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***The Formulation of a Servitization Strategy for Prefabricated
Modula Data Center Provision by Swedish Modules in
Scandinavia***

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ABSTRACT

Increasingly more manufacturing companies are embracing a servitization strategy to remain competitive, surrounding their core products with many types of services that could potentially enhance the value perceived by customers, as well as establish long-term profitable relationship. Swedish Modules, which produces modules and already entered the market of Data Centers, is planning to move from its traditional business model to a *servitized* one. When striving for the implementation of servitization it is crucial to understand which services are really required by customers, in order to avoid the provision of services that customers are not willing to pay for.

Though the support of Lean Service Creation, which is made up of seven steps aiming at guiding companies towards a successful servitization strategy, and through the answers seven selected interviewees, many services came out. The services were divided in two sections afterwards, and it emerged that the “core offering” services (meaning the expected services base that customers are expected to require just to consider the demand as competitive) are: providing monitoring and maintenance services, security devices to protect sensible information, full connection to energy and integration to company’s activities, fast delivery and consultancy during the purchase.

This research aims at providing a general guideline to Swedish Modules and to other companies evaluating the opportunity of entering the market of prefabricated Modular Data Centers. Nevertheless, it does not go through all the steps required when creating a new business model, since it doesn’t deal with financial and numerical implications emerging from the implementation of a servitization strategy. Conversely, the purpose of the study is to draw the attention to customers’ drawbacks when buying prefabricated Modular Data Centers and the services that might relieve purchasers from the burden of singlehandedly taking care of some activities.

Keywords: servitization, product-service system, prefabricated modular data centers, lean service creation, drawbacks, core offering and supplementary.

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1. Introduction

1.1 An overview about Servitization, Lean Service Creation and prefabricated Modular Data Centers

Today's world competitive environment is dominated by lots of new challenges. In this context, incumbents face a sharp competition either from low cost disruptors, usually emerged in developing countries, or disruptors belonging to other sectors that rely on new technologies and effective business models (Kotler, Keller, Acarani and Costabile, 2012). To overcome this challenge, some companies adapted their business models in order to gear towards the disruptors and provide technologically advanced and/or low costs products; others, conversely, decided to move away from that strategy, and strived for offering additional services that could enhance the value perceived by customers (Visnjic et al., 2017).

The latter have leant towards a servitization strategy, where servitization represents a business model and organizational change from selling the mere product to the provision of an integrated bundle of product and services (Bustinza et al., 2015). Through servitization the value proposition is enriched and tailored to the customers' desired outcomes, deviating from the traditional exchange between customer and firm towards a durable relationship based on a hybrid offerings (Green, Davies and Ng, 2017). Implementing servitization means a shift from providing the mere product to sell a Product-Service System (PSS), which is described as "an integrated product and service offering that delivers value in use" (Green, Davies and Ng, 2017).

First and foremost, the process of providing services associated to firm's traditional core product allows providers to generate new revenues stream (Vandermerwe and Rada, 1988), since they are providing both tangible and intangible solutions (Tukker and Tischner, 2006). Moreover, companies can benefit from an enhanced competitive advantage since their supply is not based on the single product anymore (Bustinza et al., 2015), and build unique customers' relationship (Coreynen et al., 2017), considering that the combined offering better fit the customers' expectation and enhance their satisfaction (Beuren et al., 2013).

Despite this bunch of servitization drivers, it turns out to be really tough when it comes to the implementation part. Tukker and Tischner (2006) dwell on some external factors that ought to be evaluated when dealing with such a complicated path, i.e. the *socio-technical regime* (including

rules and interests raised by institutions) and the *landscape* (the presence of supportive infrastructures, networks and activities). In addition, there could be the lack of a proper “acceptance by customers”, who may not be willing to pay more even when additional services are ensured (Beuren et al., 2013), as well as an acceptance by the people inside the company, accustomed to a product-focused market engagement (Annarelli et al., 2016). Other challenges may arise when implementing servitization, such as the lack of an effective strategic planning or a suitable training and education program for employees and an appropriate support by the senior management (Kuo et al., 2010) or a considerable increasing of corporate costs (Tukker and Tischner, 2006).

Therefore, to make matters worse, companies committed in enriching their offerings through the provision of services may incur in heavy investments and high costs and experience a lack of initial results and a difficulty in achieving revenues within the expected time (Gebauer et al., 2004). This phenomenon, named “servitization paradox”, doesn’t have to scare providers off: it could represent a necessary stepping stone for the later possibility to gain greater financial benefits by adding services to the core product (Coreynen et al., 2017). Additionally, Gebauer et al. (2004) describe some actions that should be undertaken when striving for overcoming the issues arising from a possible initial stage of unfavourable results. Thoroughly define a market oriented and service development process, understand customers need, creating a trustworthy relationship, embrace the cultural change, find a balance between service-oriented and manufacturing values are just a minor part of the whole actions that could be pursued in that sense.

As is often the case, when being involved in tricky breakthrough, being inspired by an already marked out path could represent the winning decision. In this study, the researcher choice felt into the Lean Service Creation framework, already used in Finnish telecommunication market, which combines together the elements of the Lean Start-Up culture, such as centrality of the customers in evaluating hypotheses, the continuous experimentation and iteration for prompting changes (Pasanen, 2016). It is made up of seven stages: immersions, insights, ideation, business planning, service design, prototyping, agile development and analysis and storytelling (Pasanen, 2016), but for the research’s aim it is not required to go through the whole of them. Thereupon, the analysis of data gathered will be geared towards the development of the immersion, insights, ideation and service design phases.

The above-mentioned framework has the function of supporting the Swedish Modules, in the development of a servitization strategy for the provision of prefabricated Modular Data Centers

(MDC). In fact, the increasing phenomenon of putting more and more resources and information into the cloud creates the need for smaller data centers that can be located very close to or at network's edge (Sanders, 2017). The answer to this request is given by the provision of prefabricated Modular Data Centers, which is defined as an approach to data centers design including incorporated units, usually in a prefabricated modules form (Normandeau, 2013). This term was coined about ten years ago as a "portable method of delivering information technology data centers capacity without the high cost and long construction time" (Ode, 2014), joining together the best ideas in terms of reliability, efficiency, flexibility and design (Kleyman, 2013).

The application of Lean Service Creation, aiming at the development of a bundle of services, along with the clarified concept of what prefabricated Modular Data Centers are represent the starting point of this work.

1.2 Purpose and research question of the project

The aim of this research is to find as many services as possible that could be considered by Swedish Modules, and for any other companies willing to enter in prefabricated MDC market, when implementing a servitization strategy. In achieving this results, the followed approach moves towards a deepening of the knowledge about servitization, analysing all the aspects that characterise that process, from drivers to challenges, trying to call attention towards the elements that companies must take into consideration when dealing with such important changes.

Once found a servitization framework that could be applicable to Swedish Modules case, the research moves towards the creation of a bundle of services for the production of Modular Data Centers, basing on customers' requests and observing other companies' business models. This section of the research is based on interviews to meaningful companies which have been chosen either for their relationship with Swedish Modules or because of they are providing comparable bundle of product and services.

Hence, the general research question for this research is:

Which bundle of services can surround prefabricated Modular Data Center provision?

Insights on Swedish Modules from the Scandinavian Market

With the intention of addressing the research question, the conducted study firstly undertake a focus on the theoretical background, willing to provide an explanation of why servitization represent an extremely efficient strategy for manufacturing companies.

Hence, the first section of theoretical background displays the drivers and the challenges of servitization and the different categories of services that can surround a core product to enhance the value perceived by customers. This part itself is not able to answer the research question, but will grant the reader an understanding of servitization, which is required to carry out the entire study.

Moreover, a deeper comprehension of prefabricated Modular Data Centers is ensured, otherwise it wouldn't be possible for the reader to understand the outcome that came out.

Defined that the thesis goes through these two steps to address the research question, the third one is pretty much closer to the research question itself, willing to find the services that eventually could be embraced by Swedish Modules offering of prefabricated Modular Data Centers.

To sum up, in order to address the research question this work move across three main steps: the first one aims at providing the reader with an understanding of servitization as a whole; the second one deals with describing the product, such as the final services could be effortlessly related; the third one is the gathered data analysis that, matched with the theoretical background and a comprehensive knowledge of the product, answers the research question.

1.3 Thesis disposition

The research has been carried out through a division in six chapters.

The first chapter is the *Introduction*, which gives to the reader general background information as well as a deep explanation of the research question and how it is intended to be addressed.

The *Theoretical Background* essential to the review of relevant theories and frameworks is presented in chapter 2. It is broken down into three main sections: the first is about servitization and Product-Service Systems; the second one describes Lean Service System, which is the iterative process selected to accomplish the objective of creating a service bundle; the final part gives the reader a brief description of prefabricated Modular Data Centers.

The 3rd chapter encloses the *Research Methodology*, which thoroughly describes the way chosen by the researcher to carry out the study and a brief description of how empirical findings have been sorted out and analysed.

In chapter 4, the *Empirical Findings* are arranged by company. For each one of interviewed enterprises, their expectations about possible customers, drawbacks and services are shown.

The *Analysis* of empirical findings is exposed in the 5th chapter, where they are sorted out following Lean Service Creation chosen steps, which are four out of the seven provided by the model. It includes also a personal researcher's division, that is deemed to be interesting from a company's perspective.

The final chapter contain the *Conclusions*, summing up what treated beforehand to address the research question.

The figure below recaps the thesis disposition:



Figure 1. Thesis Disposition

2. Theoretical Background

This chapter aims at providing the reader an in-depth understanding of servitization and the rationale behind manufacturing companies increasingly surrounding their products with complementary services. It goes through the Lean Servitization Service, which is the framework used as support to carry out this research and afterwards treats prefabricated Modular Data Centers.

2.1 Servitization

The concept of *servitization* has been thoroughly studied in literature and plenty of definitions come out when looking for a straightforward one. The word “servitization” refers to the widespread process of “moving from the old and outdated focus on goods or services to integrated bundles or systems with services in the lead role” (Coreynen, Matthyssens and Van Bockhaven, 2017). Through servitization the value proposition is enriched and tailored to the customers’ desired outcomes, deviating from the traditional exchange between customer and firm towards a durable relationship based on a hybrid offering (Green, Davies and Ng, 2017). Implementing servitization means a shift from providing the mere product to sell a Product-Service System (PSS), which is described as “an integrated product and service offering that delivers value in use” (Green, Davies and Ng, 2017).

More and more manufacturers are striving for an integrated offering of PSS, acknowledging that it now represents one of the most required solutions for being competitive and surviving in the market (Lee, Yoo and Kim, 2016). A successful example is related to the revenue stream of the English company Rolls Royce coming from the provision services to customers, such as maintenance and repair, which is more sizeable than the revenues from their well-known core products, the aircraft engines. The famous copier manufacturer Xerox has changed its business model in the latest years and developed a consistent system-integration, gaining from the provision of “document management” and “document solutions” systems, which allow the company to charge prices on machine usage (Lee, Yoo and Kim, 2016). Another fair example of servitization is the sharing economy, such as car or bike-sharing (Beuren et al., 2013). This type of economy, which has become incredibly diffused in recent years, has been defined in many articles as

collaborative consumption, i.e. an economic and cultural model built on the exploitation of a product without having the exclusive possession (Annarelli et al., 2016).

Servitization has the potential to alter the current standards of production and consumption, making it possible to improve competitiveness and to strive for a balance between economic, social and environmental issues (Beuren et al., 2013).

2.1.1 Drivers of servitization

From studies emerge lots of servitization drivers which find their roots in competitive, demand-based, economic (Martinez et al.) and environmental motivations (Maxwell, Sheate and Van Der Vorst, 2006).

Competitive motivations are explained by the nature of tangible products itself, that make it challenging for companies to create opportunities able to generate profits, when it comes to a moment different from the one of sale (Rymaszewska, Helo and Gunasekaran, 2017). Suffice it to think that services represented 70% of the Gross National Product in most Western Economies during the first decade of XXI century already, considering that they are able to build up more tangible and intangible values through tailored solutions (Tukker and Tischner, 2006).

Furthermore, manufacturing firms are finding themselves more and more threatened by the sharp competition coming from developing countries, which are able to produce substitutable products at attractive prices for customers (Kotler, Keller, Acarani and Costabile, 2012). Servitization creates opportunities for manufacturers to exploit new differentiation channels, since some scholars look at it as an alternative to product innovation, a means to get around the threat of commoditization, and a method to build unique customer relationships (Coreynen, Matthyssens and Van Bockhaven, 2017), considering that the combined offering better fit the customers' expectation and enhance their satisfaction (Beuren, Ferreira and Miguel, 2013). Indeed, the increasing technological development is provoking an audience fragmentation (dispersion of the attention when lots of options are provided), hence company's value proposition differs among different customer segments (Viljakainen and Toivonen, 2014).

Although lots of articles discuss the importance of "locking-in customers", servitization strategies' drivers also concern the capability to "locking-out competitors". The customization resulting from providing services around the core product create an innovating offering with a unique nature, hard to emulate by other competitors in the market (Annarelli et al., 2016).

In addition, in today fast-changing markets, providing services as elements of differentiation encourage companies to innovate quickly and to better modify their offering, since they can easily be changed according to customers' needs (Tukker, 2004).

Several authors who treated servitization believed that its implementation can't be confined only to economics and competitive motivations and highlighted the relevance of providing many types of services, in addition to the core product, from an environmental perspective. Studies conducted on Product-Service System, which will be thoroughly described in the following paragraphs, show that the strategies implemented with that purpose improved sustainability performance of the companies (Maxwell, Sheate and Van Der Vorst, 2006), especially when dealing with re-cycling or proposing different uses for the same product. Servitized offerings thereupon can lower system costs through phenomena such as sharing and leasing, that ensure a more intensive and efficient use of products (Tukker and Tischner, 2006). By offering together products and services that can prevent wastes, companies contribute to the reduction of scarce resources usage and minimize the environmental degradation (Beuren, Ferreira and Miguel, 2013). Moreover, through adoption of re-use and recycling policies many components can be used again or reintroduced in the production process, representing for companies a way to save on costs of buying entirely new components (Annarelli et al., 2016). Besides those rationales, companies demonstrating to take care about sustainability processes can benefit from an enhanced reputation and perception by customers (Gelbmann and Hammerl, 2015).

