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A strategic stakeholder mapping for the modular data center industry in Scandinavia

A case study of Swedish Modules AB

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This Master Thesis was written during the spring of 2018 at the School of Business, Economics and Law of the University of Gothenburg; and every single page written in this text wasn't made out of only my efforts and capabilities. Different persons and organizations contributed to this research in different ways, both directly and indirectly, and that's why I'm going to dedicate them the next few lines.

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ABSTRACT

In these years, an overload of the physical telecommunication network has been experienced due to the exponential growth of devices connected to the Internet and the whole new set of applications and software running on them. In order to make the services for the end-users reliable and more performant, a new approach had been proposed in the recent years to rethink in a more efficient way the connectivity paradigm. Edge (or fog) computing is the most viable solution at date, making the actors involved in the hardware side of the new network layer, active parts of one of the fastest growing businesses at a global level. Scandinavia is considered the region with the most developed agenda on the digital topics, and for this reason, a study on the stakeholders involved in such an approach to connectivity is needed to provide hardware providers a useful tool with which strategically analyze any type of stakeholders. The case study of this master thesis has the aim to give an example of a strategic stakeholder mapping for a modular data center provider, Swedish Modules AB, that is going to supply customers with hardware solutions to build the edge layer in Scandinavia. The approach here followed is to first define who are the stakeholders with the Porter's Five Forces and then group them with the Savage and Blair Model under four different families of stakeholders, making strategies and decisions to pursue towards these third parties more analytical and easier to undertake.

1. INTRODUCTION

In this project, where the industry of modular data centers is investigated, the role of Swedish Modules as a product provider will be studied and the necessary relations that will arise within competitors, suppliers and in general with the key stakeholders is presented. In order to accomplish this objective, a qualitative analysis that follows is a case study about the above-mentioned company. In this chapter, a brief overview of the company, the product and the disposition of the master thesis project is presented to give the reader a basic background of what will be discussed during the six chapters, with the aim of answering the two research questions below proposed.

Thus, the layout of this project will follow this structure:

- *Introduction*: with the scope of the research and a basic background about the problematics of this industry are given; moreover, the research questions will be here presented;
- *Theoretical Background:* in this section the foundation and the models used to conduct the analysis, as well as the necessary knowledge to understand the topic of edge computing and modular data centers is here given;
- *Methodology:* the methods and techniques to conduct this work are exemplified in this section, assessing the measures under which this research project can be evaluated from a technical point of view (e.g. Validity and reliability) and how the data gathering process had been accomplished.
- *Empirical Findings:* the chapter represents the set of data that had been collected within the beginning and the end of the thesis, it is possible here to understand the point of view of the interviewees about the topic and treat it as the primary set of information, together with the theory, to answer the research questions.
- *Analysis:* the analysis chapter is the section where the actual answer to the research questions can be observed, theoretical background and primary data are here put together, and the answer with the follow-up consequences for the company of the case study, are represented.
- *Conclusions:* this final chapter is summarizing the whole project, with an overview over the results and the final suggestions to be followed by Swedish Modules as the company to which this case study is referring to; moreover, limitations and further research are here included.

1.1 Research aim and scope

The industry for the hardware components of an edge network, defined as the intermediate layer built within the user and the central servers, is a fast-growing high-tech sector, with an undefined future that is hiding the next developments both for customers and suppliers involved in it. Thus, a study of what type of relationships will this market reserve for the already established hardware suppliers is needed, since it will define the actual forces determining the level of rivalry in such an environment.

The just born industry, will imply large investments with unclear revenue streams for the parties involved both on the software and hardware side; nevertheless, the customers are not yet really aware of the use cases of such an approach to connectivity, that will actually change the classical business models and operations routines. In the following chapters, data and sources about these introductive statements will be mentioned, together with the aspects that will arise during the interviews with the key stakeholders for Swedish Modules. The side of the industry that will be studied in depth is the one where modular data centers providers are involved, that are the actual key knots of the physical infrastructure.

The reasons why Scandinavia is the geographical area that is going to be studied are the following:

- The three nations region, made of Sweden, Norway and Finland, have one of the most developed digitalization programs of the globe, occupying respectively the first, the third and fourth place of the global chart for digitalization;
- These three countries are the hub of some of the largest telecommunication companies, such as Ericsson and Nokia, and Stockholm itself is the city that at a European level represents the biggest cluster of high-tech firms, both established and start-ups;

In this context, and due to proximity to possible interesting firms and stakeholders, Scandinavia had been chosen to be the area of study, and the three countries belonging to such area can actually form a homogenous set of nations progressing at almost the same speed and similar culture pushing it forward.

1.2 Research Question and sub-questions

The purpose of this master thesis is to answer the following research questions:

A strategic stakeholder mapping for the modular data center industry in Scandinavia.

- How can we find and strategically define the stakeholders in the Scandinavian market?
- How should Swedish Modules, a new entrant, deal with the different stakeholders?

Such questions are an important step towards a comprehensive understanding of the market for modular data centers in the edge computing approach, their main objective is to make clear the possible relationships that can be established with some of the key stakeholders and suggesting how Swedish Modules can actually pursue an effective strategy to enter the market in the best way.

As said above, this market is surrounded by a diffused uncertainty throughout all the firms interested in playing a role as hardware suppliers and also the academics; this results in a luck of reliable sources about the industry and a higher risk on undertaking all the related investments.

To answer these research questions and create a framework useful for the company and other actors, two models had been used: The Porter's Five Forces and the Savage and Blair model. These two models will make the analysis of the stakeholder reliable and easier; thus, the Porter framework is used to find the key stakeholders and categorize them within the different roles that they occupy in the industry; the Savage and Blair model instead, is used to analyze the actors and understand their role towards the company of this case study below presented, moreover, it suggests possible strategy to follow for Swedish Modules when relating with them.

1.3 Company profile Swedish modules

Swedish Modules AB is a Swedish company based in Emtunga, established in the 1974, that had been involved in hundreds of projects all around the world, suppling modular solutions to customers needing plug and play solutions for any type of use.

The company today develops and manufactures modular environments with highly functional and technical content in their production facility in Emtunga, Sweden. Their customers can be found in the datacenter, healthcare and pharmaceutical, industrial, off-shore and real estate sectors.

Swedish Modules has delivered modular constructions to demanding business areas worldwide for decades. The key value is the level of prefabrication already in the production line, which mitigates the risks of unexpected delays and expenses. The quality and the functions are tested and verified before the modules leave the factory.

The concept of 'Ship to site ready' is now further developed to the growing business of datacenter. Swedish Modules offers production of complete datacenters at their factory in Emtunga (Swedish Modules Website, 2018).

1.3.1 Modular data centers as a solution

In order to be clearer on the importance of the issue, a brief introduction to advantages and drawbacks of the modular data centers is necessary, as well as some economical aspects that justifies the implementation of such an approach when it comes to build an edge network.

The economic advantages of this approach are relative to both the type of expenditure that a customer will face when purchasing infrastructures, indeed, capital expenditure and operative expenditure.

- *The Capex advantages*: the initial costs are larger with the traditional approach of building a standard data center; the costs relative to the development of a single unit are also greater due to absent economies of scale. When developing a single unit data center many actors are involved and the costs of managing different parties might raise the final costs; moreover, installation costs are higher as well due to the preparation needed when building a traditional D.C.; Schneider Electric is also stressing the fact that with a modular and prefabricated data center the costs relative to change the destination of the location used to store the servers are much lower if a change will be needed. Instead, hardware and software expenses remain the same, independently from the approach due to the involvement of many third parties that will be involved anyway.
- *The Opex Advantages*: the differences for what concerns these kinds of expenses are relative to both maintenance and energy costs; the first ones are heavily reduced because of the limited parties involved in the process. The traditional approach normally requires different service providers, for the location, for the cooling and power systems and for the servers; furthermore, the predictability of maintenance needs and energy costs is higher with prefabricated units, making them easier to manage from a logistic point of view in the after-sale servicing.

Overall, considering the entire lifetime of a data centers, the modular and ready-made solution is more convenient when it comes to small or medium sized D.Cs.. There are drawbacks about security anyway when thinking about the pre-fabricated solution due to the position that is always dedicated to these modules. To keep the installation costs low, the modules are mostly placed outside of the buildings and are not protected by thick walls that prevent easy intrusions from the outside. Thus, depending on the final usage of these servers and the reliability needs, it might be necessary to think about security before than fixed and/or variable costs.

2. THEORETICAL BACKGROUND

The aim of this Master Thesis is to understand and define the main stakeholders and actors involved in the edge computing data centers industry, with a specific focus on the Scandinavian market defined as the region composed by Sweden, Norway and Finland.

In this chapter, an overview of the literature on which the above-mentioned analysis will be based is presented; underlying the role of existing theories here used in order to understand who and what relevance do have the participants in this specific market, that still in its embryonic phase. The theoretical background here used will also help in the further analysis the partner company Swedish Modules to formulate an effective strategy to enter the market and acquire a stable and profitable position.

The chosen framework that will be used to define the players that are shaping the industry is the "Porter's Five Forces", also relevant literature about the industry has been used beside this framework to both define the boundaries of this research and create a solid background to build the final stakeholder analysis; furthermore, the model to strategically map the stakeholders in this industry by Savage G. T. and Blair J. D. (1991) will graphically represent the actual relationships within the actors playing in such sector.

2.1 The stakeholder analysis –Definition

The stakeholder analysis is an important part of the strategic management activity in any firm already competing in an industry or trying to enter effectively a new one (Freedman, 2004). The key results of such analysis are to understand the environment in which the company is or will operate and get who will affect its operations and results while participating in the market; a largely accepted definition of stakeholder was given by Freedman (1984) in his book "Strategic Management: A Stakeholder Approach" that became a milestone for the whole literature coming after; a stakeholder is there defined as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freedman, 1984).

2.2 The Porter's Five Forces framework

In order to get an accurate picture of the industry of our interest, specifically of the stakeholders that might affect both positively or negatively the attractiveness of an industry, a model that will look

comprehensively at the forces that are shaping structure of the latter is needed; in this paragraph a description of the chosen framework is depicted followed by an explanation of its usefulness in the specific case.

The Porter's Five Forces are used to define the degree and nature of competition within a given industry, structuring the analysis around five main forces: threat of new entrants, the bargaining power of customers, the bargaining power of suppliers, the threat of substitutes and the rivalry among existing competitors (Porter, 1979).

In the industry-based view, this framework normally analyzes the competition of a given market and/or industry, but for the aim of this research is also useful to define the attractiveness of the sector itself, taking into account the behaviors of all different stakeholders that stand outside and inside the industry; thus, the intensity of these forces depends on power equilibriums within the above-mentioned actors (Porter, 1979).

The following picture represents the general model created by Porter, the four external categories are exemplifying the role of the actors that are not directly competing in the industry, instead, the middle box illustrate the actual internal rivalry.

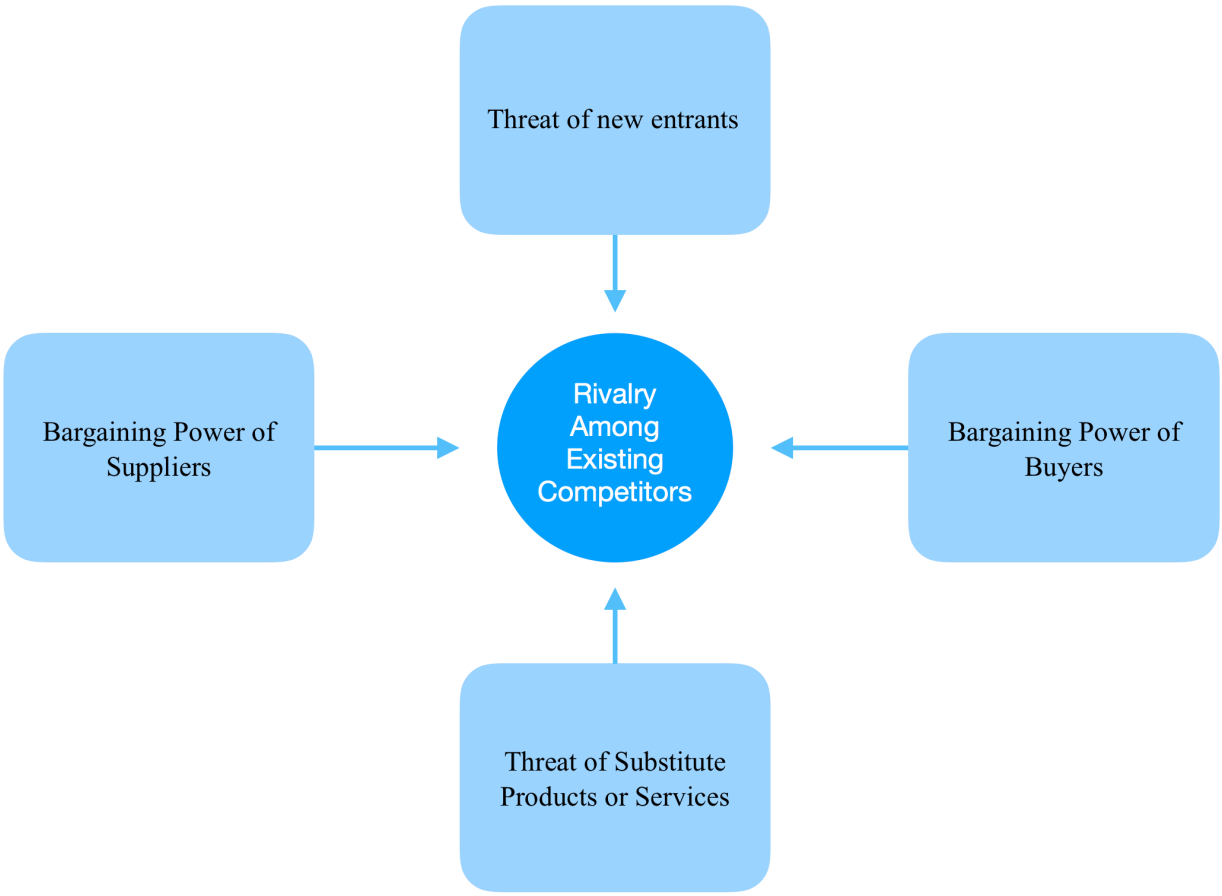

Image 2.1 - The Porter's Five Forces (Porter, 1979).

In order to use effectively the framework to find the stakeholders in the edge computing data centers industry, the five forces will here be presented:

- *Threat of new entrants:*

  new entrants are creating new capacity in the market, with the need of earning market share they are able to change the current equilibriums within the incumbents already playing in the industry. The significance of the threat that a new entrant is creating is directly related to the barriers to entry of the specific industry; nevertheless, these barriers may be managed in certain cases by the incumbents in order to avoid access to the market or they might be put in place by external stakeholders that have interest in the status quo (e.g. natural monopolies legally established by public agencies). Porter (1979) lists six kinds of barriers: economies of scale, product differentiation, capital requirements, cost disadvantages independent of size, access to distribution channels and government policy. Without getting deeper on these six, it still worth to mention them in this work since they are helpful to define who might influence the capabilities of third parties to threat some of the value chain knots.

- *Threat of substitutes products or services:*

  substitutes may increase the price sensitivity of buyers when it comes to choose alternative products, indeed, the competition is not bounded anymore to direct competitors, but the scope of the latter enlarges towards other industries as well. When studying the relevant stakeholders in any industry, it should be present an analysis of the actors right beside the defined boundaries, they might also want to earn a larger market share exploiting their substituting potential.

- *Bargaining power of suppliers:*

  the relative power of a suppliers depends on the ability of these to influence the profitability of the downstream value chain participants. Thus, exerting a certain amount of bargaining power on their customers, these powerful suppliers might reduce the margin of the subsequent knots in the value chain. The characteristics of a group of powerful suppliers are the following: a more concentrated industry than the one it sells to, the supplier is differentiating its products, it doesn't contend with other products, it might integrate downwards, the industry it sells to is not relevant from the supplier point of view.

- *Bargaining power of buyers:*

  as well as the suppliers, the customers of an industry can reduce the margins of the upward value chain by forcing down the prices and swapping from producer to producer. A group of

buyers is defined powerful when it owns some or at least one the following characteristics: high concentration of the industry, it does purchase undifferentiated products, the product it purchase is an important component of the final product, it has a low margin profit, the quality of the purchased product is not fundamental to get a good final product, the product itself doesn't save the buyers much money and finally a group of buyer might be defined powerful when it can make a credible threat of integrating upwards.

- *Rivalry among existing competitors:*

  Porter defines the level of internal competition as the sum of different factors that shape the market within the existing competitors; these factors are the following: large number of competitors similar in size and power, slow industry growth, lack of differentiation, high fixed costs, addition in capacity can be made only in big steps, high exit barriers and also differences in culture and strategy may affect the results of diverse decisions due to a higher unpredictability of the outcomes of the latter.

A deep understanding of these five forces is needed to get the big picture of the industry, and only then, understand who are the relevant stakeholders that are affecting, in the end, the performance and profitability.

