to continuous evaluation as the work progresses and data is collected.

2.0 Research background

2.1 The Norwegian telecommunications industry

The modern Norwegian telecom industry is still dominated by a few, but strong players. In particular, Telenor and Netcom claim the top positions in the market, although several smaller and competitive firms have entered during the last decade. The two companies command more than 70% of industry revenue (Norwegian Communication Authority 2015). The industry opened for competition as recent as 1988, but matured quickly and is believed to be a mature billion-dollar industry (Vinje and Nordkvelde 2011).
The Scandinavian telecom industry, and the Norwegian in particular, have a history of being in the forefront of technological development. The well-renowned engineer Herbert Laws Webb noted that the telephone had the rapidest and freest development in all of Europe (Webb and Cox 1910). In 2002, the first trial UMTS

(universal mobile telecommunication system) call took place in Norway. A mere seven years later, Netcom introduced the world´s first 4G (fourth generation) network in Oslo. Hence, the technological infrastructure in Norway is well-developed.

As the world has become increasingly mobile, the telecom industry has witnessed a major shift in their way of conduction business (Vinje and Nordkvelde 2011). Firms are no longer confined to their own industries and several new players have moved into telecom. In 2001, revenues from fixed line telephony exceeded 6.000 million NOK whereas the number was reduced to approximately 1.700 million NOK in 2015 (Norwegian Communication Authority 2015). In contrast, broadband and mobile services now constitute more than 13.000 MillNOK in revenues. Traditional services such as SMS, MMS and Voice are declining both in profits and revenues contribution, while data traffic have increased from a mere 5 million GB(gigabytes) in 2011 to close to 45 million GB in 2015 (Norwegian Communication Authority 2015). With this rapid development and change in customer needs and requirements, comes a set of challenges and opportunities for the incumbents in the industry. The potential interaction with related industries presents opportunities for increased revenues as technology enables content and services directly to the end user.

2.2 Telenor

Telenor is a Norwegian telecommunication company, headquartered in Fornebu, outside of Oslo. The company operates in 13 markets in the Nordics, Central and Eastern Europe and Asia. Furthermore, through their ownership stake in Vimpelcom ltd., they are present in 13 additional markets around the globe. In the third quarter of 2015, the Norwegian market accounted for one fifth of their total revenues. Moreover, their core business in the Nordic region is primarily in mobile and fixed services. However, they maintain a strong position in the broadband market in addition to amongst the market leaders in providing broadcasting services. (Telenor Group 2016b)

In the strategy period from 2015-2017 Telenor have established three strategic ambitions to ensure growth, value creation and a retained retail position within communication services and connectivity: 1) Internet for all, 2) Loved by customers and 3) Efficient operations (Telenor Group 2016a). The two latter

ambitions relate to an overall objective of creating customer satisfaction while increasing profits. Digital development continue to be a clear strategic focus, with Telenor stating that adjacent verticals with potential to significant contribute to growth and value creation, are promising business areas(Telenor Group 2016a).
As a measure of the importance of digital development, Telenor merged their Strategy and Digital units during 2014, to bring digital development even closer to its core (Telenor Group 2015).

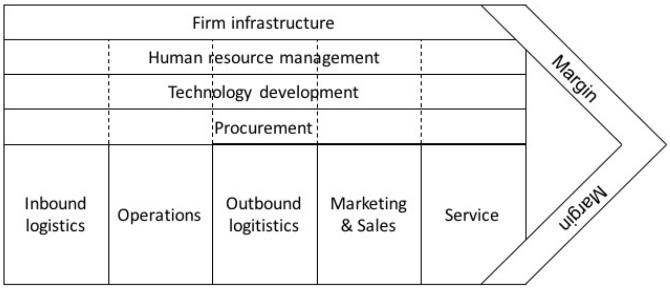
2.3 Theoretical foundation

In this section we outline the theoretical foundation of our research. Due to the nature of our research we will anchor our research in the Activity-based view (ABV). First, we start off by outlining the main body of ABV before moving on to the and its advancements over the years. Second, we outline theoretical contributions in the field of business models and telecom.