Challenge	Drivers' Nature	Services Provision Consequences
Tangibility of the product makes it hard to create opportunities of profit generation	<i>Competitive</i>	Services help companies in differentiating their offerings from competitors
The competition arising from developing countries	<i>Competitive</i>	Companies can get around the threat of commoditization
It is becoming harder and harder to "lock in customers"	<i>Building Relationship</i>	An enriched supply allows companies to build unique relationship with customers
"Locking out competitors" is a challenge that has to be faced	<i>Preventing Emulation</i>	A bundle of product and service is hard to emulate

<p>In a fast changing market companies must stay innovative</p>	<p><i>Innovative</i></p>	<p>Changing the provision services is less complicated than the manufacturing process, thus companies can change easily tailoring to market changes.</p>
<p>Providing the mere product companies lose the opportunity to create an improved sustainable performance</p>	<p><i>Environmental</i></p>	<p>Through many services (suggesting other way of usage, re-cycling, supporting the product disposal, reintroduction of product in the production process) companies may encourage a more intensive and efficient use of product.</p>

Figure 2. Drivers of servitization

2.1.2 Categories of services and the value of co-creation

Martinez and al., in their article “Exploring the journey to services”, pinpointed an interesting taxonomy of three essential categories of services, with the purpose of helping companies in the elaborate path of selecting the services that could fit their business as successfully as possible. These three categories of product-related services are: smoothing, adapting and substituting. *Smoothing services*’ aim is to provide a kind of support to product sale, hence without having any substantial impact to its functionality, and includes financing, warranty, training, insurance, maintenance services. *Adapting services* have a direct impact to the product functionality and suggest other ways of usage, support customers in the approach with a new product, propose other environment contexts in which the product could work as well. Both these two types of services fall in the broader class of complementary services, which is in contrast with substituting services, replacing the purchasing of a product. Through *substituting services* the customer purchases a service based on the product, rather than a product with services, and aim at offering the customer the required functionality, regardless of its ownership of the product (Martinez et al.) “Pay-per-use” is a fair example a substituting service, where the customer is paying for a service based on the usage.

Scholars agree on the relevance of customer centricity when it comes to define a servitization strategy for a manufacturing company (Green, Davies and Ng, 2017). Green et al. stress the importance of an *outside-in* mentality, i.e. the understanding of the value created by involving customers during the offering design process, rather than valuing exclusively the company current competencies (*inside-out*). In strengthening this necessity, customers are changing their web habits and internet is allowing people to get information easily, hence their requests are rapidly varying often looking at emotional needs and experiences linked to the product. Success can be no longer achieved through pushing the product towards defined target groups, but by involving customers in co-creating value providing the right offer, in the right time, on the right platform (Viljakainen and Toivonen, 2014). Now more than ever, companies need to invest as many resources as possible in trying to reduce the existing information asymmetry with customers and ensuring a matching of their capabilities (Green, Davies and Ng, 2017).

2.1.3 Product-Service System (PSS)

The scholars dealing with servitization and Product-Service System seem to disagree about whether these two terms can be considered synonyms or two shades of the same concept. PPS definitions coming up from conducted works are extremely similar to servitization. Tukker and Tischner (2006) state that PSS “consists of a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling final customer needs”. Annarelli, Battistella and Nonino (2016) define it as a market proposition broadening the traditional capabilities and functions of a product through the integration of complementary services.

Actually, the difference between the two terms slightly shows up if the articles taken into consideration have been written by experts on engineering or on economic sphere. What could be pinpointed among the various papers retrieved is that engineers tend to address their attention on the environmental and sustainable impact of the implementation of services to the corporate core offering: in this case, scholars prefer to use the term Product-Service System. On the other hand, “servitization” is adopted when concerning purely economic context (Annarelli et al., 2016). Nevertheless, since the purpose of the research is to embrace the whole aspects of an integrated offering of both product and services, the both terms will be used, discussed and considered as two sides of the same coin.

2.1.4 Classifications of PSS

The combination of products and services is aimed at the dematerialization of the pure product, such that companies' offerings can encounter more precisely the stakeholders demand.

Plenty of articles from Tukker (2004), Beuren et al. (2013), Reim et al. (2015), Tischner (2006), threatening the subject report the same taxonomy, highlighting three main categories of PSS: product-oriented services, use-oriented services and result-oriented services. In addition to that, each category encompasses some subclasses due to different environmental and economic features (Tukker, 2004).

In the *Product-oriented (PO)* category the business model of the provider is still primarily geared towards sales of products, striving at the same time to include services that may be related to the product (Beuren et al, 2013). Thus, the customer purchases a product whose value is enhanced by the presence of ancillary services. In turn, Tukker (2004) identifies two more subclasses:

- *Product-related services*, when the provider offers services that support the customer during the using phase of the product, such as maintenance, take-back agreements or financing schemes;
- *Advice and consultancy*, meaning the suggestions on different possible and efficient uses, or for instance advices on optimizing operations or logistics in a factory, when it comes to B2B and the product is embedded in a production process (Tukker, 2004).

The *use-oriented services* require the company still focusing on the product, but not on the sales itself of the physical product. The provider keeps the product ownership, but give to the customer the possibility to benefit from that under determined circumstances, often including sharing platforms joining together several users (Reim, Parida and Örtqvist, 2015). It can be divided into:

- *Product lease*, where the provider still owns the product and is responsible for maintenance, control and repair, charging a fee to the customer who is interested in using it for a predetermined amount of time and with an unlimited and individual access;
- *Product renting or sharing* is pretty similar to the lease, with the only difference that the user doesn't have unlimited and individual access, but the product is sequentially used by different customers;
- *Product pooling* has a great resemblance with product renting or sharing but there is a simultaneous use of the product by customers.

The last category mentioned by scholars is the *result-oriented*. Here, as the name suggest, the attention is addressed nor to the product, neither to the way the service is carried out, but just on the performed services (Beuren et al. 2016). The provider and the client agree on a certain result or outcome, without any pre-given product. Once more, Tukker (2004) pinpoints three types of services falling into this macro-area:

- *Activity management/outsourcing*, taking place when the company decides to outsource a part or an entire activity to a third party;
- *Pay per service unit*, where the client purchases the desired outcome according to the usage level of the product.
- *Functional results*. Here, the provider and the client settle on the definition of a result, regardless of how it is delivered.

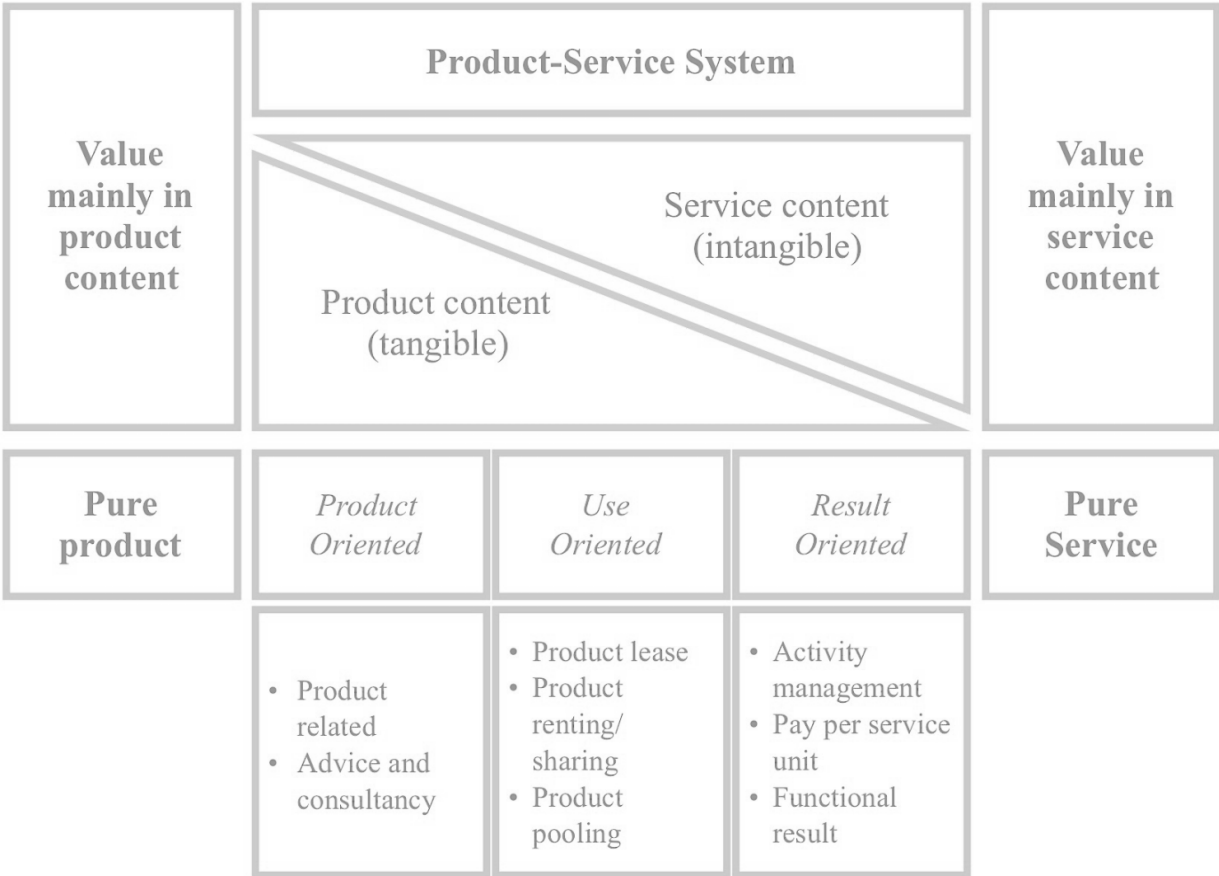


Figure 3. Product-Service System, adapted from Tukker (2004)

2.1.5 Barriers and sustainability of PSS

So far, the research discussed the positive aspects and the drivers of PSS concepts; but it should not be taken for granted that a servitization strategy always represents an economic, social and environmental win-win. The path for implementing a successful strategy is winding and many providers prefer to not abandon the status quo rather than taking the risk of going on the journey to servitization. Moreover, providers need to take care of some external factors affecting the success of the approach. The first of these elements is the *socio-technical regime*, which includes common practices, rules and interests embraced by institutions and other actors which operates in the market (financiers, suppliers, users and authorities), to prevent the creations of any type of boundaries. The second one is the *landscape*, i.e. the availability of infrastructures, networks, level of innovative activities, dominant paradigms, to ensure the accessible space for the adoption of such systems (Tukker and Tischner, 2006).

Besides these aspects, customers may not be prepared to change their purchasing habits. The “acceptance by customers” become particularly critical when the prices charged by the provider is higher as a consequence of providing additional services that other competitors do not offer. In fact, customers are accustomed to pay just for the functionality of product and may not be willing to pay more for a bundle not perceived as more valuable (Beuren et al., 2013). In this regard, many authors state that PSS strategies would not be appropriate when providing high-volume low-value products and that there could be a lack of companies’ commitment in building an integrated offering when the customer bargaining power is significantly low (Kuo et al., 2010).

The objective of successfully implementing PSS have to be pursued through a fundamental shift in corporate culture and market engagement, as a means to let the personnel embracing a new concept of value creation (Annarelli et al., 2016). Changing the orientation from a product-focused business to a service sale could collide with psychological barriers especially when it comes to marketing departments, which are accustomed to a determined value delivery (Mont, 2002). Therefore, the creation of a more complex offering expands providers’ responsibilities and requires a greater cooperation not only with clients (the extensively treated concept of “co-creation”) but with other stakeholders too. This point is highly stressed by O. K. Mont (2002), who talks about an “extended involvement that leads to intra-organisational and inter-organisational changes, such as other actors in the product-service chain” and traces back the origin of the barrier to companies’ inertia and fear of innovating. From a production perspective, PSS necessitate a

major focus on the entire product life-cycle, from the moment of the purchase to the end-of-life (reuse, remanufacturing or renovation) (Beuren et al., 2013).

Kuo et al. (2010) pinpointed other barriers that companies may face when changing towards PSS, such as lack of strategic planning, lack of an ideal management information system, lack of training and education of employees, lack of technical personnel and support, lack of support from senior management, lack of awareness related to PSS, lack of maintenance system and difficulty in managing components for maintenance.

In addition, the provision of additional services may substantially enhance corporate costs, either for high priced material or labour or for transaction costs arising from a broader networked production system (Tukker and Tischner, 2006). In this respect, costs may be enhanced by the phenomenon of cannibalisation of core products due to the provision of services. Especially in some kinds of industries that are increasingly moving towards dematerialization, incumbent firms, such as Sony, toiled to enrich their offering through services that could have cannibalised their product. Today, these services are provided by other companies (e.g. Apple or Spotify), which have been able to look ahead and be innovative (Lütjen et al., 2017).

To conclude, although servitization counts several drivers, barriers to a successful strategy are plenty and need to be accurately evaluated as well. The belief that PSS is per se sustainable is a myth and, before deciding to undertake the path of servitization, a corporate analysis must be conducted. As Tukker (2006) asserts, when considering industries where the excellence of manufacturing themselves are key strengths and the complexity of the product itself arises huge barriers to entry, diverting the focus towards services could be the recipe to lose the competitive battle.

2.1.6 The servitization paradox

Since the most critical barriers to the implementation of PSS have been extensively treated, it could not be avoided to discuss about the so called “servitization paradox”. In fact, whereas the evidences about servitization capability to create value for customers are encouraging, those ones about manufacturer’s ability to appropriate value from the adopted strategy are more unreliable (Kastalli and Van Looy, 2013). Companies committed in enriching their offerings through the provision of services incur in heavy investments and high costs, not only due to the service offering itself but also to the fundamental customer study that will hopefully lead to a successful value delivery. In some situations, providers may experience a lack of corresponding results and a

difficulty in achieving revenues within the expected time (Gebauer et al., 2004). Scholars recognize this short-term declined performance as “servitization or service paradox”.