2.3 The Savage and Blair stakeholders mapping

Many frameworks to analyze, to map and to graphically represent the stakeholders surrounding different organizations had been proposed in the recent decades, especially after Freeman's work of 1984; within these, the depicted one in the article "Strategies for Assessing and Managing Organizational Stakeholders" of Savage et al. (1991) is considered one of the most prominent.

This framework is especially useful when it comes to categorize the stakeholders in the firm's environment. In fact, they were able to identify four different groups of stakeholders, based on their capacity to threat the organization and their potential to cooperate with it. Moreover, a structured methodology like the one proposed by Savage G. T. and Blair J. D. (1991), is giving suggestions to the management on how to act with the different categories of stakeholders with explicit strategies that should be adopted consequentially.

The following tab is listing the main factors that, besides power, make stakeholders more or less incline to cooperate or threat the organization, some of them are directly related with resources considered strategic by the organization, others take into account the possible actions the actor might take towards the organization.

	FACTOR OF INTEREST	POTENTIAL FOR THREAT	POTENTIAL FOR COOPERATION
Key Resources	Stakeholder control over key resources	Increases	Increases
	Stakeholders doesn't control key resources	Decreases	Either
Power level	Stakeholder more powerful than organization	Increases	Either
	Stakeholder as powerful as organization	Either	Either
	Stakeholder less powerful than organization	Decreases	Increases
Likeliness to take action	Stakeholder likely to take action	Decreases	Increases
	Stakeholder likely to take non supportive action	Increases	Decreases
	Stakeholder unlikely to take any action	Decreases	Decreases
Potential for coalition	Stakeholder likely to form coalition with other stakeholder	Increases	Either
	Stakeholder likely to form coalition with the organization	Decreases	Increases
	Stakeholder unlikely to form any coalition	Decreases	Decreases

Tab 2.1 - Factors affecting stakeholder's potentials for threat and cooperation

Source: Savage G. T. and Blair J. D. (1991)

After the analysis made through the tool above represented, the position of each stakeholder will be graphically represented in the following matrix and the subsequent strategy defined.

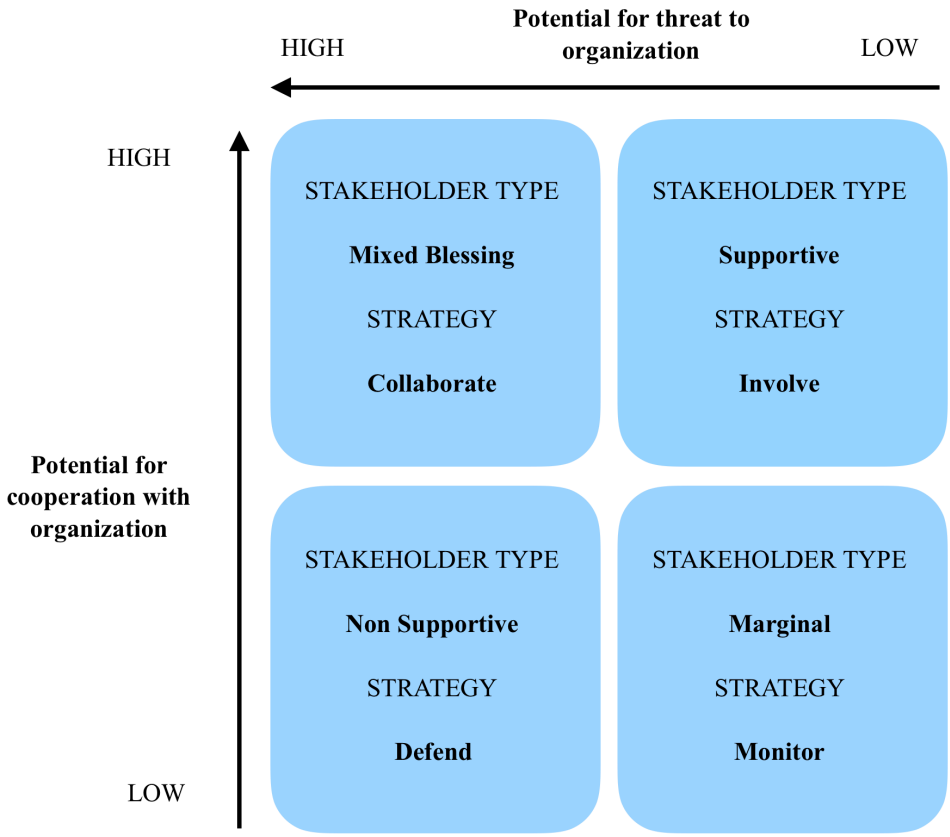

Image 2.1 - Diagnostic Typology of Organizational Stakeholders (Savage G. T. and Blair J. D., 1991).

2.3.1The four types of stakeholders and subsequent strategies

The four types of stakeholders and the suggested strategies are here represented as a result of the factor analysis underlying the potential level of threat and cooperation of each actor involved:

- *Type 1: The supportive stakeholder*

This type of stakeholder is the best one to cooperate with, in fact, it is characterized by a high cooperation potential while having a low level of threating willingness towards the organization; it is the ideal stakeholders. The logical strategy that should be pursued in this case is to involve the actor, both the firm and the stakeholder will in fact earn by this cooperative relationship.

- *Type 2: The marginal stakeholder*

These interested parties are not interested in threating the organization nor particularly attracted by cooperative behaviors; the reason is that the relevant issues for the company analyzing the stakeholder environment are not matching the ones of the "marginal" party. Thus, the strategy adopted by the managers should be a monitoring activity towards this kind of actors, but without wasting efforts and resources to make them more involved than they are.

- *Type 3: The non-supportive stakeholder*

These stakeholders are the one with a high level of potential threat and a low level of willingness to cooperate; indeed, large effort by the management should be given to that kind of actors surrounding the organization. A defensive strategy may be necessary to protect the firm against aggressive stakeholders, this phase should anyway be temporary, and the position of the non-supportive stakeholder should be managed to make them collaborative or less threatening in the future.

- *Type 4: The mixed blessing stakeholder*

The mixed blessing stakeholders, are the ones that play a major role when it come to the strategic management of the actors involved in the company's environment. High both in willingness to cooperate and threat possibilities, they have the chance to add a great value to the firm or to create important damages; the stakeholder management strategy that should be pursued is then to collaborate with them, trying to share the value created by a constructive relation and shared activities.

The main aim of this work is still limited to strategically represent the main stakeholders that are shaping the industry of modular data center for edge computing in the countries of our interest, the resulting strategy definition should be further studied in future works.

Furthermore, if Savage G. T. and Blair J. D. (1991) were concerned on depicting a strategic mapping of the stakeholders, they didn't give any advice on how to find them nor categorize the formers as players in the industry; to compensate and complete the analysis of the market here studied, we needed the Porter's Five Forces that will classify the relevant actors by the function that they are performing within the industry.

2.4 Edge computing and modular data centers – definitions and scope

With the purpose of describing the nature of the industry already mentioned above in Scandinavia, a definition of what is the product is necessary to bound the scope of this research to the interesting features that should be taken into consideration. Thus, we will proceed with a definition of a modular data center and then narrow down the horizons of the theoretical background to what concerns the possible applications of that specific technology to enable 5G standards through edge computing. A definition of the possible way to exploit modular data centers is also necessary to find the right stakeholders in the market (Y. C. Hu et al., Mobile Edge Computing, a key technology towards 5G, Etsi White Paper, 2015).

A modular data center is defined by W. Torell in a white paper of Schneider Electric (2012): a modular data center is defined as a data center with the following two characteristics;

- It should be made of a group of pre-designed subsystems, integrated and pre-tested;
- Assembled on a skid, ISO container or pod.

There isn't yet a terminology able to define exactly the kind of modular data center due to the variety of existing typology; and that makes difficult what type of M.D.C. best fit the needs of the customer.

The reasons why we are studying the modular data centers as pre-fabricated modules to deliver to customers involved in the development of an edge network should be found in the large number of servers that are spread in the geographical area of interest. In fact, to produce such an extended network will be easier, faster and cheaper if the facility will be built and tested in-house by the provider and sent to the location as a ready-made solution.

2.4.1 Edge computing – the approach

A flourishing literature about edge computing appeared in the last few years, of which a large part still represents preliminary studies of this new technological frontier. Thus, differences within the terminology are present and evident, making at a very first glance a literature review complex.

Nevertheless, if there are formal differences, the articles and publications about this topic all do agree on what are the problems that this technology will solve in the next future and what are the main drivers and possible use cases. A first definition of edge computing is given by Shi et al. (2016), when talking about edge computing, we refer to "the enabling technologies allowing computation to be performed at the edge of the network, on downstream data on behalf of cloud services and upstream data on behalf of IoT services". It is clear then that the key issue to be solved with edge computing that emerges from this definition is the possibility of moving data loads from core data centers to the source of the requests making the data transfers lighter especially on an already overloaded network (W. Shi et al., 2016).

Within the various names given to this way of thinking the network, other two are the most frequent: fog computing and mobile edge computing. It is assumed that they stand almost for synonyms, in fact, if we analyze the definition of both, and the various publications, the use of these terms is interchangeable. For what concerns mobile edge computing (MEC) a definition is given by Beck et al. (2014); they define as an approach that will introduce new network elements at the edge, providing computing and storage capabilities at the edge. Instead, when it comes to fog computing, F. Bonomi et al. (2012) are introducing the concept of an intermediate virtual network that will stand within central cloud computing and end users to provide computing, storage and networking services.

The following picture depicts the structure of a standard edge computing paradigm:

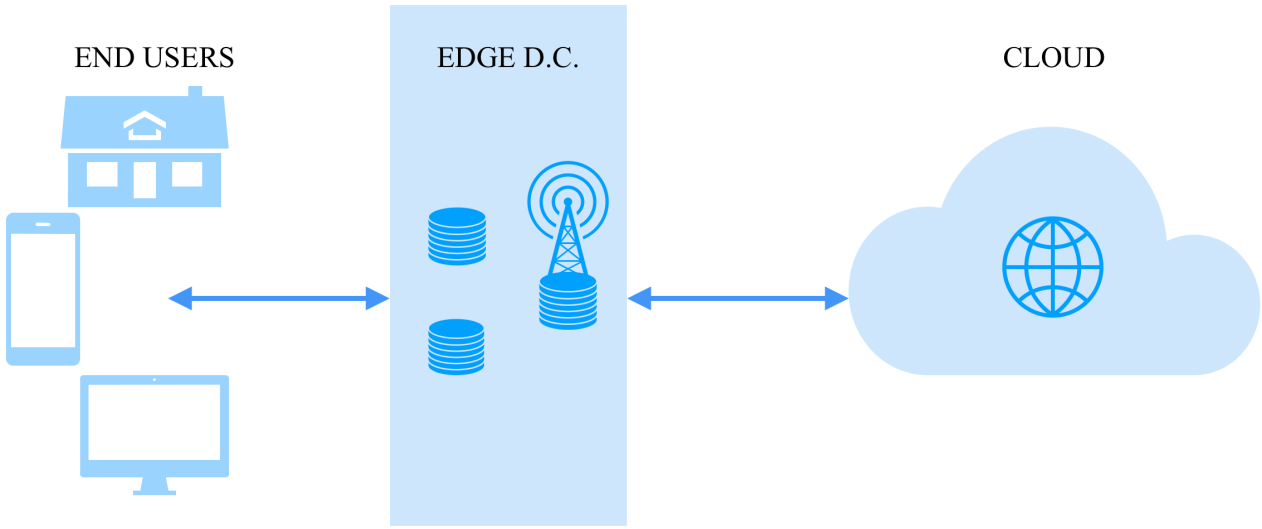

Image 2.3 – The Edge computing concept.

The picture simplifies what is the role of the three main parts of the network; with the end-users on the left side, the cloud (or large hyper-scale data centers) on the right and finally the edge data centers in the middle. The middle of the picture here represents the intermediate steps for the requests coming by the end-users, that are becoming data consumer-producer instead of only consumers (W. Shi et al., 2016). Furthermore, as previously anticipated, the tremendously increasing number of devices connected to the net is creating a problem of overloading the bandwidth of the network, that is finite.

By 2020 the number of devices connected to the Internet will reach approximately 50 billion (D. Evans, 2011); and the volume of data produced by the end of 2019 will be 500 zettabytes (Cisco White paper, 2014). The solution here provided is to localize a large part of the data close to the geographical position where it is produced and consumed; doing so will make more efficient and performant the devices connected to the Internet that need to manage only locally the data.

In the article of M. T. Beck (2014) there are described the six different classes of applications of mobile edge computing:

- *Offloading:* due to reduced computational capabilities, many demanding tasks are delegated to remote services although it is an energy and time demanding activities, data centers placed at the edge will reduce both the two types of expenses;
- *Edge Content Delivery:* as the largest part of the data in the very next future will be produced by devices that will deal only with data needed locally (as the IoT devices are doing also

today), the capacity of caching relevant data on local servers only will make usage, storing and computational activities more efficient;

- *Aggregation:* edge servers are able to aggregate related traffic instead of sending separately all data to core routers, this feature will reduce data redundancy to core infrastructure and make Big Data management easier and more reliable.
- *Local Connectivity:* the capability to redirect and manage data locally it is useful to get information only where they are needed, it is the case of some kinds of advertisement that should be distributed only locally;
- *Content Scaling:* part of the computation may be managed at the edge before sending the information at the core, the activity of reducing the information and computations at the core because performed at the edge is called downscaling;
- *Augmentation:* in the opposite direction of scaling, some information might be stored only at the edge; users connected to the edge servers can reach additional information that will improve the final experience, it might be the case of augmented reality.

Different case studies and possibilities to implement such an approach to rethink the network had been studied in the recent years to see if there is, after the necessity of changing mentality, a large enough market to justify the huge investments that is needed to set-up the necessary infrastructures. The literature here is converging on the possible outcomes of edge computing, with different authors agreeing on which industries will benefit the most by the implementation of such an approach.

Given the fact that an edge computing network is characterized by proximity, low latency and high bandwidth it will enable the deployment of new and disruptive technologies as: augmented reality, intelligent video acceleration, connected cars, internet of things (Y. C. Hu et al., 2015).

2.5 Edge Computing – the use cases

The key objectives of implementing such an extended and also expensive infrastructure to enable 5G standard had already been exposed above, thus, in this section the key use cases – some of which were exposed before - will be here presented in order to justify the interest of the high-tech and telecommunication companies in such kind of investments.

Edge applications are as diverse as the Internet of Things itself. What they have in common is monitoring or analyzing real-time data from network-connected things and then initiating an action. The action can involve machine-to-machine (M2M) communications or human-machine interaction (HMI). Examples include locking a door, changing equipment settings, applying the brakes on a train, zooming a video camera, opening a valve in response to a pressure reading, creating a bar chart, or

sending an alert to a technician to make a preventive repair. The possibilities are unlimited. Moreover, capitalizing on the IoT requires a new kind of infrastructure because today's cloud models are not designed for the volume, variety, and velocity of data that the IoT generates. (Cisco White paper, 2015).

This premise highlights the very next future importance of M2M operations running on the network, and the underlying necessity of closer to the user capacity of both storage and computation; the next lines will give few examples of developed applications that will make the existing infrastructure at risk of low performance or even crash.

- *Augmented reality (AR):* AR is the combination of a view of the real-world environment and the supplementary computer generated sensory input such as sound, video, graphics or GPS data. The main aim is to enhance the experience of a "visitor" of a sight or any place; in the AR use case the camera captures the point of interest and the application displays additional information related to what the visitor is viewing. Since the information needed to run augmented reality applications is mainly needed in a very narrow geographical scope, it is useless and not efficient to store the necessary data in the central cloud data centers, but instead closer to the user on an edge DC. Furthermore, the need to have low latency is the first problem of this kind of software, it is the case that AR applications should refresh the image got through the device's camera every-time the user is moving and compute again scales and distances; thus, lower the latency will mean better user experience.
- *Hyper-targeted mobile advertising:* Business and product manufacturers are constantly looking for new ways to segment and target consumers, with the widespread use of smartphones creating some novel opportunities. In conjunction with the radio applications cloud servers (the edge knot), mobile operators can place specific and relevant content near stores or point locations in order to create a virtual physical area that, when accessed, triggers targeted messages to their smart devices (Nokia & Intel, 2013).
- *Smart home:* IoT would benefit the home environment a lot. Some products have been developed and are available on the market such as smart light, smart TV, and robot vacuum. However, just adding a Wi-Fi module to the current electrical device and connecting it to the cloud is not enough for a smart home. In a smart home environment, besides the connected device, cheap wireless sensors and controllers should be deployed to room, pipe, and even floor and wall. These things would report an impressive amount of data and for the consideration of data transportation pressure and privacy protection, this data should be mostly consumed in the home (W. Shi et al., 2016).

- *Smart city:* The edge computing paradigm can be flexibly expanded from a single home to community, or even city scale. Edge computing claims that computing should happen as close as possible to the data source. With this design, a request could be generated from the top of the computing paradigm and be actually processed at the edge. Edge computing could be an ideal platform for smart city. To give an idea, A city populated by 1 million people will produce 180 PB data per day by 2019 [9], contributed by public safety, health, utility, and transports, etc. Building centralized cloud data centers to handle all of the data is unrealistic because the traffic workload would be too heavy. In this case, edge computing could be an efficient solution by processing the data at the edge of the network (W. Shi et al., 2016).

