Final Thesis

“Business model innovation to explore data analytics value;
A case study of Caterpillar and Ericsson.”

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Abstract

The aim of the thesis is to identify a roadmap for well-established companies towards business model innovation to explore data analytics value. The business model innovation currently taking place at Caterpillar and Ericsson in order to explore data analytics value is presented to answer the question:

“How do established companies explore data analytics to innovate their business models?”

Initially, the problem discussion, formulation and purpose are given. Then, the relevant theory is presented covering the importance of data analytics, IT infrastructure challenges due to the increased volume of data created, data analytics methods currently being used, smart connected products and the Internet of Things. The meaning of business model innovation is given, followed by a well-structured business model process which includes the business model canvas for representation purposes. The business areas affected by data analytics value and the barriers of business model innovation are given as well. After that, the theory addressing business model innovation to explore data analytics value is presented and the main industries which are currently on this journey along with the required initial steps and the business models that can come out of this process are identified. The challenges and risks if the option of not following this route is chosen are also shown. The method section follows to explain the case study design, data collection method and way of analysis. The results cover all the information gathered from numerous sources including on-line available information, papers, interviews, videos, end of year reviews and most importantly current Caterpillar and Ericsson mid-level management employee answers to a questionnaire created and distributed by the authors. The business model canvas tool is used to aid the reader understanding Caterpillar’s and Ericsson’s business model innovation. Each company’s business model is given before and after data analytics adoption. Finally, the analysis of the results and the link with the theory is given in order to answer the thesis question.

Keywords:

Business model, innovation, data analytics, Caterpillar, Ericsson
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1. Introduction

1.1. Background

The emergence of the Internet of Things (IoT), together with the decline in memory price and the development of versatile network architectures, has allowed companies to store and process huge amounts of data generated by their customers, devices and processes. Data Analytics offers the means to extract relevant information and insights from this data, giving companies numerous possibilities in terms of expanding the scope of existing products and services and/or disrupting industry barriers by offering innovative products and services.

Organizations need to adapt their business model in order to mould themselves to this new scenario and maximize the value being created and delivered to customers, while also making sure they are able to monetize this value. This thesis intends to study data driven business model innovation theoretical models and analyse the way these models are being implemented by Caterpillar and Ericsson (global leaders in their respective industries) on their effort to extract value from data analytics.

1.1. Problem discussion

1.1.1. Data analytics value

Today there are multiple data sources or data generators following the incorporation of computers in a variety of products from mobile phones, home electric appliances to cars, machinery and airplanes. Even humans are transforming into data generators through social media. The Internet of Things and advances in the IT industry allowed for the capture, storage and transmission of huge amounts of information (Loebbecke & Picot, 2015). The volume of data is continuously growing exponentially (Loebbecke & Picot, 2015). Data analytics has provided companies, both start-ups and established players, the possibility to further understand their customers’ needs and concerns, their buying patterns and also provide a platform to expand traditional product/service boundaries. Companies can now monetise this added value by exploring new business opportunities (Porter & Heppelmann, 2014) (Loebbecke & Picot, 2015).

In this evolving scenario a company’s capability to strategically innovate its business model in a way that maximizes potential revenues is a key condition for success (Loebbecke & Picot, 2015).

1.1.2. Business model and innovation

A business model is generally speaking “the rationale of how an organization creates, delivers, and captures value” (Gobble, 2014, p. 59) and is comprised of nine building blocks: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure (Osterwalder & Pigneur, 2010).

A company can gain value two ways: a) by developing new ideas, technologies, products or services and b) by innovating its business model (Chesbrough, 2010). Business model innovation occurs when a company finds a new way to perform business which disrupts its industry and differentiates it from competition. New customer value is created and the company captures the benefit (Malarkey, 2014). The majority of senior managers prefer business model innovation to new products/services as the way to offer a competitive advantage (Ammit & Zott, 2012).

Business model innovation enables the exploit of new business opportunities to create and capture value in contrast to old models which led businesses to a cycle of declining revenues and profit margins (Ammit
This is also the way forward specifically in the data analytics case (Porter & Heppelmann, 2014).

1.1.3. Data analytics and business model innovation

Data analytics enable the experimentation and innovation of business models to offer new products and services (Gobble, 2014). These capabilities are impacting the way value is created and captured by companies, lowering entry barriers in different industries and pushing incumbent companies to adopt this 3rd IT revolution at the risk of being left behind, and their products/services being commoditized while other (usually smaller) company captures value with Over-the-top (OTT) applications that are perceived by customers as value-adding (Porter & Heppelmann, 2014).

Classical manufacturers, whose previous model allowed to capture value once as the product was sold, are turning into service providers, who are able to capture value throughout the life of a product. This means that developing a great product is not sufficient and companies have to think how they can offer support services to the customer to keep benefiting from their products (Gobble, 2014). Moreover, products are becoming more efficient as the manufacturer is able to understand even better how a product is actually used. It is now possible to predict a future component failure, reducing downtime for the customer and improving operations for the manufacturer (Porter & Heppelmann, 2014). Additionally, service providers are now able to better understand their customers' needs and concerns through the implementation of data analytics techniques, opening new opportunities in terms of further customizing their services portfolio (Duan, 2015). The pressure for business model innovation to explore these new business opportunities is especially high at well-established companies (Porter & Heppelmann, 2014).

While the need to incorporate data analytics to their business model is recognized by well-established companies, taking the next step and proactively innovate and adopt data analytics is no easy task. This is because of the presence of internal barriers, mainly due to the “high inertia” of these companies (Eichen, et al., 2015) (Chesbrough, 2010).

In this scenario, the need to establish a business model innovation process and have a clear roadmap or plan leading to data analytics adoption is a key for the survival of well-established companies on this data-driven era. After doing a thorough analysis of the available literature the authors realized that there is very limited information available when it comes to identifying how well-established companies design and implement a data analytics adoption process and consequently how they innovate their business model.

1.1.4. Problem question

Taking all this information into consideration, the question to be answered in this thesis is:

*How do established companies explore data analytics to innovate their business models?*

1.2. Problem formulation and purpose

The thesis focuses on two established companies that are market leaders in their respective industries: Caterpillar and Ericsson. The purpose is to answer the problem question based on how these two companies are innovating their current business model in order to capture value from data analytics and explore new business opportunities.
1.3. De-limitations
The aim of the thesis is to identify a roadmap for well-established companies towards business model innovation to explore data analytics value. To achieve this, there are certain tasks in scope: the analysis of Caterpillar’s and Ericsson’s current business models, the innovation of these business models in order to capture value from data analytics and to take advantage of new business opportunities, the impact of data analytics to their business areas and any barriers met. The study will be theoretical and not empirical.

Out of scope is the suggestion of a different business model structure or the assessment of its effectiveness. Also, a statistical analysis of any sensitive data or IP (Intellectual Property) will not be presented. Additionally, this thesis won’t focus on issues such as data system infrastructure, selection of useful data as well as data ownership and access rights.

1.4. Thesis structure
The first step will be the theory development and literature review. The theoretical study will focus on business model innovation, any patterns adopted by incumbent companies, best practices and barriers. Moreover, it will be clearly defined what data analytics and associated technologies (like IoT) are, where are data analytics currently being used and examples of existing applications will be given. Furthermore, data analytics and business model innovation will be linked together to show how one affects the other, how companies are able to capture added value and if there are any underlying associated processes.

The next step will be the method. Two parallel case studies will be presented: Ericsson and Caterpillar. The focus will be on the challenges faced by these two large incumbent companies when it comes to adapting their (most of the times) long-standing business models to this new environment. Their current business models will be mapped out. Furthermore, how they leverage all the data collected by their equipment will be analysed (machinery and telecom equipment respectively) and ultimately the authors assess the way these companies’ business models are being changed as a consequence of using data analytics.

Lastly, a comparison of the case study results with the theoretical results previously obtained will be carried out, to answer the questions raised in the theoretical framework and ultimately answer the thesis main question.

2. Theory

2.1. Data analytics and its importance
Today there are multiple data sources or data generators as a result of the incorporation of computers in a variety of products from mobile phones, home electric appliances to cars, machinery and airplanes. Even humans are transforming to data generators through social media. The Internet of Things and advances in the IT industry allowed for data capture, storage and transmission of information (Loebbecke & Picot, 2015).

Illustrating the exponential increase in generated data (Figure 2-1) the following facts can be listed (AT Kearney, 2016):

- Every day 2.5 quintillion bytes of data are created
- Data production will be 44 times greater in 2020 than in 2009
- The volume of business data worldwide is expected to double every 1.2 years
- IT infrastructure is being challenged
- Effective data management is crucial as a misuse can lead up to 35% revenue loss

Generally speaking, big data analytics is focused on very large, fast-moving and unstructured data sets (Loebbecke & Picot, 2015). Large sets of data bring challenges (Duan, 2015):

- Data system infrastructure capability to capture, store, transfer, distribute and process data (Duan, 2015)
- The quality of the data collected as there is a lot of noise in large data sets (Duan, 2015)
- The selection of useful data from a large volume of unstructured data (Duan, 2015)
- Legal barriers to data sharing and ownership (Porter & Heppelmann, 2014)
- Data analytics methods (Duan, 2015)
- Uncertainty of the usefulness of data for strategic decision making in order to gain value from data analytics (Duan, 2015)

According to the literature, there is definitely a large volume of unstructured and noisy data which keeps growing exponentially. Moreover, there is value stored in the data that can be exploited. However, this needs the appropriate legal framework and also the analytical methods. The final part of the problem is that not all businesses are persuaded that the real value stored in the data can be used to drive more effective strategic decisions.

The area of data system infrastructure is out of this thesis scope. However, it is an important field for IT engineers’ research as the data volume increases exponentially (Figure 2-1) and the existing infrastructure will always be under pressure. The selection of useful, clean of noise data is a topic out of the scope of this thesis. Moreover, the legal barriers and data ownership is a very important and sensitive topic which currently receives a lot of attention, but still is out of topic for this thesis.
Data analytics methods and business strategy raise a number of questions regarding the addition of value to a business that need to be addressed: which are these data analytics methods? Can data analytics add real value to business strategy? If yes, which areas of the business model are affected? Is there a data analytics method that particularly favours a specific business area or are all methods relevant?

2.1.1. Data analytics methods

(Duan, 2015) gives an answer to the data analytics methods question. They can be divided in three groups based on the usage of the data:

- **Descriptive analytics** – this is the most straightforward use of analytics. The objective is to provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc. The results for descriptive analytics are usually presented in graphical form (graphics, charts and lines) and information is commonly stored in relational databases where data can later be queried and processed. Apart from the simple descriptive statistics mentioned above, there are other more complicated methods that allow to identify further patterns in data (being descriptive techniques the objective is still to provide information regarding past data). Examples of these methods include associations, clustering and generative/graphical models (Duan, 2015). Descriptive analytics are the most common type of analytics, used by most companies. Commonly used techniques are query and drill down, ad-hoc reporting, standard reporting, segmentation analysis, statistical analysis and sensitivity analysis. Descriptive analytics can be used to answer questions such as “Where is the problem?”, “How many? How often? Where?” and “What happened?”, “What are the drivers?”, “Why is this happening?” (ATKearney, 2016).

- **Predictive analytics** – in predictive analytics techniques the objective is to develop statistical models (based on past events) that can be used to predict future events. This of course is based on the assumption that past events will continue to happen in the future (Duan, 2015). The most commonly used predictive analytics techniques are regression models. In regression the objective is to create a model where parameters are calculated in a way that minimizes residuals. “Regression models are very popular because they can predict any type of values and handle any type of data. In addition, parameters related to each variable can be used to explain the impact of each variable on the final output. If they are properly used and assumptions are satisfied, regression models can generate good results.” (Duan, 2015, p. 10). Other examples of predictive techniques include decision trees, Bayesian statistics, neural networks, support vector machine and nearest neighbour. The most relevant question predictive analytics can answer is “What would happen if...?” (ATKearney, 2016).

- **Prescriptive analytics** – prescriptive analytics are an emerging technology that goes beyond descriptive and predictive models by recommending courses of action and showing the most probable outcome for each decision. Prescriptive analytics predict not only one possible future (as is the case with predictive analytics), but instead various possible futures based on the actions of the decision-maker. In addition, prescriptive analytics require a predictive model with two additional components: actionable data and a feedback system that tracks the outcome produced by the action taken (InformationWeek, 2013). For example, a company needing to determine the optimal price of a product/service for the highest profit would have to use prescriptive analytics (Duan, 2015).
In the case of prescriptive analytics, the following questions can be answered: “What is the best that can happen?”, “What can happen next?".

So, the literature offers a solution to the data analytics methods that can be used in order to extract value from raw data. The rest of the questions though remain: can data analytics add real value to business strategy? If yes, which areas of the business model are affected? Is there a data analytics method that particularly favours a specific business area or all are relevant?

2.1.2. Smart connected products, Internet of Things and Data analytics

Smart connected products offer a new approach to strategic decisions and allow businesses to alter the way value is created and captured. This is enabled through the “Internet of Things” (Porter & Heppelmann, 2014). “The phrase “internet of things” has arisen to reflect the growing number of smart, connected products and highlight the new opportunities they can represent.” (Porter & Heppelmann, 2014, p. 66). These new products differ from their strictly hardware predecessors as they now have three core elements: physical components (in the case of a smartphone for instance this would be the chips, keyboard, screen, etc.), smart components (again in the smartphone case this would refer to sensors, processors, data storage, software applications, operating system and user interface) and connectivity (in the smartphone case the antenna, ports and wireless protocols – 3G, 4G, ... - that allow the smartphone to connect with the network). Connectivity allows information to be exchanged between the product and its operating environment, its maker, its users, and other products and systems and also enables some functions of the product to exist outside the physical device - in the cloud (Porter & Heppelmann, 2014).

These new smart connected products are being developed in different sectors such as heavy machinery, telecommunications, energy, automotive, etc. They present a new array of functions and capabilities that can be divided in four big areas: monitoring, control, optimization and autonomy (Figure 2-2) (Porter & Heppelmann, 2014).
The powerful capabilities of smart, connected products are however best depicted by their capability of expanding the very definition of the industry itself. “The competitive boundaries of an industry widen to encompass a set of related products that together meet a broader underlying need. The function of one product is optimized with other related products. For example, integrating smart, connected farm equipment—such as tractors, tillers, and planters—can enable better overall equipment performance.” (Porter & Heppelmann, 2014, p. 75). Competition is no longer limited to a discrete product but to the performance of a broader product system. Manufacturers can now offer a package of connected equipment and devices and related services that optimize overall results. Furthermore, there is an additional level of complexity that can be achieved through the use of IoT: systems of systems that are comprised of several product systems and external data that can be analysed and optimized as a whole. One example of this are the so called “smart cities” (Porter & Heppelmann, 2014).

Smart connected products, IoT and data analytics offer new business opportunities, are able to disrupt the existing industries and offer new competitive advantage (Porter & Heppelmann, 2014). Business strategy should be able to answer a new series of important questions in order to make the right choices and achieve a competitive advantage (Porter & Heppelmann, 2014):

- Data system infrastructure capability and specifications (Porter & Heppelmann, 2014). It is the same issue presented also by (Duan, 2015)
- The selection of useful data (Porter & Heppelmann, 2014) which again is also mentioned by (Duan, 2015)
- Ownership and access rights to data (Porter & Heppelmann, 2014)
Business model innovation to capture value of data analytics towards a product-as-service model where the customer benefits from new services deriving from the power of smart connected products, IoT and data analytics (Porter & Heppelmann, 2014).

The pursuit of new business opportunities (Porter & Heppelmann, 2014) that can lead to new products/services outside the typical industry boundary.

Specific examples of new strategic business decisions based on IoT and data analytics value are given by (Porter & Heppelmann, 2014):

- Schindler’s PORT technology reducing elevator’s wait time
- ABB’s smart grid technology enables to be proactive before a failure occurs
- Joy Global’s autonomous mining machines for improved efficiency
- Medtronic’s medical device to alert patients for low glucose in blood
- Philips automatic lighting for increased safety and economy etc.

To summarise, the literature suggests that data analytics add real value to business strategy. Companies face new business opportunities and are able to monetise them by innovating their business model offering new products/services and gaining a competitive advantage. Data analytics can also disrupt the typical industry boundaries. The problem is now geared towards the necessary business model innovation and proper strategy in order for companies to monetise data analytics value and explore the new business opportunities.

As already mentioned in section 2.1 the data system infrastructure, selection of useful data as well as data ownership and access rights are out of scope of this thesis. However, they create a field of further investigation for IT engineers and law students.

The area of research is synthesised towards the argument that companies need to innovate their business model to capture the additional value of data analytics. This is coupled with the previous questions: which areas of the business model are affected? Is there a data analytics method that particularly favours a specific business area or are all methods relevant?

Before looking deeper into business model innovation to explore data analytics value, the area to analyse first is what a business model and business model innovation really are.

2.2. Business model innovation

Business model is the mean or the recipe through which a company creates, delivers and captures value (Chesbrough, 2010), (Malarkey, 2014) (Euchner & Ganguly, 2014) (Gobble, 2014). The business model dictates how new ideas, products and technologies are commercialized. Normally, a business model should fulfil a number of goals (Chesbrough, 2010):

- The value is created as a proposition of a product/service/technology
- The market segment that will be targeted is defined
- The supply chain is created
- The mechanism by which the revenue will be paid to the company is defined
- The cost and profit are also estimated
- The firm’s position in the market taking into account customers/suppliers/competitors is assessed
- The competitive advantage is defined to keep the company ahead of rivals
The business model canvas (Figure 2-3) developed by (Osterwalder & Pigneur, 2010) is a very helpful tool when it comes to visualizing a company’s business model aspects and the interaction between the different parts of the model.

![The Business Model Canvas](image)

*Figure 2-3: The business model canvas*

*Source: (Osterwalder & Pigneur, 2010)*

Companies invest a lot of time and resources developing new ideas, products and technologies, but spend so little to innovate/update the mean: the business model (Chesbrough, 2010). Although product innovation can be very expensive and time consuming, the return on investment is not always certain (Ammit & Zott, 2012). The same product/service can be commercialized through two different business models and it will have a different rate of success. For this reason, it makes sense for companies to invest in the innovation of their business model (Chesbrough, 2010), to find a new way to success that will change the game and disrupt the industry (Malarkey, 2014). A classic example is Xerox Corporation in which projects that were compatible with the business model were allowed to enter the market, while others that did not fit the business model were abandoned. Some of the abandoned projects were commercialised through other routes and while the majority was proven unsuccessful, a few were very valuable (Chesbrough, 2010). “Companies need to develop the capability to innovate their business model, as well as their technologies” (Chesbrough, 2010, p. 356). A global survey showed that the majority of senior management level prefer business model innovation to classical product innovation as a source to gain competitive advantage. It is more difficult to imitate business model innovation rather than product innovation. More importantly, in the new era of technological advances, business threats do not come from traditional competition, but from companies (especially new start-ups) which are outside the industry boundaries (Ammit & Zott, 2012).
Technological advances empower consumers who in turn demand more and better products/services. Forward thinking companies in response are not only innovating their products/services, but ultimately their business models (Figure 2-4) (Malarkey, 2014).

It is then clear that business model innovation is a requirement for all companies that want to achieve sustainable innovation and gain a competitive advantage like in the data analytics case. The problem according to literature is in the process of business model innovation especially in well-established companies. This issue can lead to opportunities being lost or even business extinction if taken to an extreme. Start-ups seem to be more agile and able to build up the competition. This outcome raises the following questions: how do companies innovate their business model? Do they follow a specific process? What are the barriers that make companies reluctant to innovate their business model?

2.2.1. A business model innovation process

In order to answer the question posed on the previous paragraph (Euchner & Ganguly, 2014) created a six step pyramid depicting a proposed business model innovation process which was successfully implemented in Goodyear. On the bottom of the pyramid (beginning of the process) there is high risk and lots of unknowns, but at the top of the pyramid (end of the process) most of the risks have been addressed. The risks can be reduced only by experimentation with real customers and conditions before market launch (Euchner & Ganguly, 2014). The business model innovation process has six phases (Figure 2-5):
1. **Demonstrate value creation**: There is a clear customer need along with the understanding and willingness from the business to meet it. A new or more value propositions should be identified which would be able to meet customer demand and expectations. Data can be very helpful to make the business realise how a customer behaves and how the new value proposition can be actually used (Euchner & Ganguly, 2014).

2. **Generate business model options**: The heart of the business model is the capture of the value created from a new market proposition. A competitive advantage can be created. Normally there are a number of possible business models, some more effective than others to utilize business assets in order to create, commercialise and capture the biggest part/share of the value created. A “good” or “effective” business model should have three characteristics: coherence, competitive advantage and economic leverage.

3. **Identify the risks for each option generated**: There are three types of risk: business execution or initiative, co-innovation or interdependence and adoption or integration risks. A financial model should be built and people with different backgrounds should take part in a stochastic analysis session to identify the risks/issues and actions to be taken for the business model to stand (Euchner & Ganguly, 2014).

4. **Prioritise the risks**: The risks and other parameters that have been identified from the stochastic analysis should be given a weight according to their possible effect on the business model success or failure (Euchner & Ganguly, 2014).

5. **Reduce risk through business experiments**: Experimentation is the heart of business model innovation (Euchner & Ganguly, 2014). If the experiments include real customers and transactions the effectiveness of the business model updates will be validated. Quick and low cost experiments...
that will create the appropriate set of data for evaluation are crucial. Failures are part of the process before a viable success is discovered. The best people to perform these processes are middle managers and not high corporate management as they are less agile and more attached to the current business model. A very important role will be played by the company’s cultural control system which will focus in two parts: fertilise the ground for the new model and at the same time maintain the effectiveness of the old model during the transition phase (Chesbrough, 2010).

6. Organise for incubation: The ultimate goal of the business model innovation is to bring a new successful market proposition. This will be done gradually as the profitability will be demonstrated and as the new business model will be unveiled (Euchner & Ganguly, 2014).

While this process seems to be a very good reference point for companies willing to innovate their business model, its effectiveness was demonstrated in the Goodyear case only and not for data analytics value exploitation. So, there is actually no evidence in the analysed literature that substantiates that this process (or a similar one) is in fact being implemented in operating companies looking to leverage the power of data analytics. This leads to the question: which process are established companies using to innovate their business model in data analytics case?