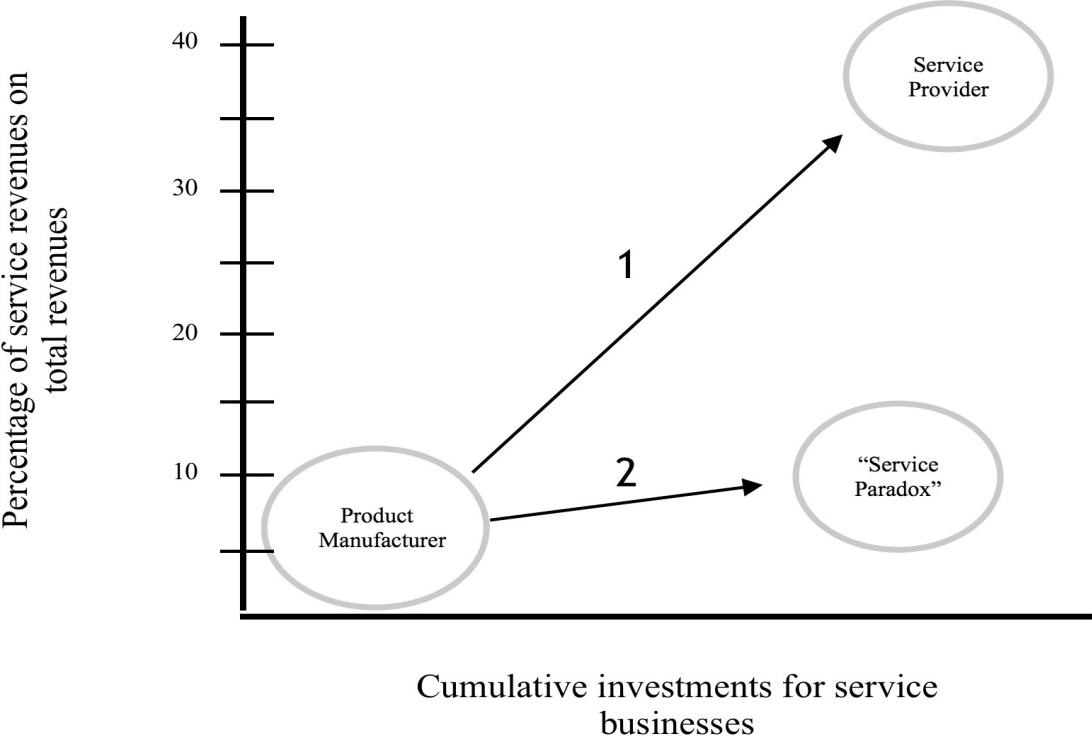


Figure 4. Service Paradox, adapted from Gebauer (2004)

The service paradox impact on companies’ revenues can be drawn by an investigation conducted by Gebauer et al. (2014) on a sample of 199 manufacturing companies. It indicates that only 11.1 percent obtained more than 40 percent of their revenues through services and more than 35 percent of the sample generated around 10 percent. The path number 1 in figure 3 represents the manufacturing companies which successfully exploited the financial potential of an extended service business, while the number 2 displays the ones which struggled to exploit them. Both these evidences of service revenues are lower than expected by most manufacturing companies.

Nevertheless, further findings posit that the servitization paradox could represent a necessary stepping stone for the later possibility to gain greater financial benefits by adding services to the core product (Coreynen et al., 2017).

2.1.7 Overcoming the Service Paradox

Gebauer et al. (2004) pinpointed some actions that need to be undertaken when implementing servitization in a manufacturing company, in order to try to overcome the issues arising from a possible first initial stage of unfavourable results.

Companies which succeed in extending their business model are those who are able to obtain as much comprehensive information as possible about customers through a wide-ranging market research. For that reason, Gebauer et al. (2004) identified among the six actions the requirement for manufacturers to thoroughly define a market oriented and clear service development process. The indispensable prerequisite of market orientation refers to deeply understand customers need in the market (De Bretani, 2001), which allows the provider to tail its value proposition to customers expectations, which is the second action treated by Gebauer et al. (2004). The third one stresses the importance of creating a marketing relationship with customers, leveraging on price charged, company image, customers' perception of the offering and committing not only on the creation of a strong communication with customers, but also on preserving that over time. Therefore, actions have to be engaged towards a cultural change to embrace the changed business model, not colliding with the existing values that make the company great, but trying to find a balance between services-oriented values and manufacturing values. Finally, in some cases, observed by the work of Oliva and Kallenberg (2003), providers reach successful objectives through the creation of de-centralized service organisation with profit-and-loss responsibility and a proper system of incentives at the level of individual employees, too.

2.2 Lean Service Creation

The following paragraphs briefly describes the Lean Start-Up process, with the purpose to give the reader a broader understanding of the topic embracing the Lean Service Creation, which is the framework used in this specific research. The analysis will concisely pass through the key elements of Lean thinking to facilitate the comprehension of the philosophy behind the Lean Service Creation, which on the contrary will be accurately treat.

2.2.1 Start-Up process

According to conventional wisdom, when starting a new business or essentially changing an existing one, the first effort to be made is the creation of a five-years business plan which displays forecasts for income, cash flow and profit. Blank (2013) states that “a business plan is essentially a research exercise written in isolation at a desk before an entrepreneur has even begun to build a product. The assumption is that it’s possible to figure out most of the unknowns of a business in advance, before you raise money and actually execute the idea”.

The Lean Start-Up process, which as the reader will discover along this research could be consistently applied to companies different from startups, relies on three key principles (Blank, 2013). First, entrepreneur should accept that they are not able to collect a hundred percent reliable information rather than engaging months of tough research and planning. Thus, instead of channelling energies towards the creation of an intricate business plan, entrepreneurs should summarize their hypothesis in a framework commonly known as *business model canvas*, which explains how company is planning to create value for itself and its customers (Blank, 2013). Second, Lean Start-Up process employs a “get out of the building approach”, requiring physical meetings with potential customers, partners or purchaser to get ideas or feedback on products, services, distribution channels and selling strategies. Once gathered those precious information, an iterative process allows the researchers to make small or big changes to their previous hypothesis aiming at being more precise (Blank, 2013). The third key principle is defined as *agile development*. Agile development goes hand-in-hand with the “get out of the building approach”, since it follows customers’ feedbacks for an iterative and incrementally development of the product. It is not based in on big release cycle, but small and continuous ones with the objective of changing parts of them when customers react negatively to the new launch (Pasanen, 2016).

2.2.2 Lean Service Creation

Lean service creation (LSC) combines together the benefits coming from the previously listed key elements of Lean Start-Up culture, such as the centrality of the customers in evaluating hypotheses, the continuous experimentation and iteration to prompt changes (Pasanen, 2016). It relies on four basic principles: *Find a problem worth solving - Get out of the building - Love the problem not the solution - Build, measure, learn* (Sarvas, 2016).

Pasanen (2016) in his research conducted in Finnish telecommunication market indicates a seven phases division of LSC: immersions, insights, ideation, business planning, service design, prototyping, agile development and analysis and storytelling. For the research purpose it is not necessary and required to go through all these phases, since some of them handle with the in-depth change of company's business model, costs, revenues streams and testing of the new strategy, which demand a far more technical analysis. Nevertheless, all the steps will be discussed by the researcher not only due to their relevance in providing a greater understanding of the matter, but also because the whole of them belong to an iterative and sequential framework that could turn out to be tricky to follow with missing stages.

The first phase, the **Immersion**, is more an introductory part essential before taking the deep dive into developing the new business. Best guess of customer's requests and problems, competitors and startups analysis, potential threatens are just part of the huge variety of areas that must be considered when dealing with Immersion (Pasanen, 2016), and they strictly change according to the type of products or services is about to be launched, the maturity reached by the market and the customers' readiness (Sarvas et al., 2017). Immersion phase help the provider to know its current position in the development process and to build an initial cornerstone that could be source of inspiration for others work.

Insights is the second, if not the most essential, step in the process (Pasanen, 2016). This phase rest on the importance of personally meeting some real people, the customers, with the objective of getting insights and find solution to the problem the researcher introduced. For this very reason, this interviews are called "problem interviews" and allows the interviewee to express their perspectives and the problems they want to be solved (Sarvas et al., 2017). The researcher should try to gather more understanding on what needs and key features should be fulfilled by the services or products. What Pasanen (2016) suggest is to totally get over the "status quo": pre-defined hypothesis or other targets set out by managers may prevent the interviewee to really explore the

potential of the exposed topic. Conversely, interviewee should feel absolutely comfortable and free to express their thoughts, without any boundaries. “Ask for facts and example, ask them to draw a picture if need be. Ask why, ask why again, and then ask why once more. Then ask why. They should talk 80% of the time [...]” (Sarvas et al., 2017). Therefore, the researcher should always keep in mind that he/she is meeting real people, not just sticky notes or segments; thus, sometimes it could be interesting to take a picture of the customer interviewed and write them down with their first name. To sum up, the three key features of Insights are: focus on customers’ problems and needs, forget the status quo and explore and connect the results.

In the third step, called **Ideation**, all the information that has been gathered in the previous phase are analysed in order to start creating ideas. The objective is to build ideas on what has been identified as critical for customers’ needs, referring either to solution fixing problems or to positive and negative emotions picked up from the meetings (Sarvas et al., 2017). In this phase, it is commonly conducted a workshop or a brainstorming among all interviewees with a view to finding answers to pinpointed questions (Pasanen, 2016).

After depicting some possible ideas and solutions, the following step, **Business Planning**, require the creation of a business model and the business model validation. Typically, this phase goes hand in hand with the usage of *business model canvas*, which describes: value proposition, customer relationships, channels for delivering value to customers and customer segments, in which customers are divided basing on their relevance and the channels the provider is planning to use to reach them. In this initial business planning phase, are definitely included cost evaluation of the new business model and the identification of clients’ willingness to pay (Pasanen, 2016). Once defined the assumptions, there is the necessity to test if they are correct; thus, the researcher goes through the validation of the value proposition, customers grouping, their willingness to pay and the arising costs (Sarvas et al., 2017).

The fifth stage, **Service Design**, is used to visualize the concept. Pasanen (2016) suggests the creation of a service blueprint, a more exhaustive customers journey that embrace the mapping and designing of customers’ journey and the display of how users find, buy, activate, use and end the service. It is a great tool when wanting to create touch points between customers’ steps of the journey and the way companies are planning to deliver their value.

Once the service design is planned, it is time to validate the brought up assumptions. In the **Prototyping** phase, the concept is put to a test through creative experiments and some types of tools such as pilots, prototypes, user interfaces or application (Pasanen, 2016). It can be worthwhile

for the researcher to identify a Minimum Lovable Product (MLP), or a Minimum Viable Product (MVP), meaning building a minimum bundle of products and services the customer could fall in love with, since it allows the provider to focus on an initial base to develop the desired outcome afterwards (Sarvas et al., 2017).

The seventh and last stage is defined as **MVP backlog and Analytics** and it represents the tool for moving from planning to really take action. The actionable backlog is nothing different from a to-do list with all the activities that have to be undertaken in order to put the product or service in the market. During this phase it is also important to focus on analytics, thus define what and how to measure and possible KPIs (Key Performance Indicators), ensuring that the product or service is having the expected success (Sarvas et al., 2017).

As anticipated previously, this research will investigate four of these seven steps, which are the immersion, insights, ideation and service design steps. These will be further discussed in the analysis chapter, tailoring to the findings gathered.

2.3 Modular Data Centers and the market

Having thoroughly described servitization and Product-Service System, it was necessary to dedicate the following chapter to introduce the reader to prefabricated Modular Data Centers (MDC), providing definition and the rationale behind the adoption of such architectures. It is not intended to an in-depth inquiry, wanting to avoid the risk of falling into too technical aspects; conversely, the outline remains geared towards a mere overall perspective, without dealing with details which are not significant for the product understanding and the research purpose. The final paragraph describes the market in which MDC are mostly expected to belong to.

2.3.1 Definition of prefabricated Modular Data Centers

Companies from all over the world are continuing to put more and more resources and information into the cloud; this increasing phenomenon creates the need for edge data centers, i.e. data centers which are located very closed to or at the network's edge, able to provide localized processing of information and fast connectivity to cloud-based application and resources (Sanders, 2017).

“Today business environment demands data centers that are increasingly more flexible and scalable with an emphasis on deployment speed” is what Kevin Brown said as Vice President in Data Center Global Offer and Strategy at Schneider Electric (Breedon, 2013).

The answer to this request is given by the provision of Modular Data Centers, which is defined as an approach to data centers design including incorporated units, usually in a prefabricated modules form (Normandeau, 2013). This term was coined about ten years ago as a “portable method of delivering information technology data centers capacity without the high cost and long construction time” (Ode, 2014). Basically, the modular solution joins together the best ideas in terms of reliability, efficiency, design and encompass everything into a “prefabricated, repeatable and operationally optimized module” (Kleyman, 2013).

2.3.2 Why prefabricated Modular Data Centers?

With the influx of Modular Data Centers, many people start wondering if the traditional ones are going to disappear due to their inefficiencies and unfitness to future applications. Well, as a matter of fact, prefabricated MDC offer a great variety of positive traits compared to the traditional Data Centers.

The way they are built allows MDC to be more scalable and flexible, and as a consequence to be more adaptable to changes arising in the continuous evolving environment they belong to (Titanpower, 2015). Data Centers Knowledge, one of the most visited website dealing with Data Centers, discusses the importance of scalability of MDC: “With a repeatable, standardized design, it is easy to match demand and scale infrastructure quickly. [...] Another characteristic of scalability is the flexibility it grants by having modules that can be easily replaced when obsolete or if updated technology is needed. This means organizations can forecast technological changes very few months in advance...” (Kleyman, 2013).

MDC can be easily delivered and moved where ever it is desired by the purchaser. Since it is prefabricated and modular, it can be either entirely transported or divided in pieces and re-assembled afterwards (Kleyman, 2013). This unique feature made MDC the perfect solution for Edge Computing, reducing the communication distance between end users and the data centers through the data analysis or knowledge generation closed to the source of data (Butler, 2017). Moreover, their mobility makes it possible the usage in situations of disaster recovery, since they can be rapidly built to assist companies working in those environments (Kleyman, 2013).

As a result of the reduced space utilization of MDC compared to the traditional ones, which are larger, companies adopting these solutions save a significant amount of money, not only considering the cut real estate costs but also that smaller dimensions comply less cooling costs. Therefore, costs decrease thanks to their modularity, which allows company to build it fast through standardised components which are shipped in assembled units (Bell, 2015).

Compared to the traditional DC, which are turning out to be oversized, CAPEX heavy and quite inefficient for new technologies requiring answers in the least time possible, MDC are more predictable in terms of expected results and more reliable in production and delivery time. Therefore, their modularity facilitates the creation of solutions which are customizable to specific needs, without involving deeply different changes in the production process (Schneider Electric)

2.3.3 Market for prefabricated Modular Data Centers

The market for prefabricated MDC took off in 2012, when the architectures started to be employed as edge data centers or other specialized operations, as opposed to traditional data centers that because of their huge dimensions could not be used with the same purposes. This notwithstanding, the initial customers’ response was meagre, due to relative immaturity of networks and technologies and to the lack of clarity about the product potential, which led to a widespread

customer scepticism (Global Industry Analysts, Inc., 2015). The following years marked the breakthrough of prefabricated MDC market, which was valued \$9.46 billion during 2017 and it is expected to reach the value of \$34.99 billion by 2023, at a CAGR¹ of 24.36% during the forecasted period, where the value accounts the solutions provided by main actors in the market and MDC professional services as well (Mordor Intelligence, 2017).