2.3.1 Activity-based view

The notion of viewing the firm as a series of functions performed to design, produce, market, deliver and support a firms' product(s) was initially a view found in the management consulting industry. The concept was termed Business Systems (see Buaron (1981), Gluck (1980). In his well-acclaimed work on competitive advantage Porter (1985) redefined the view to include activities rather than functions. The main proposition of his work showed how competitive advantage arises from the configuration and interrelationship between activities performed in the firm. He postulated that all activities inside the firm could be categorised as either primary or supporting activities. Primary activities refer to those concerned with the physical creation of the product, sales and distribution in addition to after sales services. Supporting activities support the primary activities by providing inputs, human resources and various firm-wide functions. The aforementioned categorizing of activities resulted in what became known as the value chain model (see figure 1).

Figure 1 - Porters generic value chain model



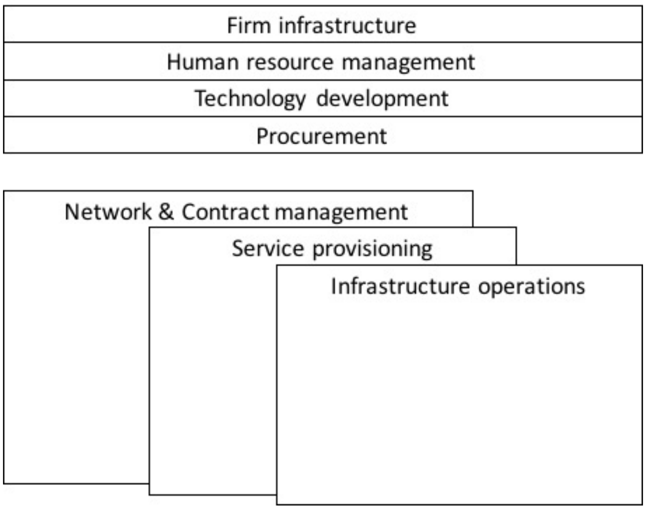
They key in diagnosing the competitive advantage of a firm lies, according to Porter, in analysing *how* each activity is performed. The way it is performed determines the subsequent cost position and differentiation effort. The diagnosing effort was termed value chain analysis and lies at the heart of the activity-based view. Porter (1985) went on to describe how linkages, or relationships between how an activity is performed and the cost or performance of another, can lead to competitive advantage in two ways: optimization and coordination. By optimizing the activities performed in such a manner that the position cannot be replicated without making significant trade-offs, allows a firm to attain sustaining competitive advantage. The ability to effectively coordinate the linkages will likely give a basis for cost-reduction or differentiation and, hence, lead to a competitive advantage.

A well decade later, Porter wrote his seminal article "What is Strategy?" which addressed a growing misconception in the utilization of the activity-based view amongst practitioners (Porter 1996). Dating back to the 1980s when Japanese firms outcompeted Western firms, companies had started to focus on operational effectiveness rather than strategic positioning. Operational effectiveness refers to the ability to perform similar activities better, while strategic positioning refers to performing different activities than your competitor. However, choosing a strategic position is not in it self enough to guarantee a sustaining competitive advantage (Porter 1996). Competitors can easily reposition themselves to match the position or more commonly match the position while maintaining the original position, also termed straddling. The solution, Porter proposed, is to configure the activities in such a manner that any replication or straddling efforts will demand the competitor to make certain trade-offs against other positions. The trade-offs may rise from three main reasons: inconsistency in image and reputation, the nature of the specific activities performed and, finally, limits on internal control and coordination.

Moreover, Porter (1996) found that in order for the strategy to yield a sustaining competitive advantage, the firm must create a fit amongst its activities. Fit excludes and locks out competitors by creating a chain which is only as a strong as it strongest link (Porter 1996). There are three main types of fit involved although they are not mutually exclusive. First-order fit refers to a simple consistency between each activity and the overall strategy. The activities must reflect the overall strategy of the company, be it low-cost or differentiation. Second-order fit is met when activities are reinforcing. This is a step further from simple consistency as it adds a reinforcement factor. In example, if marketing efforts in one part of the market are performed in such a way that the activity is reinforced in other parts, then subsequently marketing cost can be lowered and the activity is said to be reinforcing. Third-order fit or optimization of efforts refers to coordination and information exchange across activities to reduce redundancies and minimize waste. This is, however, the most basic level of optimization effort and higher levels do exist. Importantly, as emphasized by Porter (1996), the whole matters more than then individual parts. Competitive advantage comes from the entire system as fit among activities can lower cost dramatically or increase differentiation. Hence, a potential competitor won´t reap the benefits of the position by copying parts of the activities but would rather run the risk of loosing both positions (existing and new).