3. METHODOLOGY

The aim of this chapter is to give the reader an understanding of how the research has been conducted from the methodological point of view; trying to explain the structure of the literature review and the different sources of data used to gather the final conclusions. In order to do so, the following section is divided in four different paragraphs, and each one relates to the respective phase of this study.

The first is outlining the research strategy that had been followed throughout the work, listing guidelines and methodological requirements of the qualitative research; the second represents and discuss the methods used to gather the theoretical background and what are the founding basis on which this work is developed; the third will give an explanation of the research design employed to answer the research question, in the same section concepts as external validity and reliability are introduced and analyzed. The fourth paragraph's aim is to list the different kinds of empirical data gathered and the techniques used to find them, stressing the differences within primary and secondary data sources.

3.1 Research strategy

There are two types of research strategies, qualitative and quantitative (Bryman & Bell, 2011). The main differences within the two are the kind of empirical data gathered and the approach to theory that the research will follow. Thus, these two approaches will also end-up in different type of conclusions, with the quantitative analysis using a deductive approach (more focused on testing theories) and the qualitative analysis using an inductive approach (typically used to generate theories). These two research strategies are also diverging when speaking about the interpretation of the data collected and their subsequent interpretation: the quantitative analysis will give more space to personal and subjective interpretation, stressing the role of the words as main information source; the quantitative strategy will, instead, stick to an objectivistic and positivistic way of looking at data, trusting numerical information with the least possibility of being influenced by the so called research bias. There are some pro and cons on both the above-mentioned strategies, below it will be explained why for the scope of this research, the qualitative approach is the chosen one (Bryman & Bell, 2011).

Our research question is focusing on relationships that will occur in the analyzed market, with a specific focus on modular data centers suppliers. Thus, a quantitative research is not suitable to

represent all the factors that will shape certain types of links within different stakeholders, being them related to social factors like trust, industry characteristics and firm culture.

Having said so, the chosen approach of qualitative research will go through a continuous review and check of data sources to find an applicable theory that will help in establishing this relational links within the parties involved; this iterative process will then move back and forth to develop a reliable theoretical framework built on grounded data. Furthermore, dealing with a qualitative research strategy will imply a nature of the internal data sources that rely on personal observation of the participants throughout interviews about their vision of the industry, making the comparison and the findings linked to the personal judgement of the researcher.

3.2 Systematic literature review

In this section we'll go through the methods and techniques used to gather the necessary literature background, as well as through the sources used to select relevant literature. A systematic literature review is necessary to reduce the possible bias of the researcher when looking for his or her background, in fact, the qualitative research is already at risk of interpretation bias; for this reason, the analysis of how the theoretical background had been gathered is fundamental to raise the level of reliability of the entire project (Bryman & Bell, 2011).

The relevant keywords used for collecting data are: *modular data center industry, pre-fabricated data centers, edge computing, edge network, mobile edge computing, stakeholders' theory, stakeholders' analysis, stakeholders' mapping.*

As a premise, it should be said that the literature relative to the industry of modular data centers, and the applications related to this product, as edge computing is, still limited. The academic papers released under relevant keywords are only available in limited amount, and they do not give more than a preliminary knowledge about the vision and challenges that edge networks will represent for different parties. Within this type of sources important insights were given for the preliminary background on edge-computing and definitions of modular/pre-fabricated data-centers, as well as for what concerned the stakeholders' theory. Most of the theoretical background related to the two models used to identify the stakeholders, and then mapping them, was collected through two main databases: the Library of the University of Gothenburg and Google Scholar.

When it came to recent information about the industry instead, the largest amount of reliable information still be produced by consulting companies and big players in the market of telecom infrastructures and data centers, that, through white-papers and reports; are spreading their knowledge

about the sector to the public. When it was the case, company's website as the one of Schneider Electric and the publications on the IEEE website were useful pools where to pick facts and figures.

It still important to underline that the industry itself is at an embryonic level, as mentioned above, so convergence about the terminology and forecasts on the direction that the sector will undertake still not well consolidated; thus, a deep research with synonyms and similar nomenclature should be done when trying to reconstruct validated facts and stakeholders' opinions about the present and future development of this industry. Nevertheless, as it is the case for many topics in the business environment, stick to ultra-defined limitations when looking for coherent sources might lead to wrong conclusions if something that belongs to a young market will be left out when grounding the theory (Bryman & Bell, 2011).

3.3 Research design

"A research design provides a framework for the collection and analysis of data" (Bryman & Bell, 2011).

The research design chosen for this master thesis is the single case study; with this technique a deep understanding of the situation involving the subject studied (Swedish Modules AB) is required, thus, an analysis of the company profile will be given in the following chapter where the data collected will be presented. The case study research design enables to focus on a "bounded situation or system, an entity with a purpose and functioning parts" (Bryman and Bell, 2011). This approach is frequently used in business research, especially exploiting the inductive pattern of generating theory through a qualitative research strategy. Moreover, the focus of the theoretical model created by Savage and Blair is the study of the relationships within different stakeholders in relation to a specific organization or institution; it then makes the case study design the most suitable for our purpose, the just mentioned model has the objective to describe a single actor situation inside its environment.

Being the generation of a theoretical framework, through which analyze the relevant stakeholders of the industry where the company Swedish Modules is operating, the aim of this research, this design will allow to get reliable and consistent answers to our research questions. Furthermore, not only the objective company will be presented, but also a brief description of the analyzed stakeholder organizations will be given to capture how they had been chosen and selected.

Before going through the various measures used to evaluate the research quality, such as reliability and validity, it is important to be precise on the fact that the theory generated is studied to allow the company to interact within the stakeholder network that will face once entering the market, the

Scandinavian one in particular; so, measures like generalizability and external reliability do not affect the dissertation due to the tight focus of the discussed issue.

3.3.1 Business research evaluation criteria: Reliability and Validity

The evaluation criteria are important measures used to check if the methods employed in the work to perform the analysis, gather data and find conclusions are meeting the requirements to classify the research as reliable and generalizable. The relative importance of these measures for this case study, depends on the qualitative nature of the work here exposed. It is the case that the literature on business research methods do not recognize always a great value of this measurement techniques, instead they are of fundamental importance when it comes to quantitative research strategy.

In a quantitative research strategy, replicability and generalizability are important factors that will make the findings more or less valuable; instead, in a qualitative research designed as a case study, these measurements are barely mentioned in most of the literature of the same kind (Bryman and Bell, 2011). The reason why little attention is given to reliability, replicability and validity is that the case study does not have the aim to be generalized; moreover, the intensive focus on the specific case makes the assumptions not easily replicable or generalizable in other business cases.

- *External reliability:* this concept expresses the degree to which a study can be replicated, and in qualitative research this measure is of little importance due to the subjective variables taken into consideration. In fact, the study that rely on a qualitative approach, is usually strongly linked to the impressions of both the people involved in the process as researchers or as data sources. The historical situation can't be frozen and replicated a second time normally, as it is the case for this research; the relationship within stakeholders may vary across time due to the nature of this emerging industry, making this measure of little interest to validate the concept and thesis supported in the next chapters. Nevertheless, results might be the same if the relevant stakeholders here analyzed will maintain the same positioning or acquire the forecasted one, making the results lasting longer, with the undergoing assumption of a little research bias present throughout the study development (Bryman & Bell, 2011).
- *Internal reliability:* the concept of internal reliability in this specific case is of limited importance since relates to the level of agreement within the research team, and it is the case that, for this master thesis, there is only one researcher.
- *Internal validity:* Internal reliability exemplify the degree of coherence within the observations and the theory generated by the researchers. The fact that the research is spanning through a six-months period, where an iterative process was adopted to make the

theory formed the more coherent as possible with the gathered data, makes the internal validity the most significant measure to confirm the quality of this research; thus, the period spent within the partner companies and the stakeholders should make the results even more reliable.

- *External validity:* qualitative analysis, as mentioned above, makes the generalization of the findings difficult, since it is hard to replicate the studies across different contexts and moments due to the strong link within personal perceptions and social situations.

3.4 Data collection methodology

In this paragraph the researcher is going to describe the different methods that have been used to gather the necessary empirical data to perform the analysis and answer the research questions of this master thesis. With the aim of presenting a strategic stakeholder mapping for the market of modular data centers in the Scandinavia, it is necessary to understand what roles and visions the different parties are playing in the industry.

The research is structured as a qualitative analysis of the present situation, having said so, the technique here chosen to collect the largest part of the necessary data is to perform interviews with the relevant stakeholders; furthermore, necessary data to complete and interpret the interviewees' answers have to be found on relevant reports and articles about the industry. Thus, the sources are split in primary and secondary kind; of which, the primary ones are the interviews collected through the direct contact between firms and participants to the industry, and the secondary are the data gathered from the relevant literature.

Nevertheless, two workshops have been done with the partner companies Swedish Modules and First to Know, where relevant exchange of knowledge and opinions was taking place to receive feedback and together develop and always improve every part of this research through an iterative process.

3.4.1 Primary sources

The objective of the data gathering process was performed always keeping in mind the research strategy and the techniques that could fit the best such kind of project; being this master thesis qualitative the interviewing style was semi-structured, leaving space to the personal considerations of the interviewee. It is very important to highlight the relevance of the subjective perspective in this research, being the primary answer of this research questions, a representation of suggested behaviors to manage the intra-stakeholders relationships.

The structure of the interview was based on six open-ended questions, plus a last question asking for personal thoughts at the end. The reason of this last question is that, after having discussed the topic from a known perspective, it could be useful to leave space for eventually missing relevant perspectives that might differ within the different groups of stakeholders. This way of proceeding allowed the iterative improvement of the questions that slightly differed after the first and second interviews. The reliability of the findings wasn't compromised by these changes since the core questions kept the same objective and subjective meaning, in fact no relevant manipulations to the questions took place from an interview to another.

Many of the interviews were run together with a colleague performing a study on the possibilities of implementing a servitization strategy for modular data centers, she was also partnering with Swedish Modules and First to Know taking part with me to all the reunions and workshops taking place; the reasons behind this approach towards the interviews was to reach a higher number of people and enrich our knowledge about each other topic that were mutually influencing each-other, especially from a customer point of view.

The data collection has been performed through audio or video conference call, together with the interviewee all the questions had been asked and answered; no questions were skipped due to non-disclosure agreements or confidential data that shouldn't not go outside of the different organizations walls. The circumstances that made the answers exhaustive were related to the nature of the questions asked, that weren't linked to strategically sensible topics, but more on a personal way of looking at the industry and the role that the organization wants to conquer.

The way the interviews took place, was the following:

- *Introduction:* to make the interview starting in a more relaxed environment, a personal presentation of the researcher and the colleague was used as incipit, with a brief description of who they are as students, program and University; the second step of this phase was to describe projects and perspectives under which analyze the market. A short talk about the privacy requirements and recording possibilities was done, the researcher was able to record the interviews and to cite the sources in most of the cases without any problem.
- *Interview:* in this phase the actual interview was performed, the questions were asked following the outline previously planned and one by one the researcher and the second colleague performed their own interview. The margins of free-thinking and speaking left to the interviewees sometimes created the need to reschedule the order of the questions or to skip some of them. It didn't affect the reliability of each interview, instead it demonstrated the link within the six questions.

- *Final section:* the end of the interview was planned to ask the free thinking final question, that made possible the enlargement of the scope of the research throughout the different stakeholders' roles. Nevertheless, greetings to the interviewees were planned, to thank them for the time spent on the call/meeting.

The stakeholders were selected after the theory and literature analysis, this choice was adopted in order to get a general picture of the industry, and an understanding of the most important players in the Scandinavian Market. The variety of the actors interviewed allow the research to be a reliable source of information for the reader and the partner company itself, the Porter's Five Forces were here crucial to categorize and identify who will shape in the very next future this industry. The groups of stakeholders interviewed were mainly customers and competitors, the reason why substitute product producers and possible new entrants were not included should be addressed to the young nature of the sector itself; indeed, it wasn't possible to already identify in reports and relevant literature the existence of alternative products or firms willing to enter the market.

The following companies were contacted undertaking a snowball tactic, relevant representatives of each one was interviewed; the companies successfully reached are: Vertiv, Schneider Electric, Eltek, RackSpace and Ericsson. These companies are the relevant external information sources, and the interviews were used to understand their mission and vision towards edge computing approach. In the next table, the people with which the interaction was the stronger are listed:

COMPANY	ROLE	DATE	TYPE	DURATION
ELTEK	Data Center Engineer	03/05/2018	Skype for Business	40 min
ERICSSON	Country Marketing Manager Italy/ K.A.M.	19/04/2018	Phone call	50 min
SCHNEIDER ELECTRIC	Director Data Center Industry Alliances	10/04/2018	Skype for Business	30 min
VERTIV	Senior Director of service for Emerson Network Power's Energy Systems	23/04/2018	WebEx meeting	35 min
STOCKHOLM EXERGI	Head of Marketing Data Center Cooling and Heating Recovery	24/04/2018	Skype for Business	55 min
RACKSPACE	Infrastructure Design and Management Professional	25/04/2018	Zoom Meeting	35 min
OCP	VP of Channel	27/04/2018	Skype	40 min
GOTEBORG ENERGI	Business developer for GothNet, IT subsidiary	08/05/2018	Face to Face	120 min

Tab. 3.1 – External stakeholders interviews information

Moreover, a fundamental contribution to this master thesis should be awarded to the two partner companies Swedish Modules and First to Know, that through face to face meetings and workshops were able to give feedbacks and suggestions on the way to proceed. These activities, performed together with the two partners, were conducted both at the First to Know and at Swedish modules headquarters to reach more people all together and make them share ideas and perspectives with all the students taking part at the consultancy project; it has to be said that the project assumes a broader perspective than it was said until now, focusing also on a business model planning and a technical project design of a possible modular data center as final product.

The first meeting with all the students involved took place at First to Know, and it was a preliminary share of the theoretical findings gathered until that moment. There the researcher had the chance to understand that the chosen models on which the thesis was going to be built could be useful to find

proper answers to the research questions. The second meeting was after just before the start of the data collection process, with the established models of Porter and Savage & Blair that were presented to Swedish Modules' management as founding basis to get information by the stakeholders. The feedback in both the meetings was positive, and it was possible to proceed with the work without a need to revise or change the main pillars of the research.

4. EMPIRICAL FINDINGS

The aim of this chapter is to show the findings gathered through the process of semi-structured interviews conducted with the different stakeholders and key actors in the Scandinavian market for modular data centers. With the objective to give an understanding of how the interactions within the stakeholders in the industry will take place, a presentation of each company and person contacted is necessary. Moreover, while presenting them, their opinions and points of view will be interpreted, to understand the expectations and likely further development that the industry will experience when the edge computing approach will spread through different industries and end-users.

In the first paragraph a brief introduction to the present situation of edge and modular data centers is given, underlying the commonalities and the reciprocal involvement that these two technologies are sharing. It is also important to understand the possible applications that these technologies are enabling, and what are the market drivers that are emerging at the moment. From the Swedish modules point of view, and it should be also applicable for the other data centers providers, the two above mentioned variables cannot be ignored, the present and future size of the market, as well as the strongest actors within it, will be defined by the number and importance of the applications that will benefit the most by this type of infrastructure.

The second paragraph, together with its subsection, will briefly depict the specific role of modular data centers providers as the producers of the hardware components necessary to build the network. Indeed, the relation with the Porter's Five Forces will justify the choice of certain stakeholders in respect to others, with a final discussion of how they answered to the open questions during the interviews. The analysis of the data will take place in the chapter number five, thus, the data here showed are to be considered only the findings of the data collection process, also if preliminary considerations might take place to seek unambiguousness.