Key business model innovation types of organization are (Malarkey, 2014):

- **Innovation platforms** which show the way to invest and try new business models, e.g. Proctor & Gamble with the ‘Corporate Platforms’ (Malarkey, 2014).
- **In house venture funds** which give the opportunity to well-established companies to invest in new start-up companies and create new ventures, e.g. BMW’s iVenture arm. This type seem to be very successful as ‘two minds work better than one’, but most importantly the well-established company is not directly linked with the risk of failure that is highly likely with disruptive innovation (Malarkey, 2014)
- **Acquisition of new start-ups** by well-established companies which is very popular especially in the automotive industry, e.g. Avis, Daimler, VW, BMW and Toyota (Malarkey, 2014)

There is no evidence which of the three business model innovation types of organisation is best and it seems like companies choose the one that suits them better. So, which type is used in the well-established companies that will be analysed in this thesis?

2.2.2. Business model innovation areas and value drivers

Business model innovation can create value either in an existing market by exploiting new business opportunities or in a completely new market. Innovation can happen in the three areas of the business model (Ammit & Zott, 2012):

1. **Content**: new innovative activities are added to the model (Ammit & Zott, 2012)
2. **Structure**: current model activities are linked in innovative ways (Ammit & Zott, 2012)
3. **Governance**: innovating a part or more of the model that performs certain activities (Ammit & Zott, 2012)

This is a broad categorization that covers all innovation areas. It is, however, not clear if different companies innovate in all three categories or not. The business model innovation areas question remains.
To increase the possibilities of developing or innovating the business model in a way that responds to the market environment, four value drivers are important (Ammit & Zott, 2012):

1. **Novelty**: how innovative the model is (Ammit & Zott, 2012)
2. **Lock-in**: the activities of the model that keep customers linked with the business (Ammit & Zott, 2012)
3. **Complementarities**: the value created from model activities interdependencies (Ammit & Zott, 2012)
4. **Efficiency**: cost saving activities (Ammit & Zott, 2012)

These value drivers are very generic and difficult to validate as a whole. Novelty falls out of the scope of this thesis. Regarding the other three, it will be interesting to see if they are actually occurring in the studied companies.

### 2.2.3. Business model innovation barriers and solutions

While business model innovation is proven to be absolutely necessary for companies to stay competitive, there are barriers to business model innovation (Chesbrough, 2010) which can be split in different categories (Eichen, et al., 2015):

- **Awareness-related barriers**: the thinking process is narrow, affected by typical thinking patterns and the understanding of people who developed the old business model. The solution is to think out of the box and an initial concept of a product or service which answers to customer needs may eventually evolve to be a business model innovation (Eichen, et al., 2015).

- **Search-related barriers**: the industry boundaries are solid and the external environment is not considered of an interest. The solution is to search both inside and outside the industry boundaries as today they are more interconnected than ever. Moreover, do not focus only on customer demands, but keep monitoring signals from multiple sources. Be open, connect and develop (Eichen, et al., 2015).

- **System-related barriers**: the innovation system and processes can be an obstacle (taking responsibility, bureaucracy, lack of communication etc.). The solution is the management of the system complexity to allow innovative ideas to flourish and be adopted by the business (Eichen, et al., 2015).

- **Logic-related barriers**: the creation of an innovative/disruptive idea (creating value) cannot be capitalized effectively (capturing value). The appropriate logic of commercialising the product/service is missing and the price of the product/service is not aligned properly with the market supply and demand rules. The solution is to re-think the revenue model (Eichen, et al., 2015).

- **Culture-related barriers**: innovation is not always considered as positive or adding value. It can also be seen as a threat to change the status quo resulting in job and personal insecurities. The solution is to build confidence, communication and cultural coordination (Eichen, et al., 2015).

Generally, the root cause of the barriers is the conflict between the well-established business model and the new model required to commercialise the new product/service (Chesbrough, 2010). This normally happens at well-established companies which have high inertia, while small companies are more agile. It is the latter that drives innovation (Malarkey, 2014).
A typical example is the failure of Sony to invent in a similar device like iPod although it had all the technology required, tools and even the music list. Sony had even the vision of an integrated device many years before Apple. The root cause was that Sony did not envision the business model to create a new market value proposition as it was a well-established company with high inertia. Apple’s success was not the iPod as a device (its technical characteristics), but the business model innovation around music (Gobble, 2014).

These barriers have been observed in different companies. Which ones can be applied to the case of business model innovation to explore data analytics value?

Further insight is needed to the more specialised area of business model innovation in order to explore data analytics value.

2.3. Business model innovation to explore data analytics value

Business model innovation has been a topic of increasing interest since 2008 (Gobble, 2014). Especially when financial resources are scarce, business model innovation enables the exploit of new business opportunities to create and capture value in contrast to old models which led businesses to a cycle of declining revenues and profit margins (Ammit & Zott, 2012). The main reason for this is the emergence of the Internet and the exchange of information and data. The new era of digitalization and the Internet of Things are enabling a vast range of different business models to be given a chance. New services are available to customers and typical manufacturers who used to capture value only when a product was sold, are transforming their business models to offer supplemental services in order to continue capturing value throughout the life of the product (Gobble, 2014). The challenge of the business model in many traditional industries puts pressure in all companies, especially in well-established firms who find it difficult to innovate their business model to take advantage of new business opportunities (Loebbecke & Picot, 2015).

So, again it is pointed out that business model innovation is the key to take advantage of new business opportunities. This is also the way forward with the data analytics case. Additionally, well-established companies are under a lot of pressure to act on the matter. So, how do well-established innovate their business model to explore data analytics value?

2.3.1. Industries using data analytics to innovate their business model

There are numerous examples of industries where data analytics is currently being used (Figure 2-6) to transform business models and improve performance, namely retail, financial services, advertising and public relations, government, manufacturing, media and telecommunications, energy, healthcare and life sciences, logistics, etc. (ATKearney, 2016) (Duan, 2015).
Figure 2-6: Industries where big data is being used

Source: (ATKearney, 2016)

Figure 2-6 suggests that actually many industries use data analytics to innovate their business model. It divides them in eight categories. Some examples are given like GE, Macy’s or even the US government (ATKearney, 2016). Additional examples were given also by (Porter & Heppelmann, 2014) in section 2.1.2. As there are many categories the selection of more than one company to be analysed in this thesis would add validity to the study. The choice of two well established companies that are considered market leaders to their industry sector would make a more solid case (Yin, 2014). The authors decided to pick Caterpillar from the Manufacturing sector and Ericsson from the Media & telecommunications sector in an attempt to answer the thesis question “How do established companies innovate their business model to capture data analytics value?”. More details regarding the selection of these two companies and the data gathered will be given in section 3.

Companies can be divided in three groups regarding big data analytics and innovation (Figure 2-7):

- **Leaders**: they innovate using data analytics. They have a well-structured model to take advantage of this opportunity and collaborate (Marshall, et al., 2015).
- **Strivers**: they are investing in data analytic tools to support innovation, but for some specific functions. It is not yet clear to them which activities are the most valuable (Marshall, et al., 2015).
- **Strugglers**: they do not have innovation processes and the use of data analytics is very limited (Marshall, et al., 2015).
Leaders (leading organisations) have three basic strategies focusing on data, skills, tools and culture in order to create value (Figure 2-8):

- **Data quality and accessibility:** they use data generated by customers to gain a better insight to their needs. The use of data and analytics is encouraged across the organization. Data analytics is used not only to create new products and services, but also to innovate the business model (Figure 2-9). In order to promote the leaders approach in this area the following recommendations should be considered: the philosophy that data analytics and innovation are connected to gain a better
insight to customer needs, make data available across the whole organization and listen to customer needs through data analysis (Marshall, et al., 2015).

![Figure 2-9: Leaders usage of data analytics for innovation across the organisation](source)

- **Include data analytics and innovation in every role**: data analytics should be available across the organization in every role and level. Employees should be able to have the means and knowledge to analyse data in order to innovate in their field. Tools and relevant training is a must (Marshall, et al., 2015). In order to promote the leaders approach in this area the following recommendations should be considered: usage of collaborative tools for innovation across the organization, offer training in data analytics and connect teams to promote sharing of knowledge and findings, promote openness, communication and entrepreneurship thinking (Marshall, et al., 2015).

- **Create a quantitative culture**: a culture is needed to promote collaboration, creativity and innovation. If possible, create a metric to measure “return on innovation” (Marshall, et al., 2015). In order to promote the leaders approach in this area the following recommendations should be considered: promotion of innovation in all processes, separate the funding on innovation and report the metric “return on innovation”, learning should be encouraged both from successes and failures (Marshall, et al., 2015).

Caterpillar and Ericsson are market leaders in their industry. Assuming that they innovate their business model to capture data analytics value, are they also a leader when it comes to data analytics adoption or are they still working towards it? This question will work as a reference point to help the reader realise the current position of the two studied companies on the data analytics case and understand better their business model innovation process.

### 2.3.2. Getting started on the big data journey

In terms of a structured approach that allows companies to be players in this ever evolving field the three main starting steps are: 1) identifying where big data can be a game changer, 2) building future-state capability scenarios and 3) defining benefits and road map (Figure 2-10). Without taking these steps the successful implementation of a big data program is an uphill task (ATKearney, 2016).
Data analytics can be very helpful during the first step of the business model innovation process, the ‘demonstration of value creation’ (Figure 2-5). Data analytics can be the cornerstone to make the business realise how a customer behaves and how the new value proposition can actually be used. This first step is always the most important (Euchner & Ganguly, 2014).

Designing and implementing innovative business models based on big data analytics is, as such, a goal for most companies. It is not, however, an easily accomplishable goal as for every start-up that strives based on an innovative business model there are hundreds of established companies failing to monetize the huge amounts of data they have access to (Lokitz, 2016).

These starting steps can be very useful to companies that want to innovate their business model to explore data analytics value. They can be part of the business model innovation process as presented in section 2.2.1 to make it suitable or specialised for the data analytics case. This way the problem with the business model innovation process can be addressed. The question though remains: which process are established companies (Caterpillar and Ericsson) using to innovate their business model in data analytics case?

2.3.3. Business models focused on data analytics

When it comes to data analytics centred business models, there are three generic models based on their value propositions and customer interactions: Data as a Service, Information as a Service and Answers as a Service (Lokitz, 2016).

- **Data as a Service (DaaS):** the DaaS model is based on selling customer data to third parties. This data is only slightly processed and no other value is added. This is the most basic model (in terms of effort and value) and is used by organizations such as Twitter and government open data sites. Using the business model canvas (Osterwalder & Pigneur, 2010) this model is presented in Figure 2-11 (Lokitz, 2016).
• **Information as a Service (IaaS):** unlike the DaaS model where data processing is minimal, this model focuses on providing insights based on analysed data and sell it to customers looking to get tailored information. An example of this model is the health tracking industry (for example Fitbit) where the product delivers to the customer processed data about their workout habits. This model is presented in Figure 2-12 using the business model canvas (Lokitz, 2016).
• **Answers as a Service (AaaS):** this business model aims at providing answers to specific problems rather than just presenting straight facts. In order to provide answers the company needs to have more information from the customer and as such it is key to have the customer’s confidence and provide enough value for the customer to be willing to share that additional data (Lokitz, 2016). This model is presented in Figure 2-13 using the business model canvas.

![Figure 2-13: Answers as a Service business model](Source: Lokitz, 2016)

The three business models DaaS, IaaS and AaaS are a very important result of the process of business model innovation to explore data analytics value. They follow the product-as-a-service model as already mentioned by (Porter & Heppelmann, 2014) in section 2.1. Moreover, they are presented using the business model canvas which can be used as a good representation tool as again already mentioned by (Euchner & Ganguly, 2014) in section 2.2. The areas of the business model: content, structure and governance mentioned in section 2.2.2 will finally not be used as they were very generic and these models offer a more detailed approach. This leads to the question: which model of the three are Caterpillar and Ericsson using in the case of data analytics?

Furthermore, this offers the idea to present the Caterpillar and Ericsson business models using the business model canvas tool before and after the adoption of data analytics to offer the reader an easy to follow story. Are all the areas mentioned in the business model canvas innovated or not? According to the DaaS, IaaS and AaaS models, all areas are affected.

These models are the possible outcome/result of the business model innovation process which is difficult especially for well-established company to follow due to barriers. However, literature shows that if a business manages an effective way to act on and monetise the value hidden in data to explore new business opportunities, certain business areas are positively affected.
2.3.4. Data analytics value

Data analytics allow the innovation of business models in order to optimise processes that in turn can lead to higher efficiency, innovative technologies, products and services, meet new challenges and exploit new business opportunities (Loebbecke & Picot, 2015) (Marshall, et al., 2015) (Berman, 2012). Leading organisations are keen on investing on big data analytics to create competitive advantages (Marshall, et al., 2015) and/or even disrupt their industry. As such, big data is currently a hot topic in most Fortune 500 companies’ boardrooms and IT departments (ATKearney, 2016). They understand the potential of data analytics to predict and meet customer needs in a more effective way. These organisations have 36% more chances to beat competition in revenue growth and operating efficiency (Marshall, et al., 2015).

Data analytics link teams across organisations transforming collaboration (making it flexible) while traditional hierarchical structures turn obsolete. Moreover, cooperation with other teams, enterprises and companies outside the organization becomes easy which can boost product and services development. The cost for communication, exchange data and control activities is reduced (Loebbecke & Picot, 2015).

Figure 2-14 depicts areas where big data can be effective and create strategic value through decision making and improved business efficiency (ATKearney, 2016).

![Figure 2-14: Big Data impact areas](Source: ATKearney, 2016)

Data analytics have already proven to be effective. Its usage has resulted in profitable and sustainable growth in the following summarised as three main categories business areas (ATKearney, 2016):

- **Customer intimacy** – companies have now access to a lot more customer generated data from social networks, online communities, interactive websites, government data banks, etc. This allows companies to develop strategies with a much better knowledge of their target customers.
This kind of application can be seen for instance on amazon.com where customers receive customized recommendations based on their previous buying history (ATKearney, 2016). The “lock-in” value mentioned in section 2.2.2 (Ammit & Zott, 2012) is included in this category.

- **Product/Service innovation** – companies with the most effective big data strategies manage to find value in data that has been collected for some time but has never been used before (usually due to the lack of resources to process it). Data, once captured and appropriately processed, can allow established companies to improve their products and expand the range of their services in innovative ways. This is, for instance, the case of GE that is sending the terabytes of information generated by its devices (from jet engines, to health devices) back to its product engineers. By analysing this data GE is making more efficient products, saving its customers billions of dollars and developing new revenue streams (ATKearney, 2016). Moreover, customers can be engaged and collaborate with the business during a product or service design and development phase (Berman, 2012). The “complementarities” value mentioned in section 2.2.2 (Ammit & Zott, 2012) is included in this category.

- **Operations** – logistics and supply chain are areas where big data is definitely improving companies’ performance. This is achieved through the use of tracking devices such as RFID (Radio Frequency Identification) tags, GPS and microsensors. An example of this is a program developed by Airbus that monitors processes, materials and asset movements in real time through a combined use of RFID readers, motion sensors and conveyors. This resulted in reduced inventory, improved productivity and lower costs (ATKearney, 2016). Other business operation areas which can be improved are IT, accounting, sales and marketing (Berman, 2012) (Duan, 2015). The “efficiency” value mentioned in section 2.2.2 (Ammit & Zott, 2012) is included in this category.

It is therefore clear that “in order to achieve competitive differentiation and survive in the business world, companies must face the strategic and operational challenges in the era of big data. It requires them to (1) invest in data infrastructures to capture and store valuable data, (2) link business analytics to each business strategy and organizational process, and (3) keep up with the evolving techniques in big data and create an effective educational module for employees.” (Duan, 2015, p. 15)

Companies need to think differently the way they capture value as they are not selling just a product or a service, but analytical models and data professional services (Rios, 2013). Data should be considered as a core asset as it will provide the insight on how to develop the end product. What creates the true value is the application of analytical models to the data to dig out useful information (Rios, 2013). Companies should not focus on the solutions first but instead on relevant customer problems that need to be solved (Lokitz, 2016). Analytics also continue to be developed and tuned following a learning process. There is always competition and companies need to stay flexible and evolve to maintain a competitive advantage (Rios, 2013).

Small companies and start-ups already disrupt the industry as they take advantage of the low entry barriers at the moment in data analytics and they put pressure in well-established firms. They are able to expand in different markets and at the same time explore new business opportunities driven by the power of innovative business models that take advantage of data analytics investing in digital communication channels, meeting new customer needs and starting new relationships or services with the customer. Data analytics allow machines to make decisions and create value (Loebbecke & Picot, 2015).
To summarise, it is now clearly shown that companies need to innovate their business model in order to explore data analytics value, gain competitive advantage and exploit new business opportunities. Especially, well-established companies need to handle effectively the business model innovation process and strategic decisions. The business areas that are favoured by data analytics are: customer intimacy, product innovation and operations. How are these areas affected in the case of Caterpillar and Ericsson?

2.3.5. What if data analytics are not adopted
Companies may choose not to invest at all or very little on data analytics. They may choose not to innovate their business model to take advantage of data analytics value. Especially when financial resources are scarce, business model innovation enables the exploit of new business opportunities to create and capture value. In contrast, the old business models led companies to a cycle of declining revenues and profit margins (Ammit & Zott, 2012).

Manufacturers will continue to capture value only when a product is sold. They will not be able to offer new or supplement services to their customers based on added value from data analytics in order to continue capturing value throughout the life of the product (Gobble, 2014). These type of manufacturers and products will eventually move to a commodity status (Porter & Heppelmann, 2014).

Additionally, it will be difficult for these companies to (Porter & Heppelmann, 2014) (Marshall, et al., 2015) (Berman, 2012) (Rios, 2013) (ATKearney, 2016):

- have better knowledge of their target customer needs and behaviours
- predict and meet customer needs in a more effective way
- have the insight how to develop the end product
- improve their products and expand the range of their services in innovative ways
- meet new customer needs and start new relationships or services with the customer
- improve business operation areas like IT, sales, marketing and supply chain
- create competitive advantage
- be a lean organization
- do an effective business cost reduction

If Caterpillar and Ericsson are failing altogether to innovate their business models in order to capture data analytics value or if they prove to be a struggler, will this impact their future product/service innovation leading to falling behind competition and losing their current market leader place? This question will not help to answer the thesis question regarding business model innovation. Its aim is to draw the reader’s attention to the possible negative impact if the data analytics opportunity is lost. The answer will urge the reader to take action on the data analytics case.

2.3.6. Challenges
A disruption will eventually be introduced to a market by a company. It is very important for the other companies in the industry to be able to assess the possible impact of the disruption and how it can be mitigated. The initial step is the identification of the strengths/weaknesses of the business model used by the disrupter. The next step is the identification of their advantages. After that a company looking ahead should try to meet the competitive disruption. The ideal next goal is to introduce its own disruption. Finally, the assessment of how easy or difficult is for other companies to neutralise this new disruption is crucial (Wessel & Christiansen, 2012).
In order to understand how easy or difficult a disruption can be neutralised, met or even overtaken, an assessment showed that there are 5 difficulty levels (increasing from 1 to 5) depending on the type of disruption and the actions needed by competitors (Wessel & Christiansen, 2012):

1. **Momentum** – customers are used to the current market conditions (status quo set by leaders) but this can be easily changed by the introduction of value adding alternatives
2. **Technology implementation** – the second hardest level of disruption which can be met by the use of the same existing technology by other companies
3. **Ecosystem** – the disruption concerns business environment changes
4. **New technologies introduction** – a breaking new technological disruption is introduced and other companies need time to develop which is a demanding task
5. **Business model innovation** – the most difficult disruption to meet as competitors need to alter their cost structure

It is clear from the above types of disruption that data analytics alone stand in the second level. A business model innovation – level 5 – to successfully explore data analytics value towards new business opportunities would be the most difficult type of disruption for competitors to meet. However, data analytics solutions will eventually become commoditized and it will be difficult to ensure a long lasting competitive advantage of today’s business models (Loebbecke & Picot, 2015). Will data analytics keep their current key business innovation and growth role over the next ten years or so? If yes, then the business model innovation to explore data analytics value will remain a hot topic not only in the short but also in the long-term and companies cannot afford to miss this opportunity.

An area to which attention must be given is the changes in society that the era of digitalization and data analytics will bring. Some changes will be desirable e.g. improved standards of living. However, others will be critical e.g. loss of traditional jobs and knowledge-based or subjective decisions (Loebbecke & Picot, 2015). These sensitive and important changes to society are out of this thesis scope. However, they present a very interesting topic for analysis for the sociology and psychology professionals.

2.4. Theories and analysis

A number of relevant theories and models have been presented in an attempt to analyse the business model innovation problem in order for companies to explore data analytics value and answer the question “how do established companies explore data analytics to innovate their business models?”.

According to (Porter & Heppelmann, 2014), data analytics add real value to business strategy and can be disruptive. (Porter & Heppelmann, 2014), (Chesbrough, 2010), (Ammit & Zott, 2012), (Gobble, 2014) and (Loebbecke & Picot, 2015) agree that companies which innovate their business model can monetise new business opportunities, offer new product/services and gain a competitive advantage. This is particularly important in the new era of digitalisation and IoT, where there is more pressure put especially on well-established companies. So, well-established companies like Caterpillar and Ericsson, need to innovate their business model to capture the additional value of data analytics. But, how do they actually innovate their business model? Do they follow a specific process? Which areas of their business models are affected?

Data analytics methods can be divided in three groups based on the usage of the data (Duan, 2015): descriptive, predictive or prescriptive. Is there a data analytics method that particularly favours a specific business area or are they all relevant?
Key business model innovation types of organization are (Malarkey, 2014): Innovation platforms, In house venture funds and Acquisition of new start-ups by well-established companies. As there is no evidence which of the three business model innovation types of organisation is best and each company chooses the one that suits it better; which type is adopted by Caterpillar and which by Ericsson?

(Lokitz, 2016) offers three business models DaaS, IaaS and AaaS which are a result of the process of business model innovation in order to explore data analytics value. They follow the product-as-service model which can be used as a good representation tool also mentioned by (Porter & Heppelmann, 2014). Moreover, they are presented using the business model canvas which can be used as a good representation tool also mentioned by (Euchner & Ganguly, 2014). This leads to the question: which model of the three are Caterpillar and Ericsson using in the case of data analytics? Furthermore, this offers the idea to present the Caterpillar and Ericsson business models using the business model canvas tool before and after the adoption of data analytics to offer to the reader an easy to follow story. Are all the areas mentioned in the business model canvas innovated or not? According to the DaaS, IaaS and AaaS models, all areas are affected.