As the value chain analysis framework began paving its way into businesses, business schools and journals, one in particular interesting article transformed ABV. Having observed and applied the value chain analysis framework on a variety of firms in different industries, Stabell and Fjeldstad (1998) found that the framework had clear limitations. Specifically, the framework was not, as Porter had proclaimed, applicable for all firms. The primary and supporting category definitions of the generic value chain model proved difficult to fit with the activities of certain firms. Drawing on Thompson (1967) typology of long-linked, intensive and mediating technologies, they coined two additional generic models of activities in the firm. These new configurations were termed value shop and value network and were a useful addition to ABV. The value shop was characterized by firms which rely on intensive (Thompson 1967) technology to solve a complex customer problem. A typical example is professional services found in law, consulting, medicine and architecture. Central to the theme of value creation in value shop, lies in the element of information asymmetry.

Figure 2 - Generic value network model



Source: Porter, Michael E. 1985. "Competitive advantage: creating and sustaining superior performance."

The third configuration (see figure 2) outlined by Stabell and Fjeldstad (1998) include firms which rely on mediating (Thompson 1967) technology to link customers who are, or wish to be, interdependent. Importantly, the value network firm is not a network in itself, but it rather offers networking services to its customers. Telecommunication firms, retail banks, price comparison firms and insurance companies are modern-day examples of value networks. Value creation in the value network is less obvious and often more complex to understand. However, Stabell and Fjeldstad (1998) describe the value network as *"mediators [who] act as club managers"* (P. 427) who admits members who compliment one another. The process is governed by a set of customer contracts, which commit both parties to a mutual set of obligations.

The primary activities in the value network are divided into three main categories. First, network promotion and contract management consists of activities aimed at courting potential customers to be part of the network, selecting desirable customer and terminating contracts. Second, service provisioning are activities which are associated with establishing, maintaining and terminating links between customers. In addition, activities, which are aimed at charging customers for value received, also fall under the service provisioning category. Third, network infrastructure operations reflect activities concerned with running and maintaining the physical and information infrastructure. Moreover, in supporting activities, network infrastructure development and service development are of particular interest. Network infrastructure developments are activities concerned with the design, development and implementation of network infrastructure, while service development involve activities associated with everything from the modification of a large set of customer contracts to developing new services. In the value network, the ability to create and sustain competitive advantage rests upon achieving positive network externalities (Arthur 1996, Grant 1996, Katz and Shapiro 1985). In other words, the value of the network and hence its attractiveness to users depends on the size of the network. Firms will compete to increase their network size because of the aforementioned effect on the value of the network for customer (Fjeldstad, Becerra, and Narayanan 2004).

2.3.2 Digital development and business models in the telecom industry

In the past three decades, the telecom industry has undergone several significant shifts in the way business is conducted (Li and Whalley 2002). The shift from merely carrying voice, mitigating text and multimedia messages to a complete service provider, has made significant impact. In particular, the impact of internet-based services has pushed the telecommunication industry towards a "data carrier" role. This constitutes a dilemma for the incumbents. The worst case scenario for a telecom company is becoming solely a "data carrier", while other industries reap the profits from delivering services and content (Peppard and Rylander 2006). The industry has moved from a point where the complete vertical pipe was found within the firm to fiercer competition from new industries and players and have largely eliminated the need for any physical network infrastructure in order to be part of the industry. In the following section we outline the characteristic for such a change in addition to current theoretical foundations.