4.1 Edge computing market drivers

As said in the second chapter, the number of devices connected to the Internet is increasing year after year, as well as the amount of data downloaded and uploaded per device. In the next graph, we can clearly see the trend at a global level:

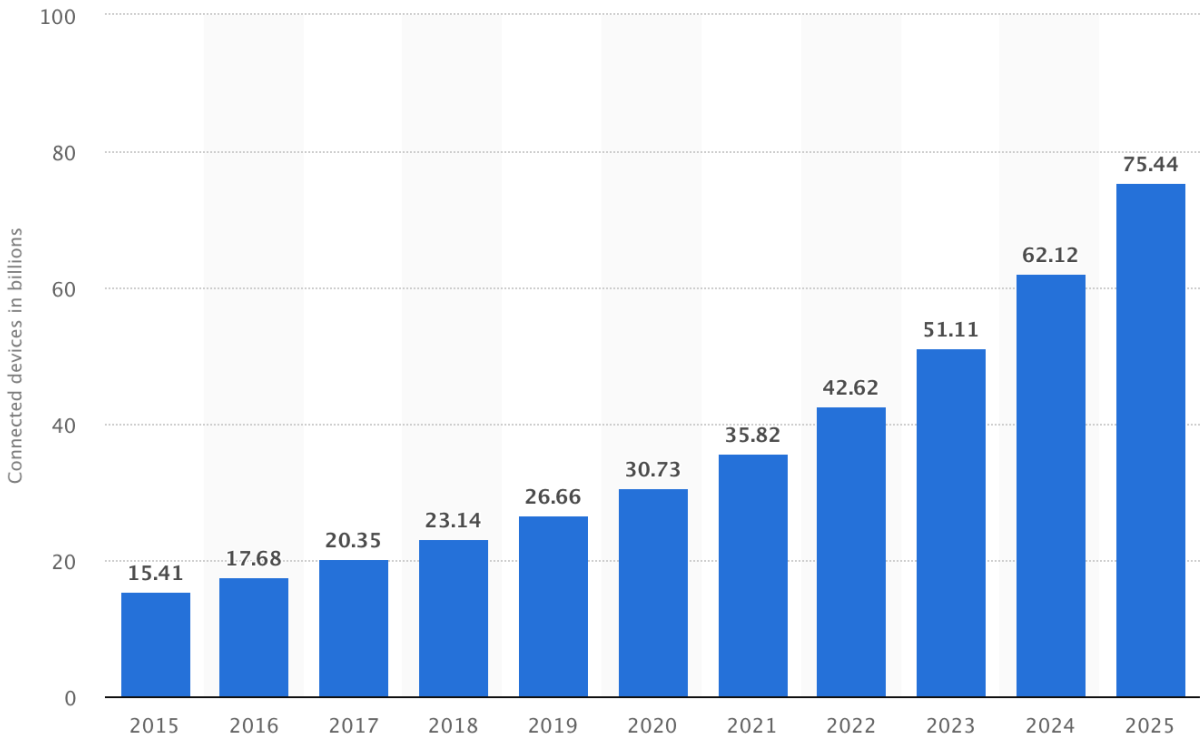

Image 4.1: Forecast of number of devices connected worldwide.

Furthermore, the role of Nordic countries is even more important, if not in absolute numbers, at least on a relative basis. In fact, Scandinavia is pulling ahead of the rest of the world on Internet of Things (IoT) adoption, according to a new report from the International Telecommunications Union (ITU), a United Nations specialized agency (D. Curry, 2016). To be even more precise, in the top four we can find in this order: Sweden, New Zealand, Norway and Finland; that is one of the fact that made the research boundaries limited to the three northern countries, they represent a cluster of pioneer countries if compared to the rest of the world when it comes to digitalization.

The importance of the three countries studied here is also related to the role that they played in the introduction and test phase of new technologies; Scandinavian and foreign tech-companies are normally launching beta versions of their newest products in this geographical area to see the possible market outcomes. Within the three, Sweden is both the largest and the most innovative country, making it the perfect field to test the possible application of such an approach as edge computing (D. Curry, 2016).

The market drivers and possible use cases of this technology had been briefly anticipated in theoretical background given in the second chapter, but it is worth to give out some data to understand the importance of the topic, making the choices of the stakeholders interviewed more consistent.

The actual possibilities of the network to transmit to core data centers all the information that billions of devices are today producing is getting to the limit, this was highlighted by many of the interviewees as well as by the data collected through secondary sources. This necessity of faster responses for a larger amount of data is the basic market driver that keeps the eyes on this new approach; indeed, the possibilities that will be opened by edge computing are also creating the need for a market research to state if the high required investments are convenient or not. Moreover, the standard that the edge computing should enable, the 5G, will be especially useful for two types of applications: the critical and the massive ones (Ericsson interviews).

- *Massive:* any use of a connected device might lead to the overuse of the current network, depending, for example, on the number of devices connected to the particular cell and the operations performed. If the marginal user for traditional video streaming won't affect the load on today network, the simultaneous download from thousands of devices in the same cell will overwhelm the network capacity; making the operation per user much slower if not impossible at all. In the era of the social networks and connected mobile devices, events such an overload of a cell may happen when emergency situations in a city or during a public event are performing upload requests.
- *Critical:* the definition of critical application is the other typical category under which many of the use cases for 5G are grouped. Under this class of possible usages, there are autonomous manufacturing machineries, automated production lines and, more in general, any device that has to perform with an extreme precision a set of operations where errors are not admitted.

Nevertheless, such a technology will enable the creation of a totally new and disruptive set of products and services, from the autonomous driving to the factories 4.0, or an all set of new applications running augmented and virtual reality scenarios. The other point that few of the interviewees were stressing was also the vision of a whole new channel of data that will be soon created by the always more common interaction of two devices without the human intervention needed; the machine to machine (M2M) interconnections are getting always more important, making also non-standardized operations automatized.

All the interviewees agreed on the large space on which this technology will find space to be applied, nevertheless, one of the take-aways of the Ericsson's interviews was the following: if the actors involved are aware of the costs that they will encounter when building the necessary infrastructure, the revenues or the savings driven by the new approach are in a grey zone that should be better understood. The problem of the first mover is to incur in a large initial cost and never see the required returns that will justify the expense. This result will affect differently the various industries, and it

might change also the business models of many companies that have within their portfolios products and services that directly relate to 5G standard and edge approach, it might be the case of telecommunication companies, mobile service providers and all the companies involved on building the infrastructure.

The revenue necessary to recover such an investment are even less sure when it comes to the stakeholders playing a role in the value chain of such an approach, actors such telecommunication companies, operators, hardware suppliers. The uncertainty is even larger when it comes to define how the pie will be cut and who'll take the slices. An interesting point of view was given by both the Ericsson managers interviewed, that expressed serious doubts about who would pay for the infrastructure and who'll take the eventual revenues.

If we talk about the 5G as a spread standard available for any device able to support such a technology in a given area (that could be a city or a region or even wider) the question that should be answered is what would be the direction of the revenue streams. What was observed is that the largest part of the money will be made by the application providers that will run their software on the infrastructure without sustaining the initial costs; if it would be the case, the revenues for the mobile service providers won't be enough to justify such an investment; furthermore, the number of applications that will need to run at a 5G speed are limited for the moment at a retail level, making the market limited and for the moment almost impossible to size.

The scheme that is then forecasted is a low average revenue per unit (ARPU) connected, due to a low willingness to pay by the end user for so many devices; at the end-retail-user level, the willingness to pay for such a high-speed connection is low if compared to the cost of a chip-set and the needed connection subscription. Thus, the consequence for the mobile service operator will be a low revenue stream and a large initial cost. On another side, the revenues will be generated, as previously mentioned, by the software providers that will collect a huge amount of information from all these devices connected; the real money will then be made by the actors able to manage and sell this Big Data.

The perspective for the next future is then a more limited scope for the 5G, with possible applications limited to specific use-cases to manage critical or massive data streams. With the industrial application the actors involved are different, and it is here that the closer future is already happening.

In order to improve their performance, firms are striving to cut costs and make improvements at a process level; in order to do so, investments in automation are required and 5G is seen as the path to follow to get a competitive advantage. During the interview process, the general perspective that emerged was the tendency of the majority of the firms to interconnect the assets at any level; these

assets, are not only machinery and plants, but more in general any key resources owned or managed by the company. Thus, the employees' performances are enhanced by mobile devices and the after-sales operations are redesigned to keep also the customer always connected with the factory.

4.2 The Stakeholders' answers

The actors involved in this industry are various, and the role that they are undertaking is not already well defined. In the business of modular data centers, the outcome of the new technologies needed to build the network still uncertain and so are the underlying business models for involved stakeholders. Indeed, the opinions and forecast of the stakeholders when answering the questions were quite general; still, the answers were giving out the same answers across the respondents, making the results more reliable than expected for such a young industry.

In the following section will be shown what were the answers to the questions proposed to the stakeholders, already presented in the methodology section, together with a brief introduction to the organization; the latter is needed to understand the role of the different firms today and get an enlarged picture to be studied then in the analysis chapter.

COMPANY	ROLE	DATE	TYPE	DURATION
ELTEK	Data Center Engineer	03/05/2018	Skype for Business	40 min
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Tab. 3.1 – External stakeholders interviews information

4.2.1 Ericsson

Company profile: Ericsson is one of the leading providers of Information and Communication Technology (ICT) to service providers, with about the 40% of the world's mobile traffic carried through their networks. Their main businesses are: physical network infrastructures, Digital services, managed services and emerging businesses all powered by 5G and IoT platforms. Founded 140 years ago by Lars Magnus Ericsson, it became a leading company setting open standards to make global communications and connections possible (Ericsson.com, 2018).

The interviews with Ericsson were especially useful in order to get a general picture of the industry and the possible future development of edge computing. These two interviews made with two managers one working at the headquarter in Stockholm and one made with the Italy's marketing manager, were gathered with the intent of confirming the data found in the available sources about the market; making the forecasts of the other interviewees clearer to the researcher.

The fact that the same questions were proposed to these two managers is explainable due to their position in the company, they were mainly concerned about the Italian market and then, the Scandinavian specific topic, could lead to answers out of their core competences or daily activities.

The findings of this interviews are summarized, together with the papers about the market, in the section above; the following paragraphs will instead furnish an internal perspective of the market itself and give insights about the actors actually playing a role in Scandinavia.

4.2.2 Schneider Electric

Company profile: Schneider Electric is a European corporation dealing with energy management, automation solutions, spanning hardware, software and services. It is currently providing prefabricated Modular Data Centers and they are expert in providing services, such as those ones for critical power and cooling, electrical distribution, life-cycle and safety monitoring, technical training and teaching solutions (Schneider Electric, 2018).

The position of the firm towards edge computing as the new approach to digitalization was supporting the theories that are looking at such an approach as something that will change the way networks are conceptualized, nevertheless, when I used the word "disruptive", the interviewee was affirming that it could be too much to define edge computing as something that will disrupt the data centers market.

Still, the opinion was that in the last years the word "edge" got into every firm playing in the digital industry at any level, making it a hot topic from different points of view, and the reason why is that the data stream that will be generated by the whole new devices connected to the Internet, both produced in other businesses by Schneider Electric and other third parties, should be able to run effectively without down periods and performance losses. Furthermore, the opinion about where the largest part of the innovations will come from and where most of the attention will be put is on the software side. The software seems to be the area of the biggest development with the whole brand-new applications able to run more efficiently than ever; hardware instead would play a supportive role with slightly less innovative contribution to the whole infrastructure.

Schneider Electric is looking forward for the opportunities given by the edge approach, on one hand the company is trying to figure out what role it can play at the hardware level, being a data center's components supplier, and also a complete solution provider. On the other hand, also the service perspective in such a market wants to be leveraged by the firm, considered a fundamental part of their businesses.

On the market perspective Schneider Electric is seeing the largest disruptions. The fact that at the edge different applications would run, makes the components needed different within each other, making the all in-house business model if not impossible, very difficult. Thus, here is where the chances for important partnerships are opening up, with many third parties involved in the creation of the final solution to provide the customer with an efficient infrastructure.

The observations of the interviewee about what is still unknown in the market is the following: "who's going to operate the hardware at the edge?" The answer is a maybe, but many possible answers had been listed; within these there are the telecommunication companies, the new trend of COADR (Central Office As Data Center) where the network will be run by more traditional IT partners. Everybody seems to be unsure about the outcome of this approach anyway, neither the interesting customers are defined yet; but the attention for the moment is going towards who'll run the up on the infrastructure that should be, then, designed to support the latter.

4.2.3 Eltek

Company profile: Eltek is a global company, headquartered in Drammen (Norway), specialist in developing, manufacturing, selling and distributing cutting-edge power solutions and services. Their solutions provide power to infrastructure belonging to markets such as telecom, data centers, railways and metro, rural electrification and power utilities. Beyond that, their purpose is to develop first class power systems, taking care about reducing the environmental footprint of energy deployment and cutting ownership costs of power equipment. The Norwegian company counts more than 2,000 employees, owns offices in 40 countries and serves firms in 100 ones (Eltek.com, 2018).

The edge computing and the Internet of Things will be a big part of the Eltek future business, that is the perspective following the forecasts that they have at the moment; the issue at the moment is more for the telecommunication company than for the solution provider as Eltek. The sensation about the present and future role of this solutions is to educate the telco firms, which are facing many problems; one of those is that the telecommunication side will be more concentrated on data centers if compared with the past; changing equipment and standard device used by these organizations until now.

What above mentioned is justified by the actual trends, that are witnessing a swap towards mobile devices and Internet connection. As mentioned by all the interviewees, the main market driver is the necessity to reduce the traffic to central data centers; moving to the edge specific information that might be required with high probability in a specific location. This might also be the case of many people trying to access the same resource simultaneously, or in the very next future, the huge amount

of data to be transferred to central data centers created by interconnected devices. Both the cases here mentioned can be managed better and more efficiently at the edge.

The critical applications needing low latency are not here mentioned, following the categorization made by Ericsson managers above, but more attention is given to the volume (massive).

The point stressed during this interview was that everybody is preparing for this change in the approach to digitalization, and the smaller modular data centers (approximately ten racks) are perfectly fitting the needs of the edge network; they are easy to transport, deploy and install around the cities.

Eltek wants to focus for the edge on the double power combination of direct current and alternate current as its competitive advantage; at the moment, they are the only one able on the market to supply power systems able to change voltage without doubling the infrastructure, meaning cheaper and smaller modules per rack.

On a perspective of market positioning, the company wants to provide the entire solution, being the first face in front of the final customer. Their product will be an integrated solution made out of third parties contributions, so the affiliation with other firms should be intended as necessary. Moreover, the contribution of Eltek will be on the power and cooling components, internally produced. The vision about the market seems to be clear on the hyperscale, that won't be affected by the edge approach; instead, the demand of smaller data centers will rise a lot with the edge computing - still, both will go without a cannibalization of each-others. The forecasts weren't shared because of the absence of accurate data, but the point is that, whatever the market would be, the target is to win the largest stake of it.

4.2.4 Stockholm Exergi

Company profile: Stockholm Exergi is the local energy company of Stockholm, owned by the city of Stockholm and Fortum. Employing around 700 employees, the company provides heating to more than 800,000 people and cooling to over 400 hospitals, data centers and other kinds of properties. This whole of thing is offered paying attention to the environmental impact, too; in fact, Stockholm Exergi succeeded in halving emissions in the last decades and today they can rely on 89% of renewable or recycled energy. During 2017 the company registered around €600 million of net sales (Stockholm Exergy.se, 2018).

Being the core-business of Stockholm Exergi the heating and cooling of houses and office in a quite strict way, the role of 5G and the infrastructure around is not seen as a possible factor that will change

the business model of the firm itself. The company has already two important "edge-knots", defined as that by the interviewee, one for the distributed production and the other for the metering processes at the edge of the distribution network. On these two knots, there's not the need to run real time critical applications; and then, they are already able to get the needed information and process anywhere in Stockholm.

Nevertheless, the company is looking forward for a smart management of the data flows from these terminals and possible application with artificial intelligence in order to make delivery of energy and heating better for the final customers. The interviewee stated the following "we don't depend on edge computing, but simply on computing".

From the point of view of their business model, the large presence of data centers in Stockholm makes the reuse of wastes already possible and an approach in use. Having said so, the use of central data centers as the ones already present in the city is something different, because the volumes differ and then synergies as well. At the moment they are doing business with only big data centers, able to warm-up several hundreds of houses. The problem exposed with the edge configuration is instead how the possible over production of heat made by decentralized data centers can be exploited, when the building that should be warmed up is not consuming all of the energy supply; it does create an heat dissipation problem to be solved. Some figures had been given to give a better understanding of the size of the problem: a 10 Mw data center can heat twenty-thousand average residential apartments. At the moment the data centers have no problems of dissipation, since they are able to generate a small amount of heating if compared with the needs of the entire city; thus, once integrated in the distribution system they are now accounting for the 3,5% of the total supply offered by the company. In the future the plan is to get to 10% at least and remove, under a sustainability point of view, any fossil sources (accounting now for about the 15% of the entire supply). The multiplicity of customers is also making the company incline to partner with third parties interested in placing data centers around the city.

The view for the future of the company representative is also to build the data centers in the middle of a new suburb to make the neighborhood more efficient, at least under a heating point of view.

The partnerships are already built up with data centers providers, with commercial contracts where the data centers heat is received in the distribution infrastructure and they pay for that wastes.

4.2.5 Rackspace

Company profile: Rackspace is an American company, based in Texas, that deliver certified expertise and integrated services across both public and private clouds. Their website states: "as recognized leader in Managed Services for public cloud infrastructure, Rackspace delivers unbiased guidance on the best-fit cloud solutions to organizations around the globe. We go beyond simple migration assistance and infrastructure management with multi-cloud managed services and professional services, as well as managed application and security services to enable true digital transformation" (Rackspace, 2018). With more than 6,000 employees, the American company serves over 150,000 business customers from data centers on five different continents (Rackspace.com, 2018).

Rackspace is mainly managing the services around data centers, with a specific focus on centralized ones. They are not already in the edge computing, but in centralized data centers. The main issue for them is that their customers, at the moment, seem to be distant from the edge; they are much more concerned on improving their current processes. The problem that they experienced in the past with edge projects is that the bandwidth available at the edge wasn't matching the expectations and the needs promised, from a physical point of view, not even from a computational perspective.

The point that was stressed by the interviewee is that the edge do exist since years, for example when we talk about financial trading there is already an edge structure behind the high-performance computers used by traders; so, the point is to define better the end-user before thinking about the infrastructure. Thus, the network should be designed on the final usage for what it will be made.