The business areas that are favoured by data analytics are (ATKearney, 2016) (Duan, 2015):

- **customer intimacy**,  
- **product innovation** and  
- **operations**.

How are these areas affected in the case of Caterpillar and Ericsson?

While business model innovation seems to be absolutely necessary for companies to stay competitive, there are barriers that make it a difficult and demanding process (Chesbrough, 2010), (Eichen, et al., 2015) (Malarkey, 2014). These barriers have been observed in different companies. Which ones are met in the case of Caterpillar and Ericsson business model innovation to explore data analytics value?

To summarise, this thesis presents a relevant framework for well-established companies that need to innovate their business model to exploit data analytics value. It is an attempt to identify the best way forward on this important topic. Many companies are not handling effectively the business model innovation process, strategy and all required actions towards data analytics value exploration because of significant barriers. As a result new business opportunities can be lost. If this is not taken seriously, especially by well-established companies, new start-ups can take advantage of data analytics value and its disruptive capability to put pressure and increase competition. The creation and implementation of a business model innovation process to explore new opportunities and offer new products/services to gain competitive advantage is crucial. As a result new types of business models can be developed and specific business areas can be positively affected.

3. Method

From all the available research methods (experiment, survey, archival analysis, history and case study), the case study is the most adequate technique to be used in this case. This choice is justified by a number of factors, namely (Yin, 2014):

- **Form of research question**: as previously stated the question this study intends to approach is “How do established companies explore data analytics to innovate their business models?”. How
questions are explanatory questions by nature and as such one of the best methods to approach it is through a case study.

- **Control over behavioural events**: in this study there is no control over behavioural events and these cannot be manipulated. This is also another key characteristic of cases where a case study is the right approach.

- **Focus on contemporary events**: this study focuses on contemporary events, and as such this condition is also fulfilled.

### 3.1. Case study design

When designing a case study there are “five components (...) that are especially important” (Yin, 2014, p. 29). In this case study these five elements were defined as follows:

- **Case study question(s)**: the first part of designing this case study revolved around identifying the key question to be answered. Having an interest in the impact of data analytics on value creation in incumbent companies, the authors decided to choose the question “How do established companies explore data analytics to innovate their business models?” mainly due to the relatively low quantity of available literature that explores this issue.

- **Study propositions**: the study proposition behind this case study refers to the validation of the main theoretical models that are presented in the Theory chapter of this thesis. Additionally since the amount of available data referring to this issue is very limited, the purpose is also to analyse the above mentioned question in an exploratory manner mainly through the use of a questionnaire. This questionnaire was presented to a group of managers of both studied companies that possess a clear idea of the way data analytics is currently being exploited and the companies’ strategy.

- **Unit of analysis**: in this case the unit of analysis will be Ericsson and Caterpillar, two well established companies that have traditionally played the role of hardware sellers (of telecommunications equipment and machinery, respectively). As such, a two cases approach will be used; this will allow to get a view on two companies working in different sectors.

- **Logic linking the data to the propositions**: this component refers to the general analytic strategy taken in the study case with the purpose of linking the case study to concepts of interest and then have these concepts give a sense of direction when analysing the data (Yin, 2014). There are four general strategies (Yin, 2014): relying on theoretical propositions, working the data from the ground up, developing a case description and examining plausible rival explanations. In this case study data collection will be based on the identified theoretical propositions in order to validate them or not.

- **Criteria for interpreting the findings**: a qualitative approach will be used. The case will have an explanatory part presenting all the information acquired regarding the way Ericsson and Caterpillar are using data analytics to innovate their business models. However, and since data analytics adoption is still at an early stage, it will also have an exploratory part that intends to give reasons and identify patterns of business model areas benefiting the most from data analytics adoption by means of a questionnaire containing prospective questions.

### 3.2. Choice of studied companies

The idea for this thesis emerged from the authors’ interest on the emergence of data analytics as a huge differentiation factor in today’s economy. As it was previously stated, data analytics has the power to
disrupt industries by giving companies the possibility to develop more comprehensive and customer-engaging business models (Porter & Heppelmann, 2014).

An aspect that emerged was that, while most of the “success stories” related to data analytics implementation known to the general public refer to start-up companies, well-established companies have also identified data analytics as an area of interest and are pushing to adopt them with the objective of delivering additional value to their customers (and avoid losing relevancy compared to the new players in the industry).

Many industries use data analytics to innovate their business model and can be divided in eight main categories which also represent different economy sectors (Figure 2-6) (ATKearney, 2016). As such, the selection of more than one company to be analysed would add validity to the thesis. The choice of two well established companies, one from each industry sector would make a more solid case (Yin, 2014). The authors decided to pick Caterpillar from the Manufacturing sector and Ericsson from the Media & Telecommunications sector to answer the thesis questions and fill the theoretical gaps that have been identified during the literature review.

Furthermore, Caterpillar and Ericsson were chosen as the target companies of this study, because:

- The authors of this thesis have access to relevant managers inside these organizations and will also be able to obtain relevant documentation based on their affiliation with these companies (either as employees or as business partners)
- A lot of information is already publically available for both companies including their current corporate business models
- Both Caterpillar and Ericsson are market leaders in their segments (heavy-machinery and telecommunications equipment respectively)

### 3.3. Data collection

According to (Yin, 2014) case study evidence may come from six different sources: documents, archival records, interviews, direct observation, participant-observation, and physical artefacts. All sources have their advantages and disadvantages. The sources are complementary and a good case study should rely on different sources (Yin, 2014). Taking into account these comments, the authors decided to use the following sources: documents and interviews.

#### 3.3.1. Documents

Relevant (and publicly available) documents will be analysed in order to further understand the way Ericsson and Caterpillar are innovating their business models based on data analytics. They will be very helpful in an attempt to answer the business model innovation type of organisation and the business areas affected by data analytics value as mentioned in section 2.4. They will provide the input for the authors to build the business model canvas of both Caterpillar and Ericsson before and after data analytics adoption.

**Advantages**

This data (meta-data) has some specific strengths: it is informative in the sense that it clearly illustrates both companies (Caterpillar and Ericsson) strategic view in terms of data analytics adoption, target business areas and business model innovation. The data is not created as a result of the thesis (Yin, 2014). There are specific examples containing all the appropriate information (Yin, 2014). Moreover, a wide area
is covered (Yin, 2014) considering time, products/services, technological advancements and business strategy. Finally, the data can be reviewed many times (as it is stable) in case of a need to add extra material (Yin, 2014).

Disadvantages

The data generally may have some weaknesses: accessibility of sensitive information (Yin, 2014) like business models. However, this was not the case, as the authors have specifically chosen Caterpillar and Ericsson after an initial research to make sure that their business models are publically available and can be analysed using the business model canvas. Another disadvantage can be a limited collection (Yin, 2014), but again this was addressed as a variety of documents were available in Year End Reviews, Videos, Interviews and Press Releases. The selection of well-established companies that offer a lot of information publically can mitigate that risk. Reporting bias may also be a disadvantage (Yin, 2014). These materials are mostly geared towards the company’s shareholders and customers. As such, they tend to offer a picture (like advertising the company) that does not necessarily reflect the current levels of adoption of data analytics by both companies. To mitigate this risk, the authors decided to proceed to Caterpillar and Ericsson employee interviews.

3.3.2. Interviews

A very important part of the data collection process was interviewing key company employees that are directly involved in business innovation activities and data analytics.

As previously mentioned, this case is mainly exploratory by nature as the amount of available data regarding the thesis question is very limited. The only way to explore the question was to interview a number of managers of the two companies (Caterpillar and Ericsson) that are directly involved with Data Analytics (and its exploitation through business model innovation). While the authors only managed to interview a limited number of managers, their answers shed light and provided information that is not accessible on public documents.

Specific questions will be asked during the interviews forming a questionnaire. The questionnaire is formed by 11 questions in total and an empty box where the interviewee could add any additional comments. The questions can be divided in three main categories which are not noticed by the interviewee.

Category 1 – Introductory questions

The first category consists of three questions which are the introduction to the topic. The authors wanted to make sure that each interviewee really understands the value of data analytics and is in line with the literature review regarding the disruptive power of data analytics, the new business opportunities and the need for business model innovation in order to monetise that value. The agreement or disagreement of the interviewee on this topic will offer an insight on his/her answers on the core questions that will follow. The introductory questions do not have any exploratory or validation value on the thesis main question.

Question 1: Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones).

Question 2: Data analytics can offer new business opportunities for your organization.

Question 3: Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data.
Category 2 – Core questions

The second category contains the core questions. They are 5 in total. Their aim is to answer the issues raised in the literature review, which were also summarised in the theoretical framework (section 2.4). The topics mentioned are the business model innovation process, the business model areas affected by data analytics, the data analytics methods used, the barriers faced and the business model outcome. The business model areas are taken from the business model canvas (Figure 2-3) to also allow the update/modification of the pre data analytics business model canvas of Caterpillar and Ericsson.

**Question 4:** The implementation of data analytics in the business model requires a well-defined process. Can you name some steps of this process?

**Question 5:** Are there difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model?

**Question 6:** Data analytics are adding/would add value to the following parts of your organisation’s business model: key partners, key activities, key resources, cost structure, value propositions, customer relationships, distribution channels, revenue streams and customer segments.

**Question 7:** Which data analytics usage: descriptive, predictive or prescriptive, is more suitable for your organization?

**Question 8:** If your organization would explore data analytics value which case of the following seems more likely: Daas, laas or Aaas?

Category 3 – Reference point and urge to action questions

The third category consists of 3 questions. The first one is used as a reference point to help the reader realise the current position of the two studied companies on the data analytics case (leader, striver or struggler) and to better understand their business model innovation process. The other two questions are mainly focusing on the possible consequences that a business may face if data analytics are not adopted and if data analytics will probably continue to drive innovation in the longer term. Again these questions do not have any exploratory or validation value on the thesis main question. Their aim is to urge the reader for action on the data analytics topic as the literature review already does.

**Question 9:** How would you rate your organization currently, depending on the level of data analytics adoption: leader, striver or struggler?

**Question 10:** If data analytics are not an option, then your organization could find it difficult to innovate and fall behind its competitors.

**Question 11:** Data analytics will be a key driver of business innovation and growth over the next 10 years.

Advantages

One advantage of the interviews is the insightfulness (Yin, 2014) offered. The interviewees have more insight on ongoing activities and could identify aspects that are not yet documented. A much clearer picture of the current level of data analytics adoption by the two studied companies is provided and in that regard interviews are a more reliable source of information (when compared to publically available documents). Another advantage is that the questions of the interview can be targeted (Yin, 2014) to focus directly on the topics of section 2.4, e.g. questions 7 and 8 from the questionnaire (see Appendix - Questionnaire).
Disadvantages

A disadvantage can be the response bias (Yin, 2014) as the interviewee can be steered towards a direction that the interviewer is eager to hear due to badly or on purpose structured questions. The authors have taken this point into account and tried to create questions without offering any hint of desirable answer. For example, in section 2.3.5 a list of possible results are given if data analytics are not an option for a company. In the questionnaire (see Appendix - Questionnaire), question 10 is focused on this theory. Deliberately the list of results was not selected, but the interviewee is encouraged to give his own opinion. Another disadvantage can be any inaccuracy due to poor response rate (Yin, 2014). The authors targeted employees as relevant to the topic as possible and took all the necessary actions to ensure that the majority of them replied (follow up emails, phone calls, reminders and one-on-one meetings). Moreover, the data gathered was qualitative. There is also a marking option to offer a quantitative feeling on how much an employee agrees or disagrees with a statement/theory (see Appendix - Questionnaire), but the sample was not big enough for proper statistical analysis. Finally, there is the risk that the interviewed employees, even though they are on mid to upper level management positions, are not completely aware of the company’s strategic vision or that they only have limited visibility to the company as a whole leading to skewed conclusions. However, this can be a positive at the same time, as the employees may have a better insight for their own business unit (Caterpillar and Ericsson are multinational companies) offering a truly interesting opinion about a part of the big company which wants to advertise itself as an industry leader (remember both Caterpillar and Ericsson are industry leaders to their fields).

To summarise the authors have though thoroughly the gathering data process in order to offer the best result for the reader and a true answer to the thesis question. The final questionnaire can be found in Appendix - Questionnaire.

3.4. Data analysis

Generally speaking there are five analytic techniques when it comes to analysing data collected on a case study (Yin, 2014): pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis.

The following three techniques will be used in this case study:

- **Pattern matching**: this technique “compares an empirically based pattern (...) with a predicted one made before you collected your data” (Yin, 2014, p. 143). In this case study a pattern will be predicted based on the relevant literature and then compared with the pattern extracted from the analytical data (meta-data and interviews).

- **Explanation building**: in this technique “the goal is to analyse the case study data by building an explanation around the case” (Yin, 2014, p. 147). A general explanation will be built that will fit the two case studies (Ericsson and Caterpillar).

- **Cross case synthesis**: it will be used to validate the theoretical model and ensure that it applies to both case studies (Ericsson and Caterpillar) analysed in parallel. Specifically, this is done on section 5.3.

3.5. Credibility

In order to ensure the credibility of a case study, authors should use four tests in order to “establish the quality of any empirical social research” (Yin, 2014, p. 45). These four tests address the following issues: construct validity, internal validity, external validity and reliability (Yin, 2014).
In this case study these tests were performed and the results were satisfactory:

- **Construct validity:** in this case study, different sources of evidence were used (interviews, documentation). Additionally, the key informants were asked to review this report and validate the findings.
- **Internal validity:** as discussed in the previous section, pattern matching was used matching the empirical data with the predicted pattern based on the literature review. Explanation building was also used by means of analysing the collected data and building an explanation around it (explaining which business model elements are mostly impacted by the adoption of data analytics).
- **External validity:** being this a two-case study, the findings from both cases were compared against each other using a replication logic.
- **Reliability:** a case study protocol was developed and used. All relevant documents were stored in a case study database. Original answers to the questionnaire can be found under Appendix - Questionnaire.

4. Results

The main results of the information gathering from documents and interviews as well as the analysis for Caterpillar and Ericsson are presented in this chapter, to offer the reader an insight of the business model innovation performed in these companies to explore data analytics value.

The interviewees’ job role is linked with data analytics and the majority has a mid-management position in either Caterpillar or Ericsson. The paragraphs below present a brief overview of the interviewees’ roles and their connection with data analytics and business model innovation.

All Caterpillar interviewees work currently in the Industrial Power Systems Division (IPSD) of Caterpillar.

**Caterpillar A:** The interviewee’s job title is “Foundational Data Process Architect”. The aim of this role is to develop the processes required to implement the data analytics tools and solutions into the business model and take advantage of data analytics value and capabilities to exploit the new business opportunities.

**Caterpillar B:** The interviewee’s job title is “DFA Manager”. The aim of this role is to maintain and develop close relations and a smooth cooperation with customers. Understanding customer needs is essential. So, the role is very important to understand and offer the appropriate feedback to the business regarding the appropriate data analytics tools and solutions that customer need.

**Caterpillar C:** The interviewee’s job title is “Software Engineering Specialist - Data Analytics Tools Team Manager”. The aim of this role is to manage the team that will create the data analytics tools that are essential for the business. On one hand essential for the R&D engineers to analyse raw data and understand the real function of a machine to resolve an issue or optimise a design. On the other hand it is also essential for the customer to improve the efficiency of its business and increase its profitability.

**Caterpillar D:** The interviewee’s job title is “Foundational Data and Data Analytics Manager”. The aim of this role is to manage the data analytics group activities and deliver the data analytics implementation in the business model. Caterpillar D is the supervisor of all previous Caterpillar employees that were interviewed.
ERICSSON A: This subject’s job title is “Solutions Sales Director, Core and Cloud Engagement Practices”. This position, and specifically the Cloud component of the work, is critical for Ericsson’s ability to not only fully develop its data analytics capabilities internally but also to engage with new customers and help positioning Ericsson as one of the key providers of data analytics solutions in the Telecommunications and Media market. In order to do so, he works closely with Ericsson internal stakeholders designing technical solutions that support the implementation of innovative, data-based business models.

ERICSSON B: This subject’s job title is “Head of TV & Media Sales”. As such this role is closely linked with a part of the business that has received tremendous investment from Ericsson (mainly through the acquisition of smaller companies and also by development of internal knowledge) in order to increase its presence on the global market - TV & Media. Ericsson wants to move from a service facilitator to a service creator role and TV & Media is a big part of this challenge. The adoption of IP TV led to the emergence of a new business model where customer intimacy is achieved through the analysis of data referring to contents’ consumption, TV watching habits and preferences. As such, this subject also has very good visibility over Ericsson’s efforts to adopt business analytics and evolve its business models in order to capture the created value through this.

ERICSSON C: This interviewees’ job title is “Director, Business Model Management”. In this role, the subject leads a team that focuses on developing innovative business models, and at this stage the adoption of data analytics is a priority to his group. Additionally, his group also manages the transition from old business models to innovative ones in order to ensure a companywide adoption. It is clear that this interviewee possesses very relevant information for the scope of this thesis.

The questionnaire was initially supplied to 23 Caterpillar employees out of which only 4 were returned (17%) and to 6 Ericsson employees out of which 3 replied (50%) although all the necessary actions to ensure a higher response rate were taken. The available time to gather the responses was agreed to two weeks by the authors, which could be stretched to a maximum of three weeks.

Regarding Caterpillar, an initial email was sent in early April to the targeted employees to give them a head start of the authors’ research. The questionnaire was sent out on the 12th of April 2016 explaining again the research topic and the information needed. It was suggested to all the employees to have an initial read of the questionnaire for a couple of days and try to answer some of the questions by themselves. Then one of the authors, as a Caterpillar employee who also supplied the questionnaire, was able to meet them in person to go through the questionnaire and fill it together. Having a telephone interview was also an option. As a last option the employees could fill the questionnaire on their own time and contact the author with any questions or clarifications before supplying the answered questionnaire. One of the employees was happy to fill the questionnaire with the author present during a discussion session. Two of the other employees replied that they will contact the author if they want any clarifications and will fill and supply the questionnaire on their own time. At the end of the first week three questionnaires were completed. The same day the author sent a follow-up email as a reminder. Two automated responses were received for out of office time. The beginning of the next week the fourth employee called the author and asked for a couple of clarifications as he was filling the questionnaire. This took the form of a phone interview. As a next step, the second week the author sent another follow up email. At the end of the second week only the four questionnaires were gathered, so the decision was to use the one extra week according to plan in an attempt to increase the response rate. During the third week ten Caterpillar employees were chosen from their job description and contacted by the authors by
phone as a reminder. The majority replied that they were aware of the research, but they will answer on their own time due to busy schedule. A few did not answer the call. During all the follow up actions, the deadline of the third week (29th of April 2016) was mentioned. Finally, no other responses were gathered.

Regarding Ericsson, the authors started by identifying potential interviewees based on the relevance of their position inside the organization and the visibility they had towards Ericsson data analytics’ strategy. Based on the mentioned criteria, six potential interviewees were identified and initial contact was established either via phone conversation, email or LinkedIn messages. On this initial approach the authors gave an overview of the thesis in order to provide context to the questionnaire. Additionally this initial contact turned in some cases into an unstructured interview where the author and interviewees discussed different points of view on data analytics, possible use cases, data analytics adoption issues, business model innovation and other relevant topics. One week after initial contact a “friendly reminder” was sent out to all interviewees that had not delivered a complete questionnaire. A second reminder was sent by the end of the second week. In two cases the authors had a follow-up meeting with the interviewee in order to further understand some of the statements on their questionnaires responses and the interviewee’s personal opinions in regards to data analytics and business model innovation.

The response rate was lower for Caterpillar compared to Ericsson. If the response rate was in general higher, no major change in the results would be expected. As already mentioned in section 3.3, the interview answers were analysed in a qualitative way, not quantitative, as the sample size was not adequate. So, no impact was expected as no statistical results would be presented. The only effect could be on the marking, meaning a ‘5 = completely agree’ may be changed to a ‘4 = partially agree’ towards a statement/theory. But again this marking will be used as an indication and not as absolute data for quantitative analysis. The scope was qualitative analysis and the importance was on the interviewee comments.

The complete questionnaire format and all the answers (raw information) are available in the Appendix - Questionnaire.

4.1. Business models and strategy
Business models and strategy of Caterpillar and Ericsson will be presented in an attempt to provide to the reader an initial understanding of how these organizations create, deliver and capture value.

4.1.1. Caterpillar
Caterpillar is the market leader “of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. The company principally operates through its three product segments – Construction Industries, Resource Industries and Energy & Transportation, and also provides financing and related services through its Financial Products segment” (Caterpillar, 2015). Caterpillar is a global company (Figure 4-1) and most of its operations are outside the US. It was founded in Peoria, IL, in 1925 and its headquarters are still located there.
Caterpillar’s business model (Figure 4-2) as stated in the company’s strategy: “We win by delivering valued, quality products, services and solutions to our customers that provide them the best economic proposition for their business. This value proposition, enabled by our unmatched customer support, creates the largest global field population, highest customer loyalty and attractive profitability through the business cycle.” (Caterpillar, 2014). Caterpillar’s business model structure follows a seed, grow and harvest logic (Caterpillar, 2014). Caterpillar’s brand value is based on three pillars: quality products and services, customer support through dealers and highest market share.

Caterpillar has a specific strategy designed to remain the global leader in its industry. This strategy is encapsulated in the Vision 2020 (Figure 4-3). The three key stakeholders are: the stockholders, customers
and people. Caterpillar promises the highest return to the stockholders (e.g. profit per share). It will help its customers to succeed in their businesses by remaining the global leader and providing quality products, services and support. Also, Caterpillar pursues the best talent as its employees, supports them and provides them the right environment to flourish (Caterpillar, 2014).