During the data collection, interviewees often referred to possible customers as belonging to three main markets: colocation, hyperscale and other enterprises. Such nomenclatures required the researcher to add this paragraph, trying to make a definition of the three with the purpose of having a clearer depiction of which markets are more likely to embrace these architectures.

Data Centers colocation (sometimes *collocation* or *co-location*) is a process allowing companies to rent physical spaces, internet bandwidths, networks and other types of resources in an existing Data Center. Through this service, primarily offered by Data Center or IT service providers, the pool of their resources is shared enabling external customers and organizations to benefit without purchasing or managing the entire facility. The providers, named *carrier hostels* or *colos*, ensure to the companies the exploiting of the floor space, power, cooling, physical security, storage and/or applications to enterprises (Techopedia, 2018). The colocation market for Data Centers industry is expected to extremely grow in the future decade: from \$30.9 billion in 2016 to \$54.8 billion by 2020, at a CAGR of 15.4% for the period of 2016-2020. As segments, America's forecasts show a growth from nearly \$16.8 billion to \$26.4 in the same period (at a CAGR of 12 %) and Asia-Pacific's market is expected to shift from \$5.4 to \$13.2 billion (at a CAGR of 25%) (BCC Research, 2018).

The term *hyperscale* refers to “large-scale Data Centers often architected for a homogeneous scale-out greenfield application portfolio using increasingly disaggregated, high-density and power-optimized infrastructures. They have a minimum of 5,000 servers and are at least 10,000 sq ft in size but generally much larger” (Recap, 2018). Offering unique capabilities and strong competitive advantage when it comes to support advanced delivery mechanism, hyperscale data centers basically represent requirement when dealing with big data, robust cloud and other types of larger distributed computing (Kleyman, 2017). Cisco recently underlined that hyperscale data centers

¹ Compound annual growth rate (CAGR) is the mean annual growth rate of a market or an investment over a specific period of time longer than one year.

already account for 34% out of all data centers and it is expected to increase up to 53% by 2020 (Kleyman, 2017).

Finally, enterprises from either public or private sector may decide to house and maintain back-end information technology systems and data stores in their own data centers, even embracing the possibility of outsourcing the operation and maintenance of the data center facility (Recap, 2018). The main advantage of enterprise data centers is that they have “complete command and control of their infrastructure” (Recap, 2018); thus, these firms are more likely to deal with commercially-sensitive, mission-critical or deeply customized data that would hardly be willing to share and to expose to the danger of other companies accessing information. The drawbacks are easily found in the huge expenses firms incur into in terms of physical real estate and other related infrastructure, storage, servers, networking equipment, operating and maintenance personnel (Recap, 2018).

The Uptime Institute² results for its seventh annual Data Center Industry Survey, released on May 2017, shows some noteworthy key findings for Data Center industry trends and developments. The results point out that even though the vast majority of IT organizations are transferring their workload to the cloud, the number of enterprise-owned data centers remained almost steady since 2014. The takeaway is that firms increasingly see data centers as essential to their strategy, but tend to prefer relying on other solutions rather than running the high cost related to the facility’s investment (Uptime Institute, 2017).

Additional findings show that compared to the previous year (2016), nearly 75% of companies’ budget intended to Data Centers’ investments have increased or remained consistent in 2017. Moreover, respondents report that approximately two-thirds of their IT assets are currently kept in their own data centers, and the residual one-third is both deployed in colocation or in the cloud. Going through these numbers and data, displaying a fast-growing and profitable market, the rationale behind companies’ choice to undertake such a delicate path looks straightforward, even more by the chance of gaining extra-profit through the provision of services able to differentiate companies’ profile from the others.

² Uptime Institute “is an unbiased advisory organization focused on improving the performance efficiency and reliability of business critical infrastructure through innovation, collaboration, and independent certifications” (Uptime Institute, www.uptimeinstitute.com).

3. Research Methodology

This section analyses the research strategy, design and methodology that have been chosen by the researcher to address the research question. Therefore, it includes the interviewees' selection, to provide the reader with the elements that made the respondents suitable for the study aim, the research validity and reliability, as well as a brief explanation of empirical findings and analysis setting.

3.1 Research Strategy

Considering the research question set out in previous paragraphs, the researcher strongly deemed that the study has to be carried out through a qualitative analysis, rather than quantitative. What emerges as the fundamental difference between quantitative and qualitative research is the former putting emphasis in the quantification of data analysis and collection, while the latter focusing on words; moreover, going through a quantitative research does not lock the results on a predetermined path, but foster the discovery of even totally new outcomes (Bryman and Bell, 2011).

The research purpose does not strictly relate to numerical and statistical data, which could be meaningful whether looking at the financial impact of servitization as a new business model for the company; conversely, to address such research question as adequately as possible a qualitative analysis based on customers' requests is necessary.

The approach adopted to achieve significant results is the *inductive* approach, which generates theory starting from the observations. Notwithstanding this, an in-depth and structured analysis of data is better to rely on some kind of theoretical background, implying some deductive elements, which eventually are not going to affect the overall result of the research.

3.2 Research Design

The data collection has been conducted through multiple semi-structured interviews to different companies, which could represent either suitable candidate in purchasing Modular Data Centers from Swedish Modules or current providers of Data Centers or Modular Data Centers. In addition,

on 5th of April, the researcher took part to a workshop in the headquarter of Swedish Modules (Emtunga, Goteborg), to a site visit at HCL's (Volvo IT) Datacenter on the 20th of February and at Swedish Modules factory in Emtunga, with the purpose of having a clear picture of Swedish Modules business and operations.

3.2.1 Semi-structured Interviews

Semi-structured interviews are made up of a list of questions on a specific topic to be covered (the *interview guide*), although sometimes they may not follow the established scheme, because they leave to the interviewee a lot of leeway in how to reply, such that questions may slightly change according to the answers gathered. Despite this, by and large, all the questions should be asked using similar wording from interviewee to interviewee, not wanting to affect the overall results (Bryman and Bell, 2011). The choice of the researcher fell into such category with the objective of tailoring the questions to the answers given, wherever possible, and gaining even more results than simply following a locked, predetermined path. Moreover, open questions let the interviewees feel free to express the whole of their expectations and needs, without being bounded by structured and closed questions. For the research aim, the researcher considered not strictly necessary to settle a very long questionnaire, since the structure of the interview itself is supposed to allow the speaker to dwell as much as desired without feeling stressed by a huge number of questions.

3.2.2 Workshop

On the 5th of April, Swedish Modules along with First to Know³ organized a workshop including all researchers who were supporting Swedish Modules about prefabricated Modular Data Centers and Hedge Computing, aiming at sharing the progress and key findings of the researches. After a preliminary session of works' presentations, the workshop was undertaken and the participants had to join some activities, such as describing the knowledge gained during others' presentations and making suggestions about the treated topics. For the sake of the research, the workshop was fundamental for a deeper understanding of the product, since not all the researches were focused on the business development, but embrace every aspect from technical to the market insights.

³ First to Know is the consulting company that is supporting Swedish Modules in entering the market of prefabricated Modular Data Centers, without which such research would not be possible.

3.2.3 Site visit to HCL's (Volvo IT) Data Center and to Swedish Modules factory

Aiming at displaying a clearer picture of Swedish Modules business activities and operations related to the construction of modules, the researcher was invited to join a site visit at Swedish Modules factory in Emtunga (Goteborg), on January 31st. Sven Lans, CEO of Swedish Modules, shows us the whole manufacturing process of the modules, the dimensions and explains the main issues that they face in production.

As a final point, even if from a chronological perspective it happens in the very beginning of this study, a site visit to a Data Center was organized by Swedish modules, in order to let the researchers get in touch with the product, the issues linked to the cooling, heating, electrical connection of the product, even slightly different to the one discussed in this research.

3.3 Data Collection

In order to address the research questions, the data has been gathered either through secondary or primary sources. Secondary data comes from the literature that has been collected in the various papers and articles available in the library of Gothenburg University, other articles retrieved online and some books from previous courses attended both in Gothenburg University and LUISS University in Rome.

Notwithstanding the great amount of available literature on the treated topic, primary data seldom can be considered enough when carrying out a complete research for a company, which is *embracing* a new business in a completely untouched market. Because of that, primary data was collected through semi-structured interviews, willing to depict a more structured portray of the services bundle matching customers and Swedish Modules requests.

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3.4 Interviewees Selection

Since the research aims at investigating needs and requests customers may have, that can be satisfied by the provision of additional services, the whole of researcher’s choices fell into possible customers. In addition, other companies which are heading to this market have been interviewed, striving for suggestions about potential services they are providing or thinking about to include in their offerings.

It is quite hard in this particular case to exactly define “customers” and distinguishing them from the “end users” that will enjoy services offered by Modular Data Centers (e.g. edge computing). However, for the sake clarity suffice it to say that when talking about “customers” it will denote companies, accessible to Swedish Modules, which are interested in buying or renting MDC, rather than end users. Thus, the provision of MDC was observed more from a Business to Business (B2B) perspective, rather than a Business to Consumer (B2C) one.

The following table displays the companies that have been interviewed during the months in which the study has been carried out. Due to time and geographical constraints, only one of them was executed face to face, while the others were supported by technological devices and softwares. Out of more than fifteen companies contacted via mail or via mobile calls, these seven replied to the interview’s request showing their willingness to collaborate.

Before going through all the interviewees, the researcher believes it is necessary to underline that, although not all the interviewees are part of the Swedish market and operate there, the gathered information can be applied to Sweden and the interviewees were all aware that the research was undertaken along with (and for) Swedish Modules. In other words, even though the interviews are not all from Sweden, the results of the research are not affected and all the data are perfectly valid and relevant for the Swedish market.

Company	Interviewee’s role	Location	Date	Type	Duration
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Schneider Electric	Director of Data Center Industry Alliances	USA	10/04/2018	Skype for Business	30 min
Vertiv	Senior Director of service for Emerson Network Power's Energy System	Sweden	23/04/2018	WebEx Meeting	30 min
Stockholm Exergi	Head of Marketing Data Center Cooling and Heat Recovery	Sweden	24/04/2018	Mobile Call	60 min
Rackspace	Infrastructure Design and Management Professional	USA	25/04/2018	Zoom Meeting	35 min
OCP	VP of Channel – Open Compute Project	Hong Kong	27/04/2018	Skype	40 min
Eltak	Data Center engineer	Germany	03/05/2018	Skype for Business	40 min
Goteborg Energy	Business Developer in Gothnet, subsidiary of Goteborg Energy	Sweden	8/05/2018	Face to Face	120 min

Figure 5. Interviewees Selection

3.5 Interviews Structure

Interviews were always preceded by a brief introduction to some researcher's personal information, the research question and a general overview about the questions that will be asked.

As previously mentioned, the choice leaned towards semi-structured interviews made up of two main sections. The first one is aimed at deepening the knowledge about customers' that are (and could be) interested in purchasing prefabricated MDC, hence the questions focused on interviewee opinions about which customers are there in the market so far, which one could be taken into account for the future and from which markets. The second section, more decisive for the definition of a servitization strategy, revolves around the services themselves, willing to stress the importance of providing bunches of services to relieve customers' drawbacks in purchasing prefabricated MDC.

Moreover, a final section was introduced as well, including a broad open question to allow the interviewee to add any further consideration about the exposed matter.

3.6 Research Quality

Some scholars consider that qualitative researches are less rigorous compared to quantitative ones and look at the former with a sort of scientific scepticism. Conversely, other academics believed that qualitative findings possess relevance, which is in a trade-off position with rigour, being relevance far more important than rigour when carrying out a research (Hinds et al., 1989). Hence, the aim of the researcher is to verify the research quality, commonly evaluated through two assessment strategy named validity and reliability.

3.6.1 Reliability

In literature, reliability is described as the capability of the research of being replicated by studies conducted by other researchers (Bryman and Bell, 2011). It is the repeatability of the scientific observations, also ensuring that the sources which may affect the consistency of the research have been evaluated in their deployment (Hinds et al., 1989).

This research relies on the outcomes gained from interviews and, as Bryman and Bell (2015) highlighted, one of the main concern of qualitative research reliability is the difficulty of conducting utterly equal interviews with different respondents. Moreover, the answers may change according to people they are asked to, even though belonging to the same company, because can be the result of personal experiences, background and perceptions. Since the researcher choice fell into open questions and vocal interaction it may happen that, even whether starting from the same predetermined bunch of questions, they are slightly tailored on the given answers.

Nevertheless, to further enhance the quality of the report, the researcher tried to pose the questions as equally as possible to different respondents. Furthermore, all the interviews have been recorded and coded, so as to not undermining its reliability, and the whole of their details are reported in the Figure 5, including interviewees' name and role, enhancing the transparency of the research.

3.6.2 Validity

Bryman and Bell (2011) describe validity as composed by two different parts: *internal validity* means whether there is a reasonable match between researcher' observations and the theoretical developed ideas; *external validity* instead represents the degree by which the findings can be

generalized across social contexts. From an overall perspective, validity measures if the research investigate what it is supposed and expected to investigate (Bryman and Bell, 2011).

As the two scholars deemed, the internal validity is a strength of qualitative analysis, because through the inductive approach it generates outcomes starting from findings and observations; thus, considering the undertaken qualitative approach and the results that are drawn by interviews and revised afterwards, the internal validity requirement is encountered.

The external validity is a far more challenging measure to meet, mainly because of some limitations of the present study, that will be described in the following paragraph. Notwithstanding this, it can be argued that it is not strictly a researcher objective to comply with this requirement, since it is specifically emphasized that the interviews have been carried out in a restricted area and to localized companies. Therefore, because of time constraints – and lack of responses as well - the interviewees don't represent an utterly heterogeneous group. The scope is rather to provide a general understanding of what can possibly meet customers' demand in such a new market and also to offer some kinds of suggestions for companies rising to the challenge of Modular Data Centers production. Hence, the purpose of internal validity satisfaction is left for further research, preferably quantitative.

3.7 Empirical Findings and Analysis settings

Chapter 4 highlights the most relevant results gained through semi-structured interviews. For the sake of clarity and simplicity, they have been sorted out by company; each company is briefly described, with the purpose of allowing the reader to understand why it has been selected as interviewee, and is followed by two sub-paragraphs revealing their expectations about possible customers, their drawbacks and services. The researcher's choice felt into this classification, in order to maintain the data as they have been chronologically gathered, bearing in mind that during the analysis they would have been grouped by drawbacks and services.