They don't want to provide the physical infrastructure, but they will partner with services that will come afterwards the creation of the infrastructure. The challenge that they will face supporting edge computing will be on this side since instead of few locations they will have to get to hundreds or thousands of locations; and it will certainly push to more automation of these processes as well.

They probably will change their mindset because of this change in the data centers market, but the entire picture still not very clear. The company won't be necessarily disrupted, and the biggest changes will certainly happen at the facility providers level; having said so, the players should remain almost the same anyway because of the future size of the markets, without seeing a disruption by new entrants.

4.2.6 OCP

Company profile: Open Compute Project is an organization that shares information about data centers among different companies, including Intel, Facebook, Microsoft, Google, Rackspace, Dell,

Lenovo and Cisco. It is a global community of technology leaders working especially on the design of hardware, with the purpose of making it more efficient, scalable and flexible. Their website states: "we believe that openly sharing ideas and specifications is the key to maximizing innovation and reducing operational complexity in the scalable computing space" (Open Compute Project.org, 2018).

All the telecommunications companies have thousands of COARD (Central Office Rearchitected as Data-centers); that are the last knots before the end users, before the so called "last-mile". Across these firms, the hardware is getting way cheaper with standardized components not anymore provided by big players (like Cisco) that owns IPR on them. This is also the way that they are proceeding to build the 5G necessary infrastructure, with a further step of separating the hardware from the software. The other actors that are trying to participate at this process on the infrastructure through commodity hardware, are the application and software providers.

The word disruptive is not anyway adopted for that approach yet, the market is changing, and some actors are definitely more aggressive like Telefonica and AT&T; Chinese actors are also the most aggressive, trying to provide entire and ready-made solutions to potential customers.

The suppliers are also trying to re-brand themselves, without changing the actual products, calling their products under the edge family. This will be a marketing effort more than an effective innovation action. If on one side we have aggressive actors that are trying to enlarge their stake over this growing market, on the other side there are a group of companies that are on any side of the value chain (Facebook or Schneider Electric) contributing and collaborating to create standards under the supervision of a community that will approve the specifications. This change will lead to the situation in which the hardware will have one standard to be followed by a multiplicity of suppliers, making the racks, switches and so on cheaper and more diffused; also, the changing tools and the reparations must be run in an easy and fast way. Indeed, a more stable and simpler supply chain will be there for all the actors.

That's also the aim of OCP itself, to separate the hardware from the software, something that it wasn't happening until now with all the IPR on hardware pieces. The consequence will be that the hardware infrastructure will be run by the software providers.

Two major things are happening at the moment, one on the side of the customer and the other on the supplier side. On the customer side, they want to run applications of third parties on their hardware and not be blocked by non-standardized components that are not able to run any application. Instead, on the supplier side, HP, Cisco, etc. are going to realize that the customers have the need to a more

open infrastructure in order to run applications of other players. This direction is already being understood by these suppliers, and they are slashing the prices to not lose their market share.

The customers are also moving towards the middle suppliers of their hardware providers since the original product are now normally produced by third parties and then rebranded with IBM or Cisco names. The idea behind the OCP is then to provide a market opportunity for smaller supplier and put a margin on top of a standardized product without IPR on the standards, it will reduce the margin of the big players, but also the costs to build up the physical infrastructures.

The forecasts about the data centers market are uncertain also from the OCP perspective, but the sensation is that the industry itself is getting overcrowded with the possibility of an over-supply that will easily going to squeeze the profit margins of all the suppliers involved. In this situation is also unclear the positioning that the actors want to undertake, with the consequence that, for the moment, everyone is focusing on efficiency and better pricing. The interviewee instead is suggesting that good positioning strategy should be to be able to run the software that the customers are asking to be run on the facility itself; it is in line with the OCP mentality, but far from the suppliers since they want to lock-in the customers.

4.2.7 Vertiv

Company profile: Vertiv is a global company leading in designing, building and servicing infrastructures intended to support data center, industrial and commercial facilities and communication networks (Vertivco, 2018). It was launched as a standalone business in 2016, having its heritage as Emerson Network Power, and matches its leadership in the industry with the spirit and focus of a startup. According to their website, Vertiv mission is "to empower the vital application of digital world" and they also provide plenty of services including maintenance services, training and performance optimizing service. Counting around 19,000 employees all around the world, Vertiv revenues was worth $3.9 billions during 2017 (Vertivco.com, 2018).

The perception of edge computing still a big question mark for Vertiv since the definition of what edge computing will be in the next future is not yet clear at all to many of the stakeholders that will try to enter part of the supply chain of the physical infrastructure. Nevertheless, the approach to establish such a network seems a spread of data centers built modularly; the cost and speed of installing are the key factors that will and is making it the preferred approach.

The vision for the company itself is to continue on the data centers industry side both as components and complete solution provider; with a particular focus on the pre-fabricated products able to satisfy

a larger demand rapidly evolving towards large number of smaller datacenters. This need is enhanced by the small size needed to fit these modules all around cities and key infrastructures; moreover, there is also the need to scale up or down following the needs, the single knots of the infrastructure.

When it came to forecast the layout of the market, the answer was quite uncertain. The future is not already defined, but the industry should not be totally disrupted by the introduction of such an approach; thus, particular attention won't be on the innovative products, but more on the players trying to get more space in the market. There are possibilities for small players to overtake the equilibriums established in the already existing industry, but also space for partnerships and mergers is behind the corner.

The possibilities for these partnerships are already part of the Vertiv's business model, that is already working together with Swedish Modules on some parts of modular data centers; still, this kind of products represent a small part of their businesses. Within the portfolio of partner companies here we can find big names as Ericsson as a final solution provider at a level of the physical infrastructure.

4.2.8 Goteborg Energi

Company profile: Goteborg Energi is a public owned company of the city of Gothenburg; they distribute and trade in the energy market and the profits are returned to the city of Gothenburg. To be more specific, the company is providing electricity, heating and cooling to the city as well as the underground telecom infrastructure like fiber. The business is growing in the IT solutions as well, where the company is one of the largest players when it comes to build and rent out data centers facilities around and inside the urban area (Goteborgenergi.se, 2018).

The vision about the company from the interviewee point of view is still partly unclear, part of the research on the datacenter business is not yet done. They know more about the telecommunications, and their business is growing in parallel with the growth of the operators' physical infrastructure since they cooperate both on the energy side and on the underground physical network.

The actual development of 5G represent even a bigger opportunity given the number of knots and datacenters needed to enable such a standard. Albeit, it's a huge opportunity for both the company involved in the value chain and the future customers, there are two problems arising: power consumption inside of the city and the space needed to host the datacenters in the urban areas. Furthermore, there is also a constraint that might limit the possibilities for these projects; the population of Gothenburg, today, is spread in a large geographical area making the population density

low and inefficient, when compared to other cities in Europe, to serve with a diffused physical network.

The progress that is possible to have for the company in Sweden to move up on the value chain is limited due to regulations. There are margins to move up easily and cost effectively in the value chain, starting to provide for example services and software on top of their owned infrastructure; but the competition regulator won't allow such a move to guarantee the competition at least on the last step of the value chain before the end users.

At the moment they are providing data center facility to the companies operating in and around the city, also partnering with Swedish Module; by their providers they would like to have the entire solution, especially from the foundation and building point of view. It is difficult to build facilities around Gothenburg due to the field quality and the company would like to take part at the least number of steps when it comes to plant and after-market services.

5. ANALYSIS

In the fifth chapter of this master thesis, the aim that the researcher is pursuing, is to match the two theoretical frameworks – the Porter's five forces and the Savage and Blair model – with the empirical findings gathered during the interviewing process. In order to do so the structure will be split in a first section where the selected stakeholders will match the categories listed by Porter, to make an analysis of the relevant classifications of actors that are shaping the market; furthermore, in the second section, a representation of the stakeholders will match the Savage and Blair model to get the matrix of interactions for our specific purpose.

The structure of the analysis will follow a stakeholder per stakeholder structure, as it was the case for the empirical findings chapter; the reason is to get a specific and more reliable overview of each possible relation that can arise within the interviewed organizations and Swedish Modules. Moreover, from the model will also come a suggested managerial strategy to maintain towards the single actors, no matter if they are customers, competitors or suppliers.

Having said so, the aim of this research is to provide a theoretical framework applicable also to other stakeholders not included in this research; indeed, the map here proposed in the last part of this chapter should be updated with the development of this market and the perspective on the future of Swedish Modules.

The results, in fact, should be updated when changing the geographical scope and other players will enter this young industry; it is possible that, in such an evolving environment, disruptive changes are likely to happen frequently, further information about this aspect will be given in the conclusions and limitation sections that will come after this chapter.

5.1 Identifying the stakeholders' categorization through the five forces

In order to find the stakeholders, the Five Porter's Forces framework has been adopted; the employment of this model was useful to get an exact picture of the actors that primarily affect the industry rivalry. The categories of major interest, that have been then investigated, are the ones that represent the possible customers and competitors; instead, the supplier side was sometimes mixed with the competitors since the components provided to Swedish Modules, that is mainly a manufacturer of the final product, are in the largest part produced by companies providing also the entire final solutions to the same customers group.

Although each company has its own core business and have a clear idea of where to locate in the value chain, many of the interviewed firms have more than one role towards Swedish modules itself; it is the case of many of the modular data centers producers that may act both as components provider (supplier) or as competitors or even as customers of complete solutions to put on the market with their own names on it.

The fact that many companies are going to assume diverse roles, make the analysis of the relationships and power roles more complicated. Thus, the strategy that Swedish Modules is going to assume with respect to each of these actors should focus on the most likely role that each partner or competing company will undertake in this market. In the next picture, representing the Porter's Five Forces model, each of this actor is going to be represented in the area that best represents the role they will assume based on the results of the interviews.

Ericsson

As a provider of complete telecommunication infrastructure, Ericsson can be seen as a potential partner that can use the data centers provided by Swedish Modules to build up the networks of which it undertakes the entire construction. For that main reason the position of Ericsson in the model will be only the one that represent a potential *customer*. Albeit this outcome seems to be clear enough, the differences in size and level of internationalization of the two companies must be taken into account, making Ericsson a company that is potentially able to add this step in its value chain once the market will be profitable enough. Having said so, attention should be placed on this firm to check whether it will keep the position of customer only or it will verticalize upwards to increase the value added of its operations.

Schneider Electric

Schneider Electric is, like many of the companies chosen to be part of this research involved in the commercialization of modular data centers as a complete product, but is also focusing a large part of its business in the production and supply of many key components to build them up. As a consequence of it, there are two considerations that should be made relating to the two-sided role that the company may assume towards Swedish Modules:

- On one hand, the role of *supplier*, especially of the power units and components, can stimulate a long-lasting partnership of which both the companies may enjoy the results. Thus, a cooperative environment can be created to enlarge the horizons of the two actors;

- On the other hand, the role of *competitor* is clear. Due to the fact that they both produce ready-made solutions the risk of falling in a rivalry intense situation is always behind the corner. Anyway, they are active members of the OCP, and the forecast about the market are optimist enough to believe that to build a collaborative field within the players in the community will be a much more remunerable opportunity.

Eltek

Being Eltek a company that both provides entire modular data centers and power components for them, the analysis of what position to occupy seems to be quite close to what had been done with Schneider Electric. In their value proposition, they aim to provide the most advanced power efficiency solutions, showing particularly good skills when it comes to the double use of alternate current (AC) and direct current (DC) and the subsystems to switch within these two.

The close geographical position of the head-quarter and the Nordic company's culture leave room for partnerships and collaborations; nevertheless, the interviewee stated that the aim of the company when it will come for edge data centers is to become the end-knot before the customer, providing entire solutions and, so, looking for the best position in that value chain. Anyway, it was also said that they might partner with competitors and third parties for the production phases.

After this little discussion, we can say that Eltek might assume three roles:

- *Supplier,* when it comes to power solutions for data centers it seems to be a market leader with one of the best solutions, having Eltek in the supplier portfolio may add a big value for the final product of Swedish Modules;
- *Customer,* looking to be the end knot means or to build in house or to outsource, the role of Swedish Modules in relation with the company might assume the appearance of a supplier;
- *Competitor,* it is a fact that they already produce complete data centers, making Eltek an actual competitor on the market.

Stockholm Exergi

The company is in a totally different industry, with data centers production out of the scope of their core competencies; although they are currently providing only heating and cooling to city households and infrastructures, their businesses are quickly moving towards sustainability, making data centers an important part of their key energy sources. For that reason, today, they are partnering with data

centers supplier to reduce the footprint on the environment of these facilities, closing long-term contracts with suppliers both for the energy and also for the big data management in the city.

No clashes of interests are at the horizon, and for the moment the only role that Stockholm Exergi might cover for Swedish Modules is to be a *customer.*

Rackspace

The company's focus is on services, so, also if the core competencies are all around the data centers, Rackspace can't be identified as a competitor. They can be seen as a good partner, *suppling* expertise to Swedish modules on the certification and after-market services, adding a great value to the final product with their know-how. Today, the importance of seeing the quality of the product recognized is one of the most important characteristics needed in a new market with unestablished incumbents to gain market share; thus, to partner with this company can evolve pretty easily in a win-win situation.

OCP

The opportunity offered by the OCP community are a lot, and the main feature that relate to this phase of the analysis is the network that it can provide. It will not participate at the market directly as a supplier of products r service, so it is not easy to attribute a role to OCP relating to the Porter's Five forces model, instead it's possible to get to this actor the role of a "trend-setter" in the market, defining future standards and rules within the parties involved.

In order to accomplish the role above mentioned, there are few possibilities that it will evolve in a distribution branch for the partner companies, assuming the form of a *customer* interface within the actual providers and the end users of certain technologies like the data centers.

Vertiv

As above for Eltek and Schneider Electric, Vertiv is a hardware provider with core products around the infrastructures needed to run the digital applications; nevertheless, the core focus is on pre-fabricated solutions able to satisfy a large and rapidly growing demand. The actual production of data-centers is split in both complete solutions and components provider; due to the size it will be also easy to geographically expand.

The facts are leading then to the conclusion that the role of Vertiv towards Swedish Modules in this framework may lead to assume two possible different roles:

- The first and already existing role is the one of the *competitor,* due to the complete solutions in their portfolio and already oriented to build-up the edge network of our interest.
- The second role that it might assume, if not already there, is the one of *supplier* since the data centers components supply is one of their key businesses.

Goteborg Energi

As Stockholm Exergi, this company is providing heat and cooling for households and infrastructure all around a large city, in this case Gothenburg. In addition, Goteborg Energi is also providing the infrastructure for telecommunications in Gothenburg, like the fiber network that covers all the city and still growing. This variety of products that it offers, made the company move into the business of data centers, providing ready infrastructures to the local companies and public authorities. The possibilities to establish long term relationships at a *customer* level are big here, and already some deal had been finalized within Swedish Modules and the utilities provider.

The attention that could be placed on Goteborg Energi to become a possible competitor moving upward in the value chain can here be reduced due to regulators interventions on public owned companies.

5.2 Mapping the stakeholders

In this paragraph the criteria to map the stakeholders will be shown, and the different standards to place them in the final matrix will be analyzed. In order to finalize the model for the Swedish Modules case, we should take into account the different variables that the academics define as important for the strategic mapping:

- *Key resource perspective,* it does investigate the ability of the stakeholder to maintain and acquire control over an important resource.
- *Power level in comparison to the target company,* it analyzes the level of power that the actor is able to exert over the target company.
- *Likeliness to take action,* it explores the possibilities for which other parties are likely to take action against or in favor of Swedish Modules in our case.

- *Likeliness to form coalitions,* in this case the analysis will research the possibilities that the stakeholder will form a coalition or partnership with the target company, as well as the likelihood that these coalition will be made with other third parties.

These categories belong and are enlisted in the table in the theoretical framework, where the factors of interest made by Savage and Blair define the potential of threat and cooperation (see table 2.1). Based on the results gathered we'll be able to place the stakeholders on the final map already presented in the second chapter.

5.2.1 Ericsson

- *Key resource perspective:* during the interviews not many particulars arose about the specific case of modular data centers in Scandinavia, but it is clear that, being Ericsson one of the leader in the telco market, the resources (both tangible and intangible) controlled by the firm are of huge relevance to anybody that is looking to participate at the market. It is the case that through their networks pass the 40% of the global mobile traffic, making the company strong from the point of view of both relations and size. We can state then that from a key resource point of view the potential for threat increases.
- *Power level in comparison to the target company:* moreover, the difference in size can make the relations difficult under negotiations of agreements; the size diversity makes the risk higher for Swedish Modules, but in contrast can create huge growth opportunities that managed well, might make the case study firm scale up fast and easily.
- *Likeliness to take action:* given the amount of suppliers that are in the Ericsson's portfolio, it is difficult that specific actions will be taken in favor or against Swedish Modules itself, but given the interests and the size that the company has, it is possible that big changes all over the industry might directly affect S.M..
- *Likeliness to form coalitions:* the possibilities to form coalitions are potentially huge, since our case study company may find in Ericsson a big customer with a huge network ready to be served; nonetheless, Ericsson may find in the value proposition of Swedish Modules itself a great potential due to its expertise and local network.