Caterpillar vision 2020 for success is based in very specific imperatives (Caterpillar, 2014):

- Be recognized as the leader and achieve superior results
- Relentlessly pursue growth in construction industries, resource industries, energy and transportation and financial products
- Expand globally: win in China, grow in India and grow market share elsewhere
- Enterprise excellence, lean transformation and integrated value chains
- World class supply chain (new machines delivery, aftermarket parts, always close to customer)
- Continuous improvement of dealer collaboration and performance
- Products and services help the customers succeed exceeding their expectations based on deep expertise, innovative technologies and investment
- People are talented and live by the “Our Values in Action: Integrity, Excellence, Teamwork, Commitment and Sustainability” (Figure 4-4)
Combining all the information given above, the authors created the Caterpillar’s business model canvas which is presented in Table 4-1:
### Table 4-1: Caterpillar business model canvas

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
<th>Customer Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealers</td>
<td>- Product design and development</td>
<td>- Deliver quality products, services and solutions to the customer</td>
<td>- Always close to the customer</td>
<td>- Construction Industries</td>
</tr>
<tr>
<td></td>
<td>- Research and new technology introduction</td>
<td>- Best economic proposition for the customer</td>
<td>- Highest customer loyalty</td>
<td>- Resource Industries</td>
</tr>
<tr>
<td></td>
<td>- Product (e.g. machine) built</td>
<td>- Attractive profitability for the customer</td>
<td></td>
<td>- Energy &amp; Transportation</td>
</tr>
<tr>
<td></td>
<td>- Product delivery</td>
<td>- Unmatched customer support through a global dealer network</td>
<td></td>
<td>- Financial services</td>
</tr>
<tr>
<td></td>
<td>- Product service and support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Customer support</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Financial services</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Resources</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
<th>Customer Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockholders</td>
<td>- Continuous improvement of dealer collaboration and performance</td>
<td>- Always close to the customer</td>
<td>- Construction Industries</td>
</tr>
<tr>
<td>People</td>
<td>- Global leader</td>
<td>- Highest customer loyalty</td>
<td>- Resource Industries</td>
</tr>
<tr>
<td>Dealers</td>
<td>- Strongest brand name in industry</td>
<td></td>
<td>- Energy &amp; Transportation</td>
</tr>
<tr>
<td>Customers</td>
<td></td>
<td></td>
<td>- Financial services</td>
</tr>
<tr>
<td>Intellectual property</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Materials</td>
<td></td>
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<td></td>
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<tr>
<td>Assets</td>
<td></td>
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<td></td>
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<tr>
<td>(e.g. factories)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost Structure</td>
<td>Revenue Streams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Design and development centres</td>
<td>- Brand name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- People</td>
<td>- Quality products, services and solutions help the customers succeed exceeding their expectations based on deep expertise, innovative technologies and investment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Assets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Materials</td>
<td>- Unmatched customer support through a global dealer network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Lean transformation</td>
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<td></td>
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</tbody>
</table>

4.1.2. Ericsson

Ericsson is a Swedish multinational company operating in the Information and Communication Technology (ICT) industry, being a provider of communications industry-leading network equipment and software, as well as services for network and business operations and operating and investing in several business areas.

Ericsson’s vision is to make the Networked Society a reality, one in which “connectivity brings people closer together than ever before, where collaboration is part of everyday life, and where every person and every industry is empowered to reach their full potential.” (Ericsson, 2016). In order to achieve this vision, Ericsson aims to lead transformation through mobility; this transformation will impact the way
people organize their lives, share information and do business. Ericsson’s core values are: respect, professionalism and perseverance (Ericsson, 2016)

Ericsson’s activities are divided into 3 main business areas (Ericsson, 2016):

a) Networks

Ericsson is the world’s biggest supplier of mobile networks, chosen by around half of the world’s operators with commercial mobile broadband networks.

The company is the leader in the development and deployment of 4G (LTE) networks around the world while continuously investing in R&D efforts targeting both previous (GSM, WCDMA) and new (5G) standards.

Ericsson has also become a major player in core networks, microwave networks, IP networks and fixed-access solutions. All these solutions are complemented and run by Ericsson’s portfolio of OSS (Operations Support Systems) solutions.

This business unit accounts for 55% of Ericsson’s global revenues (Ericsson, 2016).

b) Services

Combining people, processes and partnerships, Ericsson helps operators in their efforts to maximize network quality and performance, allowing them to focus on their customers, by having Ericsson integrate equipment from multiple vendors, handle multi-technology change programs, design and integrate new solutions, and manage their operations.

These services are delivered through a combination of local and global expertise. Ericsson has four Global Services Centres – in China, India, Mexico and Romania – housing Global Network Operation Centres that, in combination with local and regional centres, manage networks for 900 million subscribers. The Global Services Centres also support regional service-delivery organizations in delivering professional services for the ICT sector in areas such as complex consulting, IT, systems integration, network rollout and customer support.

The Services business unit accounts for approximately 40% of Ericsson’s net sales (Ericsson, 2016).

c) Support Solutions

Ericsson’s Business Unit Support Solutions develops and delivers software-based solutions for OSS/BSS (Operations Support Systems/Business Support Systems), TV and media solutions, as well as solutions and services for the emerging m-commerce ecosystem.

With the increased need for operators to rapidly respond to changing consumer demands and the requirement for greater experience, efficiency and innovation, OSS/BSS are a key element of any operator’s network and business strategy. Ericsson is a leading player in the OSS/BSS market with key positions in service enablement, service fulfilment, assurance, network optimization and real-time charging, as well as significant capabilities to support operators end-to-end.

As a consequence of the increasingly connected society, the TV and media industry presents tremendous potential. As an example, within five years 50% of the mobile data traffic will be video content. In TV and media, Ericsson is committed to enabling operators and content owners to efficiently deliver and monetize video content through experience-rich multiscreen TV services.
This business unit is still in its early stages and as such revenues are limited to 5% of global sales (Ericsson, 2016).

Ericsson’s strategy is to excel in its core business, establish leadership in targeted areas and expand business in new areas (Ericsson, 2016). Its two core business areas are “Radio, Core and Transmission” and “Telecom Services”; new areas refer to all areas where Ericsson is trying to establish itself as a dominant player in the market and are related to the Services and Support Solutions business units (Figure 4-5).

Figure 4-5: Ericsson: Strategic Direction

Source: (Ericsson, 2016)

Ericsson’s business model canvas is presented in Table 4-2:
Table 4-2: Ericsson business model canvas

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
<th>Customer Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunications Services Providers</td>
<td>Research and new technology introduction</td>
<td>- Deliver quality network infrastructure rollout, operation &amp; maintenance services to customers, using the latest technologies</td>
<td>- Long-term relationships - Earns customer trust (e.g. managed services contracts)</td>
<td>Telecommunications Operators (mainly mobile)</td>
</tr>
<tr>
<td></td>
<td>- Product design and development</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Equipment production</td>
<td></td>
<td></td>
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<td></td>
<td>- Service Provisioning</td>
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<td></td>
<td>- Network design and delivery</td>
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<td>- Network Maintenance</td>
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<td>- Customer support</td>
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<td>- Financial services</td>
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<td></td>
<td><strong>Key Resources</strong></td>
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<tr>
<td></td>
<td>- Intellectual property</td>
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<td>- People</td>
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<td></td>
<td>- Brand name</td>
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<tr>
<td></td>
<td>- Network equipment</td>
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<td></td>
<td>- Financial resources</td>
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</tbody>
</table>

| **Cost Structure**                  | **Revenue Streams**                                  |                                                                                    |                                                                                        |                                |
|                                     | - Research and development centres                    | - Telecommunications equipment sales                                             |                                                                                        |                                |
|                                     | - People                                             | - Services agreements                                                             |                                                                                        |                                |
|                                     | - Assets (telecommunications equipment manufacturing)  | - Licensing fees                                                                  |                                                                                        |                                |
|                                     | - Licensing fees                                      |                                                                                    |                                                                                        |                                |

4.2. Data analytics value

The data analytics value recognition by Caterpillar and Ericsson will be presented in this section. It is not an attempt to use the results in order to validate any theories or models from the literature review. As already mentioned in section 3, the information gathered both from the introductory questions of the interviews as well as the gathered documents will be used to offer an insight to the reader to help him realise the appreciation of these companies of data analytics value.

4.2.1. Caterpillar

Caterpillar in the Year in Review 2015 (Caterpillar, 2015) states that a new era of innovation has started. Caterpillar was a product innovator for 90 years advancing the technology of the machines. However, now this innovation is happening outside the machine, away from the yellow hardware.

**Question 1:** Caterpillar employees partially or completely agree with the statement that data analytics is a disruptive force redefining industry existing boundaries (Appendix - Questionnaire). Large Engineering
Manufacturing businesses have historically not used data analytics to interrogate its business data well enough to understand its value chain (Caterpillar B). Although data analytics is nothing new, the ease with which it can be performed has significantly changed over the past few years. This has enabled many areas to conduct analysis which previously would have worked from heuristic models (Caterpillar C). The competition will come from existing players mining their own data more effectively. Caterpillar products are becoming commodities and it will be how this information is used to improve the quality, service and supportability which will be the key differentiator (Caterpillar A). A new competitor will need connectivity to the data in order to be integrated into value chain (Caterpillar D).

Caterpillar wants to disrupt its industry first by being aggressive in the area of data analytics and provide services and solutions. Caterpillar’s CEO wants to speed up this process and do two things at the same time: beat competition and keep other players out of the game of data analytics (Caterpillar, 2015).

**Question 2:** Caterpillar employees completely agree with the statement that data analytics offer new business opportunities (Appendix - Questionnaire). Data analytics is a business in itself and can be used to provide real value to customers through the introduction of new service businesses (Caterpillar B). Moreover, it will allow the business to identify missed opportunities and act earlier in similar circumstances (Caterpillar D).

Caterpillar’s business is a great business according to its CEO Doug Oberhelman (Caterpillar, 2015). It manufactures machines, engines as well as other products and also offers services to its customers. Additionally, Caterpillar dealers offer product support. They sell parts, services and are always close to the customer to respond to his needs (Caterpillar, 2015). There is though a third business opportunity: all the data created by the 3 million Caterpillar machines worldwide which can be transformed to usable information (Caterpillar, 2015).

**Question 3:** Caterpillar employees completely agree with the statement that companies need to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics (Appendix - Questionnaire). The world is changing at a rapid pace and investment is required to keep up (Caterpillar C). Current business model is geared to selling hardware, so an innovation is needed to sell data analytics services (Caterpillar D). Analysing available business data, which is mostly transactional (build, financial, sales, warranty, service, etc.) linked to macro and social media will help provide greater clarity in opportunities to explore new and exploit existing markets (Caterpillar A). Customers require much more immediate added value from Caterpillar products and services and this can be provided through analytics. Two typical examples are prognostics and autonomous vehicles (Caterpillar B).

Caterpillar is “harnessing the power of big data to offer our customers insights that decrease operating costs, increase uptime and maximize profitability. In the process, we’re shaping a new era for Caterpillar in which we not only manufacture machines and engines, but also deliver value-added solutions that take our customer relationships to an entirely new level” (Caterpillar, 2015, p. 12).

According to Caterpillar “Customers use our sophisticated technology solutions today to monitor their fleets, track fuel efficiency, idle times, location and to proactively predict required equipment maintenance prior to component failure. Our existing solutions are effective, but we’re working to take them to the next level, expanding what we’re known for to change the fortunes of our customers worldwide. Our relationship with Uptake will combine Caterpillar’s world-class product engineering and
design capabilities with Uptake’s software, application and data analytics expertise. As a result, Caterpillar will be able to transform the massive amount of incoming data we receive every day into even more useful information to feed back to our customers for on-the-spot decisions and planning purposes to further reduce owning and operating costs” (Caterpillar, 2015, p. 13).

The aim is to create a new data analytics platform which will allow customers to shift from a reactive status of “repair after failure” to a proactive status of “repair before failure”. Reducing down time ensures the machines, engines, locomotives and generally all the equipment to continue running, hence make money (Caterpillar, 2015). Data analytics and the insight they offer are transforming the way the industry works. The platform will gather all the data that are created by sensors. Then this data will be combined with data created by engineers to translate and understand their meaning. The knowledge created by this insight will be translated into specific actions to optimize performance, reduce down time and cost and increase efficiency (Caterpillar, 2015). The platform will be a cross-industry product combining the best sides of both construction and IT industry. It will help Caterpillar and its customers to retain a competitive advantage. According to Caterpillar’s CEO Doug Oberhelman “What we’re really talking about is graduating to even smarter, more connected products. We’re working on getting ahead of the curve, because with our knowledge and expertise, there is no one better than Caterpillar to provide the platform and tools necessary to help our customers achieve new levels of equipment availability, productivity and profitability” (Caterpillar, 2015, p. 1).

Caterpillar in Munich, at Bauma 2016

Caterpillar has taken part at Bauma 2016, the largest construction equipment exhibition in the world. Caterpillar’s main theme was “The Age of Smart Iron”. As CEO Doug Oberhelman stated “The Age of Smart Iron describes Caterpillar’s strategy to be the industry leader bringing digital solutions designed to improve productivity, efficiency, safety and profitability for customers. Caterpillar is the world’s leading innovator around iron. We’re going to lead innovation in smart iron, too. This is not technology for technology’s sake. It is technology that’s focused on solving, and even anticipating, customer problems. We’re taking the machines, locomotives, engines and parts we’re so well known for and making them smarter, while also equipping the people who operate them with data that makes them more productive, enhances safety and improves sustainability” (Caterpillar, 2016).

Caterpillar’s CEO Doug Oberhelman mentioned in his speech that Caterpillar focuses on digital technology, data analytics and smart connected products: “First, we’re already doing it. We have approximately 400,000 connected assets and an installed base of three million machines and engines at work around the world today. That foundation gives us a head start, and we’re building on it. Second, when you combine that with the expertise and experience of our people with our unmatched dealer network, you see Caterpillar’s great competitive advantage. We know how to build solutions, and we have the distribution network to deliver and service those solutions. Third, since 1925, Caterpillar has been dedicated to helping our customers succeed. Visit just about any country in the world and you’ll see Caterpillar yellow iron at work, building and delivering the infrastructure and energy that brings higher standards of living. Think about the benefits when all of that yellow iron is smart iron, too. Fourth, we are not going to offer just one solution across our global footprint, but multiple solutions to meet the demands of our customers in construction, mining, energy and transportation. Our vision is that by enhancing our Cat Connect Technology and Services offerings, entire fleets and job sites – every machine, engine, truck, tablet, light tower, smart device and drone – will eventually share data on one common technology platform and
speak the same language. I can’t wait to see what that means for our customers – and for us” (Caterpillar, 2016).

4.2.2. Ericsson

Ericsson, as a global ICT company, has in its hands large volumes of data created by customers using its network equipment and infrastructure. Ericsson’s purpose is to be “able to connect raw data from customers’ networks and IT and in combination with information from various external sources use the whole picture on big data to build business advantages for our customers across the entire organization.” (Ericsson, 2014, p. 14). This is achieved by getting high definition insights by means of collecting data on different points of the network, combining all these sources creating an end-to-end analysis of all events, process this data and produce actions or recommendations (Figure 4-6).

![Figure 4-6: Ericsson’s big data view](Source: (Ericsson, 2014))

When inquiring Ericsson’s interviewees regarding the perception of the value created by data analytics (questions 1, 2 and 3 of the questionnaire) the following comments were received:

**Question 1** focused on potentially disruptive nature of data analytics and its impact on industry boundaries. Subject ERICSSON A stated that this is generally true both for Ericsson and for its traditional clients (Telecommunications Operators). Data analytics has opened the floor for a number of Over-the-Top (OTT) Internet Application providers that exploit the data generated by Ericsson’s network elements and use it on different business models and areas. Additionally, as the wireless standard evolves towards 5G and the internet of Things becomes ubiquitous, Ericsson will have the opportunity to be involved in new verticals, with new stakeholders and using new business models. Subject ERICSSON B also agreed with this statement adding that Ericsson needs to adapt to new consumer behaviours which in turn will eventually lead to the point of redefining solutions and competitors. Interviewee ERICSSON C added that Ericsson and overall telecommunications vendors should look out for potential predators like Google that come from an angle with analytics as a background and seem to be willing to get more and more involved in the telecommunications business.

**Question 2** approached the relation between data analytics and new business opportunities. Subject ERICSSON A completely agreed that data analytics will/are opening new business opportunities for Ericsson, namely:
- Location services (for instance proximity and predictive services) that can be monetized directly back to the end user.
- Sponsored data which basically means an end user gets a free chucks of data service but in return he also receives advertising messages from an enterprise sponsoring this data.
- Parental control and content filtering giving parents the ability of paying for controlling the contents received by their children.
- Closed loop automation allowing an operator to automatically adjust capacity using a cloud based virtualized telecom solution. These almost real-time adjustments are based on load measurements that are taken from the network (hence, closed-loop automation).

Interviewees ERICSSON B and ERICSSON C completely agreed with this statement as changes in consumer behaviour and consumption patterns, if properly exploited, will lead to new or increased sales and will also give an opportunity to remove obsolete offerings from the market, saving costs and/or optimizing the value chain. Another area where Ericsson will be able to create and capture value through the use of data analytics is through improved end-user customer experience.

**Question 3** focused on the need to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics. Interviewee ERICSSON A thinks this statement partially applies to Ericsson’s case. For Ericsson data analytics are just one of the factors driving Ericsson’s innovative business model that was tagged as “Network Society”. This networked society will create networks that are used by an ever growing number of stakeholders (enterprises, verticals, cities and municipalities, etc.), where the majority of data is created by machines and sensors and not by human subscribers. Filtering this data and using it to create value to different stakeholders will definitely be a key activity for Ericsson. Analytics will become an important means to a more holistic end of improving productivity, safety and security in industries and enterprises and also to continue improving end user experience, freedom and convenience to telecommunications networks’ end users. Subject ERICSSON B partially agrees with this statement as Ericsson cannot intend to attack new business opportunities using old business models as that could create the perception that there is no demand for the innovative service/product in question when in reality the market is looking for a different offering altogether. ERICSSON C agrees with this statement as he considers data analytics as a catalyst of change in most parts of Ericsson’s current business model.

Additionally, by analysing publically available documents it can be said that Ericsson considers data analytics the basis that will allow Communications Services Providers to address all its final customer (subscribers) needs, while also providing them insights that allow them to grow their businesses on an efficient and pertinent way (Figure 4-7) (Ericsson, 2014).
In terms of product portfolio and target areas, Ericsson has been committed over the last few years to increase its footprint and shift from a telecommunication equipment vendor model to a communications services provider model and its approach to data analytics is a proof of this (Figure 4-8) (Ericsson, 2014).
4.3. Business model innovation process

In this section the results of the data gathering regarding the business model innovation process in Caterpillar and Ericsson in order to explore data analytics value will be presented.

4.3.1. Caterpillar

Question 4: The majority of Caterpillar employees completely agree with the statement that the implementation of data analytics in the business model requires a well-defined process (Appendix - Questionnaire). Data analytics is a new area for most traditional businesses and the governance processes and policies are still being defined. Innovative ideas and access to data to enable personnel to explore opportunities needs to be encouraged. This can be achieved through having an established analytics team which supports appropriate ideas sharing, assistance (how to and technical) and enabling access to the appropriate data. Then a number of prototype projects can be created to enable the rest of the organization to see the practical benefits of using analytics (Caterpillar A). A good MGPP (Multi Generation Project Plan) applying 6 Sigma DMEDI (Define, Measure, Explore, Develop and Implement) needs to be applied along with change in management so data analytics is successfully embedded into the business culture (Caterpillar B). The process will change for each business unit, department or type of analysis. Blindly throwing data at software will not yield results. A strategy is required to determine what is to be understood (Caterpillar C) and the nature of the analytics e.g. visualization vs optimizing. There is a need for governance, structure and clear alignment with business goals (Caterpillar D).

Caterpillar has done a big investment in data analytics realizing that digital transformation is important nowadays to stay ahead of the competition. Despite the existence of Caterpillar in-house engineers working with data analytics to answer customer demands, it was decided to cooperate with Uptake creating a joint venture. Uptake has won the Forbes magazine hottest start-up company award for 2015 (Caterpillar, 2015). Uptake is based in Chicago which is nearby Caterpillar headquarters in Peoria, Illinois (Caterpillar, 2015). Uptake will help Caterpillar move faster and bring high technical skills in data analytics in a world where information is extremely valuable (Caterpillar, 2015). Innovation and collaboration is the key answer to move forward in the data analytics area (Caterpillar, 2015).

Question 5: Caterpillar employees completely agree with the statement that there are difficulties/obstacles faced while trying to implement data analytics solutions in the current business model (Appendix - Questionnaire). Important obstacles are: funding, appropriately skilled resources and access to clean and consistent data (Caterpillar A). Moreover, the lack of confidence with data management and the analysis results. Another obstacle is the IT capability to support, maintain and service the hardware (Caterpillar D). There is a lack of understanding at senior levels as to what data analytics actually is (Caterpillar C) and leaders need to provide the vision (Caterpillar B). Everyone applies some form of data analytics but its strength is in having a business wide integrated approach and any form of change that requires funding without easily defined OPACC (Operating Profit After Capital Charge) benefits will provide an obstacle (Caterpillar B).

Question 6: Caterpillar employees completely agreed that all the categories of the business model as defined by the business model canvas will benefit greatly and bring significant change to the way the business is run (Appendix - Questionnaire).

Questions 7: Caterpillar employees completely agree that all three types of data analytics usage are important for the organisation depending the requirements (Appendix - Questionnaire). Each usage area
is key for the business, it will be of greater value or less to different departments (Caterpillar A) depending on maturity and availability of data (Caterpillar D). A “one size fits all” approach should be avoided (Caterpillar C) e.g. Engineering – Predictive, Warranty – Descriptive and Predictive, Marketing – Prescriptive (Caterpillar A). Descriptive is important because field data is critical for the understanding of the supply, design, development and manufacturing capability. Predictive is also important because there is the need to produce robust products and services with the least amount of physical testing (Caterpillar B). However, Predictive and Prescriptive should be used carefully as they both involve extrapolation (extrapolation from regression will lead to +/- infinity (Caterpillar C)).

**Question 8:** Caterpillar employees completely agree that IaaS is the most probable option as a data analytics service. AaaS is following closely, while DaaS gets the last place (Appendix - Questionnaire). All can be used in some form; increase revenue from DaaS, product improvement from IaaS and better customer satisfaction from AaaS (Caterpillar C). By obtaining more field data on customer products (IaaS) will enable better insights into how these products are used, serviced, maintained which will then enable product to be designed for specific functions (Caterpillar A) and add value through optimized cost of ownership (service interval, running cost, prognostics, down time etc.) (Caterpillar B).