Through the lens of ABV, Li and Whalley (2002) argued that the telecommunications industry has moved from a value chain towards a value network. The incumbents in the industry comprise no longer of suppliers inherent to the telecommunication industry, but a pool of actors from a wide range of industries collectively serving the needs of the customer. Moreover, Zwass (1996) noted that the increasing importance and spread of the Internet would likely diminish all of the benefits associated with the integrated firm. This emerging paradigm has resulted in declining stock prices for traditional telecommunication firms and questions have been asked to the viability of the integrated firm (Fertig, Prince, and Walrod 1999, Isern and Rios 2002). The term business model has generally been defined as the way a company earns it revenues (see example Ethiraj, Guler, and Singh (2000)). However, as noted by other scholars (see example Porter (2001), (Timmers 1998, 1999)) the definitions of the business model is subject to scrutiny and thus a rock solid definition is yet to be agreed upon. In this research, we follow the definition outlined by Amit and Zott (2000) and Li and Whalley (2002) where the business model is defined as the way in which value is created for all partners, customers and suppliers through enabling transactions.

The traditional business models focused on attracting new customers to the network as it was vital to the profitability of the network, the changes in digital development have forced the incumbents to form closer relationships with the end customer. In their efforts to deconstruct the telecommunications industry, Li and Whalley (2002) found that infrastructure companies are likely to choose one of five routes to reach the end customer faced with the digital development. Each of these routes is also a business model. Software intermediaries, financial intermediaries, content providers, portal and resellers constitute the five possible routes. Software and financial intermediaries act as facilitators to bridge the gap between the infrastructure company and the end-user. The aim of this particular type of business model is to bring the company closer to the end customer and, hence, integrating the network by leveraging their existing capabilities. Content providers are usually thought of as having little or nothing to do with the infrastructure companies, however such a link is not unimaginable for the infrastructure company. The portal business model is that of an aggregator. The infrastructure company chooses to either passively or actively integrate third-party software into its services. In the heart of such a business model is the establishing, maintenance and termination of relationships with other companies. Finally, the reseller business model represents a very different approach. The reseller purchases capacity from the infrastructure company and then turns its focus on the end customer by offering his products and services. This strategy allows him to effectively bypass the former need for physical network infrastructure, and reach the end customer with little investments.

Finally, Peppard and Rylander (2006) described how the structure of the industry changes even further. As digital development provides new business opportunities, companies from other industries move in and claim positions. This puts increasingly pressure on the incumbent firms to further develop their business models to best position themselves. Infrastructure no longer poses a high barrier, and new and innovative competitors effective may compete away the industry incumbents.

Brought together, our initial literature review points to some highly interesting theoretical foundations for the further research. Although the value chain has predominately been the focal point for analysis of most companies, advances have provided new insight. The value chain does not apply to the characteristics of the telecommunications industry. Rather, the model of a value network is a more accurate model of analysis. The technological developments in the industry have changed the structure and new emerging business models face the industry. The incumbents face a new and fiercer competition as the boundaries of industries fade.

3.0 Research Methodology and data collection

3.1 Research design

For the thesis at hand, we have chosen a qualitative research strategy. The research will be performed using a single-case study design, with an exploratory approach. Moreover, our primary source of data will stem fro in-depth interviews. We will however also have to rely on secondary sources of data to complete the project. The use of multiple sources of information is one advantage of the case study approach (Yin 2014, Woodside 2010). This enables us to triangulate the findings from each method, which will hopefully contribute to the surfacing of converging lines of inquiry and strengthen the validity of our research.

3.2 Data collection

Our main empirical data will be collected through a series of semi-structured interviews of managers at different levels in Telenor. The use of this methods allows us to narrow our focus as compared with an unstructured interview approach. The narrowing of focus decreases the possibility of being overwhelmed by data (Eisenhardt 1989). Additionally, it might ease the process of coding the data once collected. Finally, such an approach facilitates flexibility to deviate from a rigid structure in our interviews(Saunders, Lewis, and Thornhill 2009). Such a trait is valuable as it provides us with the leverage to explore further into specific areas during our interview. Summarized, using semi-structured interview will provide us with an optimal combination of focus and flexibility to obtain the best possible data collection and suits the aim of our research well.