The 5th chapter involves the analysis of empirical data. It has been developed according to the four phases of Lean Service Creation. As mentioned beforehand, the research will not go through all of the seven steps since for the research purpose it is not necessary to deal with financial and numerical implication of servitization, which would require a far more technical analysis, and

moreover the testing and prototyping part has to be done by the company itself after the implementation.

So, the Immersion phase is made up of personal researcher guesses from both the HCL's (Volvo IT) data center and the factory visit at Swedish Modules.

The Insights step re-orders the findings exposed during chapter 4, dividing them into three sections: customers, customers' drawbacks and services that can relieve the drawbacks. Aiming at giving the reader a more structured analysis, drawbacks and services have been divided in three more phases reflecting the ones the customer passes through when buying any product: the purchase, the deployment and the obsolescence and end-usage.

The Ideation part is a match of Immersion and Insights, where the findings are summarised in a table to give the reader an immediately visible cause-effect connection of drawbacks and services.

Finally, the Service Design phase treats the services from a different point of view. With the intention of having a clearer service strategy, the researcher divided the services in two sections: services that should be part of the core offering of the company, just to allow the customer to consider the product as competitive, and service provisions that could be implemented when striving for differentiation (supplementary).

4. Empirical Findings

The following chapter displays the gathered empirical findings, that has been collected through several interviews. The companies have been briefly described, since the researcher aimed at allowing the reader to get a comprehensive overview of which ones have been identified as potential clients or competitors. The findings have been sorted out according to two sub-paragraphs: customers and customers' drawbacks and services. The rationale behind this choice is that, in researcher's opinion, it was primarily necessary to define which could be the possible customers interested in buying the product. Defined that, with the aim of understanding services that customers may require it was fundamental to deepen the knowledge of their drawbacks, the pain they will face when buying a prefabricated MDC. These data gathered, the services relieving these drawbacks have been discovered and analysed.

4.1 Schneider Electric

Schneider Electric is an European corporation dealing with energy management, automation solutions, spanning hardware, software and services. Their revenues in 2017 were around 24.7⁴ billion, and it counts 142,000 employees worldwide (Schneider Electric, 2018). It is currently providing prefabricated Modular Data Centers and their website shows that they are expert in providing bunch of services, such as those ones for critical power and cooling, electrical distribution, life-cycle and safety monitoring, technical training and teaching solutions. All these features make Schneider Electric a perfect candidate for the carried out research.

4.1.1 The customers

During the interview the Director of Data Center Industry Alliances stated that prefabricated MDCs belong to an interesting market that is increasingly growing and attracting customers. It is expected to get more and more value as it becomes more standardized, because it will allow the

4 This data refers to the fiscal year of 2017 and it was gained from Statista (<https://www.statista.com/statistics/596171/revenue-of-schneider-electric/>)

enhancement of a stronger competition by the presence of more manufacturers, even if right now customers are geared towards more customized solutions tailored to their specific needs.

The standardization of the market, from Schneider Electric perspective, means moving towards these kind of pre-assembled subsystems, that are pre-connected and pre-wired through switchgears and electrical distribution panels on a platform and delivered to the site afterwards, so that all the work has not to happen directly close to the customers. The process of connecting together electrical supports in the module, testing it and shipping to the site is called “modular deployment” and embodies the common way of producing prefabricated MDC, used by both Schneider Electric and other competitors. When getting involved with this type of standardization (even far away from a real standardization of the product) the main customers are expected to be large retailers from both colocation and hyperscales operators.

4.1.2 Customers’ drawbacks and services

The interviewee stated: “Why someone should go prefabricated? First and foremost, because of the speed of deployment on site, since theoretically it should make the construction process faster; secondarily, prefabricated MDC are characterized by a more predictable high quality”. Striving for these two features, clients often face the issue of the high costs related to the purchasing and deployment of such complicated structures. Moreover, customers require plenty of room and a strategic planning about the disposition and the most effective deployment. In the light of this, the services suggested by the interviewee are furnishing training to customers, to support them in the usage of prefabricated MDC, and providing staff able to run and operate a MDC, such that the customers do not have to struggle in making it works properly.

4.2 Vertiv

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

optimising service (Vertivco, 2018). Counting around 19,000 employees all around the world, Vertiv revenues was worth \$3.9 billions during 2017.

4.2.1 The customers

The interviewee, senior director of service for Emerson Network Power's Energy System business in Europe, Middle East and Africa, claims that prefabricated MDCs constitute a breakthrough in IT and data industry: they are flexible, quickly deployable and allow firms to increase their capacity in handling huge amount of data. The main customers that are currently moving towards these technologies belong to the telecommunication sector, but in the next decades prefabricated MDCs could be used in many other industries. Unfortunately, at this point it is quite challenging to identify all the industries that could embrace these facilities, due to the unpredictability of 5G, IoT⁵ and Cloud (but even many others) future applications.

The public sector could be taken into account as possible customer, as well; it goes without saying that only tech-advanced countries can afford networks and equipment necessary to support prefabricated MDC deployment. Moreover, referring to the public sector it could maybe work more effectively by the usage of traditional Data Centers through colocation operators, so as to stave off all the potential issue arising from owning one.

4.2.2 Customers' drawbacks and services

The senior director argued that since prefabricated MDCs are fairly new technologies plenty of customers may find it troublesome to take care of every steps from the integration in firm's activities to the achievement of the most efficient usage. Other problems may arise when trying to come to an agreement with providers, especially regarding dimensions and design (since he underlined that we are far away from defining MDCs market as standardized), or when it comes to the maintenance part.

5 Internet of Things (IoT) is when the networks and internet are applicable to other fields such as manufacturing and healthcare facilities, energy grids and transportation (<https://www.cisco.com/c/en/us/solutions/internet-of-things/overview.html>)

That being said, many services that could relieve customers' pains arose. The maintenance is one of the mostly required, unburdening the purchaser from singlehandedly finding maintenance operators; thus, companies should provide customers with a number to call for emergency, or even better invest more in providing monitoring services in order to ensure a timely support when accidents occur. Therefore, with the purpose of assisting the purchaser in take the best advantage from the utilisation of the prefabricated MDC, the presence of experts and technicians *in loco* could help the provider in gaining customers' appreciation. Finally, another suggestion offered by the interviewee is to constantly collect data about the running status of the structure, such as temperature and cooling conditions.

4.3 Stockholm Exergi

Stockholm Exergi is the local energy company of Stockholm, owned by the city of Stockholm and Fortum⁶. 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, 2018).

4.3.1 The customers

The respondent, head of marketing Data Center cooling and heat recovery, highlighted the division among three market segments (the previously listed colocation, hyperscale and enterprise) to talk about possible customers. From his point of view, the most appealing customers among them are represented by the enterprises, because using prefabricated MDC they would be able to enjoy higher flexibility and a risk reduction in terms of losing sensible data and managing problematic situations. Hyperscale operators may use a prefabricated MDC not when running their standard business, but sometimes when they rely on colocators for renting infrastructures handling data.

⁶ Fortum is a Swedish company providing energy solutions such as heating, cooling, recycling and waste management to final customers, and other services to firms belonging to energy industry (<https://www.fortum.se/om-oss/vart-foretag/det-har-ar-fortum>)

Moreover, according to the interviewee, colocation operators are likely to use prefabricated MDC only when undertaking different paths from the usual ones, such as clients having particular requirements (specific way of cooling, batteries, generators or sensible data treatment) that hinder the collocator to satisfy the demand through its default infrastructure. In the view of this, even collocators could lean toward a modular approach, allowing them to furnish different services to whomever ask for.

4.3.2 Customers' drawbacks and services

In the respondent point of view, prefabricated MDC customers are not likely to ask for plenty of services. The rationale behind this opinion is that Data Centers customers tend to rely on collocators when looking for lot of services that can relieve them from the burden of managing such complex architectures. That being so, MDC customers are unexpected to have high desires for services, because they should be aware that they will be responsible for running the entire structure, even if being supported by provider's personnel in loco. To sum up, the interviewee strongly deems that if the client wants bunch of services, the right choice to make is to rely on a collocator.

Nonetheless, it is not difficult to imagine that customers may be challenged by some situations, such as finding the ground where to place the prefabricated MDC and succeeding at plugging it into the company mainstream. Security's problems obviously arise when talking about engaging such a delicate journey, since in all likelihood purchasers may treat sensible data and feel threaten by the fear of losing them.

Consequently, the suggested services revolve around the provision of in loco personnel, that supports clients in connecting the product to cooling, heating and power and in integrating the structure to the mainstream. Security services should be offered, both from an infrastructure and IT perspective, as well as maintenance and end-life services.

4.4 Rackspace

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, 2018).

4.4.1 The customers

The interviewee, infrastructure design and management professional, indicate as having the most potential for being interested in prefabricated MDC the highly scalable enterprises, since these facilities support rapid changes and leverage the space in a more efficient way. Looking at the market, that is not standardized so far, private enterprises are more likely to switch from traditional Data Centers (either through colocation or hyperscale operators) to prefabricated solutions, that are easier to control especially when dealing with sensible information.

4.4.2 Customers’ drawbacks and services

When looking at the infrastructure itself, customers’ concerns in opting for prefabricated MDC are primarily related to effective cooling and electrical connection systems, that could be hardly achievable without a proper technical knowledge. Thus, a service provision should be focused on furnishing in loco personnel that could give physical support to companies; this type of service is the one that mostly changes compared to other standard Data Centers, so providers should hire or partnering with high-skilled workers in prefabricated solutions. Conversely, all other remote services that could be required by clients, such as security or monitoring, do not need a significant change if the provider is currently running a business in Data Centers. Therefore, when providing this product-service system, the interviewee believes that offering monitoring, security and in loco personnel is something that can be considered as part of the core offering in the market; contrariwise, the provider could differentiate itself from the others by tailoring the design and architecture of MDC to customers’ need. Since the market is not standardized right now and clients always required a product that could perfectly fit their expectation, there could be the necessity of providing not entirely standardized product, so it would be probably more profitable to let them change a little on shape and design.

4.5 Open Compute Project

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, 2018).

4.5.1 The customers

The interviewee, Vice President of Open Compute Project, sees potential customers for prefabricated MDC both in private and public sectors. First and foremost, he detects telecommunication operators as the most suitable clients for modular structures, because they could take advantage not only from the modularity but also from the possibility of moving the data centers closer to the required edge. Public sector was identified, as well, but its deployment of prefabricated MDC depends on the availability of advanced infrastructure and networks, as an appropriate support to allow the most efficient exploitation of the facilities. At this point, there is the need of make a division between emerging markets, that could not be prepared for embracing these technologies, and mature ones, such as North America, Sweden or Singapore, able to leverage on their advanced networks. To conclude, the usage on the public sectors is bounded by the disposal of efficient supports. The manufacturing sector may benefit from prefabricated MDC, too, especially when treating sensible information, since it will allow them to have a major control on a security level. He listed also other sectors that could be interested in prefabricated MDC: service providers, financial sector and, more in general, the whole of web operators.

4.5.2 Customers' drawbacks and services

The first drawback, customers may face when opting for a prefabricated MDC, the respondent thought of was the connection of all the equipment with the shell, which would require the provision by the vendor of operating and supporting services. Clients may be concerned also by the obsolescence of their Data Centers due to fast changing technologies, so they could be willing to pay for services guaranteeing yearly changes of MDC components. With regard to a related topic, the terms of recycling the facility when it is no more needed, or the buy back from the vendor

as well, is something that should be discussed and considered, since it relieves the customer from the burden of finding singlehandedly some other way for the disposal. Other services should be aimed at the efficient shipping of the product, since one of the strength of prefabricated MDCs is their mobility, and a full rack⁷, wire and cable integration.

According to the carried-out interview, a significant element of differentiation based on services could be based on providing different sizes of the product, according to customers' needs, and the possibility of purchasing just some components of MDCs, when customers do not desire the entire facility.

Finally, it was stressed the importance of putting the customer in the position of exploiting a comprehensive usage of the architecture, through some kind of consultancy or training. In fact, the interviewee underlined the presence of a gap in prefabricated MDC market, due to the absence of proper consulting companies able to furnish services supporting purchasers and guiding them from the moment of the buying to the ending.

4.6 Eltek

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, 2018).

4.6.1 The customers

Eltek interviewee, Data Centers engineers at Eltek Deutschland, have no hesitation in pinpointing as most appealing customers for prefabricated MDC the operators in telecommunication sector. In our world, there is an increasing demand for data coming from mobile telephones, telecom market

⁷ data centers racks are tools providing proper airflow such that the internal working technologies are not damaged by changes in temperatures (<https://www.racksolutions.com/news/data-center-trends/what-is-a-data-center-rack/>)

is slightly moving towards data centers; since MDC are more flexible, movable and efficient there is no reason for not considering them as huge source of profit. Other private enterprises are expected to be geared towards modularity, from lots of industries such as manufacturing and financial companies. The growing shift towards Internet of Things will bring companies to consider prefabricated MDC as the best solutions to operate the enormous amount of data, but there is not a real awareness about which companies would exploit it more. Maybe public sectors or cities will manage IoT by themselves and thus be interested in buying those structures.

4.6.2 Customers' drawbacks and services

Since the amount of widespread prefabricated MDC is forecasted to increase significantly, companies selling a bundle of product and services, should focus on providing maintenance and monitoring. For instance, a telecom provider could have around 200 of these modules distributed all over a country and could not handle all replacements, substitutions and problems arising from all of them. Offering a maintenance and monitoring service, such that it is feasible for the provider to tackle those issues, represents a tangible added value for customers.

Moreover, training services should be supplied as well, to prevent customers to face difficulties in understanding the best practice to run the structure; it is especially related to low-developed countries, such as Nigeria or Ghana, where there would be the necessity of having local distributors, operators and trainers.

Finally, the respondent believes that cooling, power, energy connections and training sessions should be provided as part of the core offering of the company, along with replacements of single elements either when they stop working properly or when they become obsolete. Conversely other services like furnishing in loco specialists (especially when talking about countries different from the ones that have company's offices) and giving the possibility of small changes in design and shape of the module could be considered as ancillary.