4.3.2. Ericsson

**Question 4** inquired about the necessity of having a well-defined process when implementing data analytics in the business model. Subject ERICSSON A focused on practical aspects of the implementation of data analytics, and namely data governance and privacy. There is a clear need to adapt current SLAs (Service Level Agreements) in order to control aspects such as who collects the data, who owns the data, when is data deleted, how to apply regulatory requirements and how to protect privacy and prevent security threats. Interviewee ERICSSON B is neutral about this statement as he believes the adoption of methodologies such as Agile contributes to having lean organizations that don’t necessarily need to have a complex process in place in order to implement big data analytics in the business model. Subject ERICSSON C believes Ericsson does need to have a structured approach to business model transformation including: defining change program, projects and action plans in order to bridge the gap between the as-is-state and the to-be-state.

In its effort to establish itself as a dominant player in this data analytics area, Ericsson identified the need to diversify its product and services portfolio and did so by both developing new competencies internally and by acquiring smaller companies that could quickly extend Ericsson’s footprint in business areas that didn’t use to be Ericsson’s core. For instance by acquiring Mediaroom, Ericsson instantly became one of the major players on the IPTV industry (Figure 4-9) (Ericsson, 2016).
Ericsson also decided to open a new R&D office in Santa Clara focused on the IP, TV and Media, SDN, NFV and mobile innovation knowledge areas (Ericsson, 2014).

**Question 5** focused on difficulties/obstacles faced while trying to implement data analytics solutions in an organisation’s current business model. Interviewee ERICSSON A partially agreed with this statement. The most common business models which Ericsson currently operates are either the sale of software licenses or system integration services. For the software licensing case Ericsson already has most of the capabilities needed to collect data and take decisions based on the analysis of this data. On the systems integration side, things get more complicated: while it is clear that the use of advanced analytics can help improving quotes and delivery accuracy, some obstacles are faced and need to be overcome such as getting access to customer’s network data, security concerns and data ownership issues. ERICSSON B also partially agreed with this statement citing resistance to change and lack of area specific knowledge, lack of sales oriented organization and shared sales goals and concerns about the possibility of data analytics uncovering errors/flaws in current ways of working as main obstacles faced by Ericsson when trying to implement data analytics solutions. ERICSSON C completely agreed with the statement as he believes Ericsson’s current business model is not geared up to handle analytics in an effective way. The depth of the needed transformation activities depends/will depend on the width of the new value proposition.

**Question 6** was focused on how data analytics is adding/would add value to the different parts of the organisation’s business model. Generally speaking, interviewees ERICSSON A and ERICSSON C indicated that data analytics will add value by impacting most of the parts of Ericsson’s business model, with the exception of **key resources** and **cost structure** as Ericsson already has most of the infrastructure and expertise in place in order to implement a data analytics driven business model. ERICSSON A also states that data analytics won’t necessarily disrupt Ericsson’s business model in most cases but will act more like a vehicle to lowering cost, improving efficiencies and increase agility in existing models. Only in some specific case will the use of data analytics originate additional revenue *per se*. Subject ERICSSON B identified **revenue streams** as the part of Ericsson’s business model where data analytics will have the biggest impact, followed by customer segments, customer relationships, value propositions and key
resources. Subject ERICSSON C believes that value propositions and customer relationships are the 2 areas of Ericsson’s business model that will have the biggest impact on Ericsson’s business model.

**Question 7** wondered about the interviewee’s opinion on which type of data analytics usage is more suitable for the interviewee’s organization. Subject ERICSSON A stated that predictive and prescriptive analytics are both important to Ericsson (giving an edge to predictive analytics). He also mentions that the value of these analytics is based on having a good feedback loop that allows to compare predicted results with actual data and act accordingly. This gives Ericsson the possibility of for instance predicting a major network problem before it has happened, avoiding major costs. ERICSSON B states that prescriptive data analytics are the most suitable for Ericsson as providing several scenarios enables more discussion and innovation when exploring business models. ERICSSON C states that Ericsson currently uses both descriptive and predictive analytics, but in order to develop new offerings and increase customers’ perceived value, Ericsson should adopt prescriptive analytics.

**Question 8** focused on the way the organization explores data analytics value. Interviewee ERICSSON A considers that the three models are not mutually exclusive and that, generally speaking, information as a service is probably the model that best adapts to Ericsson’s business model. This was also the opinion of ERICSSON B. Answers as a service is something that Ericsson already provides to its customers today, and not necessarily through big data. Data as a service can be valuable but in order to do that Ericsson must own the data which is generally not the case (Ericsson’s customers, telecoms operators, do). ERICSSON C also concurs on the idea that data as a service presents various security and integrity concerns and as such it is unlikely that Ericsson will directly sell customer data to third parties.

A key part of Ericsson’s strategy was to develop the Ericsson Expert Analytics platform. EEA (Figure 4-10) is a data analytics solutions tool that was developed using Ericsson’s telecom domain knowledge with the objective of offering CSPs an all-inclusive customer experience management tool that can help them improve customer experience, optimize their processes and deliver insights that will drive new revenue growth (Ericsson, 2016). It is, therefore, the foundational platform for all data-related services Ericsson offers to its customers.
The tool collects metrics and events from different network points such as mobile terminals, radio interface and core network, probes, OSS/BSS systems, social media and other relevant sources. It then processes these large volumes of data creating correlated, real time customer session records. These records offer key insights that can be used to deliver personalized offers and customer responses including: (Ericsson, 2016)

Service level index: Predicts customer satisfaction – based on objective quality and subjective weightings by customer segment – over time, allowing for better targeting of retention or upsell actions.

Subscriber profile: Incorporates usage trends, location patterns and customer value indicators for a complete understanding of the subscriber and best actions to take.

End-to-end session record: Correlates experience impacts with granular network and device events, and interprets these events to determine the “most probable cause” and therefore the “best next action” to improve experience or target offers.

Device analytics: Provides in-depth insights about which devices drive profitability, usage and superior experiences.

OTT application analytics: Offers insights about applications usage that supports informed investment and marketing decisions.

4.4. Business areas affected by data analytics value

It is clear that both Caterpillar and Ericsson have made an effort to adapt their business models in order to extract the additional value created by the adoption of data analytics. In terms of concrete business areas/applications affected by data analytics, the analysis of different documents led the authors to splitting these affected areas in three parts for both companies: customer intimacy, product & service innovation and operations.

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4.4.1. Caterpillar

**Customer Intimacy**

All the available data and alerts collected by the data analytics tools and solutions are sent in real time to the dealer, so he is fully aware of a situation and can respond faster to resolve an issue (Caterpillar, 2012). Now it is possible to meet customer demands more efficiently than ever (Caterpillar, 2015).

“Caterpillar is committed to staying out in front as emerging technologies revolutionize our industry. We have more opportunities than ever before to help our customers maintain a competitive advantage and achieve new levels of equipment productivity and profitability” (Caterpillar, 2015, p. 26).

“Caterpillar becomes a trusted, hands-on partner in our customers’ production and fleet management. Importantly, their costs for these solutions are based solely on the actual value received from the improvements we help them implement. It’s about pay for performance. In very concrete terms, when the customer wins, we win. It’s a way in which Caterpillar, our dealers and our customers can realize and share gains together, helping improve efficiency and profitability, as well as sustainable, long-term relationships” (Caterpillar, 2015, p. 25).

“In the heavy equipment industry, time is money. If worn-out parts suddenly fail, costly shut downs could be needed until the part is repaired or replaced. Caterpillar employees and Cat® dealers work hard every day to make sure that doesn’t happen. And now, new digital technology is helping better equip customers and dealers to avoid failure before it happens. Specifically, the ability to better measure wear rates and manage replacements could save customers hundreds of hours and millions of dollars” (Caterpillar, 2015, p. 26). Caterpillar and its world-wide network of dealers is able to respond quicker and supply parts or any other service to meet customer demands more efficiently based on the value of data analytics solutions.

**Product & service innovation**

*Product innovation - Design innovation for optimum performance*

Tying in telematics information from on board control systems will enable engineers to understand how equipment is used and to refine the product to meet the conditions it is utilized in (Caterpillar A).

During the design phase of the new CAT 994K Large Wheel Loader (Figure 4-11), customer input was valuable. The voice of the customer was important and information was refined to provide the appropriate customer and product objectives which resulted into meaningful technical objectives. This way the machine would be a true representation of the customer needs on the field. It would respond to all its requirements. All the updates were done using simulation and design before any prototype was built reducing cost further. The fifth generation of the 994K was launched in 2016. All systems were redesigned to respond to customer needs (Caterpillar, 2015).
“As a result, the Cat 994K is positioned to lead the industry in safety and serviceability, with improved machine access and visibility, along with a best-in-class operator environment. It is bigger on the outside and better on the inside. The Cat 994K increases payload by 29 percent and improves cost per ton by 8 percent over the previous model” (Caterpillar, 2015, p. 16).

**Service innovation - Service before failure**

Machine health and proactive servicing (service before failure rather than after failure) is very important for the customer as “If the equipment isn’t working, then they’re not making money” (Caterpillar, 2015, p. 13).

Solar Turbines (a Caterpillar subsidiary and manufacturer of mid-sized industrial gas turbines) has created a predictive analytic tool called Solar™ InSight System™ (Figure 4-12). It manages the health of the equipment. Analysing data collected since 2003, it allows for better equipment design and solving product issues faster. There are predictive alerts in place before a machine fault occur, so an anticipated issue can be resolved at a convenient time to avoid failure. There is also a mobile app version. “Solar has avoided more than 450,000 hours of unplanned downtime for its customers” (Caterpillar, 2015, p. 14).
The same story applies also to locomotives (Figure 4-13). An advanced technology platform allows the customer to collect data from various railroad equipment and business systems. Data analytics provide a useful insight to abnormal situations and allow the customer to address an issue/problem before it occurs. This way the assets are utilized the most efficient way as downtime is reduced. At the same time performance and profitability are increased (Caterpillar, 2015).

Finally, Caterpillar has developed a mobile tool that collects wear measurement data from a machine part/component. Then the data is synchronized to the dealer so the customer receives a quick reliable analysis of the component health. “The goal is to bring customers simple processes on web-based and
mobile platforms that provide accurate, immediate access to useful, real-time data while still in the field” (Caterpillar, 2015, p. 26).

**Service innovation - Tools to enhance a safety culture**

Many incidents or accidents can happen without any fault in the machine, but due to operator’s fatigue. “Caterpillar Safety Services is responding to this challenge with a solution that combines technology and cultural change to help customers see, mitigate and manage fatigue on the job site” (Caterpillar, 2015, p. 15).

Characteristic examples are: the Fatigue Avoidance Scheduling Tool (FAST), the Cat® Smartband and the Driver Safety System (DSS) which monitors operator’s fatigue and distraction data. Cameras in the machine cab, monitor an operator’s face and eyes and immediately alert any signs of fatigue before an incident occurs. Furthermore, Caterpillar safety advisors review the data in a 24/7 fleet monitoring centre, who in turn can also alert the job site management if required (Caterpillar, 2015). Customers can now use this important information that was previously invisible to create safer and healthier conditions for their employees (Caterpillar, 2015). Caterpillar uses digital analytics to pinpoint and quantify trouble areas, empowering customers with data. It is a solution that combines technology and safety cultural change (Caterpillar, 2015).

Caterpillar has also developed the Multi-Inspection Radar Appliance (MIRA) tool for locomotives following its safety culture. “MIRA can detect, from multiple vantage points, when an object is blocking the tracks and send a signal back to the train, so that it can immediately begin decelerating” (Caterpillar, 2015, p. 21).

Finally, Caterpillar’s deep expertise in the mining sector was combined with customer needs to offer semi-autonomous and autonomous solutions such as the Cat® Command tool for Hauling. “Trucks operating with Cat Command for Hauling use sophisticated onboard intelligence and advanced guidance technology, so a small number of people can run the whole project and centralize the control. For job sites such as underground mines, autonomous solutions are fast becoming a safety necessity” (Caterpillar, 2015, p. 17).

**Service innovation - Site solutions for improved efficiency**

Caterpillar offers the Job Site Solutions tools that make it easy for the customer to gather raw real time data, analyse it and act accordingly. “Simple, real-time data can show them what went wrong (or right) on the last run, how they’re doing against their production goals, whether they have the right number of trucks on the route or need to reduce wait times – nearly every aspect of their operations is factored in” (Caterpillar, 2015, p. 25).

An example is the Cat® Product Link™ site solution tool which redefines fleet management (Caterpillar, 2012). The customer is able to monitor a fleet of mixed CAT connected machines at a distance (Figure 4-14).
All machines are shown in one map and lots of different information can be filtered out like fuel usage and idle time which are important to the site command team (Caterpillar, 2012).

Using GPS technology, site boundaries can be created and alerts can be displayed immediately (using a mobile phone) signalling a break down, a damage or a machine at risk out of the site boundaries. The alerts are customized according to customer needs (Figure 4-16).
Moreover, a single machine can be monitored through Google maps, specifically its current health status. If a part is needed, the customer can go directly to the dealer website and order it. Specific service plans can be arranged to avoid breakdowns and reduce downtime. Fuel usage can be monitored and a fuel saving route can be identified helping to reduce cost. The machines utilization can also be displayed and compared to find out if any machine is spending a lot of time under idle, so there is an opportunity to improve its capacity and efficiency (Figure 4-17).
A specialized tool for the mining sites only is called Cat® MineStar™ System (Error! Reference source not found.) (Caterpillar, 2012). It is the industry’s broadest, most comprehensive integrated mine operations and mobile equipment management system. It enables the customer to adjust the system to his needs by integrating products, process and people.

- The *Fleet* tool can optimise the operation of the assigned connected machines.
- The *Terrain* tool can improve accuracy of material control.
- The *Detect* tool offers machine proximity awareness or personnel detection for enhanced safety.
- The *Health* tool can improve equipment availability through real time machine event monitoring.
- The *Command* tool enables remote control of completely autonomous machines over and under the ground.

The Cat® MineStar™ System leads to improved operator’s safety, equipment availability and site productivity. It is a tool that provides solutions/answers to meet customer needs. It leads the way to the next generation of mining, resulting in a safer, more efficient and productive site than ever before. Through the available data and analysis the motto is: “know more, do more, achieve more” (Caterpillar, 2012).

**Operations**

Interviewees while answering question 2 regarding new business opportunities offered a lot of examples on the business areas that are affected by data analytics. There are huge opportunities in period and variable cost reduction, quality and improvements (Caterpillar D). Smarter utilization of the existing data will enable the business to identify process efficiencies through the build process, testing of engines, warranty and service (Caterpillar A). Analysing customer data will enable the business to see spend trends. Moreover, by bringing macro-economic data in (already done in parts of Caterpillar) trend data will enable enhanced forecasting e.g. Earthquake in Szechuan province creates a surge for generator sets 3 months later (Caterpillar A). Data analytics can be used to connect sales data to supply chain to engineering (for example) so that more informed decisions can be made with respect to various departments. This can lead to new market areas or leaner ways to produce products (Caterpillar C).
Supply chain

The tools based on data analytics that make ‘Service before failure’ a viable reality also positively affect the parts supply chain. The supply chain among manufacturer – storage – dealer – supply to customer works a lot more efficient and responds quicker to any part demand. According to the customer “Being able to predict when that one major component is going to be at the end of its life cycle is pretty important to me because then I can schedule my maintenance and downtime” (Caterpillar, 2015, p. 26).

Autonomous machines and high productivity operating sites

A fleet of autonomous trucks can be seen nowadays in mining sites. The CAT 793 (Figure 4-18) is an example. Autonomous trucks operate with minimal human intervention. The goal is to maximize productivity and safety under demanding working conditions (Caterpillar, 2015).

![Figure 4-18: CAT 793 autonomous mining truck](source)

Caterpillar’s deep expertise in the mining sector was combined with customer needs to offer semi-autonomous and autonomous solutions such as the Cat® Command tool for Hauling. “Trucks operating with Cat Command for Hauling use sophisticated onboard intelligence and advanced guidance technology, so a small number of people can run the whole project and centralize the control. For job sites such as underground mines, autonomous solutions are fast becoming a safety necessity” (Caterpillar, 2015, p. 17).

Mining sites are different from each other. In some there is a view of the autonomous trucks from the command centre, but in others this is only possible through cameras. “Cat Command reduces variations in the way the machine is operating, ensuring that it operates the same way, every time. It’s like having the mine’s best operator at the controls, but he or she is located safely away from any potential hazards. It’s the best of both worlds: increased productivity combined with increased safety” (Caterpillar, 2015, p. 17). This system was not available 5 years ago. Now it is possible to meet customer demands more efficiently than ever (Caterpillar, 2015).
Effective fleet management results in maximum site efficiency, increased productivity and lower operating costs (Caterpillar, 2012).

4.4.2. **Ericsson**

When it comes to business applications affected by data analytics value the same three areas that were identified in the theory chapter (customer intimacy, product & service innovation and operations) are also applicable to Ericsson’s case.

**Customer Intimacy**

Understanding customer’s needs and addressing their concerns are key activities for all Communications Services Providers (CSPs). In this era where there are not much differences in terms of network performance, differentiation comes down to customer experience and optimizing all touch-points experience. If a customer is not happy with the quality of service he is currently getting, all he needs to do is to switch CSPs (the feared phenomenon of *churning*). Ericsson identified this concern as a major opportunity when it comes to leveraging the data that flows through its networks introducing Customer Experience Management solutions to its customers (Figure 4-19) (Ericsson, 2014).

![Figure 4-19: Customer Experience Management](source: Ericsson, 2014)

An example of Customer Experience Management use case is:

**Empowered Customer Care:** By means of having access to real-time data regarding subscriber’s quality of service, customer care agents have a much more in-depth understanding of customer issues by the time they receive a call from the customer. With this information, customer care agents are able to provide personalized recommendations and resolutions to the calling customers resulting in an increase on first call resolution rates (and a consequent increase on customer satisfaction indexes). Even if the issue cannot be solved by first line agents, once the issue is escalated to second and third line customer support, the enhanced and comprehensive information related to the specific issue will increase the probability of resolution on a reasonable period of time (Ericsson, 2014).
**Product & service innovation**

Further to the development of new services/solutions on Ericsson’s traditionally offered services (mentioned on the sections previously), the leverage of data and the development of a data based infrastructure is also leading Ericsson to explore new business areas where it did not have a noticeable presence up until recently. The strategic vision is to position itself as a “service creator” (moving from previous “network developer” and “service enabler” positions) (Ericsson, 2016).

In this sense, Ericsson has secured a number of partnerships with companies in different industries (such as Volvo and Scania for instance) in order to work on developing data analytics-based innovative services focused on the following areas: connected car, smart city and energy management (Ericsson, 2016).

This represents a clear breakthrough for Ericsson as it opens doors for new customer segments (generalist Communications Services Providers, automotive industry, utilities industry, retail…) and consequently adds new revenue streams.

Figure 4-20 shows how the Ericsson Expert Analytics platform can be used to create a unified database for an energy retail company creating a “single version of truth” that can be used to take optimized decisions in almost real-time.

![Figure 4-20: Data structure for energy retail industry](source: Li Vigni, 2015)

Figure 4-21 depicts how this knowledge base can be used from a marketing standpoint, giving companies the possibility to handle multi-channel requests and process and perform continuous monitoring.
Finally, in Figure 4-22 it can be seen that from an operational point of view, value is also added as this solution allowing energy retail companies to monitor costs, monitor operations and plan operations in a much more efficient and cost-efficient manner.

**Operations**

Another area where using data analytics techniques is highly advantageous for Ericsson is the operational efficiency area. This encompasses different activities such as network planning and optimization, project management and billing activities. The premise is that by having high definition insights, Ericsson can
optimize all of its processes by focusing resources on the most relevant areas, increase efficiency by predicting and preventing issues that have occurred in previous instances and efficiently control all resources (Figure 4-23) (Ericsson, 2014).

![Figure 4-23: Data Driven Efficiency](source: Ericsson, 2014)

An example of Operational Efficiency use case is:

**Real Time Customer Experience Monitor and Optimization**: Using Ericsson Expert Analytics capabilities (and specifically advanced correlation), it is possible to monitor in real time a specific customer experience. This is a big step forward in relation to the “old days” where network optimization was done based mainly on switch-level statistics, which meant that there was no efficient way of optimizing the network in order to target specific customer segments (Ericsson, 2014). With this new capability, network operators can act on incidents grouped by service, location, incident type, device, etc. and as such can prioritize their network optimization efforts based on the business impact that addressing each specific issue will have.

### 4.5. Reference point and urge for action

Having identified the need to innovate their business models, Caterpillar and Ericsson are actively pursuing this alternative. Setting a reference point regarding the current level of data analytics adoption in Caterpillar and Ericsson was seen as crucial by the authors to offer the reader a point to compare and assess where these two leading companies truly are placed in the data analytics field, so the reader can then realise his current business position or future target position. Only then the reader can fully appreciate the business model innovation to adopt data analytics value in its true scale, implemented by the two well established companies. Furthermore, investigating the urge to action by assessing the interviewee’s personal opinions on the future of data analytics would also offer the reader the extra motivation to follow the data analytics adoption path or not.
4.5.1. Caterpillar

**Question 9:** Caterpillar as a whole is probably an industry leader in data analytics (Caterpillar A). Industrial Power Systems Division (IPSD), which is a business unit of Caterpillar, is striving to catch up and to expand analytics capabilities to all of its brands (Caterpillar A) (Caterpillar C).

As CEO Doug Oberhelman stated “The Age of Smart Iron describes Caterpillar’s strategy to be the industry leader bringing digital solutions designed to improve productivity, efficiency, safety and profitability for customers. Caterpillar is the world’s leading innovator around iron. We’re going to lead innovation in smart iron, too.” (Caterpillar, 2016).

**Question 10:** Caterpillar employees completely agree with the statement that if data analytics is not an option, then the organisation could find it difficult to innovate and fall behind its competitors (Appendix - Questionnaire). Without data analytics, innovation and development of both products and services will lag market leaders (Caterpillar B). The one that gets to market first will obtain a competitive advantage (Caterpillar A). Areas that will be most affected are: period and variable cost management, as well as customer relationship management (Caterpillar D).