It has to be said that the great difference within the two companies from the point of view of the dimensions and level of international footprint may lead easily to unpredictable outcomes for Swedish Modules, having said so, the latter represents a great opportunity for Ericsson because of higher flexibility in respect to bigger players. This analysis lead to place Ericsson in a position of both high

threat and high cooperation potential, depending on the types of relations that will be created within the parties, making it a *mixed blessing stakeholder*.

The strategy to be followed should then be to *collaborate* with this multinational corporation, in order to enter the industry from a different perspective; building long-lasting relationships that can make the company more stable from both a structural and financial point of view.

5.2.2 Schneider Electric

- *Key resource perspective:* the company here discussed has in the portfolio solutions that are similar in the value proposition to the ones of Swedish Modules, with prefabricated data centers ready to be the infrastructure knots of the edge network; moreover, Schneider Electric owns a name in the market of the power and cooling systems for big and small data centers with a special expertise in the UPS branch. These competences are not going to affect the control over important resources, but should be taken into account when considering the value proposition as a resource for the firm itself.
- *Power level in comparison to the target company:* the company has other volumes of productions and sales, making it an established actor in the market of interest; thus, the visibility and easiness to interact with new customers might be a good advantage for such a competitor. On one hand, a large size is not always a quality, in fact a smaller company as S.M. might be more agile in such a young industry, on the other hand, for established and larger actors, the capacity of suppling larger volumes and nevertheless financial availability, might be a critical strength to conquer the largest market share.
- *Likeliness to take action:* given the uncertainty of the situation in the very next future, the likeliness to take action by this competitor still a question mark; but being a participant to the OCP community can be seen as a prerogative to do not engage in aggressive or extremely competitive behaviors, at least the other members.
- *Likeliness to form coalitions:* from the interview emerged a strong attitude of the corporation to establish partnerships and long-lasting relationship with customers, suppliers and competitors. The history of the company is full of such cases, and the company's interviewee stated that in such a young and uncertain environment relations are the way to in order to achieve results.

The data gathered are leading to the conclusion that Schneider Electric will for sure be a competitor, but with the history and the good premises for the creation of a cooperative environment. Moreover, the potential for (a direct) threat Swedish Modules is quite low, being both participants to the OCP

and sharing the same aim of opening up the standards of hardware components to make it easier to everyone to get a share of the market. It can be said that the role of Schneider Electric, although keeping the role of competitor, can be defined as *supportive.*

The strategy that should then be pursued is to *involve* the company and make it a strong partner, with which share the effort of establishing new standards and innovation in this market; a huge possibility is also given by the already existing personal network within the two organizations.

5.2.3 Eltek

- *Key resource perspective:* as it was the case for Schneider Electric, the expertise in the power and cooling systems together with the possibility to provide an entire solution has to be taken into consideration as a factor that may give a competitive advantage to Eltek in respect of Swedish Modules or other manufacturers; the size is also to be intended as a key resources when it comes to ability in providing larger suppling volumes, larger customers portfolio, but also less agile structure and personalization processes available.
- *Power level in comparison to the target company:* also here, the same reasoning already made for Schneider Electric may be done for Eltek as well; the financial capacity and supply possibilities, together with a large network of suppliers may lead to a competitive advantage difficult to imitate.
- *Likeliness to take action:* in respect to Swedish Modules itself there are no reasons to think that direct actions will be taken by Eltek, nevertheless their explicit desire to be the front-face with the customer may escalate in a stronger rivalry in the first phases of the market development, where usually different actors are trying to establish their brands in the best position.
- *Likeliness to form coalitions:* being part of the OCP makes the possibilities to form partnerships with different actors, also with competitors, likely to happen; the culture that is pursued in this community is in fact to partner to establish innovative standards with a sharing ideal behind that will make every member stronger. The fact of being experts on power components is also a point that will enlarge the chances to partner with third parties and manufacturer since they need a market where to sell also single components for D.Cs.

The data suggest that the position of Eltek is still likely to be *mixed blessing* towards Swedish modules and the other data centers providers, due to the unclear development that the market will undertake; the stronger the link with third parties involved in shaping the industry then, the better the position for Eltek in the future. The likely outcome is still a bit of more competitiveness at a final market

level with third parties providing prefabricated solutions, due to the fact that the business model is likely to shift from the single components supply and data centers as a product, to one that includes the servitization in the after-market phases.

The strategy should then be different than what was suggested with Schneider Electric (*involve*) and get to a *collaboration*, with *monitoring* activities on the future steps that will be shaping their business model, in order to do not enter the probably winning servitization strategy late.

5.2.4 Stockholm Exergi

- *Key resource perspective:* Stockholm Exergi is the most influential power supplier of whole the city of Stockholm, and it manage the most extensive heating and cooling infrastructure of the city with many characteristics close enough to define it a natural monopoly at a distribution level. The fact that many customers are, in theory, locked-in with the company infrastructure make the demand stability for Stockholm Exergi predictable and stable, with good potential for long-term business approaches. The key resources that the company is managing are of fundamental importance for Swedish Modules to enter the market at a city level.
- *Power level in comparison to the target company:* the company itself as a scope that belongs exclusively to the geographical area of the city, but in this context, this is probably the only one so influential, that can think of data centers as a resource on which to invest in such a scale. The power that the actor can enforce at a city level is great, but it's none outside.
- *Likeliness to take action:* not being a competitor, but more a customer, the possibility to take action against or in favor of Swedish Modules are quite limited. The role that data centers providers are playing out of the total of the business of such a firm is in fact limited to the 3,5% of the entire customer base, and there are no reasons to bargain suppliers in that branch of their industry.
- *Likeliness to form coalitions:* this factor instead is of great importance, since the company have stated as future objective, to move to the 10% of the customer base to be satisfied through the reuse of the energy of data centers in the city. It means a lot of business opportunities for the D.Cs. providers and personalized solutions for Stockholm Exergi itself; it will be necessary to partner closely with the actors like Swedish Modules and/or other suppliers.

Being a customer, without any interest on entering the industry of the modular data centers suppliers, the utility company is the perfect case where the suppliers might take the place of a partner with which develop personalized and dedicated solutions to fit the best the expectations and try to lock-in

a profitable client in the long-run. It is the case to place Stockholm Exergi in the *supportive* section, with the aim to *involve* as close as possible due to the possible sales volumes that might arise from this relation.

5.2.5 Rackspace

- *Key resource perspective:* the main resource that they have at the moment is their credibility, a recognized brand may create a huge added value for any partner of Rackspace. Moreover, their skills on after-market processes may add great value for an entire value proposition that is comprehensive of the servicing of the facilities.
- *Power level in comparison to the target company:* the huge portfolio of customers (150.000 as said in the introductive description) is the proof of their ability to manage large volume of contracts, making the marginal customer less important than normally is in a business-to-business environment. Having said so, there are no data on the concentration of their revenue stream in relation to the number of customers, making it an information to be confirmed.
- *Likeliness to take action:* the probability that the company will take any action against Swedish modules is low, they are in different but complementary industries, making instead easier the positive action taking more likely to happen. This might be an opportunity since the level of threat towards our case study company is not at the horizon for the moment.
- *Likeliness to form coalitions:* the possibilities are big, since the business are complementary, and the companies share the network of the OCP; enrichment of both network and product/services portfolio may be easily enlarged without cannibalization of none of the two.

From a strategic point of view, Rackspace seems to be a perfect partner in order to implement a more service-oriented business model; but the company is not yet involved deeply in the edge approach to connectivity, as said by the interviewee. They are still more focused on the traditional centralized cloud, and the implementation of the edge will disrupt totally their business module; this limitation is reducing their potential to cooperate. For that reason, it can assume the role of a *marginal* stakeholder for Swedish Modules; that should be anyway strictly *monitored* to understand their direction towards edge computing.

5.2.6 OCP

- *Key resource perspective:* the greatest resources on which OCP owns control are the network of big and small players that it enjoys and manage, that together are changing the way of

creating standards from the hardware point of view, and the fact that it is influencing the direction on which these players will go with their innovation. The limits posed towards the use of IPR in the hardware industries are the new wave of rethinking high-tech, and the players, like OPC, who are able to direction the interests, have a huge power on firms.

- *Power level in comparison to the target company:* it isn't easy to compare the power of the two organizations, but the power that OCP can have on Swedish Modules planning is huge. The capacity to open or close to the firm ways to keep in touch with the network based on the conduct and establish boundaries to the freedom of the company's strategies is enough to declare a strong power in respect to our company.
- *Likeliness to take action:* the possibilities on this side are limited if Swedish Modules will decide to keep its movements inside the guidelines, instead, the consequence for any infringement of the OCP policies might lead to heavy consequences for S.M. like the loss of contacts and rights to trade on established standards.
- *Likeliness to form coalitions:* being the primary objective of the open compute project to make different actors to cooperate on common innovations and standards, the likeliness to form coalition is explicit.

The OCP is then a cooperative and pro-coalition actor that will also promote network development within third parties with also a small margin of possible threat as first-mover. This is definitely the case of a *supportive* stakeholder, that is willing to partner with the companies agreeing with its policies.

The strategy suggested is, indeed, to *involve* in the creation process as much as possible the relevant persons and units inside the OCP.

5.2.7 Vertiv

- *Key resource perspective:* the company here discussed has in the portfolio solutions that are similar in the value proposition to the ones of Swedish Modules, with prefabricated data centers ready to be the infrastructure knots of the edge network. The rest that had been said for Schneider Electric and Eltek can be here repeated on the perspective of key resources control.
- *Power level in comparison to the target company:* the size, as in the previous two data centers suppliers, is for sure within the largest differences of the two companies, as well as the level of internationalization; this should not be seen as an obstacle for possible partnerships, but it is also a source of possible threat being a competitor.

- *Likeliness to take action:* as any competitor in a rival situation, Vertiv may undertake some bargaining actions in respect to Swedish Modules, but for the moment the roles of the two companies are not interfering with each other in this business.
- *Likeliness to form coalitions:* this aspect is already developed, since Swedish Modules has Vertiv in the supplier portfolio for what concerns some components of the modular data centers.

The two companies are already in good relationships, they already have undertaken a contractual relation for key components in the Swedish Modules datacenters, still, the business for Vertiv still of little importance in relative values if compared with other branches.

These together represent the reasons why Vertiv can be identified with a low margin of potential for threating Swedish Modules, but instead a good margin of cooperation (also due to the fact that they both belong again to the OCP). From these two parameters we can define, for the moment, Vertiv as a *supportive* stakeholder, that should be *involved* in the different phase of development of the single components.

5.2.8 Goteborg Energi

- *Key resource perspective:* as it was for Stockholm Exergi, this company is a publicly owned utility company that provides not only heating and cooling, but also electricity and with the help of a subsidiary, the physical telecommunication infrastructure like the fiber. At a local level this last information means that the firm as the control over the largest physical telco infrastructure of the city and the surrounding. Moreover, it is the largest investor in this business and owns also many large datacenters that then rents out to other companies. Indeed, some local key resources are definitely controlled by Goteborg Energi.
- *Power level in comparison to the target company:* at a local level the company is powerful, having the majority of the reachable customers under their infrastructure both at a business or retail level. Moreover, they are the final interface when it comes to rent out data center space, meaning that their work is already recognized by local public authorities and private companies.
- *Likeliness to take action:* there is no reason to think that direct action will be taken towards Swedish Modules or similar companies since the industry are different, the regulator doesn't want Goteborg Energi to interfere too much with the private sector and the interviewee himself stated that the company is looking for complete solutions to then rent out space on their servers.

- *Likeliness to form coalitions:* this was explicitly declared during the interview; the company wants an actor that is able to perform from the beginning to the end (and after the servicing operations) on their data centers; they want to have the least parties to contract with to make operations simpler on their data centers.

So, since Swedish Modules has the aim not only to perform the set-up of the data center, but also to surround it with the necessary services, it seems to be the perfect partner to solve the problems of Goteborg Energi. The utility company might assume the face of a *supportive* stakeholder with a huge local potential for new business opportunities.

From the strategical point of view, the tactic to *involve* this stakeholder might be ideal; they need personalized solutions with very specific standards and certifications to satisfy the end users of their servers.

5.3 Creation of the matrix

The graphical representation of what just said in the last paragraphs, will be the final and most relevant result of the analysis; it will depict the current situation from the point of view of Swedish Modules and the possible ways to relate with the relevant stakeholders.

In this matrix the position of each stakeholder represents the attitude of the former to threat and/or cooperate with the company to which this case study is referred:

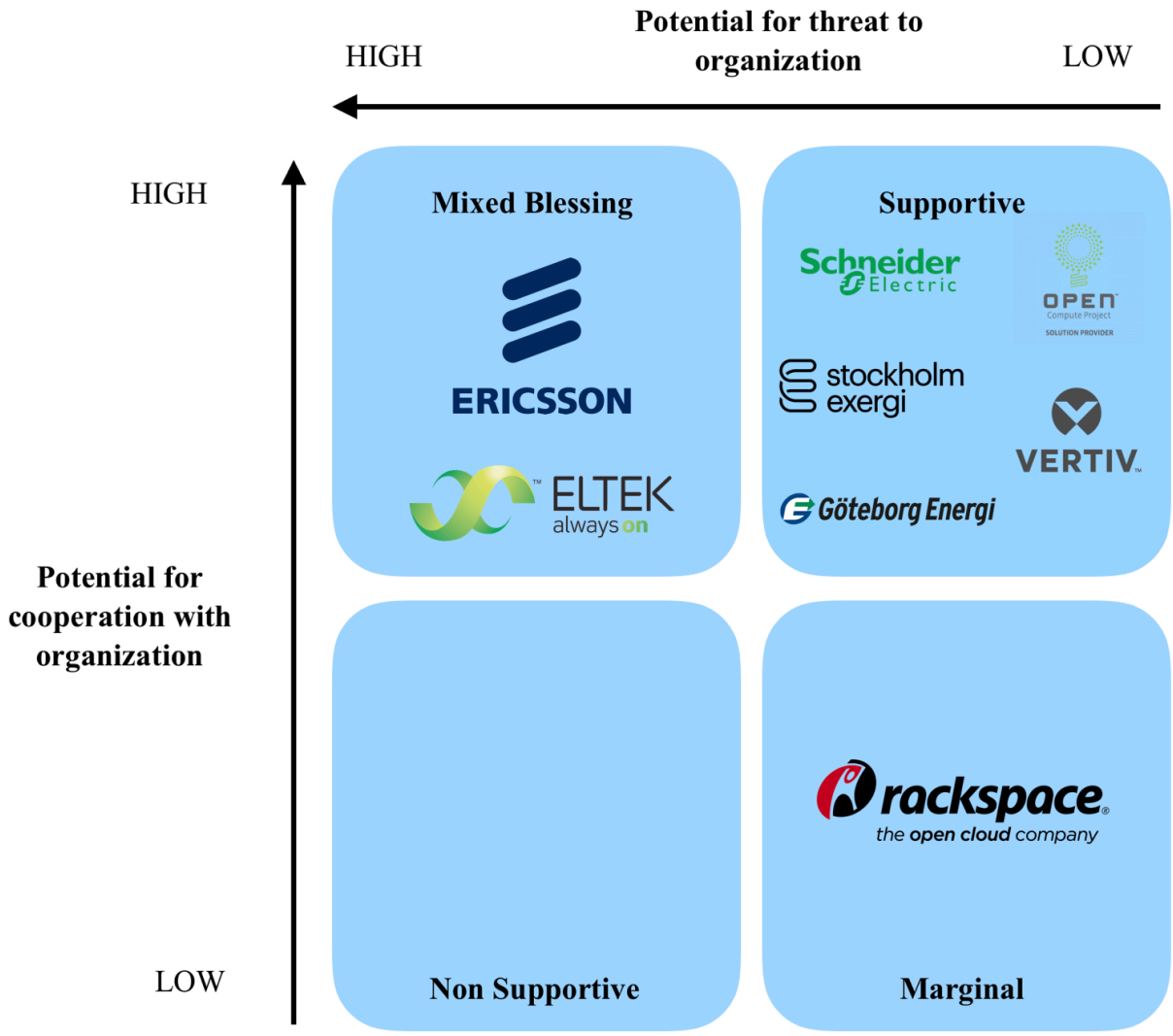

Figure 5.1 – The stakeholder matrix after the analysis

The matrix shows that the actual position of each stakeholder is correlated with the role that it can actually play in the industry. Indeed, the competitors are all in the same quadrant, as well as the customers that share the same one, creating clusters of actors divided per role also when it comes to the second model application. Furthermore, the strategy that Swedish Modules should follow when getting in touch with one actor into a cluster is very similar to the one that should be adopted with the ones related to the same family. This evidence leads to the conclusion that a correlation within the role played in the industry and the relative type of stakeholder that the actor is going to be towards Swedish Modules is present and assumes also a significant value. Moreover, the type of strategy that should be undertook is similar across the same family of stakeholders. To define a personalized strategy for each stakeholder is out of the scope of this thesis, but for each kind is possible to outline

at least an approach that will be useful to make the relationships the least threatening and the most cooperative in a broad sense.