4.7 Goteborg Energi

Goteborg Energi is an energy company owned by the City of Gothenburg, which deals with renewable energy and smart systems solutions for transport, housing and business, with a specific focus on improving sustainability and safety. The Swedish company, employing around one

thousand workers, is also involved in telecommunication sector, since it owns the networks with the fibre connecting the city and the surrounding area. In their business is included the keeping of data centers, which are rented either to public sector or to private enterprises through colocation systems, even though the provision merely involves the facility, while the servers must be brought by users. One of their data centers has been provided by Swedish Modules, so they are expected to perfectly fulfil buyer's requirements in purchasing prefabricated MDC.

4.7.1 The customers

The customers pinpointed by the respondent, business development for Gotnet (a subsidiary of Goteborg Energi), belong to telecommunication sectors, since they are expected to operate huge amounts of data and exploit technologies that needs MDC. Therefore, since in Sweden companies running telecommunication businesses are often owned by the cities, the public sector can be considered as a potential customer as well. Finally, companies that work on energy market may be interested in purchasing MDC, for running their operations with better supports.

4.7.2 Customers' drawbacks and services

As the interviewee underlined, established companies that are involved in energy, telecommunication and related businesses usually prefer to not deal with all the issues arising from the purchase, the usage and the end-life of the product. Goteborg Energi itself, would rather rely on other services providers than take care of everything singlehandedly.

That said, lots of services that should be offered by the provider arose. First of all, providers should take the responsibility of the deployment from the groundwork, to the connection of all electricity, cooling and heating cables, to the integration of the structure in company's mainstream, as well. In view of the fact that established enterprises do not wish to take care about the maintenance and monitoring of the facility, such services should be ensured along with a full in loco support either by providers or by their partners.

The security should be guaranteed even through some settled agreements, since companies are increasingly asking for more security devices, hence providers ought to grant them by themselves or relying on others. Right now, MDC are frequently assembled in a way that make it possible the positioning of cages around the racks in order to protect sensible data from others' access. This

could be an additional service offered by the supplier to warrant higher protection of information, perhaps in addition to other services devices.

Finally, the shipping is an uppermost clients' requirement, bearing in mind that one of the main features of prefabricated MDC is that they can be easily repositioned close to the edge of clients' need.

5. Analysis

This chapter embodies the heart of the research, since it is aimed to the analysis of data gathered both from primary and secondary data. Indeed, the analysis has been carried out through the previously described Lean Service System, which supported the researcher in sorting out all the information. As mentioned in the second chapter, the analysis will not go through all the seven passages provided by the LSS, because it is not researcher's intention to come up with financial implications and empirical testing of the proposed solution. Hence, this chapter focuses on Immersion, Insights, Ideation and Service Design phases, these being amply adequate to fulfil research purposes. The very first paragraph is intended in giving the reader an overview about the company, Swedish Modules, since it is the company the research has been undertaken with and thus worthwhile of a separate description.

5.1 Swedish Modules: company profile

Although its origins traces back to Emtunga Mekaniska Verskstad AB, founded in 1945, Swedish Modules' launch occurred in 1974 in Emtunga, Vara (Gothenburg, Sweden), where it currently has its headquarter. The facility's total footprint area is around 50,000 m², including a modern 8,500 m² factory space, which contains a warehouse and staff rooms.

From the very beginning, its interests were addressed towards the production of housing modules and afterwards the pharmaceutical ones, joining over hundred high quality projects throughout the world and building unique customers' relationships. The Swedish company is now active in different business areas: clean rooms, real estate, data centers, pharmaceutical factories and operating theaters. All these business areas have in common that Swedish Modules deal with the planning, construction, manufacturing and assembling of modular environments "with high demands on functionality, quality and technical content" (Swedish Modules, 2018).

On their website is stated: "our goal is always to complete at least 95% of our work on the modules in our own factory before the project is delivered" (Swedish Modules, 2018).

The Swedish company is currently thinking about entering the market of prefabricated MDCs, that it is expected to experience and incredible growth in the following decade as a consequence of the

increasing diffusion of technologies such as IoT or Edge Computing, that would need the support of these structures.

5.2 Immersion

As previously mentioned, the immersion phase is composed by personal researcher's guesses about customers' requests and problems, before going in depth with information and data collected through interviews.

For this study, personal researcher's guesses come from three main situations: the very first visit to Swedish Modules' factory in Emtunga (Goteborg), the visit to HCL's Volvo IT Data Center and the workshop at Swedish Modules. All these activities took place before having any interview, but strictly after having completed the literature review about servitization, prefabricated Modular Data Centers and Lean Service System. Hence, the researcher could have a general overview of the product even before arranging the questions for the interviews, starting to get an idea about which pains customers may face and which services are expected to relieve these pains.

The visit to Swedish Modules' factory was more from a technical perspective, rather than from a business one. Sven Lans, CEO at Swedish Modules AB, illustrated how the company operate in modules manufacturing, from the assembling of steel supports to the positioning of interior technical equipment, such as for highly-specialized rooms for surgery or for the army. Because of the professional installation of bunches of parts and equipment, it was straightforward that the maintenance and monitoring parts are likely to be carried on by someone different from the purchaser, who may not always have the ability of dealing with such activities. Additionally, it was contemplated the recycling part as well. In fact, since the Sweden company is skilled in producing the exterior shell of these structures, that is relatively durable as such without taking into consideration the obsolescence of the internal equipment, relieving the customers from handling the issue arising from the product end-usage it is likely to be very much required. For instance, a company selling modules for other purposes may take back the sold ones, when not used anymore by clients, and re-introduce them into the production process, to adjust them according to different requests.

The visit to HCL's Volvo IT Data Centers aimed at giving the researchers (both undertaking business and engineering studies) a general understanding of how Data Centers work, including racks' disposition and design, other than the importance of cooling/heating balance inside the

structure, that must be ensured for the best usage of devices. The first conjecture arising from the Data Center tour was the guarantee of heating and cooling efficient connection, without which the regular functioning of the racks. Furthermore, the importance of granting the security coverage all around was stressed by the fact that some racks were positioned in special structures, isolated from the others, with the objective of granting more security for sensible data.

Finally, the workshop at Swedish Modules was clarifying with regards to the market analysis and the prefabricated MDC construction itself, exposed by engineering researchers. During others' presentations, the importance of ensuring an energy, cooling and heating connection was emphasized again, and were also underlined some size aspects, that customers may have opted for.

To go over the main points, before starting any interviews, the researcher came up with some ideas of services that should surround the core product of a prefabricated Modular Data Centers, and the whole of them revolved around five main topics: maintenance, monitoring, security, recycling and connectivity to energy systems.

5.3 Insights

The insights' phase is the result of interviews conducted to the previously listed companies, in order to have a clear idea of which customers such structures could attract, their drawbacks buying prefabricated MDC and which services could relieve these problems.

5.3.1 Customers

Defining customers' segments, which would be willing to purchase prefabricated MDC, is fairly tricky. Technologies such as 5G, IoT, Cloud Computing and Edge Computing are increasingly moving forward, making it unpredictable to have a straightforward portrayal of all possible sectors clients would belong to. Suffice it to say that, for instance, the diffusion of the Industry 4.0⁸ (*Smarta Fabriker* in Sweden) will need more and more data centers to store all data and

⁸ "Industry 4.0" refers to an automated industry in which all production processes will be connected remotely to computer systems that can control the robotics with a very low human collaboration (<https://www.forbes.com/sites/bernardmarr/2016/06/20/what-everyone-must-know-about-industry-4-0/#507c2f4e795f>).

information, such that the whole of manufacturing sector in the future could be considered as potential customer, as well. Moreover, customers' willingness to pay may depend upon other product features such as the possibility of altering the design or dimensions.

The first category mentioned by almost all the interviewees is, for obvious reasons, the telecommunication sector, since it has to deal with huge amounts of data and information, especially those deriving from mobile telephone usage. Companies running their business through the owning of networks and infrastructures are supposed to be interested in buying prefabricated MDC more willingly than continuing to rely on colocation operators or hyperscales; indeed, such products would allow them to be positioned closer to the edge of the necessity. All companies operating in IT and data industry are likewise likely to invest in prefabricated MDC, as a consequence of the increased flexibility, capacity and security they would gain.

Public sector deserves a comment of its own, in view of the fact that the deployment of these architectures depends on the availability of advanced technological supports, networks and equipment that could ensure an effective exploiting. Hence, maybe public sectors, participating to telecommunication or even energy businesses, in mature market may opt for them; quite the contrary, emerging market are expected to rely on colocators or hyperscales.

Additionally, companies which operate within the web and virtualized platforms or entities encompassed in the financial ecosystem (dealing with massive volumes of data of investments and investors), may be inclined to go for prefabrication, meaning for them high security control in handling extremely sensible information.

As a result of prefabricated modularity these products would perfectly fit highly scalable enterprises, seeking for support to rapid changes and to leverage space more efficiently; that applies to manufacturing companies in general, too, depending on the level of automation and technology achieved.

Finally, large retailers from colocation or hyperscale may lean towards prefabricated MDC not while running their usual business, but rather when relating to customers who deal with sensible information or have specific requirements in terms of energy, cooling, heating connection.

5.3.2 Customers' drawbacks

Based on the assumption that as a general rule clients do not want to handle all the issues arising from purchasing and properly deploying complex structures, there are some drawbacks that have been pinpointed as creating significant burdens for customers. Trying to have a clearer understanding of these, they have been sorted out by the moment in which they occur. The researcher leaned towards this division for the sake of simplicity and order, but also because it should not be forgotten that this study has been carried out with and for a specific company; hence, in one of the meetings the researcher had with First To Know, it was suggested to arrange the services in a way that could be valuable, rather than leave them as a list of unorganized services.

The choice fell into this straightforward classification, that could also be perceived as a chronological order of the drawbacks that are expected to be encountered by customers.

The purchase

- The lack of a proper **consultancy** is one of the main drawback pinpointed by the interviewees, since there are no consultancy companies that can provide support and advice around the decision of moving towards prefabricated MDC. Thus, customers may feel the need of being accompanied in making such troublesome decisions.
- Since the existing market is not utterly standardized, even if aiming at, customers may be willing to be involved in the decisions about **dimensions and design**. One of the strengths of prefabricated MDC is indeed the smaller dimensions, that allow a better positioning wherever necessary. Hence, some customers could require bigger or smaller MDC or very specific designs for aesthetic or efficiency purposes.
- Another drawback that was identified by almost all interviewees is the **shipping**. This research investigates massive architectures, that are extremely challenging to move and deliver for the customer, thus companies selling prefabricated MDCs are expected to take care of the transport where required.

The deployment

- Once shipped where needed, purchasers may struggle in **connect every part** of the module to the company's mainstream. The attempt of achieving an effective cooling, heating and energy connection may represent a huge drawback for customers, especially when not

having a proper highly technical knowledge. It is a matter of a strategic disposition planning that could require some kinds of consulting supports to achieve the best outcome and exploit a comprehensive usage.

- The **maintenance** of the structure represents a huge issue for customers, since they should ask for assistance to other companies (when their own technicians are not able to handle the problem), that could be unreliable, not always closed to the need and expensive.
- **Monitoring** the whole of the equipment furnished along with the external shell is a very time-consuming drawback for customers, and even deeply necessary when dealing with highly technological devices, that operate sensible information.
- Talking about sensible information, a lot of companies may struggle in having high levels of **security** in their prefabricated MDCs. Especially telecommunication and financial enterprises are daily processing thousands data and could feel threatened by the fear of losing them either because of others' access to them, or because of occurring accidents.

The obsolescence and end-usage

- The technologies that are deployed in prefabricated MDCs are destined to become **obsolete** quite rapidly, such to hinder the customer to continue the full exploitation of the system after few years. It represents a great drawback for clients, that would opt for modularity in order to have the possibility to change some elements easily when necessary, and may have problems in the purchasing, delivery and integration of the new elements.
- As a final concern, customers do not want to deal with the **recycling** of the building when it comes to the end of its life-cycle, which means to find a way for an efficient recycling and disposal.

5.3.3 The services

In the last part of the interviews were finally discussed possible services that could relieve the pains arising from drawbacks listed beforehand. For the sake of clarity and order, and to have a sense of continuity as well, they have been arranged as the drawbacks in the paragraph above.

The purchase

- One of the interviews highlighted the lack of consulting companies that can advise customers on which module could perfectly match their needs. This huge gap in the market, could be fulfilled by furnishing **consultancy** to companies that are considering to go for prefabricated MDCs, but are not sure about the choice and the advantages it would lead to.
- Since the market is not utterly standardized at the moment and customers look for product tailored to their needs and requests, sellers should offer them the possibility to partially decide around **dimensions and design** of the structure. The intent is not to let them totally influence the shape of prefabricated, but rather offer some different types of shell's dimensions, that could be as closed as possible to what they are seeking for.
- One of the strength of prefabricated MDCs is that they can be placed and moved easily to ensure the exploitation of the benefits to the edge of the need. Thus, providers should take care of all the issues related to the **shipping** and transport of the structure, either providing it by themselves or relying on other reliable service providers; the objective is to relieve the customer from the burden of contact operators for shipping services, and thus include this service in their offering.

The deployment

- All the interviewees stressed the importance of providing **in loco personnel**, such as technicians and specialists, who are skilled in connecting every part of the prefabricated MDC, including in finding the best way to integrate it to the mainstream of the company. The personnel could be either hired by the company or be supplied by other service providers, but should be prepared to furnish a perfect connection and integration to the purchaser.
- Along with in loco personnel, providers should grant to the customer a deep understanding of how the structure works and which way of deployments may ensure a perfect exploitation. In order to achieve this result, the provision of some **trainers** that could guide clients along this path, at least during the first steps, should be ensured.
- Since the provider has the knowledge to solve accidents or other sorts of problem, it should offer **maintenance services**, unburdening the purchaser from singlehandedly taking care of issues arising and finding some maintenance providers that could turn out to be unreliable.

- Similar to maintenance services, remote **monitoring supports** can be considered as well, with the purpose of avoiding that levels of cooling, heating or energy diverge significantly from the optimal ones.
- Bunch of companies, for instance from telecom sector, belonging to customer segments process highly sensible information in their usual business; when they operate through data centers usually require **high security standards**, either preventing others' access or with respect to accidents that may occur. Since it is amply required by customers, providers should provide high-tech security devices or even special cages (sometimes part of these products) that hinder others' access to the rack.
- One of the main advantage of modularity is that the **replacement** of some elements can happen effortlessly and the purchaser can decide to substitute just some parts, when they stop working as expected or become obsolete. Hence, the seller could take care of making available special agreements for a convenient replacement of the elements that customers want to change, ensuring that the elements come from a trustworthy source.