**Question 11:** Caterpillar employees completely agree with the statement that data analytics is a key driver of business innovation and growth over the next 10 years (Appendix - Questionnaire). The Industrial Internet of Things (IIoT) growth will continue at a pace and the amount of data provided needs to be harnessed and understood. By doing this IPSD will be able to add value around its product which will encourage customers to keep coming back (Caterpillar A). Understanding the end value chain in areas such as marketing, procurement, design, development, manufacturing and distribution as well as the customer experience is critical to winning customer loyalty and developing a sustainable business (Caterpillar B). As the use of data analytics proliferates anybody not using it will soon be left behind with respect to their market. Heuristic approaches have historically been used as it was not possible to analyse large amounts of data. Big data technologies such as Hadoop and Map/Reduce have eliminated the need for guesswork (Caterpillar C).

**Question 12:** “Knowledge is power” (Caterpillar A) was the most important comment.

4.5.2. Ericsson

**Question 9** focused on labelling the organization as a struggler, striver or leader when it comes to data analytics adoption. Subject ERICSSON A labels Ericsson mainly as a striver as innovative ecosystems take time to develop and Ericsson (and the ICT industry as a whole) is going through the most dynamic transformation phase it has ever seen. Data analytics will be a cornerstone in this, being this the reason why Ericsson is investing on them and exploring possible application together with its customers. Ericsson is a leader when it comes to applications that provide value for today’s business model for instance in areas related to end user experience and service assurance. However subjects ERICSSON B and ERICSSON C consider Ericsson to be a struggler in the sense that Ericsson is trying to adapt to a multi-vertical customer base and, while managing quite a few networks on behalf of its clients, is still not leveraging this data on the business model.

**Question 10** related to the difficulties that the organization would potentially face if it did not adopt data analytics, namely finding it difficult to innovate and fall behind its competitors. Interviewee ERICSSON A completely agrees with this statement adding that not adopting data analytics would create challenges across most if not all Ericsson’s business areas. He also stated that it’d be difficult to answer this question.
without being too speculative. Subject ERICSSON C also completely agrees as outcome business models are a need in order to stay competitive and data analytics is a pre-requisite for them. Interviewee ERICSSON B has a neutral opinion regarding this statement as he believes data analytics are not as relevant on a Business-to-Business (B2B) environment as they are on a Business-to-Customer (B2C) environment.

**Question 11** asked whether data analytics will be a key driver of business innovation and growth over the next 10 years. Subjects ERICSSON A, ERICSSON B and ERICSSON C completely agree with this statement. ERICSSON A states that the emergence of 5G will open up networks to hundreds of new stakeholders, each with their own use cases and device needs. All-IP technologies such as Cloud, Software Defined Networks, and Network Function Visualization will enable this new network. The need for data analytics will accelerate as this transformation takes place and will be a key differentiator when it comes to being able to deliver value to these different user profiles. Closed loop machine learning systems will also be widely adopted and will drive new ways to sell and monetize data. Subject ERICSSON B added that as end users leave a greater digital footprint, more opportunities will be there for companies that can analyse data and extract behavioural information from it. ERICSSON C believes that data integrity will be an even more important factor in the future and it’ll certainly have to be considered when developing data-based business models.

### 4.6. Business model canvas including data analytics

The business model canvas of Caterpillar and Ericsson presented in chapter 4.1 will be revisited and updated in this section, so the data analytics value can be added. The effect of data analytics in the business model canvas that highlights the business model innovation of Caterpillar and Ericsson in order to exploit data analytics value is given in *italics*.

#### 4.6.1. Caterpillar

The Caterpillar business model innovation is presented in the updated business model canvas in Table 4-3. All of the business model canvas areas except the *customer segments* have been affected by data analytics adoption.
Table 4-3: Caterpillar business model canvas including data analytics value

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
<th>Cost Structure</th>
<th>Revenue Streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Dealers</td>
<td>- Product design and development</td>
<td>- Deliver quality products, services and solutions to the customer</td>
<td>- Always close to the customer</td>
<td>- Design and development centres</td>
<td>- Brand name</td>
</tr>
<tr>
<td>- Uptake</td>
<td>- Research and new technology introduction</td>
<td>- Best economic proposition for the customer</td>
<td>- Highest customer loyalty</td>
<td>- People</td>
<td>- Quality products, services and solutions help the customers succeed exceeding their expectations based on deep expertise, innovative technologies and investment</td>
</tr>
<tr>
<td>- Customer</td>
<td>- Product (e.g. machine) built</td>
<td>- Attractive profitability for the customer</td>
<td>- Engage customer to product design</td>
<td>- Customers</td>
<td>- Unmatched customer support through a global dealer network</td>
</tr>
<tr>
<td></td>
<td>- Product delivery</td>
<td>- Unmatched customer support through a global dealer network</td>
<td></td>
<td>- Intellectual property including data analytics solutions</td>
<td>- Brand name</td>
</tr>
<tr>
<td></td>
<td>- Product service and support</td>
<td>- Continuous improvement of dealer collaboration and performance</td>
<td></td>
<td>- Materials</td>
<td>- Unmatched customer support through a global dealer network</td>
</tr>
<tr>
<td></td>
<td>- Customer support</td>
<td>- Global leader</td>
<td>- Global dealers network</td>
<td>- Lean transformation</td>
<td>- Data analytics platform</td>
</tr>
<tr>
<td></td>
<td>- Financial services</td>
<td>- Strongest brand name in industry</td>
<td>- On line analytics solutions</td>
<td>- IP</td>
<td>- Data analytics solutions</td>
</tr>
<tr>
<td></td>
<td>- Create data analytics solutions</td>
<td>- Services, tools and solutions to customers to further increase efficiency, profitability, productivity and safety (IoaaS, AaaS)</td>
<td></td>
<td>- Data analytics platform</td>
<td></td>
</tr>
</tbody>
</table>
### 4.6.2. Ericsson

The Ericsson business model innovation is presented in the updated business model canvas in Table 4-4. This canvas was built taking into consideration all the information provided by Ericsson’s interviewees as well as through the analysis of publically available documentation.

<table>
<thead>
<tr>
<th>Table 4-4: Ericsson business model canvas including data analytics value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ericsson business model canvas (after)</strong></td>
</tr>
<tr>
<td><strong>Key Partners</strong></td>
</tr>
<tr>
<td>- Telecommunications Services Providers</td>
</tr>
<tr>
<td>- Communications Service Providers</td>
</tr>
<tr>
<td>- Content Providers</td>
</tr>
<tr>
<td>- Industrial partners (automotive, utilities,...)</td>
</tr>
<tr>
<td>- Local governments</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Key Resources</strong></td>
</tr>
<tr>
<td>- Intellectual property</td>
</tr>
<tr>
<td>- People</td>
</tr>
<tr>
<td>- Brand name</td>
</tr>
<tr>
<td>- Network equipment</td>
</tr>
<tr>
<td>- Financial resources</td>
</tr>
<tr>
<td>- Data platform (EEA – Ericsson Expert Analytics)</td>
</tr>
</tbody>
</table>

As it can be seen, not all of Ericsson’s business mode areas have been impacted by the adoption of data analytics, in large part due to the technological nature of the company (as such, no major infrastructure and cost structure changes were required). The most impacted areas were: customer segments, customer relationships, channels, revenue streams, value proposition and key partners.
5. Analysis

All the information gathered was presented in section 4 including the business model canvas of both Caterpillar and Ericsson. The main aim of this section 5 is to analyse and link the information gathered in section 4 with section 2 which is the literature review. This way, the thesis question will be answered along with the questions raised in section 2.4 (theoretical framework). Section 5.1 presents the Caterpillar analysis and section 5.2 Ericsson’s analysis. Section 5.3 summarises the results of the analysis to offer the reader a complete insight on the similar trends and the discovered differences.

5.1. Caterpillar

Caterpillar is the market leader of construction and mining equipment (Caterpillar, 2015). To remain in the current leading position it has recently launched the “Age of Smart Iron” which is based in innovation driven by data analytics value to explore new business opportunities (Caterpillar, 2016).

Data Analytics Value

(Porter & Heppelmann, 2014), (Chesbrough, 2010), (Ammit & Zott, 2012), (Gobble, 2014) and (Loebbecke & Picot, 2015) agree that there is value in data analytics which can offer new business opportunities. To take advantage of these opportunities a company should innovate its business model. Moreover, data analytics have a disruptive power which can redefine the industry boundaries. It must be pointed out again that these theories do not need any further validation. They are already proven. The authors wanted to present the interviewees’ opinion on the matter to offer an insight to the readers, to help them realise the appreciation of these companies on data analytics value and reveal the background, the basis for their answers in the next core topic of business model innovation.

Caterpillar employees partially or completely agree with the statement that data analytics is a disruptive force redefining industry existing boundaries (Appendix - Questionnaire). They point out two important things: existing competitors will become stronger if they improve their data analytics capability (Caterpillar A) and data accessibility is key to create new competitors (Caterpillar D). Caterpillar’s CEO wants to speed up the data analytics innovation process and achieve two things at the same time: beat competition and keep other players out of the game of data analytics (Caterpillar, 2015).

Caterpillar employees completely agree with the statement that data analytics offer new business opportunities (Appendix - Questionnaire). Moreover, according to Caterpillar’s CEO, there is a business opportunity: all the data created by the 3 million Caterpillar machines worldwide which can be transformed to usable information (Caterpillar, 2015).

Caterpillar employees completely agree with the statement that companies need to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics (Appendix - Questionnaire). This comment along with the theory lead to the core topic of the thesis which is the business model innovation to explore data analytics value.

Business Model Innovation to explore data analytics value

Theory showed and interviewees also agreed that companies like Caterpillar and Ericsson, need to innovate their business model to capture the additional value of data analytics. The question is though: how do they actually innovate their business model? Do they follow a specific process? The majority of Caterpillar employees completely agree that the implementation of data analytics in the business model requires a well-defined process (Appendix - Questionnaire). Caterpillar A interviewee states that data
analytics is a new area for most traditional businesses, so the processes are still being defined. This is not an encouraging reply from the interviewee whose job role is to develop the process to take advantage of data analytics value in the IPSD business unit. The need for a separate data analytics team to encourage access, sharing and also provide assistance to the employees dealing with data analytics is only mentioned. This is a strong indication that currently there may be no defined process to the specific Caterpillar business unit on how to implement data analytics in their strategy. Caterpillar B interviewee referred to a “good” project plan applying 6 Sigma DMEDI (Define, Measure, Explore, Develop and Implement) tools. This is a second indication of a formal process absence in this business unit from the interviewee whose job role is to be the link between the business and the customer. This may mean that not all Caterpillar customers are enjoying the benefits of data analytics tools and solutions. The same interviewee also mentions a need for change in management so data analytics is successfully embedded into the business culture. This probably means that the climate and the culture in the top management of that specific business unit is not convinced 100% yet for the real benefits of data analytics. The process will change for each business unit, department or type of analysis (Caterpillar C). This means that the process can be different and probably should be among different business units of the same multinational company. This explains the fact that although Caterpillar is advertised as the leader and a pioneer in data analytics solutions (Caterpillar, 2015) (Caterpillar, 2016), not all of its business units are aligned yet or are at the same level. There is a need for governance, structure and clear alignment with business goals (Caterpillar D).

Key business model innovation types of organization are (Malarkey, 2014): Innovation platforms, In house venture funds and Acquisition of new start-ups by well-established companies. As there is no evidence which of the three business model innovation types of organisation is best and each company chooses the one that suits it better; which type is adopted by Caterpillar and which by Ericsson? Caterpillar already has in-house engineers working with data analytics to answer customer demands. Additionally, it was decided to cooperate with Uptake creating a joint venture. Uptake is based in Chicago which is nearby Caterpillar headquarters in Peoria, Illinois and has won the Forbes magazine hottest start-up company award for 2015 (Caterpillar, 2015). Uptake will help Caterpillar move faster and bring high technical skills in data analytics in a world where information is extremely valuable (Caterpillar, 2015). Innovation and collaboration is the key answer to move forward in the data analytics area (Caterpillar, 2015). So, a joint venture approach seems to be the best working solution in Caterpillar’s case.

Data analytics methods can be divided in three groups based on the usage of the data (Duan, 2015): descriptive, predictive or prescriptive. Is there a data analytics method that particularly favours a specific business area or are they all relevant? Caterpillar employees completely agree that all three types are important for the organisation depending on the requirements (Appendix - Questionnaire). Each usage area is key for the business, it will be of greater value or less to different departments (Caterpillar A) depending on maturity and availability of data (Caterpillar D). A “one size fits all” approach should be avoided (Caterpillar C). Examples of usage were also given: Engineering – Predictive, Warranty – Descriptive and Predictive, Marketing – Prescriptive (Caterpillar A). Descriptive is important because field data is critical for the understanding of the supply, design, development and manufacturing capability. Predictive is also important because there is the need to produce robust products and services with the least amount of physical testing (Caterpillar B). So, all types are important, but some types may suit specific business areas better than others.
(Lokitz, 2016) offers three business models DaaS, IaaS and AaaS which are a result of the process of business model innovation in order to explore data analytics value. Which model of the three is Caterpillar using in the case of data analytics? Furthermore, presenting the Caterpillar business model using the business model canvas before and after the adoption of data analytics; are all the areas mentioned in the business model canvas innovated or not? Caterpillar employees completely agreed that all the categories of the business model showed in the business model canvas will benefit greatly and bring significant change to the way the business is run (Appendix - Questionnaire). Looking and comparing the canvas before (Table 4-1) and the canvas after (Table 4-3) data analytics adoption it is clear that all except one area which has not changed. Moreover, Caterpillar employees completely agree that IaaS is the most probable option as a data analytics service. AaaS is following closely, while DaaS gets the last place (Appendix - Questionnaire). All can be used in some form though; increase revenue from DaaS, product improvement from IaaS and better customer satisfaction from AaaS (Caterpillar C). IaaS first place is mainly summarise in one example: By obtaining more field data on customer products (IaaS) will enable better insights into how these products are used, serviced, maintained which will then enable product to be designed for specific functions (Caterpillar A) and add value through optimized cost of ownership (service interval, running cost, prognostics, down time etc.) (Caterpillar B). So, Caterpillar can use all three depending on the case, with IaaS to be clear favour.

The business areas that are favoured by data analytics are (ATKearney, 2016) (Duan, 2015): customer intimacy, product/service innovation and operations. How are these areas affected In the case of Caterpillar? Customer intimacy is definitely affected by data analytics. The CAT dealers are made aware of a customer issue and can respond faster to resolve it. There is a stronger link created between Caterpillar and customers enhancing communication and cooperation to meet customer demands more efficiently than ever (Caterpillar, 2015). Product innovation is also favoured and a specific example is the new CAT 994K Large Wheel Loader. The customer was involved in the design process resulting in higher efficiency, optimised machine performance and higher satisfaction rate by the customer (Caterpillar, 2015). Service innovation has similarly benefited with the introduction of specialised tools for improved efficiency like CAT Minestar System, service before failure to reduce costly downtime and even safer working environment (Caterpillar, 2015). Operations were equally positively affected. More efficient processes lead to period and variable cost reduction, higher product quality (Caterpillar D), improving building and testing of engines, lower warranty claims and need for service (Caterpillar A). This can lead to new market areas or leaner ways to produce products (Caterpillar C). Furthermore enhanced forecasting is enabled e.g. Earthquake in Szechuan province creates a surge for generator sets 3 months later (Caterpillar A). Supply chain among manufacturer – storage – dealer – supply to customer works a lot more efficient and responds quicker to any part demand. Finally, autonomous trucks in sites operate with minimal human intervention leading to maximized site productivity, efficiency and lower operating costs (Caterpillar, 2015).

There are barriers to business model innovation process: awareness related, search related, system related, logic related and culture related barriers (Chesbrough, 2010), (Eichen, et al., 2015) (Malarkey, 2014) which have been observed in different companies. Which ones are met in the case of Caterpillar business model innovation to explore data analytics value? Caterpillar employees completely agree that there are difficulties/obstacles faced while trying to implement data analytics solutions in the current business model (Appendix - Questionnaire). Interviewee Caterpillar A mainly focuses on issues that fall into system related barriers: resources, access to and usability of data. These barriers are mainly due to
the lack of processes. Interviewee Caterpillar D refers to the lack of confidence on data and results which is a culture related barrier, along with the lack of vision from management. This is a serious point raised by the interviewee. It shows that not in every business unit of Caterpillar the same vision of data analytics value is shared as the CEO would like to advertise. Additionally, he mentions systems related barriers; IT infrastructure. Furthermore, interviewee Caterpillar C agrees with Caterpillar D on the culture related barriers as his comment is again about the lack of understanding at senior levels as to what data analytics actually is! Caterpillar B mentions a system related barrier which is the lack of process to align the benefits of data analytics to be measured with an economic metric, so it will be easily understood by every employee and lower resistance to change. All in all, the most significant barriers in the case of Caterpillar seem to be system related (processes) and culture related (at least in some business units and not in the headquarters).

**Urge for Action**

Caterpillar as a whole is probably an industry leader in data analytics (Caterpillar A) (Caterpillar, 2016). However, Industrial Power Systems Division (IPSD), which is a business unit of Caterpillar, is striving to catch up and to expand analytics capabilities to all of its brands (Caterpillar A) (Caterpillar C). Moreover, Caterpillar employees completely agree with the statement of (Porter & Heppelmann, 2014) (Marshall, et al., 2015) (Berman, 2012) (Rios, 2013) (ATKearney, 2016) that if data analytics is not an option, then the organisation could find it difficult to innovate and fall behind its competitors (Appendix - Questionnaire). Furthermore, Caterpillar employees believe that data analytics is a key driver of business innovation and growth over the next 10 years (Appendix - Questionnaire). The Industrial Internet of Things (IIoT) will continue growing at a pace and the amount of data provided needs to be harnessed and understood (Caterpillar A). Understanding the end value chain in areas such as marketing, procurement, design, development, manufacturing and distribution as well as the customer experience is critical to winning customer loyalty and developing a sustainable business (Caterpillar B). As the use of data analytics proliferates anybody not using it will soon be left behind with respect to their market (Caterpillar C). “Knowledge is power” (Caterpillar A). To summarise, a business may be a leader, striver or struggler (Marshall, et al., 2015) in data analytics field. It may even have different business units that are currently on a different level of data analytics adoption like Caterpillar. One is certain though: businesses need definitely to follow the data analytics route to stay ahead of competition and survive in the future. They need to act and act now! Data analytics urge for action as the development in this field is a lot quicker than the industry was used to. Companies need to realise their real current position and take a bold decision to go further the data analytics route and realise the benefits; “Knowledge is power”.

### 5.2. Ericsson

Ericsson is a global leader on the ICT industry with 140 years of history, providing industry-leading telecommunications network equipment and software. Ericsson’s vision is to make the Networked Society a reality, one in which “connectivity brings people closer together than ever before, where collaboration is part of everyday life, and where every person and every industry is empowered to reach their full potential.” (Ericsson, 2016). In order to achieve this very ambitious vision, Ericsson aims to lead transformation through mobility. Historically, Ericsson has been a leader on the wireless network equipment and wireless network services areas. These two areas correspond to Ericsson’s Networks and Services business divisions which are still
today the main drivers of Ericsson’s revenues representing 55% and 40% respectively of Ericsson’s global revenues (Ericsson, 2016).

**Data Analytics Value**
The ICT industry is going through a phase of enormous transformation where industry boundaries are being broken and where different sub-sectors (wireless, wireline, IT, Media,...) are converging. This transformation is being driven by the digitization phenomenon. Although the validation of data analytics value creation and disruptive potential is not a goal of this thesis (as these are generally accepted assumptions), the authors decided to gauge the interviewees’ view on these issues in order to establish a baseline of their views towards data analytics.

By analysing the answers for questions 1, 2 and 3 of the questionnaire (Appendix - Questionnaire), it is clearly seen that all three Ericsson interviewees see data analytics as a disruptive force on the telecommunications industry, having the potential to shatter industry boundaries and create new business opportunities for the company. They also mention that in order to leverage data analytics value it is necessary to innovate on the business model front. This falls in line with (Loebbecke & Picot, 2015) thinking that well-established companies need to innovate their business model to explore new business opportunities due to Data Analytics.

**Business Model Innovation to explore data analytics value**
Having established that Ericsson employees recognize the potential of data analytics (as expected), the next step was to dig deeper in the main questions of this thesis: how is Ericsson innovating its business model in order to capture data analytics value? Which process/model is being followed (if any) and which areas of the business model have been/will be impacted the most? These issues were targeted on the questionnaire by questions 4, 5, 6, 7 and 8. The authors also found relevant information on this topic by analysing public documents issued by Ericsson.

In order to adapt to emerging business opportunities, Ericsson created a third business area called Support Solutions. The intent was to develop competence (both internally and through company acquisitions) in areas where it previously did not have a strong presence, namely: IP Networks, Cloud, OSS/BSS, TV and Mobile, and Industry & Society (Ericsson, 2016). Company acquisitions has been a key part of Ericsson’s business model innovation as it can be seen on Figure 4-9. This strategy was presented by (Malarkey, 2014) where it is stated that the three key business model innovation types of organization are innovation platforms, in-house venture funds and acquisition of new start-ups. While developing internal competences is always a desired outcome, the speed at which change is occurring as well as the relative lack of expertise of Ericsson’s personnel in what are now key areas led the company to the acquisitions route. This seems to be a route to be possibly followed by large-companies looking to quickly ramp-up their data analytics competences in an agile environment. Validation of this strategy as the preferred route taken by well-established companies would be a possible area of study for a later stage.

However, when answering question 4 of the questionnaire, the interviewees were not adamant in terms of Ericsson having a clearly defined process to implement business model innovation (and namely business model innovation due to data analytics). Based on conversations with the interviewees this question was interpreted on a practical manner, from a Program Management perspective and not so much from a strategy perspective. While some interviewees did mention some specific needs such as operational/legal processes, it does not seem to exist a transversal business model innovation process in
place. In fact, interviewee Ericsson C that specifically manages the Business Model Management group confirmed that the company does not have a structured approach to business model transformation and needs one that should include the following steps: defining change program, projects and action plans in order to bridge the gap between the as-is-state and the to-be-state. This is specially revealing given the role of this interviewee and clearly seems to indicate that Ericsson does not have implemented a business model innovation process in order to capture value through the use of data analytics. A deeper and broader analysis of all different Ericsson Business Units and local operations in different countries around the world would have to be performed in order to validate this lack of a well-defined business model transformation process as a company-wide phenomenon.