By choosing Telenor Norway as the unit of analysis, data collection is made easier because of the close proximity of the company headquarter. Conducting the interviews will not require immense travelling and, thus, provides us with flexibility should any unforeseen event emerge. This is a genuine concern as managers might have pressing issues which arise at the time of the interview. Moreover, the close proximity of the company enables us to conduct our interviews face-to-face, which provides a richer and more dynamic communication than if the interviews were executed with individuals through Skype or phone-interviews.

3.3 Interviews

Through conversations with supervisor Torger Reve, we have developed an initial interview plan. The plan is depicted in table 1.

Table 1: Interview objects

Name	Position	Industry
Ellen Altenborg	Formerly Telenor employee, now management consultant with expertise in Value Network Business	Telecom Consultancy
Frank Elter	Vice President Telenor Research	Telecom
Berit Svendsen	CEO Telenor Norge	Telecom
Øystein Fjeldstad	Telenor Professor at BI Norwegian Business School. Expertise in Value Networks and strategy	Academic
Amir Sasson	Associate Professor at BI Norwegian Business School. Expertise in Network theory	Academic

The overview will become richer as contact is made with key personnel in Telenor and we expect the final number to be between 10-15 in total.

To further enrich our research and to gain a broader perspective in our research, we intend to interview key scholars from academia as well. Our hope is that the academic view will provide us with compelling contributions in terms of the theoretical point of view with regards to our RQ. Ideally, these will support what we observe in Telenor but, nonetheless, we believe the expected contributions to be valuable. The mix of interview objects from top-management, academic research and consultancy will provide us promising focal point in our quest to answer the RQ. Furthermore, an interview guide will be developed to ensure that we do not drift too far away from the research focus.

3.4 Secondary sources

Secondary data, such as journal articles, books, newspaper articles, annual reports, analysts reports and company webpage will be used when analysing the case. A favourable aspect of doing a case study on Telenor is the numerous publically available sources, which provide vital information. The contributions will be cited according to academic standards to ensure that credit is awarded where credit is due.

3.5 Sensitive information

Since Telenor is a publicly traded company, we must anticipate that some of the information we acquire access to, may entail the signing of a non-disclosure agreement (NDA). Faced with such a dilemma, the authors are prepared to take the necessary steps to ensure that no sensitive information is published.

3.6 Research challenges and limitations

Our most prominent research challenge is that of our chosen design. A multiple-case study approach is by some perceived as more robust and preferred relative to single-case studies (Yin 2014). Moreover, comparative case studies usually build a stronger foundation for creating novel theory (Yin 1994). However, since our aim is not to develop novel theory, we feel confident that our chosen approach is appropriate. Additionally, due to time constraints, a single-case study seems advantageous to our research and aim. Lastly, a single-case study approach allows us to gain a more in-depth understanding of the company in question and hence will provide a richer study with regards to our chosen RQ.

The second challenge addresses our chosen interviewees. As we aim to interview top-management personnel, access might be difficult as these managers have tight schedules. Meticulous preparation will thus be crucial as proper execution of the interview will be vital in gaining the highest quality interaction with interviewees in a limited timeframe. Moreover, to counteract this potential hinder, we must make contact with interviewees early in the process.

A clear limitation of our research is our top-down approach. Since our main bulk of interviewees are either middle- or top-managers we might overlook important data residing within lower parts of the organization. Hopefully, our interview subjects will recognize this and guide us to appropriate personnel if such is the case. Lastly, due to the nature of our research design and methods, the conclusions and finding will not be generalizable to other industries nor will it develop novel theory.

4.0 Expected contributions

The aim of the research conducted in this thesis, is to shed light on how the digital development in the telecommunication industry affects the business models of incumbent firms. We do so through a single-case study of the major telecommunications firm Telenor. More specifically, we study the effect on the business model of Telenor within the boundaries of the Norwegian market.
Our expected contribution is hence twofold: *a.* The research adds to empirical contributions on the topic of digital development and evolving business models and *b.* The research presents new insights to Telenor and its management team.