The obsolescence and end-usage

- Dealing with structures equipped with high-tech elements that could become obsolete really fast, customers will face the problem of the **recycling** and disposal. The provider may offer special **agreements for the buy-back** of the structure itself, when the customer want to replace the whole or even some parts, that could be either re-introduced in the production process to other purposes or given to other companies responsible for the recycling. Some companies in other tech industries offer special prices for the purchase of some components in exchange for the obsolete ones, to encourage the appropriate recycling or to reuse some of the elements.

5.4 Ideation

The ideation phase is basically combining together the key finding analysed in the Insight part (both drawbacks and services) with the purpose of answering the research question and starting drawing significant conclusions.

In the light of this, looking at the analysed information it emerges that for each customers' drawback there is a type of service that could be provided along with the sale of prefabricated MDCs. The choice of providing all these services or just some of them depends only on companies' decision; likewise, deciding whether to provide services by themselves or to rely on other reliable service providers is an evaluation that is left to the seller.

This phase aims at displaying which drawbacks came out and how a company that is thinking about surrounding its product by services can relieve some of them. The outcome is revealed in the following table, which is divided in three macro-areas according to the design used beforehand (purchase, deployment, obsolescence and end-usage).

Moment	Drawback	Service
<i>Purchase</i>	Dimension and Design	Granting to purchaser to chose among different sizes and shapes
	Fast and Efficient Delivery	Providing efficient delivery in order to place the module close to the edge of the need
	Lack of consultancy	Ensuring the customer to be followed during the decision process, with the purpose of guiding him/her towards the right choice

<i>Deployment</i>	Connection to energy, cooling, heating and full integration to the company's business	Providing <i>in loco</i> personnel supporting the connection of all racks, wires and cables and ensuring a full integration to exploit the module in the best way
	Maintenance and Monitoring	To avoid the customer taking care singlehandedly of maintenance, offering reliable maintenance and monitoring services
	Security	Equipping the prefabricated MDC with security devices (both for preventing accidents and others' access to sensible information) and even the possibility of isolating the rack through cages
	Lack of Knowledge	Providing training session to help customers to fully understand the how the product works
	Components Replacement	To exploit the modularity of prefabricated MDC, giving the customer the possibility to replace some elements when stop working or become obsolete
<i>Obsolescence and end-usage</i>	Obsolescence	Offering the buy-back of some elements or the entire structure when it becomes obsolete or is not needed by the customer anymore
	Recycling	Providing special recycling agreements, to relieve the customer from the burden of finding singlehandedly efficient ways of disposal

Figure 6. Drawbacks and Services

5.5 Service Design

The service design phase is aimed at defining a bundle of services that could be valuable for customers when buying prefabricated MDCs. The last question asked to the interviewees concerns whether some services could be considered of the core offering or supplementary, with the intention to give a well-defined servitization strategy.

In achieving this purpose, turned out services have been re-organized within two sections. To the first section, that for sake of simplicity has been called “core offering”, belong all the services that emerged from the interviews as having higher relevance. These services are expected to be part of the company’s supply, otherwise the customer will not look at such company as a competitive provider. Conversely, the interviewees pointed out some services that could be “supplementary” of the core offering, meaning that they can be provided as additional services, representing not only an additional value for clients but also a mean of differentiation from competitors.

The interviewees agreed on this taxonomy, since it should not be taken for granted that every company could be able to offer all these services; hence, such division aims at highlighting which one could be the most-required.

The following picture shows the division cited beforehand: the core product has been placed in the smaller circle, to bear in mind that the investigated services are just used to enhance the value of the supply and do not represent the whole offering; the middle circle displays the services that turned out to be the most-required or at least the ones that should be part of the standard offering to be competitive; the external one is intended to show the services that, even though came out from the interviews, were recognized as a proper element of differentiation.

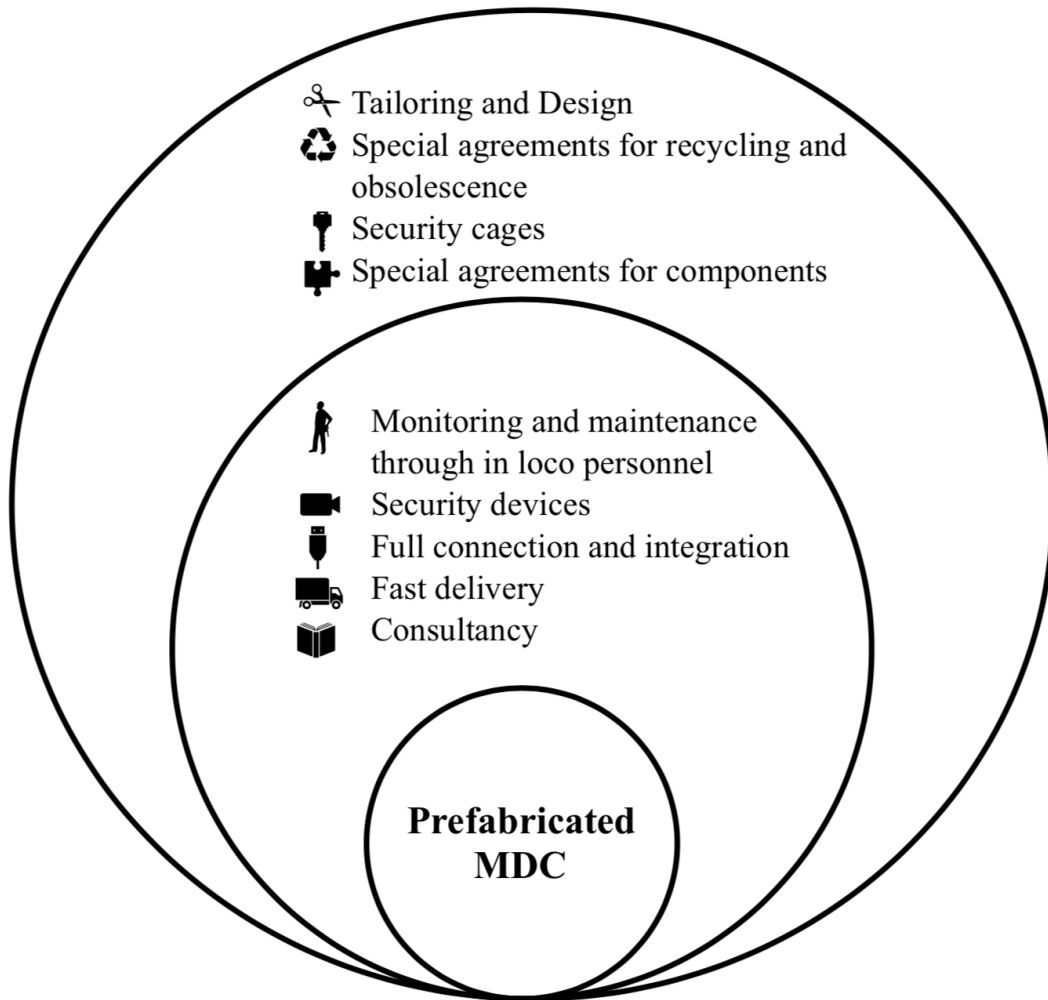


Figure 7. Services division among “core offering” and “supplementary”

6. Conclusions

The ultimate conclusions are drawn in this chapter, which aims at giving an overall perspective about the outcome this research came up with. The first part contains a brief overview about servitization and research question, needed to bear in mind the theoretical background of this study and afterwards it answers the research question, summarising the findings that have been already treated in the analysis.

6.1 A brief overview of the topic and the research question

The research starts by analysing servitization, an increasingly widespread trend adopted by companies in order to provide a superior value perceived by customers (Visnjic et al., 2017). The servitization strategy embodies a business model and an organizational change, which is pursued through shifting from selling the mere product to the provision of an integrated bundle of product and services (Bustinza et al., 2015).

Depending on the product-service combination, Tukker (2004) brought to light a taxonomy of Product-Service Systems⁹, which identifies three servitization strategies: product oriented (product related services such as consultancy and advisory), use oriented (product lease, renting or sharing and pooling) and result oriented (i.e. activity management, pay per service unit and functional results).

The products taken into consideration for this study are prefabricated Modular Data Centers, i.e. special types of Data Centers that, due to their smaller dimensions, are more flexible, scalable, innovative and easy to move, embedding the perfect data storages to support new technologies such as 5G, IoT, Cloud Computing and Edge Computing.

Considering all these aspects, this research is intended to address the following research question:

⁹The term “Product-Service System” has been used in this research as a sort of servitization synonym. Indeed, some scholars use it as a way to identify a bundle of product and service, whereas some others pinpointed some trivial differences.

Which bundle of services can surround prefabricated Modular Data Center provision?

Insights on Swedish Modules from the Scandinavian Market

Aiming at answering the research question, the research deeply analyses servitization, in order to understand why a company should undertake that strategy and identifies an ascertained framework which could encounter thesis' requirements.

For the sake of clarity, Lean Service Creation has been recognized as a suitable basis to undertake this path and to address the research question, because it guides the company along seven steps, from the modest assumptions made by the researcher to a full-fledged testing of the chosen business model. Nevertheless, the research doesn't go through all these phases, since it is not a research purpose to handle financial implications, prototyping and testing; whereas, it focuses on: Immersion, Insights, Ideation and Service Design. *Immersion* is comprised of best research guesses before having any interviews, *Insights* phase is a summary of the interviews' outcome, *Ideation* is matching together the previous two phases to start creating ideas and *Service Design* is the final presentation of the bundle of services.

6.2 Customers' Drawbacks

It goes without saying that looking for services that could surround the company's core product means also dwelling on which problems customers face when buying it, thus this research's outcomes are intended to raise the issue of which drawbacks may clients stumble upon.

The drawbacks that emerge from the study are revealed below and has been sorted out based upon different moments the customer passes through.

The purchase

- Lack of consultancy, that hinder the clients from having a deeper knowledge about which product could perfectly fit their needs
- Delivery, that has to be fast and efficient, considering that one of the strengths of prefabricated MDC is that they can be placed closed to the edge of customers' necessity.

- Dimension and design, because it emerges that the market is not standardized so far, hence customers' may be willing to have multiple choice about the structure.

The deployment

- Connection to cooling, heating, energy and full integration to company's business, given that not all the customers may be aware of how to ensure a full connection and integration.
- Maintenance and monitoring have been cited by almost all interviews, who are likely neither to be willing to deal with maintenance and monitoring singlehandedly nor to seek out trustworthy companies to rely on.
- Security has to be granted as well, bearing in mind that companies are increasingly putting in the Cloud sensible information and they feel threatened by the risk of losing them due to an accident or others' access.
- Many enterprises underlined the lack of a base of knowledge about how to properly run prefabricated MDC, which could lead to an inefficient exploitation of the product.
- An issue faced by clients is how to deal with some components when they stop working and to handle the substitution of these parts, that enhance the risk of rely on untrustworthy suppliers.

Obsolescence and end-usage

- Since they are based on continuously evolving technologies, these architectures are expected to become obsolete quite early. Because of that, customers are not willing to singlehandedly find some ways to take care of the elements (or the whole structure) when it is considered too obsolete to work competitively.
- The end-usage marks the moment in which the client has to tackle the issue of recycling, that may entail long times for the disposal of the external shell and the other elements.

6.3 Services

Once described the drawbacks that customers are expected to tackle during the purchase, the deployment, the obsolescence and end-usage, many corresponding services have been identified. With the purpose of giving a clearer depiction of the existing cause-effect relation, where the cause is meant to be the pinpointed drawbacks and the effect the provision of services, they have been sorted out with the same classification.

The purchase

- In order to match customers' request of being involved in design and dimension decisions, companies should provide different shapes, design and dimensions. The idea is not to perfectly tailor the architectures to clients' desire, but rather to provide a small number of different options, that could work as well.
- A fast and efficient delivery service should be ensured, considering that one of the main strengths of prefabricated MDC is their relatively trouble-free mobility.
- The lack of consultancy in the market could be fulfilled by providing consultancy services that can follow the customer along the decision path, assisting him toward the right decision.

The deployment

- To relieve customers from the burden of energy connection, the product should be provided with a full connection to energy, cooling and heating, as well as the integration of the structure to company's activities.
- With the aim of avoiding that the customer takes care of maintenance and monitoring singlehandedly, with the risk of relying on untrustworthy companies, providers should grant maintenance and monitoring services through in loco personnel.
- In order to ensure security inside prefabricated MDC, the company should provide both technological devices remotely guaranteeing sensible data protection and also the possibility for the customer to implement the use of special cages, that prevent others' access to information. This cages are already employed by some DC providers, and could

represent a significant tool for those companies which process huge amounts of sensible data every day.

- The lack of knowledge on how to properly run a prefabricated MDC could be overcome by training lessons, that aim at making the buyer totally aware of how all the potential of the product, such as to allow the full exploitation.
- To take advantage from the modularity of the product, providers should give the possibility of change just some elements, maybe through special agreements of buy-back of the elements that the customer is willing to replace. In this way, customers will rely on the provider also for buying single components, rather than seek for other companies.

The obsolescence and end-usage

- When the whole structure, but some elements as well, becomes obsolete or stop working, manufacturing companies could provide some special agreements, with the intention of relieve the customer from the burden of dealing singlehandedly with such situations.
- Many special agreements may also be provided to ensure the correct recycling of the facility.

6.4 “Core offering” services and “supplementary” services

One of the last questions asked to the interviewees was whether services could be classified as belonging to the core offering, or rather be considered as supplementary. The intention was to figure out which services are expected to shape the core offering as such, to be valued as competitive, and which others could conversely represent a mean of differentiation from the other actors in the market.

As shown in fig. 7, the services that have been pinpointed as “core offering” are: in loco personnel for maintenance and monitoring, consultancy services, provision of security devices, full connection and integration and fast delivery.

Contrariwise, services identified as “supplementary” are: provision of different shapes and design, special agreements for obsolescence and recycling, possibility of implementing security cages and other agreements for the substitution of some elements.

6.5 Suggestions for future research

The aim of this research was to find a bundle of services that could surround prefabricated Modular Data Centers as product, without going in-depth with financial implication and costs. It might be intriguing, in researcher's opinion, to further analyse and test the services this research came up with, from a financial standpoint as well, as it is envisaged by the adopted Lean Service Creation model. In other words, it would be deeply remarkable to execute more quantitative studies based on the empirical findings analysed in this study.

Unfortunately, going through all Lean Service Creation phases means utterly shaping the research on one and only company; indeed, there are so many decisions that should be made when providing services and the whole of them depends upon some factors such as the country, the customers, the supply chain, the financial assets, company's willingness to rely on other supplier and even its risk propensity. In doing that, the research will lose its replicable nature.