Also, the implementation of data analytics methods, and the use of these methods in order to extract value and deliver innovative business models (ATKearney, 2016) comes with challenges mentioned by (Chesbrough, 2010) (Eichen, et al., 2015) (Malarkey, 2014) namely awareness related, search related, system related, logic related and culture related barriers. When answering question 5, interviewee ERICSSON B cited these challenges when he mentions “concerns about the possibility of data analytics uncovering errors/flaws in current ways of working” as one of the obstacles to the introduction of data analytics in Ericsson’s business model. The need to address and overcome these obstacles was in general mentioned by all interviewees as a key to successfully implement business model innovation. The following barriers were mentioned by the interviewees: resistance to change, lack of area specific knowledge, and concerns about the possibility of data analytics uncovering errors/flaws in current ways of working. These are aligned with the awareness-related and culture-related barriers mentioned by (Eichen, et al., 2015).

In terms of data analytics methods that have been adopted by Ericsson all the interviewees (when answering question 7 in (Appendix - Questionnaire) mentioned predictive analytics as the most commonly used technique. It was also stated that moving forward Ericsson would definitely need to focus on prescriptive analytics in order to deliver as much value as possible to its customers. On the contrary, descriptive analytics are characterized as not adding enough value by themselves. As such well-established companies should look to use predictive and prescriptive analytics when developing a new business model based on data analytics. The use of descriptive analytics was discard by the interviewees based on the limited value that is added by using this analytics method.

When identifying the areas of Ericsson’s business model that were most affected by the introduction of data analytics, and taking into consideration both the answers to question 6 of the questionnaire (Appendix - Questionnaire) and the collected data, it can be said that the most impacted areas are: value propositions, revenue streams, customer segments, customer relationships and key activities. The cost structure is not seriously affected as Ericsson already had the infrastructure needed to implement data analytics and as such no major investments were needed. This is depicted on Ericsson’s updated business model canvas (Table 4-4). Generally speaking the introduction of data analytics will allow market-leaders to further understand their customers’ needs and address their concerns; as a consequence these companies will be able to effectively relate to their customers, further segment them based on all the insight given by data analysis, develop new value propositions that address these unveiled opportunities and consequently develop new revenue streams.

When answering question 8 of the questionnaire that directly alluded to the statement (Lokitz, 2016) that data focused business models can be split in three different categories depending on the value proposition
and the way customers interact (Data as a Service - DaaS, Information as a Service – IaaS, or Answers as a Service - AaaS) all interviewees agreed that Information as a Service is the model that better reflects what Ericsson is currently doing. Data as a Service was discarded by the interviewees based on the data security, ownership and governance issues that could arise from using this business model. Additionally, some use cases that are currently being developed can also be characterized as following an Answers as a Service business model. Examples of such use cases are localization data monetization and contextual advertising.

In terms of business areas affected by the adoption of data analytics three main categories were identified: customer intimacy, product/service innovation and operations. Examples of data analytics usage in order to deepen customer intimacy are services such as Empowered customer care and TV/Media experience optimisation. Regarding operations Ericsson has leveraged data analytics and used them on applications such as Self-Optimizing Networks (SON) and Real Time Customer Experience Monitor and Optimization. Finally, data analytics based product/service innovation is seen in solutions such as Smart Grid and Location Data Monetization.

**Urge for Action**

After analysing Ericsson’s current business model (including all the latest products and services added to the Support Solutions business unit) (Table 4-4) with Ericsson’s business model prior to the adoption of data analytics (Table 4-2) it can be seen that Ericsson has already significantly evolved its business model adding elements to some of its key areas, namely: value propositions, revenue streams and customer segments. There’s still much to be done by Ericsson in this area, as indicated by the fact that when answering question 9 of the questionnaire, subject ERICSSON A stated that Ericsson is a *striver* (Marshall, et al., 2015) when it comes to data analytics adoption and subjects ERICSSON B and ERICSSON C classified Ericsson as a *struggler* in the sense that the company is still trying to adapt to a multi-verticals customer base. There is however a strategic vision from Ericsson’s management (Ericsson, 2014) that the adoption of data analytics is not a luxury but a necessity when it comes to further grow its global market and to being able to deliver innovative value solutions to its customers.

When answering questions 10 and 11 (Appendix - Questionnaire) the interviewees indicated that not adopting data analytics would be a key strategic mistake that would undoubtedly make Ericsson loose its competitive position in the market. The interviewees also agreed that data analytics will open a number of new business opportunities and the use of data analytics will be fundamental as new networks enabled by all-IP technologies such as Cloud, Software Defined Networks, and Network Function Visualization emerge. The need for data analytics will accelerate as this transformation takes place and will be a key differentiator when it comes to being able to deliver value to these different user profiles. Subject ERICSSON B added that as end users leave a greater digital footprint, more opportunities will be there for companies that can analyse data and extract behavioural information from it.

5.3. Caterpillar and Ericsson; similar or different routes?

Both Caterpillar and Ericsson employees agree that there is value in data analytics, which can be disruptive, but at the same time offer new business opportunities. They also agree that they need to innovate their business model in order to monetise that value. The value of data analytics is already proven by the theory (Porter & Heppelmann, 2014), (Chesbrough, 2010), (Ammit & Zott, 2012), (Gobble, 2014), (Loebbecke & Picot, 2015) and needs no further validation. However, the alignment of these two companies with the theory shows to the reader that the matter should not be taken lightly. Moreover, the reader understands the starting point for these companies and is ready to follow the core analysis of
the thesis in an attempt to answer the question: “how do well-established companies innovate their business model to explore data analytics value?”.

The question regarding the existence of a formal process towards business model innovation did not offer any reference to a formal documented and in use process. It is not that the interviewees did not want to reveal any steps of an existing process due to IP reasons. A genuine process was absent both form the Caterpillar business unit and Ericsson. Interviewees only agreed that there is a need for a process and offered tips for action, plan and what should be included. For Caterpillar it seems that a defined process exists in the highest corporate level of the parent company as CEO states in the “Age of Smart Iron” (Caterpillar, 2016), but this is not the case in all business units. This is aligned with the findings that although Caterpillar may be seen as a leader in data analytics field, some of its business units are strivers. Ericsson as a whole is also seen as a striver. So, both companies are still defining the processes towards business model innovation and data analytics adoption, but certainly they are heading towards this route.

Caterpillar and Ericsson follow different approaches towards the key business model innovation types of organization. Caterpillar has established a joined venture with Uptake, while Ericsson follows the acquisition of new start-ups route such as Mediaroom and Conceptwave that immediately expanded its portfolio into new areas. The aim is the same: gain competence in the data analytics field from more experienced companies in this area (Malarkey, 2014).

Data analytics methods can be divided in three groups based on the usage of the data (Duan, 2015): descriptive, predictive or prescriptive. For Caterpillar all three types seem to be important depending on the need and some examples were also offered: Engineering – Predictive, Warranty – Descriptive and Predictive, Marketing – Prescriptive. Ericsson seems to be interested only in two types: predictive and prescriptive. So, both Caterpillar and Ericsson mainly use predictive and prescriptive in different applications.

Comparing Caterpillar’s and Ericsson’s business model canvas before and after the adoption of data analytics in an attempt to highlight the areas affected, it is clear that in the Caterpillar case all areas except one (customer segments) have been changed, while in Ericsson the only area that didn’t suffer a major impact with the emergence of data analytics was cost structure as no major infrastructure development was needed.

(Lokitz, 2016) offers three business models DaaS, IaaS and AaaS which are a result of the process of business model innovation in order to explore data analytics value. Both Caterpillar and Ericsson agree that Information as a Service is the preferable model. However, the rest cannot be excluded depending on the business case.

The business areas that are favoured by data analytics are (ATKearney, 2016) (Duan, 2015): customer intimacy, product/service innovation and operations. Both Caterpillar and Ericsson agree that the same three business areas are favoured offering multiple examples.

There are barriers to business model innovation process: awareness related, search related, system related, logic related and culture related barriers (Chesbrough, 2010), (Eichen, et al., 2015) (Malarkey, 2014) which have been observed in different companies. The most significant barriers in the case of Caterpillar seem to be system related (processes) and culture related (at least in some business units and
not in the headquarters). For Ericsson the main identified barriers were awareness-related and culture-related.

Both Caterpillar and Ericsson interviewees after having realised the value of data analytics and the need for the business model to be updated, urge for action in this area. They all believe that if data analytics are not adopted there is a high risk for a business to fall behind competition as it is also stated in the theory and point out that data analytics will continue to drive growth in the near future.

6. Conclusions

Today there are multiple data sources or data generators from the incorporation of computers in a variety of products from mobile phones, home electric appliances to cars, machinery and airplanes. Even humans are transforming to data generators through social media. The Internet of Things and the advancement in the IT industry allowed the data capture, storage and transmission of information. Data analytics has provided companies, both start-ups and established players, the possibility to further understand their customer’s needs and concerns, their buying patterns and also provide a platform to expand traditional product/service boundaries. In other words, data analytics enable the experimentation and innovation of business models to offer new products and services. Business model innovation occurs when a company finds a new way to perform business which disrupts its industry and differentiates from competition. Classical manufacturers, whose previous model allowed to capture value once a product was sold, are turning into service providers, who are able to capture value throughout the life of a product. Pressure is especially put on well-established companies which have more difficulties in adapting quickly to the new environment and innovate their business model due to the existence of barriers. There are some examples in the literature of companies that have both managed or fail to innovate their business model to adapt in new environments. However, there is a gap in the data analytics case and more specifically of a successful process or roadmap towards that direction. So, the question to answer in this thesis is: “How do established companies explore data analytics to innovate their business models?”

The theoretical study initially focused on data analytics and its importance. The exponential increase in generated data created new challenges: in IT system infrastructure, in the selection of useful data, in data ownership and in the usefulness of data for strategic decision making. Data analytics methods were also presented. The capabilities of smart connected products, the Internet of Things and data analytics are reshaping industry boundaries, offering new business opportunities and competitive advantage, while data analytics add real value to business strategy. Companies are able to monetise new business opportunities by innovating their business model and offering new product and/or services. The problem is now geared towards the necessary roadmap for business model innovation. Secondly, a business model definition was given. Following the proposal that a business model innovation can lead to a competitive advantage and is difficult to be replicated, a 6 step business model innovation process was presented. Moreover, the business model canvas was identified as a very useful representation tool. The business model innovation areas and the value drivers were explored along with the barriers that make business model innovation not an easy task, but also some solutions were offered. Lastly, the business model innovation to explore data analytics value was analysed. The different industries that use data analytics to innovate their business models were given. The starting steps of how a company could start on the data analytics journey were presented, followed by three generic business models focused on data analytics value exploitation: DaaS, IaaS and AaaS. The data analytics value effect on specific business
areas: customer intimacy, product/service innovation and operations were highlighted. The challenges and risks for a business which would not adopt data analytics were also given.

The case study method, the selection of Caterpillar and Ericsson, the data collection and the data analysis technique were explained. The data gathered came mainly from two sources: documents and interviews. Both advantages and disadvantages were explained. For the interviews a questionnaire was created which was split in three sections: introductory questions, core questions, reference and urge to action questions. Each section had specific questions deriving from the literature review mainly to answer the thesis question, but also to help the reader understanding the current status of the companies, the view of employees on data analytics value and the future. The questionnaire was supplied to targeted employees in both companies.

In the results section the current business model of Caterpillar and Ericsson were analysed and also presented using the business model canvas tool. Then the answers of the questionnaire along with the information gathered from documents were presented. Moreover the business areas affected by data analytics value were identified. Furthermore, the business model canvas after the data analytics adoption for both Caterpillar and Ericsson was presented to better visualise the business model innovation to explore new business opportunities and the effect of data analytics.

The analysis section linked the literature review with the results section to answer the thesis question. Both Caterpillar and Ericsson have invested in business model innovation to explore new business opportunities offered by data analytics. Caterpillar moved toward an Age of Smart Iron strategic direction while Ericsson aims to achieve its vision of Networked Society.

A formal process with clearly defined steps towards business model innovation to explore data analytics value was not possible to be defined in either of the two companies by the interviewees or the documents. Interviewees only agreed that there is a need for a process and offered tips for action, plan and what should be included. For Caterpillar it seems that a defined process exists in the highest corporate level of the mother company, but this is not the case in all business units. Ericsson seems to be in a similar state, as again there was no proof of such a process. So, both companies are still defining the processes towards business model innovation and data analytics adoption, but certainly they are heading towards this route. Moreover, each Business Unit of the same company may use its own innovation method.

Regarding business model innovation types of organization to deliver the new strategic direction, Caterpillar created a joint-venture with the hottest start-up of 2015 Uptake to build a data analytics innovation platform. Ericsson took mainly the acquisitions route having acquired companies such as Mediaroom and Conceptwave that immediately expanded its portfolio into new areas.

In terms of methods of data analytics usage both Caterpillar and Ericsson mainly use predictive and prescriptive in different applications.

Comparing Caterpillar’s and Ericsson’s business model canvas before and after the adoption of data analytics in an attempt to highlight the areas affected, it is clear that in the Caterpillar case all areas except one (customer segments) have been changed, while in Ericsson the only area that didn’t suffer a major impact with the emergence of data analytics was cost structure as no major infrastructure development was needed.
Out of the three business models DaaS, IaaS and AaaS which are a result of the process of business model innovation in order to explore data analytics value, both Caterpillar and Ericsson agree that Information as a Service is the preferable model. However, the rest cannot be excluded depending on the business case.

The business areas of Caterpillar and Ericsson that are favoured by data analytics are: *customer intimacy, product/service innovation and operations*.

However, there are barriers to business model innovation process. The most significant barriers in the case of Caterpillar seem to be system related (processes) and culture related (at least in some business units and not in the headquarters). For Ericsson the main identified barriers were awareness-related and culture-related.

Finally, both Caterpillar and Ericsson interviewees after having realised the value of data analytics and the need for the business model to be updated, urge for action in this area. They all believe that if data analytics are not adopted there is a high risk for a business to fall behind competition as it is also stated in the theory and point out that data analytics will continue to drive growth in the near future.
References


Caterpillar, 2012. *Cat Product Link*. [Online] Available at: https://www.youtube.com/watch?v=PxUf79kblTg


Appendix - Questionnaire

Please answer to the questions below by giving a mark according to the following scale:
1 = Completely Disagree, 2 = Partially Disagree, 3 = Neutral, 4 = Partially Agree, 5 = Completely Agree

Please add any comments to the relevant box. Thank you!

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<th>#</th>
<th>Question</th>
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<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
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<td>Data analytics can offer new business opportunities for your organization</td>
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<td>Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics</td>
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<td>The implementation of data analytics in the business model requires a well-defined process</td>
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<td>If yes, can you name some steps of this process?</td>
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<td>There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model</td>
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<td>6</td>
<td>Data analytics are adding/would add value to the following parts of your organisation’s business model: <em>(give a mark to each)</em></td>
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<td>- key partners</td>
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<td>Which data analytics usage is more suitable for your organization? (give a mark for each)</td>
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| 7 | - Descriptive = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc.  
- Predictive = develop statistical models that can be used to predict future events (e.g. regression analysis)  
- Prescriptive = predict not only one possible future but instead various possible futures based on the actions of the decision-maker  
Please comment on the option with the highest mark |

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<th>If your organization would explore data analytics value which case of the following seems more likely: (give a mark for each)</th>
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| 8 | - Data as a service: selling slightly processed customer data to third parties  
- Information as a service: providing insights based on analysed customer data  
- Answers as a service: providing answers to specific customer problem  
Please comment on the option with the highest mark |

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<th>How would you rate your organization currently, depending on the level of data analytics adoption: (give a mark to each)</th>
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| 9 | - leader: has already a business model and innovates using data analytics  
- striver: currently investing in data analytics, but not everything is clear yet  
- struggler: no innovation processes to take advantage of data analytics or very limited  
Please comment on the option with the highest mark |

|   | If data analytics are not an option, then your organization could find it difficult to innovate and fall behind its competitors.  
If yes, in which areas?  
If no, why? |
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<th>Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.</th>
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<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
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<td>The competition will come from existing players mining their own data more effectively than we do. Our products are becoming commodities and it will be how we use this information to improve the quality, service and supportability will be the key differentiator.</td>
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<td>2</td>
<td>Data analytics can offer new business opportunities for your organisation</td>
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<td>If yes, which ones?</td>
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<td>If no, why?</td>
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<td>Smarter utilization of the existing data we have around us will enable the business to identify process efficiencies through the build process, testing of engines, warranty and service. Tying in telematics information from onboard control systems will enable engineers to understand how equipment is used and to refine the product to meet the conditions they are utilized in. Analysing customer data will enable us to see spend trends and by bringing macro economic data in (already done in parts of Caterpillar) trend data will enable enhanced forecasting (e.g. Earthquake in Szechuan province creates a surge for generator sets 3 months later)</td>
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<td>3</td>
<td>Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics</td>
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<td>Using data we have around the business, which is mostly transactional (build, financial, sales, warranty, service, etc.) linked to Macro and social media will help provide greater clarity in opportunities to exploit existing markets and to explore new.</td>
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<td>4</td>
<td>The implementation of data analytics in the business model requires a well-defined process</td>
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<td>If yes, can you name some steps of this process?</td>
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<td>Data analytics is a new area for most traditional businesses and we are still defining governance processes &amp; policies. However would suggest that we need to encourage innovative ideas and access to data to enable personnel to explore opportunities. Through having an analytics team established which supports appropriate ideas sharing, the provision of assistance (how to and technical) and to enable access to the appropriate data then a number of prototype projects can be created to enable the rest of the organization to see the practical benefits of using analytics.</td>
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<td>There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model</td>
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Funding, appropriately skilled resources and access to data

6 Data analytics are adding/would add value to the following parts of your organisation’s business model: *(give a mark to each)*
- key partners
- key activities
- key resources
- cost structure
- value propositions
- customer relationships
- distribution channels
- revenue streams
- customer segments

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Additional comments:
All these areas will benefit greatly by the use of appropriate analytics

7 Which data analytics usage is more suitable for your organisation? *(give a mark for each)*
- **Descriptive** = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc.
- **Predictive** = develop statistical models that can be used to predict future events (e.g. regression analysis)
- **Prescriptive** = predict not only one possible future but instead various possible futures based on the actions of the decision-maker

Please comment on the option with the highest mark

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Additional comments:
Each area is key for the business, it will be of greater value or less to different departments. E.g. engineering – predictive, warranty – descriptive and predictive, Marketing - Prescriptive

8 If your organisation would explore data analytics value which case of the following seems more likely: *(give a mark for each)*
- **Data as a service**: selling slightly processed customer data to third parties
- **Information as a service**: providing insights based on analysed customer data
- **Answers as a service**: providing answers to specific customer problem

Please comment on the option with the highest mark

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Additional comments:
Still a new area for the business however by obtaining more field data on customer product will enable better insights into how these products are used, serviced, maintained which will then enable product to be designed for specific functions

9 How would you rate your organisation currently, depending on the level of data analytics adoption: *(give a mark to each)*
- **leader**: has already a business model and innovates using data analytics
- **striver**: currently investing in data analytics, but not everything is clear yet
- **struggler**: no innovation processes to take advantage of data analytics or very limited

Please comment on the option with the highest mark

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Additional comments:
Caterpillar as a whole is probably a leader in analytics for our industry. IPSD is striving to catch up and to expand analytics capabilities to all of its brands

10 If data analytics are not an option, then your organisation could find it difficult to innovate and fall behind its competitors.
If yes, in which areas?

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If no, why?

**Additional comments:**
Agree, however all our competitors are in the same boat, it is the one that gets to market first will obtain a competitive advantage.