With regards to a) three expected contributions are identified:

1. The research provides a description of the current digital development in the telecommunication industry. Hence, it contributes in providing such an analysis in itself.
2. The research can serve as a basis or incentivize further research on the chosen topics.
3. The research becomes an empirical contribution on the development of business models within the telecommunication industry in Norway.

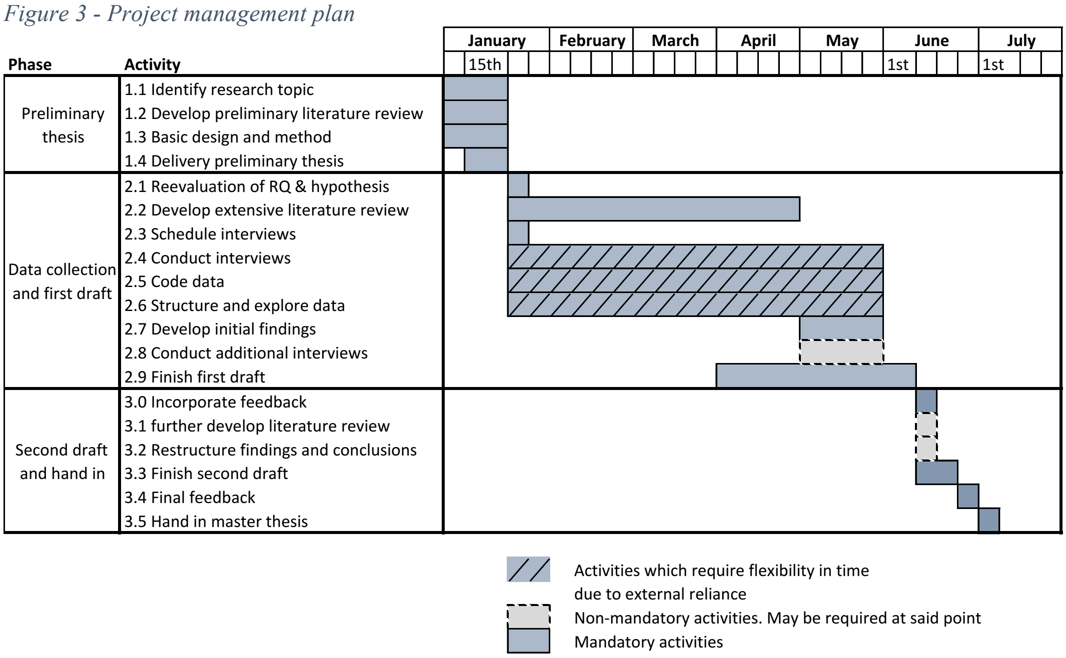
Moreover, we expect two distinct contributions for the Telenor management team:

1. The research reveals novel insight to the management team, which allows them act upon this if deemed appropriate.
2. The research confirms what is already known within Telenor and, hence, strengthens their initial efforts in developing a successful business model.

5.0 Progression plan and project management

The project will be carried out by MSc students Stig-Jonathan Eikenaar Kjetså and Eric Pascual under the supervision of Professor Torger Reve. The preliminary will be handed in the 15th of January 2016 and marks the starting point for our further work. Figure 4 outlines the current project plan and will serve as basis for our further progress.

Figure 3 - Project management plan



The plan outlined above is a proxy for the progress and is thus subject to change during project lifetime. We aim at delivering the final thesis on the 1st of July 2016.

5.1 Critical activities

In order to ensure a sound progress is made, some critical activities are crafted. They differ from other activities in the sense that they will serve as rigid dates for which to aim our progress. The activities are outlined in table 2.

Table 4 – Critical activities

Activity	Date	Description
1.4 Delivery of preliminary thesis	15.01	Deliver the preliminary thesis. First chance for feedback on thesis.
2.3 Scheduling interviews	Week 4	Scheduling interviews is critical as access to key personnel is of the essence.
2.9 Finish first draft	01.06	The first draft is critical in the sense that it serves as date in which to aim the progress toward.
3.3 Finish second draft	15.06	The second draft is the last milestone in which only finalization of the thesis remains
3.5 Hand-in	01.07	The hand in date of the finals thesis

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