Therefore, it might be worthwhile to analyse the services from a more technical perspective, drawing interesting conclusions about, for instance, the expected obsolescence time of some components or the most efficient heating and cooling connection. It is researcher's opinion that such a study must be carried out when making servitization decision.

6.6 Limitations of the research

The current study is the result of requirements that had to be fulfilled coming from three different parts: Swedish Modules, LUISS University in Rome and the Goteborg Universitet in Gothenburg. In order to ensure that the whole of these stakeholders was aware of the expected outcome, it has been relevant to highlight the limitations of this research.

One of the limitation of the present research lies behind the number of interviewees that have been set up, which obviously affected the amount of data gathered. Lots of emails have been sent out to have the possibility of interviewing, but since most of these companies are huge and established, clearly not much answers went back. Nevertheless, it is a researcher's belief that having more interviews wouldn't have brought to considerably different results; at least, it cannot be said that the outcomes gained are wrong because the lack of more data, but of course having the possibility

of interviewing more companies could have revealed more customer's drawbacks and service needed.

The geographical scope represents another limitation and it depends on two different factors: first and foremost, researcher's time and resources constraints, that didn't ensure a generally applicable research, and secondly the presence of Swedish Modules into Scandinavian territory. Therefore, it has to be mentioned that not all the interviews were carried out with Swedish companies, but there are some others settled in North America, one in Hong Kong and one in Germany. Nevertheless, all the interviewees know Swedish Modules and were aware that the study was undertaken along with that company; additionally, all the interviewed enterprises are operating in advanced market in terms of telecom infrastructures and network, thus there is no reason to not consider their standpoints as valuable for research's aim.

Therefore, a significant limitation is the use of a predetermined theoretical framework. On the one hand using an established theoretical framework supports the researcher in properly analysing data, especially when the framework has already been used by other companies for similar purposes, as Lean Service Creation. On the other hand, it may be argued that using different theoretical backgrounds could have moved the research in other paths.

This research is intended to come up with significant information to support a company willing to provide a bundle of services that can surround prefabricated Modular Data Center provision, but the data gathered will not take account of financial implications, costs and prices of the proposed solutions. Hence, from an academic point of view the research will be limited to identify potential customers' drawbacks in buying prefabricated MDC and services that could relieve their issues.

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Appendix

The questions that have been asked to the interviewees are listed below. They are divided into two sessions: the first aims at understanding which customers may be interested in buying prefabricated MDC, the second is intended to figure out which drawbacks may be faced and which services could be required to relieve them.

1. Which main customers (B2B) a company selling prefabricated MDC could attract right now and in the future?
2. Which markets these customers belong to?
3. When dealing with prefabricated MDC, which drawbacks customers may face during the purchase, the deployment and end-usage?
4. Which services can be provided with the purpose of entirely or partially relieving these drawbacks?
5. Which of these services, in your opinion, should define the core offering of a provider?
6. Which services, on the other hand, should be considered as secondary, meaning as a mean of differentiation compared to other providers?
7. Do you have any further consideration to add about the treated topics?

SUMMARY

Literature review and research question

Today's world competitive environment is dominated by lots of new challenges. In this context, incumbents face a sharp competition either from low cost disruptors, usually emerged in developing countries, or disruptors belonging to other sectors that rely on new technologies and effective business models (Kotler, Keller, Acarani and Costabile, 2012). To overcome this challenge, some companies adapted their business models in order to gear towards the disruptors and provide technologically advanced and/or low costs products; others, conversely, decided to move away from that strategy, and strived for offering additional services that could enhance the value perceived by customers (Visnjic et al., 2017).

The research starts by analysing servitization, an increasingly widespread trend adopted by companies in order to provide a superior value perceived by customers (Visnjic et al., 2017). The servitization strategy embodies a business model and an organizational change, which is pursued through shifting from selling the mere product to the provision of an integrated bundle of product and services (Bustinza et al., 2015).

The latter have leant towards a servitization strategy, where servitization represents a business model and organizational change from selling the mere product to the provision of an integrated bundle of product and services (Bustinza et al., 2015). Through servitization the value proposition is enriched and tailored to the customers' desired outcomes, deviating from the traditional exchange between customer and firm towards a durable relationship based on a hybrid offerings (Green, Davies and Ng, 2017). Implementing servitization means a shift from providing the mere product to sell a Product-Service System (PSS), which is described as "an integrated product and service offering that delivers value in use" (Green, Davies and Ng, 2017).

First and foremost, the process of providing services associated to firm's traditional core product allows providers to generate new revenues stream (Vandermerwe and Rada, 1988), since they are providing both tangible and intangible solutions (Tukker and Tischner, 2006). Moreover, companies can benefit from an enhanced competitive advantage since their supply is not based on the single product anymore (Bustinza et al., 2015), and build unique customers' relationship

(Coreynen et al., 2017), considering that the combined offering better fit the customers' expectation and enhance their satisfaction (Beuren et al., 2013).

Despite this bunch of servitization drivers, it turns out to be really tough when it comes to the implementation part. Tukker and Tischner (2006) dwell on some external factors that ought to be evaluated when dealing with such a complicated path, i.e. the *socio-technical regime* (including rules and interests raised by institutions) and the *landscape* (the presence of supportive infrastructures, networks and activities). In addition, there could be the lack of a proper "acceptance by customers", who may not be willing to pay more even when additional services are ensured (Beuren et al., 2013), as well as an acceptance by the people inside the company, accustomed to a product-focused market engagement (Annarelli et al., 2016). Other challenges may arise when implementing servitization, such as the lack of an effective strategic planning or a suitable training and education program for employees and an appropriate support by the senior management (Kuo et al., 2010) or a considerable increasing of corporate costs (Tukker and Tischner, 2006).

Therefore, to make matters worse, companies committed in enriching their offerings through the provision of services may incur in heavy investments and high costs and experience a lack of initial results and a difficulty in achieving revenues within the expected time (Gebauer et al., 2004). This phenomenon, named "servitization paradox", doesn't have to scare providers off: it could represent a necessary stepping stone for the later possibility to gain greater financial benefits by adding services to the core product (Coreynen et al., 2017). Additionally, Gebauer et al. (2004) describe some actions that should be undertaken when striving for overcoming the issues arising from a possible initial stage of unfavourable results. Thoroughly define a market oriented and service development process, understand customers need, creating a trustworthy relationship, embrace the cultural change, find a balance between service-oriented and manufacturing values are just a minor part of the whole actions that could be pursued in that sense.

This research was carried out along with Swedish Modules, a Swedish company currently producing Data Centers and modules for very specific usages and interested in entering the market of prefabricated Modular Data Centers. These are special types of Data Centers that, due to their smaller dimensions, are more flexible, scalable, innovative and easy to move, embedding the perfect data storages to support new technologies such as 5G, IoT, Cloud Computing and Edge Computing. Swedish Modules aims at offering to customers a bundle of services that can surround

the core product described beforehand, thus this research is geared towards the investigation of services that customers may require when buying prefabricated Modular Data Centers.

Considering all these aspects, this research is intended to address the following research question:

***Which bundle of services can surround prefabricated Modular Data Center provision?
Insights on Swedish Modules from the Scandinavian Market***

Aiming at answering the research question, the research deeply analyses servitization, in order to understand why a company should undertake that strategy and identifies an ascertained framework which could encounter thesis' requirements.

As a framework to look at during this research, the choice fell to Lean Service Creation (LSC). Pasanen (2016) in his research conducted in Finnish telecommunication market indicates a seven phases division of LSC, from the modest assumptions made by the researcher to a full-fledged testing of the chosen business model: immersions, insights, ideation, business planning, service design, prototyping, agile development and analysis and storytelling. For the research purpose it is not necessary and required to go through all these phases, since some of them handle with the in-depth change of company's business model, costs, revenues streams and testing of the new strategy, which demand a far more technical analysis. Hence, the research focuses on: Immersion, Insights, Ideation and Service Design. *Immersion* is comprised of best research guesses before having any interviews, *Insights* phase is a summary of the interviews' outcome, *Ideation* is matching together the previous two phases to start creating ideas and *Service Design* is the final presentation of the bundle of services.

Research Methodology

Considering the research question set out in previous paragraphs, the researcher strongly deemed that the study has to be carried out through a qualitative analysis, rather than quantitative. Therefore, the approach adopted to achieve significant results is the inductive approach, which generates theory starting from the observations. Notwithstanding this, an in-depth and structured analysis of data is better to rely on some kind of theoretical background, implying some deductive elements, which eventually are not going to affect the overall result of the research.

The data collection has been conducted through multiple semi-structured interviews to different companies, which could represent either suitable candidate in purchasing Modular Data Centers from Swedish Modules or current providers of Data Centers or Modular Data Centers. In addition, on 5th of April, the researcher took part to a workshop in the headquarter of Swedish Modules (Emtunga, Goteborg), to a site visit at HCL's (Volvo IT) Datacenter on the 20th of February and at Swedish Modules factory in Emtunga, with the purpose of having a clear picture of Swedish Modules business and operations.

As previously mentioned, the choice leaned towards semi-structured interviews made up of two main sections. The first one is aimed at deepening the knowledge about customers' that are (and could be) interested in purchasing prefabricated MDC, hence the questions focused on interviewee opinions about which customers are there in the market so far, which one could be taken into account for the future and from which markets. The second section, more decisive for the definition of a servitization strategy, revolves around the services themselves, willing to stress the importance of providing bunches of services to relieve customers' drawbacks in purchasing prefabricated MDC.

The interviewed companies are seven: Schneider Electric, Vertiv, Stockholm Exergi, Rackspace, OCP, Eltek and Goteborg Energy. Due to time constraints, and to companies' choice as well, just one out of the seventh was conducted face to face, whereas the others have been carried out through supporting platforms.

Analysed Findings

The findings have been sorted out according to the four steps of Lean Service Creation, that the author planned to use: Immersion, Insights, Ideation and Service Design. For the sake of the summary, in this section they won't be thoroughly described; conversely the drawbacks and the services will be listed below, as the required way to answer the research question.

It goes without saying that looking for services that could surround the company's core product means also dwelling on which problems customers face when buying it, thus this research's outcomes are intended to raise the issue of which drawbacks may clients stumble upon.

The drawbacks that emerge from the study are revealed below and has been sorted out based upon different moments the customer passes through.

The purchase

- Lack of consultancy, that hinder the clients from having a deeper knowledge about which product could perfectly fit their needs
- Delivery, that has to be fast and efficient, considering that one of the strengths of prefabricated MDC is that they can be placed closed to the edge of customers' necessity.
- Dimension and design, because it emerges that the market is not standardized so far, hence customers' may be willing to have multiple choice about the structure.

The deployment

- Connection to cooling, heating, energy and full integration to company's business, given that not all the customers may be aware of how to ensure a full connection and integration.
- Maintenance and monitoring have been cited by almost all interviews, who are likely neither to be willing to deal with maintenance and monitoring singlehandedly nor to seek out trustworthy companies to rely on.
- Security has to be granted as well, bearing in mind that companies are increasingly putting in the Cloud sensible information and they feel threatened by the risk of loosing them due to an accident or others' access.
- Many enterprises underlined the lack of a base of knowledge about how to properly run prefabricated MDC, which could lead to an inefficient exploitation of the product.
- An issue faced by clients is how to deal with some components when they stop working and to handle the substitution of these parts, that enhance the risk of rely on untrustworthy suppliers.

Obsolescence and end-usage

- Since they are based on continuously evolving technologies, these architectures are expected to become obsolete quite early. Because of that, customers are not willing to singlehandedly find some ways to take care of the elements (or the whole structure) when it is considered too obsolete to work competitively.

- The end-usage marks the moment in which the client has to tackle the issue of recycling, that may entail long times for the disposal of the external shell and the other elements.

Once described the drawbacks that customers are expected to tackle during the purchase, the deployment, the obsolescence and end-usage, many corresponding services have been identified. With the purpose of giving a clearer depiction of the existing cause-effect relation, where the cause is meant to be the pinpointed drawbacks and the effect the provision of services, they have been sorted out with the same classification.

The purchase

- In order to match customers' request of being involved in design and dimension decisions, companies should provide different shapes, design and dimensions. The idea is not to perfectly tailor the architectures to clients' desire, but rather to provide a small number of different options, that could work as well.
- A fast and efficient delivery service should be ensured, considering that one of the main strengths of prefabricated MDC is their relatively trouble-free mobility.
- The lack of consultancy in the market could be fulfilled by providing consultancy services that can follow the customer along the decision path, assisting him toward the right decision.

The deployment

- To relieve customers from the burden of energy connection, the product should be provided with a full connection to energy, cooling and heating, as well as the integration of the structure to company's activities.
- With the aim of avoiding that the customer takes care of maintenance and monitoring singlehandedly, with the risk of relying on untrustworthy companies, providers should grant maintenance and monitoring services through in loco personnel.
- In order to ensure security inside prefabricated MDC, the company should provide both technological devices remotely guaranteeing sensible data protection and also the

possibility for the customer to implement the use of special cages, that prevent others' access to information. These cages are already employed by some DC providers, and could represent a significant tool for those companies which process huge amounts of sensible data every day.

- The lack of knowledge on how to properly run a prefabricated MDC could be overcome by training lessons, that aim at making the buyer totally aware of how all the potential of the product, such as to allow the full exploitation.
- To take advantage from the modularity of the product, providers should give the possibility of change just some elements, maybe through special agreements of buy-back of the elements that the customer is willing to replace. In this way, customers will rely on the provider also for buying single components, rather than seek for other companies.

The obsolescence and end-usage

- When the whole structure, but some elements as well, becomes obsolete or stop working, manufacturing companies could provide some special agreements, with the intention of relieve the customer from the burden of dealing singlehandedly with such situations.
- Many special agreements may also be provided to ensure the correct recycling of the facility.

One of the last questions asked to the interviewees was whether services could be classified as belonging to the core offering, or rather be considered as supplementary. The intention was to figure out which services are expected to shape the core offering as such, to be valued as competitive, and which others could conversely represent a mean of differentiation from the other actors in the market.

As shown in figure below, the services that have been pinpointed as “core offering” are: in loco personnel for maintenance and monitoring, consultancy services, provision of security devices, full connection and integration and fast delivery.

Contrariwise, services identified as “supplementary” are: provision of different shapes and design, special agreements for obsolescence and recycling, possibility of implementing security cages and other agreements for the substitution of some elements.