5.4 The strategies related to the stakeholder positioning

In this section, the strategy suggested by the general model by Bryman and Bell will be developed for the specific industry, following the results gathered partially during the interviewing process and partially by the secondary data about edge computing and modular data centers literature.

Involve the supportive stakeholders:

The first group of stakeholders to begin with is the *supportive* one: when dealing with them the model suggests to *involve* the actors belonging to this group, making them actual partner in many of the core activities that the company is undertaking.

Getting external stakeholders involved in different parts of the organization yield positive results. For example, by involving suppliers in its production process, Xerox reduced net product cost by ten percent per year between 1981 and 1984. It accomplished this by substituting performance specifications for product blueprints, thus allowing suppliers to design parts. Rejects of incoming materials by Xerox were reduced by ninety-three percent, new product development time and cost were reduced by fifty percent, and production lead times were reduced from fifty-two weeks to eighteen weeks (D.N. Burt, 1989).

Swedish Modules can actually partner with the companies having their place in this family, they are mostly suppliers or customers, and work together on the solutions necessary to build the right product and understand each-others needs can make the creation and innovation process cheaper, faster and performant.

Monitor the marginal stakeholders:

The current situation in a market at its embryonic phase might change very quickly, making the current marginal stakeholders to become key ones in a very short time. It is the case of Rackspace, a large service company based in the US; the fact that the interviewee stated that the company is not yet involved in considering edge computing a key business, doesn't mean that when it will become a spread approach the strategy of the corporation can't suddenly change its point of view. A continuous monitoring activity on possible future players to exploit as partners or to bargain as competitors should be in place; the consequence of not doing so may disrupt the current position or the possibilities of development in otherwise predictable and less harmful manners.

The other opportunity to take into account when talking about marginal stakeholders is to boost their awareness of the potential in the market. Thus, if Swedish Modules will be able to highlight the possibilities of the edge computing infrastructure market to Rackspace, under a partnership point of view, the potential of the two complementary businesses might create good synergies that both the firms will enjoy.

Defending against the non-supportive stakeholders:

Although within the stakeholders interviewed no one was actually identifiable as non-supportive, every company should be aware of its bunch of antagonists. The right approach towards them is initially to defend the position against other's hostile attitudes; indeed, a deep knowledge about the non-supportive stakeholder should be the objective, in order to reduce at the minimum the unpredictable outcomes coming from that side of the industry.

The target of any strategic manager should be, anyway, to transform this detrimental relationship into a more profitable situation; understanding the possible meeting points where the companies might come together.

Collaborate with the mixed blessing stakeholders

The mixed blessing stakeholder, high on both the dimensions of potential threat and potential cooperation, may best be managed through collaboration. If business executives maximize the stakeholders' cooperation, potentially threatening stakeholders will find it more difficult to oppose the organization. A variety of joint ventures or other collaborative efforts, up to and including mergers, are possible.

If this type of stakeholder is not properly managed through using a collaborative strategy, it can easily become a non-supportive stakeholder.

The differences in size and level of internationalization makes the two actors (Ericsson and Eltek) in a position of high potential of both cooperation and threat, nevertheless the reason why Eltek is not with the other data centers providers is the strategy that was declared of becoming the front-face with the customers in respect to its suppliers. The conclusions about partnering and collaborate are here applicable, taking into account that the two companies might also incorporate different parts of the value chain, if made of much smaller players.

In the conclusions section the vision and perspectives of Swedish Modules will be summarized to give an overview of the current situation.

6. CONCLUSIONS

This conclusive chapter as the aim to summarize the findings gathered in the previous ones, where theory and practice have been matched to construct a map of the stakeholders of the industry in which the company Swedish Modules is interested, the modular and pre-fabricated data centers industry to build edge networks in the Scandinavian region.

Thus, the chapter will try to recall the main passages through which these conclusions had been constructed and also, at the very end, suggests further research to enhance the value that such work could bring to the partner company of this case study. Limitations of such work are also enlisted to make sure that the findings won't be replicated or taken for applicable in situations that are not similar in the fundamental assumptions; in fact, the findings presented here, as well as the categorizations behind them should be managed carefully when trying to understand for other companies but Swedish Modules the effects on the stakeholders' relations.

6.1 Recommendations for Swedish Modules

In this case study the company Swedish Modules has been studied under the point of view of which stakeholders are the most important in the scope of entering the market of modular data centers for the edge computing approach. Once these actors had been classified under the categories of the Porter's Five Forces framework, they had been interviewed to get more information about both their point of view on this industry and their company future and present positioning in the actual market.

The market itself is not yet well defined; as a matter of fact, the various companies that might be considered competitors for Swedish Modules and that wants to enlarge its presence, are not already aware of their place in the industry. This situation, common to every single stakeholder interviewed, makes statements about figures difficult to be made at the moment. In this landscape, where forecasts aren't always matching within themselves and the state of the art is not already there, to formulate a value proposition and create parameters to manage efficiently the surrounding players, is a difficult task for both large and small organizations. Long-term investments are also, in some cases, discouraged by the actual capacity of the infrastructure to add value at some of the proposed applications; it is the case of the internet of things at the present stage: the absence of many critical (in the sense defined in the empirical findings section) applications running on such devices, makes the investments not justifiable yet. On the other side the actual growth of connected devices and the

growing flow of data on the existing network is going to make edge computing necessary in the very next future for other uses like: autonomous cars, smart factories and virtual reality.

Indeed, the companies entering in the edge branch of telecommunications networks should be careful when sizing the actual customer base, that is currently limited at some specific use cases as the ones above mentioned. That characteristic emerged especially during the interviews' process, where the lack of reliable information was diffused throughout all the firms reached. Nevertheless, the need for a faster and more efficient way of managing the new data sources is obvious for most of the literature available, and also commercial forecast and public statistics are confirming the exponential trend that in the next years will make the new infrastructure necessary.

In the context just depicted, the need of a strategic mapping of the key stakeholders, with which engage different and personalized relationships is of crucial importance. With the aim of presenting a framework to analyze the possible way to interact with these entities, in this thesis the Savage and Blair model has been used to study the strategies that the target company, Swedish Modules, should undertake when taking part to the industry. To each different kind of stakeholder, a different strategy should be associate, with the aim of extracting the greatest value from a partnership or to reduce at the minimum the possible losses caused by a hostile behavior.

The findings of this research are highlighting also that for each type of force defined by Porter, within which each actor fall in, one type of stakeholder is found to represent them the best; that is the case of the end user customers belonging to the supportive stakeholder kind for example, or of the majority of the suppliers. The fact that many of the competitors are grouped under a low threat category should be mostly attributed to their linkages with the OCP, that is providing a powerful network in exchange of openness towards standards and intellectual property rights. This fact, should not suggest that all the competitors will actually pursue a collaborative strategy with the other players, as stated during the interviews, but maybe that through collaboration, the actual internal rivalry of the industry will decrease.

Each actor should have a personalized analysis anyway, and this model can be used in the future and by other companies as well, to estimate the potential for both cooperation and threat of each organization taking part to the industry. It is a matter of fact, and also emphasized during the interviews, that the annual growth of such a sector is within the fastest of the world, making it appealing for both the software and hardware producers at a global level.

Most of the interviewees were, as the literature is, aware of the topic and the related issues; but hard facts about the possible developments of each firm within this innovative approach weren't totally clear , as it isn't the future aspect that the market will assume. Thus, the models used in this master

thesis have the objective of making order at a strategic level from the point of view of Swedish Modules, that being a relatively small player in respect to companies such as Vertiv or Eltek, might experience harsh and disruptive moves by larger stakeholders.

Problems may also arise from other side, as the Porter's Five Forces are stating: corporations like Ericsson might assume a strong bargaining role towards smaller actors, making the profitability of a relation much lower than it would be within same sized companies. Nevertheless, the downward or upward vertical integration is a threat for the company of this case study, since many relationships are entertained on both side with multinational actors.

At date, within the interviewed firms, the margins for cooperation are high, making the position of Swedish Modules good to think about long-lasting partnerships also with actual competitors, in a market that seems to be dominated for the moment, by large players trying to conquer the biggest share of the customer base. The answer to the second research question, given in the analysis chapter, is then helpful in this specific case, but should be replicated with other stakeholders to make the mapping complete and covering most of the areas that define, in the Porter's Model, the causes for rivalry in any given industry. Moreover, the actors that at the moment result as complementary in their businesses, like Rackspace, but not involved yet in the industry, should be monitored to possibly exploit their expertise in a future change of situation.

Every relation, every actor should be separately approached, keeping in mind a long-run perspective together with the need of being flexible and agile as a market at the initial stage require to be.

6.2 Limitations and further research

This master thesis was developed to study the interactions within the different stakeholders in the Scandinavian market for modular data centers. Nevertheless, some limitations to the effectiveness and reliability of this research should be mentioned, in order to apply the findings showed in the next chapters with the due attention.

The research is, first of all, based on a qualitative research strategy, this means that the assumptions, the data collection and the findings were gathered with an important influence of a research subjective perspective; this will not reduce necessarily the reliability of the research, but will make the repetition of the study difficult, if not impossible. This limitation is due to the nature of qualitative research, as a matter of fact, as mention by Bryman and Bell (2011), this strategy relies on methods that might be affected by researchers' bias.

The theoretical frameworks of Porter and Savage and Blair had been used in many researches before this one, making the theory grounded and reliable. Indeed, the work is not affected by a new and untested framework, but it should be mention that the general nature of the two models exploited to define and study the stakeholders might bias the results, considering the specific industry of modular data centers. Until now, the industry still young and hadn't been study applying these models neither in other markets.

The geographical scope is not a limitation in the literal sense of the word when it comes to answer the research questions of our interest, but more when the findings might be tested in the future in other markets. The stakeholders interviewed are all from the Nordic countries, with a majority of them working or belonging to Swedish branches; indeed, the results are gathered on a cultural sub-set of knowledge that may not represents a common approach to the establishment of an edge network.

Lastly, the limited amount of contacts reached outside the boundaries of the two partner companies might be a limitation, also if the answer and the points of view do not vary a lot across the whole sample. Respondents, seem to agree when it comes to the general questions about the future development of this technology; nevertheless, the differences about the outcomes for the respective companies do not affect the research or limit it.

In continuity with this work, the company should try to map as many as possible stakeholders in this environment, understanding their target objectives and cultural values to manage the possible outcomes of disruptive activities in the market. The researchers in this field will then continuously apply the model of Savage and Blair to strategically define the role of each of these actors for Swedish Modules, with the help of the Porter's framework to understand the relevant categories of players to study.

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APPENDIX

INTERVIEWS OUTLINE AND QUESTIONS

- Presentation of the researcher and colleague, scope of the project and why the researchers are interviewing the company's members. (can we register the audio of the interview, and what level of privacy do you want to have when we'll report the interview results).

EDGE COMPUTING POINT OF VIEW

E.C. stands for "Edge Computing"

1. How do you see your organization development with edge computing? Will it affect in anyway your businesses, will it be part of your business?

2. What technology do you think E.C. will enable that will affect your industry?

3. Do you expect to get involved in any part of the value chain of the infrastructure enabling the creation of an edge network, or to be an end-user?

ORGANIZATION POSITION IN ITS MARKET

4. What makes your organization, if it is the case, interested about E.C.?

5. Which role will your organization undertake in the respective industry when E.C. will become a geographically spread technology? Will it change your position in the market?

6. Will the market where you today compete be disrupted by E.C.? Do you see potential for coalitions and partnerships or a more intensive rivalry?

7. Something to add? (Market forecasts, possible outcomes of E.C., personal thoughts?).

SUMMARY

a. Introduction

In these years, an overload of the physical telecommunication network has been experienced due to the exponential growth of devices connected to the Internet and the whole new set of applications and software running on them. In order to make the services for the end-users reliable and more performant, a new approach had been proposed in the recent years to rethink in a more efficient way the connectivity paradigm. Edge (or fog) computing is the most viable solution at date, making the actors involved in the hardware side of the new network layer, active parts of one of the fastest growing businesses at a global level.

Scandinavia is considered the region with the most developed agenda on the digital topics, and for this reason, a study on the stakeholders involved in such an approach to connectivity is needed to provide hardware providers a useful tool with which strategically analyze any type of stakeholders. The case study of this master thesis has the aim to give an example of a strategic stakeholder mapping for a modular data center provider, Swedish Modules AB, that is going to supply customers with hardware solutions to build the edge layer in Scandinavia.

The approach here followed is to first define who are the stakeholders with the Porter's Five Forces and then group them with the Savage and Blair Model under four different families of stakeholders, making strategies and decisions to pursue towards these third parties more analytical and easier to undertake.

The purpose of this master thesis is to answer the following research questions:

A strategic stakeholder mapping for the modular data center industry in Scandinavia.

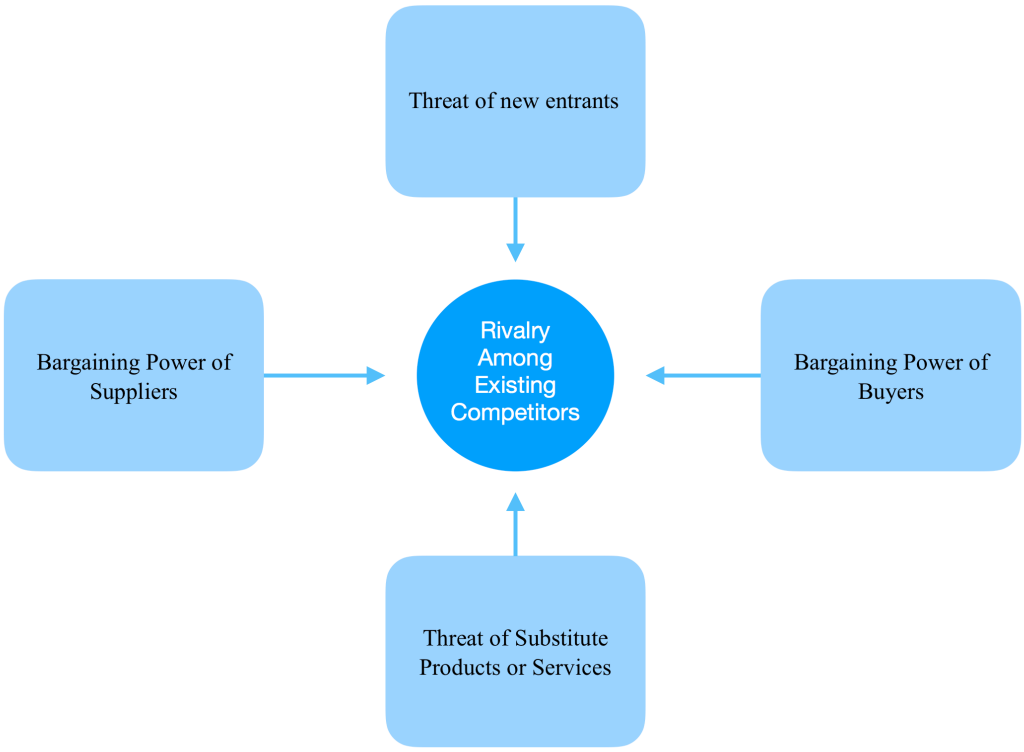
- How can we find and strategically define the stakeholders in the Scandinavian market?
- How should Swedish Modules, a new entrant, deal with the different stakeholders?

Such questions are an important step towards a comprehensive understanding of the market for modular data centers in the edge computing approach, their main objective is to make clear the possible relationships that can be established with some of the key stakeholders and suggesting how Swedish Modules can actually pursue an effective strategy to enter the market in the best way.

b. The theoretical background

Two main frameworks had been applied in this project to create a reliable and useful stakeholder mapping technique for the company Swedish Modules AB. These frameworks are the Porter Five Forces and the G. T. Savage and J. D. Blair model, the first used to find the key stakeholders and divide them per role in the industry, and the second to map them in a strategic framework elaborated by the two academics from which the name of the framework come from.

The Porter's Five Forces are used to define the degree and nature of competition within a given industry, structuring the analysis around five main forces: threat of new entrants, the bargaining power of customers, the bargaining power of suppliers, the threat of substitutes and the rivalry among existing competitors.