<table>
<thead>
<tr>
<th>11</th>
<th>Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.</th>
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<tbody>
<tr>
<td></td>
<td><strong>Additional comments:</strong></td>
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<tr>
<td></td>
<td>The Industrial Internet of Things (IIoT) will continue at a pace and the amount of data provided needs to be harnessed and understood. By doing this IPSD will be able to add value around its product which will encourage customers to keep coming back.</td>
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12 Please add any other comments:

*Knowledge is power*

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**Caterpillar B**

**DFA Manager**

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<tr>
<th>#</th>
<th>Question</th>
<th>Mark</th>
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<tbody>
<tr>
<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
<td>5</td>
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<td></td>
<td><strong>Additional comments:</strong></td>
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<td></td>
<td>Large Engineering Manufacturing businesses have historically not used data analytics to interrogate its business data well enough to understand its value chain.</td>
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<tr>
<td>2</td>
<td>Data analytics can offer new business opportunities for your organisation If yes, which ones? If no, why?</td>
<td>5</td>
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<tr>
<td></td>
<td><strong>Additional comments:</strong></td>
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<td></td>
<td>Data analytics is a business in itself and can be used to provide real value to our customers through the introduction of new service businesses.</td>
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<tr>
<td>3</td>
<td>Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics If yes, why? If no, why?</td>
<td>5</td>
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<td></td>
<td><strong>Additional comments:</strong></td>
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<td></td>
<td>Customers require much more immediate added value from our products and services and this can be provided through analytics. Examples include such things as prognostics and autonomous vehicles to mention only two.</td>
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<tr>
<td>4</td>
<td>The implementation of data analytics in the business model requires a well-defined process If yes, can you name some steps of this process? If no, why?</td>
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<td></td>
<td><strong>Additional comments:</strong></td>
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<td></td>
<td>A good MGPP (Multi Generation Project Plan) applying 6 Sigma DMEDI (Define, Measure, Explore, Develop and Implement) needs to be applied along with change management if data analytics is to become embedded into the business culture</td>
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<td>5</td>
<td>There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation's current business model</td>
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<td>If yes, which ones?</td>
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<td>If no, why?</td>
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<td>Additional comments:</td>
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<tr>
<td>Everyone applies some form of data analytics but its strength is in having a business wide integrated approach and any form of change that requires funding without easily defined OPAAC benefits will provide an obstacle. Our leaders need to provide the Vision.</td>
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<tr>
<td>6 Data analytics are adding/would add value to the following parts of your organisation’s business model: <em>(give a mark to each)</em></td>
<td>5</td>
<td></td>
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<tr>
<td>- key partners</td>
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<td>- key activities</td>
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<td>- key resources</td>
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<td>- cost structure</td>
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<td>- value propositions</td>
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<td>- customer relationships</td>
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<td>- distribution channels</td>
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<td>- revenue streams</td>
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<td>- customer segments</td>
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<tr>
<td>Additional comments:</td>
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<tr>
<td>The application of a business wide analytics program will provide benefits in all areas of the business but will require significant change to the way we run the business.</td>
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<tr>
<td>7 Which data analytics usage is more suitable for your organisation? <em>(give a mark for each)</em></td>
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<tr>
<td>- Descriptive = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc.</td>
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<tr>
<td>- Predictive = develop statistical models that can be used to predict future events (e.g. regression analysis)</td>
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<td>- Prescriptive = predict not only one possible future but instead various possible futures based on the actions of the decision-maker</td>
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<td>Please comment on the option with the highest mark</td>
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<td>Additional comments:</td>
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<td>Descriptive (5) because field data is critical for our understanding of our supply, design, development and manufacturing capability. Predictive (5) because we need to produce robust product and services with the least amount of physical testing. Prescriptive (4) because we are still immature in descriptive and Predictive,</td>
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<tr>
<td>8 If your organisation would explore data analytics value which case of the following seems more likely: <em>(give a mark for each)</em></td>
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<tr>
<td>- Data as a service: selling slightly processed customer data to third parties</td>
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<td>- Information as a service: providing insights based on analysed customer data</td>
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<td>- Answers as a service: providing answers to specific customer problem</td>
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<td>Please comment on the option with the highest mark</td>
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<td>Additional comments:</td>
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<tr>
<td>By applying data analytics information on how a Customer uses our products and services we will be in a very strong position to add value through optimized cost of ownership (service interval, running cost, prognostics, down time ... etc.)</td>
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<tr>
<td>9 How would you rate your organisation currently, depending on the level of data analytics adoption: <em>(give a mark to each)</em></td>
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<tr>
<td>- leader: has already a business model and innovates using data analytics</td>
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- **striver**: currently investing in data analytics, but not everything is clear yet  
- **struggler**: no innovation processes to take advantage of data analytics or very limited

Please comment on the option with the highest mark

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<td>10</td>
<td>If data analytics are not an option, then your organisation could find it difficult to innovate and fall behind its competitors. If yes, in which areas? If no, why?</td>
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<td><strong>Additional comments:</strong> Without data analytics innovation and development of both product and services will lag market leaders.</td>
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<tr>
<td>11</td>
<td>Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.</td>
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<td><strong>Additional comments:</strong> Understanding our end to end value chain in areas such as marketing, procurement, design, development, manufacture and distribution as well as the experience our customers are having whilst using our products and services is critical to winning customer loyalty and developing a sustainable business.</td>
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<td>12</td>
<td>Please add any other comments:</td>
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**Caterpillar C**  
**Software Engineering Specialist - Data Analytics Tools Team Manager**

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<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
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<td><strong>Additional comments:</strong> Although data analytics is nothing new, the ease with which it can be performed has significantly changed over the past few years. This has enabled many areas to conduct analysis which previously would have worked from heuristic models.</td>
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</table>
| 2  | Data analytics can offer new business opportunities for your organisation  
If yes, which ones?  
If no, why? | 5    |
|    | **Additional comments:** Data analytics can be used to connect sales data to supply chain to engineering (for example) so that more informed decisions can be made with respect to various departments. This can lead to new market areas or leaner ways to produce products. |      |
| 3  | Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics  
If yes, why?  
If no, why? | 5    |
|    | **Additional comments:** The world is changing at a rapid pace and investment is required to keep up! |      |
| 4  | The implementation of data analytics in the business model requires a well-defined process | 5    |
If yes, can you name some steps of this process?  
If no, why?  

**Additional comments:** The process will change for each department or type of analysis. Blindly throwing data at software will not yield results. A strategy is required to determine what is to be understood.

| 5 | There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model.  
If yes, which ones?  
If no, why?  

**Additional comments:** Access to data, clean data, consistent data. Lack of understanding at senior levels as to what data analytics actually is. |

| 6 | Data analytics are adding/would add value to the following parts of your organisation’s business model: *(give a mark to each)*  
- key partners  
- key activities  
- key resources  
- cost structure  
- value propositions  
- customer relationships  
- distribution channels  
- revenue streams  
- customer segments  

**Additional comments:** ALL! |

| 7 | Which data analytics usage is more suitable for your organisation? *(give a mark for each)*  
- *Descriptive* = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc.  
- *Predictive* = develop statistical models that can be used to predict future events (e.g. regression analysis)  
- *Prescriptive* = predict not only one possible future but instead various possible futures based on the actions of the decision-maker  

Please comment on the option with the highest mark.  

**Additional comments:** “Descriptive” is data analysis, not analytics. “Predictive” and “Prescriptive” should be used carefully as they both involve extrapolation (extrapolation from regression will lead to +/- infinity). They are all very important in different ways to different areas of the business. We should avoid a “one size fits all” approach. |

| 8 | If your organisation would explore data analytics value which case of the following seems more likely: *(give a mark for each)*  
- *Data as a service*: selling slightly processed customer data to third parties  
- *Information as a service*: providing insights based on analysed customer data  
- *Answers as a service*: providing answers to specific customer problem  

Please comment on the option with the highest mark.  

**Additional comments:** All can be used in some form. We could increase revenue from DaaS, improve our product from IaaS and improve customer satisfaction from AaaS. |

| 9 | How would you rate your organisation currently, depending on the level of data analytics adoption: *(give a mark to each)*  
- *leader*: has already a business model and innovates using data analytics  

---
- **striver**: currently investing in data analytics, but not everything is clear yet
- **struggler**: no innovation processes to take advantage of data analytics or very limited

Please comment on the option with the highest mark

### Additional comments:

- Struggler/striver. We have started our data analytics journey and investigating the most applicable methods.

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| 10 | If data analytics are not an option, then your organisation could find it difficult to innovate and fall behind its competitors.  
If yes, in which areas?  
If no, why? | 5 |
| 11 | Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark. | 5 |
| 12 | Please add any other comments: | |

**Caterpillar D**  
*Foundational Data and Data Analytics Manager*

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<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
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| 2  | Data analytics can offer new business opportunities for your organisation  
If yes, which ones?  
If no, why? | 5    |
| 3  | Your organisation needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics  
If yes, why?  
If no, why? | 5    |
<p>| 4  | The implementation of data analytics in the business model requires a well-defined process | 3    |</p>
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<tr>
<td>If yes, can you name some steps of this process? If no, why?</td>
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<td><strong>Additional comments:</strong> The implementation within the business process will depend on the nature of the analytics - e.g. visualization v optimizing. There is a need for governance, structure and clear alignment with business goals.</td>
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<tr>
<td>5 There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model If yes, which ones? If no, why?</td>
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<tr>
<td><strong>Additional comments:</strong> General capability &amp; confidence with data management &amp; outputs. GIS capabilities to support &amp; maintain &amp; hardware capability.</td>
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<tr>
<td>6 Data analytics are adding/would add value to the following parts of your organisation’s business model: (give a mark to each) - key partners 3 - key activities 5 - key resources 5 - cost structure 5 - value propositions 4 - customer relationships 5 - distribution channels 5 - revenue streams 5 - customer segments 5</td>
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<td>7 Which data analytics usage is more suitable for your organisation? (give a mark for each) - Descriptive = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc. 5 - Predictive = develop statistical models that can be used to predict future events (e.g. regression analysis) 5 - Prescriptive = predict not only one possible future but instead various possible futures based on the actions of the decision-maker 5</td>
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<td><strong>Please comment on the option with the highest mark</strong></td>
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<tr>
<td><strong>Additional comments:</strong> All in different areas depending on maturity and availability of data</td>
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<tr>
<td>8 If your organisation would explore data analytics value which case of the following seems more likely: (give a mark for each) - Data as a service: selling slightly processed customer data to third parties 1 - Information as a service: providing insights based on analysed customer data 5 - Answers as a service: providing answers to specific customer problem 4</td>
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<td><strong>Please comment on the option with the highest mark</strong></td>
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<tr>
<td><strong>Additional comments:</strong></td>
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<tr>
<td>9 How would you rate your organisation currently, depending on the level of data analytics adoption: (give a mark to each) - leader: has already a business model and innovates using data analytics 1 - striver: currently investing in data analytics, but not everything is clear yet 5 - struggler: no innovation processes to take advantage of data analytics or very limited</td>
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<td><strong>1</strong></td>
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Please comment on the option with the highest mark 3

Additional comments:

10 If data analytics are not an option, then your organisation could find it difficult to innovate and fall behind its competitors.
   If yes, in which areas?
   If no, why?
   Additional comments: period & variable cost management. Customer relationship management

11 Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.
   Additional comments:

12 Please add any other comments:

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**Ericsson A**

**Solution Sales Director**

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<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
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<td><strong>Additional comments:</strong></td>
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<td></td>
<td>This is generally true for Ericsson, as well as our customers – the telecom operators. In addition, regulations, as well as brand value sometimes can make it difficult for a telecom operator to monetize data about their users, and it is easier to do so, for so called “over the top” Internet Application Providers. As we evolve towards 5G, and Internet Of Things, we will have many new stake holders and business models on the networks that we deploy. New technologies such as cloud and virtualization, brings much better multi tenancy capability, which in turn helps improve the data, along with an ability to monetize it for the correct stakeholder audience. In addition, the ability to apply policy and governance on the data, constrain it to a particular geography, etc., will mean improved revenues, and lowered operational cost to the ecosystem as a whole.</td>
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<td>2</td>
<td>Data analytics can offer new business opportunities for your organization</td>
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<td></td>
<td>If yes, which ones?</td>
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<td>If no, why?</td>
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<td><strong>Additional comments:</strong></td>
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<td>Yes, there are a lot of new business opportunities for Ericsson and our customers, be it telecom operators or Enterprises through our direct channel. Just a few examples of opportunities are:</td>
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<td>- Location Services, which can be monetized directly back to the end user.</td>
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<td>Examples are “proximity” and predictive services based on data available to the operator</td>
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<td>- Sponsored data, which is a concept that allows an end user to get a “no cost” chunk of data service, in return from receiving advertising from an Enterprise sponsoring the data.</td>
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<td>The Enterprise would be by paying an access fee to the operator, potentially triggered by a known preference in e.g. a specific sport.</td>
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<td>- Parental Control, and content filtering, which allows a parent to pay for controlling the content received by a child that is part of the same household</td>
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</table>
- Closed Loop Automation, which allows an operator to order an automatic capacity expansion on a cloud based virtualized telecom solution, based on the load reaching a threshold value close to the maximum, and without human intervention. This is something that can offer tremendous OPEX reduction for the operator.

3 Your organization needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics
   If yes, why?
   If no, why?

   Additional comments:
   Yes, but to us, Analytics is just one of the factors driving this. We talk about the “Networked Society”, and we see a network that is used by a much larger number of stakeholders, for example enterprises, verticals, cities and municipalities, etc. Compared with today’s network, where the majority of devices on a typical mobile network are smartphones, tomorrow’s network will need to be optimized for machines, sensors, etc. To filter out which data is meaningful, what the data means, and to which stakeholders it can add value, will be a key area of business innovation and technology innovation side by side. In the end of the day, Analytics becomes an important means to an end of improving productivity, safety, security, in industries and enterprises, and also continue to improve end user experience, freedom, and convenience to end users. New business models are going to be needed.

4 The implementation of data analytics in the business model requires a well-defined process
   If yes, can you name some steps of this process?
   If no, why?

   Additional comments:
   Yes, even if the industries we work with are all used to rather complicated Service Level Agreements, which include the exchange of information to govern enforcement of Terms and Conditions, Data Analytics will bring in several new aspects. Some examples are:
   1. Improving existing SLAs and performance by applying data analytics
   2. Selling data as part of the SLA, which will bring aspects such as who collects the data, who owns the data, does the data have an “expiration date”, how to apply regulatory requirements, and how to protect privacy and prevent security threats.

5 There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model
   If yes, which ones?
   If no, why?

   Additional comments:
   Yes, today we support a number of different business models, but the most common ones are outright sales of software licenses, based on peak capacity metrics, and system integration services that are essentially project sales. In the case of software licensing, our systems are already quite capable of recording and reporting the capacity purchased, used, etc. In the case of Project Sales, we are able to improve our quotes and our delivery accuracy, based on advanced data analytics, and by combining data from the networks, which the customer make available to us, with historical project data from other similar engagements. However, collecting and combining this data becomes important, but not without its obstacles, such as getting access to network data owned by the operator.
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<td>- customer segments</td>
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**Additional comments:**

It is difficult to break down the value in an organizational manner like this. We do see that data analytics used in the right way, provides more value as a vehicle to lowering cost, improving efficiency, and increasing agility, than as a direct revenue stream. For our customers, we can provide important insights based on our global presence, and in some of the segments the data can be captured and sold. In some segments, we can indeed generate significant revenue, based on aspects such as uniqueness, timeliness, etc.

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**Please comment on the option with the highest mark**

**Additional comments:**

The quality and therefore value of predictive and prescriptive analytics, is based on having a good feedback loop that uses descriptive data to compare “actuals” with the previous forecasted result. In the industries we work in, we often aim for “closed loop” type of solutions that has this learning capability. Being able to predict for instance a major network problem, has the highest value in our industry, as you can avoid major costs if you can detect it early.

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<td>- <strong>Data as a service</strong>: selling slightly processed customer data to third parties</td>
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<td></td>
<td>- <strong>Answers as a service</strong>: providing answers to specific customer problem</td>
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**Please comment on the option with the highest mark**

**Additional comments:**

These are not mutually exclusive, but in general, analysing, and be able to provide insights is generally of the highest value. We work in so many fields and industries that it is hard to generalize but for our existing business mix, this is the case. Answers as a service is something we provide today, within our area of expertise, and often as part of an existing contract. You don’t always need data analytics for this. Data as a service could be valuable, but only when we own the data, which would be the case for a service that we own and operate, otherwise known as a “hosted”, or “as-a-service” solution, and only with the constraints of the existing SLA for the service. It could however provide a higher value within in our own IT organization.
9 How would you rate your organization currently, depending on the level of data analytics adoption: (give a mark to each)
- **leader**: has already a business model and innovates using data analytics
- **striver**: currently investing in data analytics, but not everything is clear yet
- **struggler**: no innovation processes to take advantage of data analytics or very limited
Please comment on the option with the highest mark

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<td>leader</td>
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<tr>
<td>5</td>
<td>striver</td>
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<tr>
<td>2</td>
<td>struggler</td>
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Additional comments:
Ecosystems take time to develop, and we are going through the most dynamic transformation that our industry has ever seen. Analytics will be a cornerstone in this, which is why we are investing and exploring together with our customers. We are sometimes a leader, when there is business value in today’s networks, for instance in the area of analytics of data relating to end user experience and service assurance.

10 If data analytics are not an option, then your organization could find it difficult to innovate and fall behind its competitors.
If yes, in which areas?
If no, why?

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Additional comments:
Yes, and it would create challenges across most if not all of our areas. It is a good thing that analytics IS an option.

11 Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.

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Additional comments:
As covered earlier in this survey, we are moving into the area of 5G which opens up our networks to 100s of new stakeholders, each with their own use cases, and each with their own device needs. All-IP Technologies such as Cloud, Software Defined Networks, and Network Function Virtualization will enable this new network, and will allow all these “tenant” stakeholders to run their own businesses over this network. The need for data analytics will accelerate as this transformation takes place, and the need to customize the analytics to each stakeholder need will become the key in differentiation the services. Closed loop “learning” systems will become increasingly popular and will also open up new ways to sell and monetize the data. While regulations may lag some of the innovation taking place right now, the industry will need to consider security, privacy, and policy and governance in the solutions from day one, or these issues will become business blockers. Also in this space, advanced real time analytics will play a major role.

12 Please add any other comments:
I found question number 10 hard to answer without speculating too much.

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**Ericsson B**  
Head of TV & Media Sales

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<tr>
<th>#</th>
<th>Question</th>
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<tr>
<td>1</td>
<td>Data analytics can be disruptive and redefine your industry existing boundaries (e.g. new competitors may appear rather than the traditional ones). Please also comment.</td>
<td>4</td>
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Additional comments:
First impact should be felt on offerings and the need to adapt to new behaviours, eventually up to the point of redefining solutions and competitors.
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| **2** | Data analytics can offer new business opportunities for your organization  
   If yes, which ones?  
   If no, why? |   |
|   | **Additional comments:**  
   Changes in customer behaviour and consumption leading to adaptations in offerings. If properly managed should lead to new or increased sales.  
   Opportunities to remove offerings from the market, saving costs or optimizing the value chain | **5** |
| **3** | Your organization needs to invest not only in product or service development, but also in business model innovation to explore new business opportunities created by data analytics  
   If yes, why?  
   If no, why? |   |
|   | **Additional comments:**  
   New business opportunities commonly don’t follow the traditional business models or are just not known. Trying to attack a new business with a traditional business model could create the perception that there is no market, when in reality the market is looking for something different. | **4** |
| **4** | The implementation of data analytics in the business model requires a well-defined process  
   If yes, can you name some steps of this process?  
   If no, why? |   |
|   | **Additional comments:**  
   If properly engineered there should not ne the need for complex process. Agile methodologies and lean organizations are one way of ensuring that. | **3** |
| **5** | There are difficulties/obstacles faced while trying to implement data analytics solutions in your organisation’s current business model  
   If yes, which ones?  
   If no, why? |   |
|   | **Additional comments:**  
   Resistance and lack of knowledge are common  
   Lack of sales oriented organization and shared sales goals  
   Concerns of the solutions uncovering errors/flaws in current ways of working leading to organizational impacts | **4** |
| **6** | Data analytics are adding/would add value to the following parts of your organisation’s business model: *(give a mark to each)*  
   - key partners  
   - key activities  
   - key resources  
   - cost structure  
   - value propositions  
   - customer relationships  
   - distribution channels  
   - revenue streams  
   - customer segments |   |
|   | **Additional comments:** | }
7. Which data analytics usage is more suitable for your organization? (give a mark for each)
   - **Descriptive** = provide information regarding past events by calculating descriptive quantities such as mean, average, mode, standard deviation, histograms, etc.
   - **Predictive** = develop statistical models that can be used to predict future events (e.g. regression analysis)
   - **Prescriptive** = predict not only one possible future but instead various possible futures based on the actions of the decision-maker

Please comment on the option with the highest mark

Additional comments:
Providing several scenarios enables more discussion and innovation, particularly when exploring business models

---

8. If your organization would explore data analytics value, which case of the following seems more likely? (give a mark for each)
   - **Data as a service**: selling slightly processed customer data to third parties
   - **Information as a service**: providing insights based on analysed customer data
   - **Answers as a service**: providing answers to specific customer problems

Please comment on the option with the highest mark

Additional comments:
Most likely to extract value

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9. How would you rate your organization currently, depending on the level of data analytics adoption? (give a mark for each)
   - **Leader**: has already a business model and innovates using data analytics
   - **Striver**: currently investing in data analytics, but not everything is clear yet
   - **Struggler**: no innovation processes to take advantage of data analytics or very limited

Please comment on the option with the highest mark

Additional comments:
Extracting value from Data analytics is more complex in a B2B environment

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10. If data analytics are not an option, then your organization could find it difficult to innovate and fall behind its competitors. If yes, in which areas? If no, why?

Additional comments:
Same issue applies to competition, B2B market is less prone to statistical/predictive evaluation

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11. Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.

Additional comments:
End users of services tend to have a greater digital footprint, that allows for more data to be cross-referenced and behavioural information extracted

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12. Please add any other comments:

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Ericsson C  
Director Business Model Management
<table>
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<tr>
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<td><strong>Additional comments:</strong> Telecom operators should look out for potential predators like Google, they come from another angle with analytics as a background and seems to be targeting telecom.</td>
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<tr>
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<td>Data analytics can offer new business opportunities for your organization</td>
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<td><strong>Additional comments:</strong> By using the information we already have today we can create a better customer experience for the end-users which would be beneficial for the telecom operators.</td>
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<td><strong>Additional comments:</strong> It is a fundamental shift of most parts of our business model.</td>
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<td><strong>Additional comments:</strong> We are talking about a business model transformation including steps as: Define change program, projects and action plans, Define projects and action plans based on the gap between the described as-is-state and to-be-state</td>
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<td><strong>Additional comments:</strong> Current business models are not geared up to handle analytics in a good. Depending of the width of the value proposition there will be different kinds of transformation activities needed.</td>
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<td><strong>7</strong> Which data analytics usage is more suitable for your organization? (give a mark for each)</td>
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<td>In current business we use both descriptive and predictive analytics, in order to develop new offerings and increase our customers competitiveness we will need to use Prescriptive as well.</td>
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<td><strong>8</strong> If your organization would explore data analytics value which case of the following seems more likely: (give a mark for each)</td>
<td>Data as a service: selling slightly processed customer data to third parties 3 Information as a service: providing insights based on analysed customer data 4 Answers as a service: providing answers to specific customer problem 4 Please comment on the option with the highest mark</td>
<td>Security and integrity are important for us, it is unlikely that we would sell data to third parties. In most of the above cases it would be more metadata that we sell.</td>
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<td><strong>9</strong> How would you rate your organization currently, depending on the level of data analytics adoption: (give a mark to each)</td>
<td>Leader: has already a business model and innovates using data analytics 2 Striver: currently investing in data analytics, but not everything is clear yet 4 Struggler: no innovation processes to take advantage of data analytics or very limited 5 Please comment on the option with the highest mark</td>
<td>We have a lot of data, we are managing quite a few networks on behalf of our customers – yet we are not leveraging on this in our business models.</td>
</tr>
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<td><strong>10</strong> If data analytics are not an option, then your organization could find it difficult to innovate and fall behind its competitors. If yes, in which areas? If no, why?</td>
<td>Y</td>
<td>Additional comments: We see more Outcome based business models and a prerequisite for them is that we can handle the data we have access to.</td>
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<td><strong>11</strong> Data analytics will be a key driver of business innovation and growth over the next 10 years. Please justify your mark.</td>
<td>Y</td>
<td>Additional comments: I’m sure it will be so, however I think Integrity will be an even more important factor in the future and this will have to be considered.</td>
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<td><strong>12</strong> Please add any other comments:</td>
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