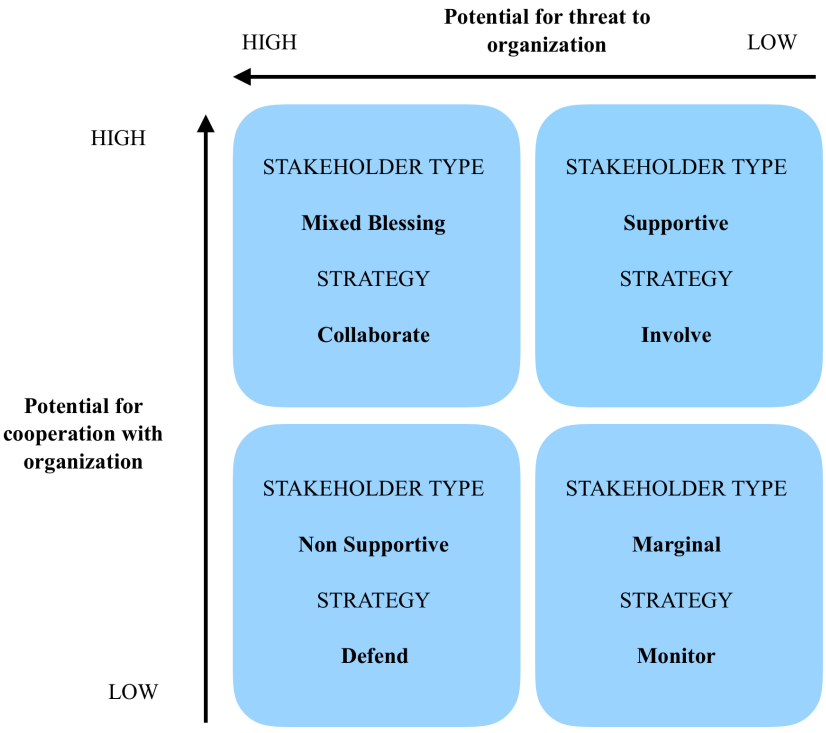


Instead, the Savage and Blair framework is especially useful when it comes to categorize the stakeholders in the firm's environment. In fact, they were able to identify four different groups of stakeholders, based on their capacity to threat the organization and their potential to cooperate with it. Moreover, a structured methodology like the one proposed by Savage G. T. and Blair J. D. (1991), is giving suggestions to the management on how to act with the different categories of stakeholders with explicit strategies that should be adopted consequentially.

The following tab is enlisting the factors of interest to analyze each single stakeholder:

	FACTOR OF INTEREST	POTENTIAL FOR THREAT	POTENTIAL FOR COOPERATION
Key Resources	Stakeholder control over key resources	Increases	Increases
	Stakeholders doesn't control key resources	Decreases	Either
Power level	Stakeholder more powerful than organization	Increases	Either
	Stakeholder as powerful as organization	Either	Either
	Stakeholder less powerful than organization	Decreases	Increases
Likeliness to take action	Stakeholder likely to take action	Decreases	Increases
	Stakeholder likely to take non supportive action	Increases	Decreases
	Stakeholder unlikely to take any action	Decreases	Decreases
Potential for coalition	Stakeholder likely to form coalition with other stakeholder	Increases	Either
	Stakeholder likely to form coalition with the organization	Decreases	Increases
	Stakeholder unlikely to form any coalition	Decreases	Decreases

With these factors, we are able to place and graphically map the actors of interest in the matrix, in order to understand the role and possible strat4egies to pursue; the following picture shows the model as presented by the two researchers:



Each type of stakeholder here presented is characterized by a specific level of potential for both cooperation and threat towards the target organization of the study, that in this case is Swedish Modules AB.

Moreover, in the theory a background on the edge computing approach and modular data centers is given, to allow an easier reading of the empirical findings and analysis chapter. For the purpose of this summary, the two definitions are to find below:

A modular data center is defined as a data center with the following two characteristics;

- It should be made of a group of pre-designed subsystems, integrated and pre-tested;
- Assembled on a skid, ISO container or pod.

Edge computing is defined as: the set of enabling technologies allowing computation to be performed at the edge of the network, on downstream data on behalf of cloud services and upstream data on behalf of IoT services.

c. Methodology

The chosen approach of qualitative research will go through a continuous review and check of data sources to find an applicable theory that will help in establishing this relational links within the parties involved; this iterative process will then move back and forth to develop a reliable theoretical framework built on grounded data. Furthermore, dealing with a qualitative research strategy will imply a nature of the internal data sources that rely on personal observation of the participants throughout interviews about their vision of the industry, making the comparison and the findings linked to the personal judgement of the researcher.

The research design chosen for this master thesis is the single case study; with this technique a deep understanding of the situation involving the subject studied (Swedish Modules AB) is required, thus, an analysis of the company profile will be given in the following chapter where the data collected will be presented. The case study research design enables to focus on a "bounded situation or system, an entity with a purpose and functioning parts".

The technique here chosen to collect the largest part of the necessary data is to perform interviews with the relevant stakeholders; furthermore, necessary data to complete and interpret the interviewees' answers have to be found on relevant reports and articles about the industry. Thus, the sources are split in primary and secondary kind; of which, the primary ones are the interviews collected through the direct contact between firms and participants to the industry, and the secondary are the data gathered from the relevant literature.

The following tab represents the set of interviews performed by the researcher to gather the above mentioned primary data:

COMPANY	ROLE	DATE	TYPE	DURATION
ELTEK	Data Center Engineer	03/05/2018	Skype for Business	40 min
ERICSSON	Country Marketing Manager Italy/ K.A.M.	19/04/2018	Phone call	50 min
SCHNEIDER ELECTRIC	Director Data Center Industry Alliances	10/04/2018	Skype for Business	30 min
VERTIV	Senior Director of service for Emerson Network Power's Energy Systems	23/04/2018	WebEx meeting	35 min
STOCKHOLM EXERGI	Head of Marketing Data Center Cooling and Heating Recovery	24/04/2018	Skype for Business	55 min
RACKSPACE	Infrastructure Design and Management Professional	25/04/2018	Zoom Meeting	35 min
OCP	VP of Channel	27/04/2018	Skype	40 min
GOTEBORG ENERGI	Business developer for GothNet, IT subsidiary	08/05/2018	Face to Face	120 min

d. Data analysis

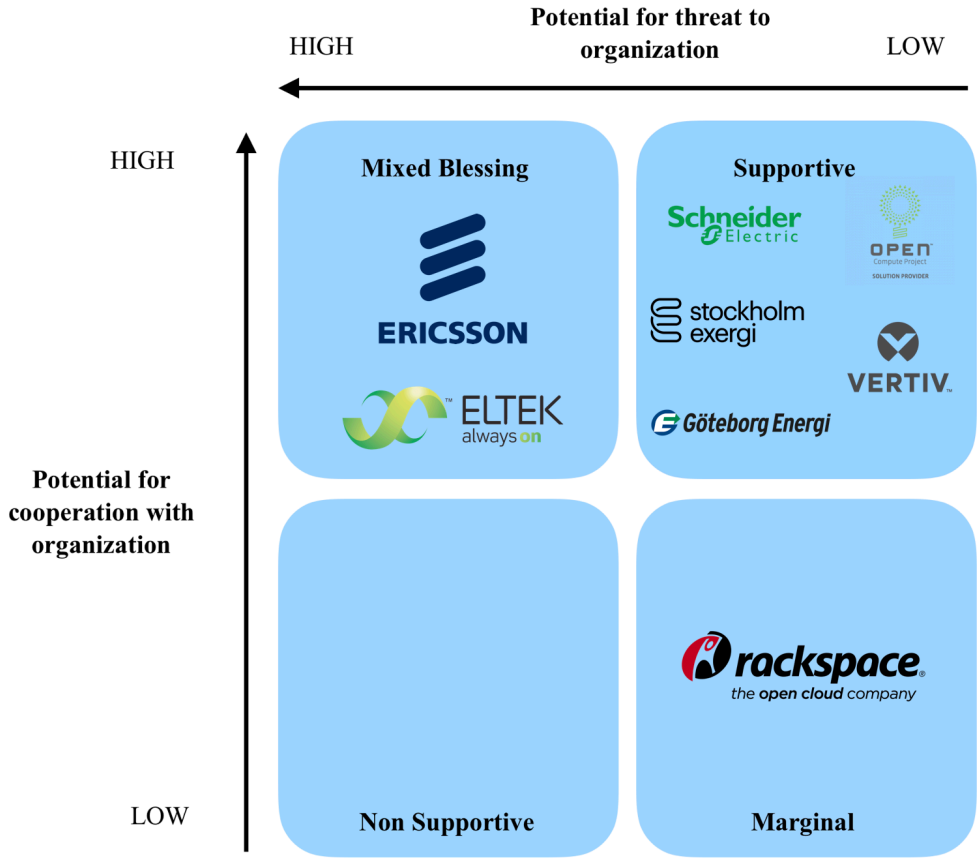
The aim that the researcher is pursuing, is to match the two theoretical frameworks – the Porter's five forces and the Savage and Blair model – with the empirical findings gathered during the interviewing process. In order to do so the structure will be split in a first section where the selected stakeholders will match the categories listed by Porter, to make an analysis of the relevant classifications of actors that are shaping the market; furthermore, in the second section, a representation of the stakeholders will match the Savage and Blair model to get the matrix of interactions for our specific purpose.

1- In order to find the stakeholders, the Five Porter's Forces framework has been adopted; the employment of this model was useful to get an exact picture of the actors that primarily affect the industry rivalry. The categories of major interest, that have been then investigated, are the ones that represent the possible customers and competitors; instead, the supplier side was sometimes mixed with the competitors since the components provided to Swedish Modules, that is mainly a manufacturer of the final product, are in the largest part produced by companies providing also the entire final solutions to the same customers group.

The result of the application of the Porter's five Forces Model is that, within the interviewed organizations, the actors are split in three of the five categories, indeed:

- *Customers:* Ericsson, Stockholm Exergi, Goteborg Energi;
- *Competitors:* Schneider E., Eltek, Vertiv;
- *Suppliers:* Schneider E., Eltek, Vertiv, Rackspace, OCP.

2- The result of the second model are represented in the following matrix, where the actors are located in the area that represent them for the level of potential threat and cooperation that they can undertake towards Swedish Modules AB:



The matrix shows that the actual position of each stakeholder is correlated with the role that it can actually play in the industry. Indeed, the competitors are all in the same quadrant, as well as the customers that share the same one, creating clusters of actors divided per role also when it comes to the second model application. Furthermore, the strategy that Swedish Modules should follow when getting in touch with one actor into a cluster is very similar to the one that should be adopted with the ones related to the same family. This evidence leads to the conclusion that a correlation within the role played in the industry and the relative type of stakeholder that the actor is going to be towards Swedish Modules is present and assumes also a significant value. Moreover, the type of strategy that should be undertook is similar across the same family of stakeholders. To define a personalized strategy for each stakeholder is out of the scope of this thesis, but for each kind is possible to outline at least an approach that will be useful to make the relationships the least threatening and the most cooperative in a broad sense.

In the following lines, the strategies will be presented more in depth:

Involve the supportive stakeholders:

The first group of stakeholders to begin with is the *supportive* one: when dealing with them the model suggests *to involve* the actors belonging to this group, making them actual partner in many of the core activities that the company is undertaking.

Getting external stakeholders involved in different parts of the organization yield positive results. Swedish Modules can actually partner with the companies having their place in this family, they are mostly suppliers or customers, and work together on the solutions necessary to build the right product and understand each-others needs can make the creation and innovation process cheaper, faster and performant.

Monitor the marginal stakeholders:

The current situation in a market at its embryonic phase might change very quickly, making the current marginal stakeholders to become key ones in a very short time. It is the case of Rackspace, a large service company based in the US; the fact that the interviewee stated that the company is not yet involved in considering edge computing a key business, doesn't mean that when it will become a spread approach the strategy of the corporation can't suddenly change its point of view. A continuous monitoring activity on possible future players to exploit as partners or to bargain as competitors should be in place; the consequence of not doing so may disrupt the current position or the possibilities of development in otherwise predictable and less harmful manners.

The other opportunity to take into account when talking about marginal stakeholders is to boost their awareness of the potential in the market. Thus, if Swedish Modules will be able to highlight the possibilities of the edge computing infrastructure market to Rackspace, under a partnership point of view, the potential of the two complementary businesses might create good synergies that both the firms will enjoy.

Defending against the non-supportive stakeholders:

Although within the stakeholders interviewed no one was actually identifiable as non-supportive, every company should be aware of its bunch of antagonists. The right approach towards them is initially to defend the position against other's hostile attitudes; indeed, a deep knowledge about the non-supportive stakeholder should be the objective, in order to reduce at the minimum the unpredictable outcomes coming from that side of the industry.

The target of any strategic manager should be, anyway, to transform this detrimental relationship into a more profitable situation; understanding the possible meeting points where the companies might come together.

Collaborate with the mixed blessing stakeholders

The mixed blessing stakeholder, high on both the dimensions of potential threat and potential cooperation, may best be managed through collaboration. If business executives maximize the stakeholders' cooperation, potentially threatening stakeholders will find it more difficult to oppose the organization. A variety of joint ventures or other collaborative efforts, up to and including mergers, are possible.

If this type of stakeholder is not properly managed through using a collaborative strategy, it can easily become a non-supportive stakeholder.

The differences in size and level of internationalization makes the two actors (Ericsson and Eltek) in a position of high potential of both cooperation and threat, nevertheless the reason why Eltek is not with the other data centers providers is the strategy that was declared of becoming the front-face with the customers in respect to its suppliers. The conclusions about partnering and collaborate are here applicable, taking into account that the two companies might also incorporate different parts of the value chain, if made of much smaller players.

e. Conclusions

In this case study the company Swedish Modules has been studied under the point of view of which stakeholders are the most important in the scope of entering the market of modular data centers for the edge computing approach. Once these actors had been classified under the categories of the Porter's Five Forces framework, they had been interviewed to get more information about both their point of view on this industry and their company future and present positioning in the actual market.

The market itself is not yet well defined; as a matter of fact, the various companies that might be considered competitors for Swedish Modules and that wants to enlarge its presence, are not already aware of their place in the industry. This situation, common to every single stakeholder interviewed, makes statements about figures difficult to be made at the moment. In this landscape, where forecasts aren't always matching within themselves and the state of the art is not already there, to formulate a value proposition and create parameters to manage efficiently the surrounding players, is a difficult task for both large and small organizations. Long-term investments are also, in some cases, discouraged by the actual capacity of the infrastructure to add value at some of the proposed applications; it is the case of the internet of things at the present stage: the absence of many critical (in the sense defined in the empirical findings section) applications running on such devices, makes the investments not justifiable yet. On the other side the actual growth of connected devices and the growing flow of data on the existing network is going to make edge computing necessary in the very next future for other uses like: autonomous cars, smart factories and virtual reality.

Indeed, the companies entering in the edge branch of telecommunications networks should be careful when sizing the actual customer base, that is currently limited at some specific use cases as the ones above mentioned. That characteristic emerged especially during the interviews' process, where the lack of reliable information was diffused throughout all the firms reached. Nevertheless, the need for a faster and more efficient way of managing the new data sources is obvious for most of the literature available, and also commercial forecast and public statistics are confirming the exponential trend that in the next years will make the new infrastructure necessary.

In the context just depicted, the need of a strategic mapping of the key stakeholders, with which engage different and personalized relationships is of crucial importance. With the aim of presenting a framework to analyze the possible way to interact with these entities, in this thesis the Savage and Blair model has been used to study the strategies that the target company, Swedish Modules, should undertake when taking part to the industry. To each different kind of stakeholder, a different strategy should be associate, with the aim of extracting the greatest value from a partnership or to reduce at the minimum the possible losses caused by a hostile behavior.

The findings of this research are highlighting also that for each type of force defined by Porter, within which each actor fall in, one type of stakeholder is found to represent them the best; that is the case of the end user customers belonging to the supportive stakeholder kind for example, or of the majority of the suppliers. The fact that many of the competitors are grouped under a low threat category should be mostly attributed to their linkages with the OCP, that is providing a powerful network in exchange of openness towards standards and intellectual property rights. This fact, should not suggest that all the competitors will actually pursue a collaborative strategy with the other players, as stated during the interviews, but maybe that through collaboration, the actual internal rivalry of the industry will decrease.

Each actor should have a personalized analysis anyway, and this model can be used in the future and by other companies as well, to estimate the potential for both cooperation and threat of each organization taking part to the industry. It is a matter of fact, and also emphasized during the interviews, that the annual growth of such a sector is within the fastest of the world, making it appealing for both the software and hardware producers at a global level.

Most of the interviewees were, as the literature is, aware of the topic and the related issues; but hard facts about the possible developments of each firm within this innovative approach weren't totally clear , as it isn't the future aspect that the market will assume. Thus, the models used in this master thesis have the objective of making order at a strategic level from the point of view of Swedish Modules, that being a relatively small player in respect to companies such as Vertiv or Eltek, might experience harsh and disruptive moves by larger stakeholders.

Problems may also arise from other side, as the Porter's Five Forces are stating: corporations like Ericsson might assume a strong bargaining role towards smaller actors, making the profitability of a relation much lower than it would be within same sized companies. Nevertheless, the downward or upward vertical integration is a threat for the company of this case study, since many relationships are entertained on both side with multinational actors.

At date, within the interviewed firms, the margins for cooperation are high, making the position of Swedish Modules good to think about long-lasting partnerships also with actual competitors, in a market that seems to be dominated for the moment, by large players trying to conquer the biggest share of the customer base. The answer to the second research question, given in the analysis chapter, is then helpful in this specific case, but should be replicated with other stakeholders to make the mapping complete and covering most of the areas that define, in the Porter's Model, the causes for rivalry in any given industry. Moreover, the actors that at the moment result as complementary in

their businesses, like Rackspace, but not involved yet in the industry, should be monitored to possibly exploit their expertise in a future change of situation.

Every relation, every actor should be separately approached, keeping in mind a long-run perspective together with the need of being flexible and agile as a market at the initial stage require to be.