Kaunas University of Technology

School of Economics and Business

Cloud Servitization Business Strategy

Master's Final Degree Project

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Declaration of Academic Integrity

I confirm that the final project of mine, Edita Gedgaudė, on the topic „Cloud Servitization Business Strategy“ is written completely by myself; all the provided data and research results are correct and have been obtained honestly. None of the parts of this thesis have been plagiarised from any printed, Internet-based or otherwise recorded sources. All direct and indirect quotations from external resources are indicated in the list of references. No monetary funds (unless required by Law) have been paid to anyone for any contribution to this project.

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Summary

The cloud computing technology intervention into the HVAC (Heating, Ventilation and Air Conditioning) industry BMS (Building Management System) sector and the cloud BMS software project's emerging appearance in the markets leads to a rather revolutionary and possible game changing business concept, integrating cloud computing into traditional BMS service business. Therefore, the cloud BMS software providers are facing challenges in creating successful business model innovations and business strategies due to the lack of knowledge about practical and theoretical recommendations of merging digital IoT and cloud computing with civil engineering HVAC business models into an innovative one. Moreover, there is a lack of cloud computing business-related and market-focused knowledge as 71% of business-related articles are concentrated on global scope (not market-focused). So, it is crucial to investigate the key factors influencing the BMS cloud servitization business model creation and supporting successful strategy implementation into the market.

The aim of this study is to ground the strategy of integrating the cloud computing concept into the HVAC BMS business model.

The study of scientific articles has highlighted the HVAC market specifics and trends as well as cloud computing specifics and challenges. The results of a qualitative, practice-oriented, in-depth case study of a Lithuanian cloud BMS software provider show that, due to the global BMS market accelerating drivers such as new constructions and need for retrofitting, environmental regulations, constant rise of annual temperature, economic growth, etc., the Lithuanian cloud BMS software provider has great opportunities to penetrate into the niche BMS market. The analysed company's strengths and weaknesses indicate the challenges of cloud computing industry: socio-economic, technological, legislative and economic, which are known for the cloud BMS software founders, therefore many development technological solutions solve legislative and economic issues. The socio-cultural challenges, such as non-readiness to adopt and fear, impact customers' willingness to acquire the cloud BMS software, but the market's break-even point is near as the small and medium visioners already search for affordable BMS alternatives that cannot be offered by large manufacturers. The know-how is the key strength in the BMS market.

Due to the fact that the research data analysis has proved the company's cloud BMS software's value to a customer, its rarity, the inimitability prevention and organizational issues, the company

has a sustainable competitive advantage, therefore, the business model innovation and strategic design are presented as the final product of this study.

The research confirms that there is a target customer who is not fully satisfied with BMS solution offers from current large BMS manufacturers, therefore, the small and medium BMS integrators acting in building retroffings can be a focus target customer. Due to the product complexity and the market's unreadiness to adopt, direct sales and sales via foreign agents are the best solution to overcome the customers' objections. In order to raise the customers' trust and to build relationship, the co-creations of the system amendments should be practiced and the Service Level Agreement (SLA) of mutual obligations should be signed. As the cloud BMS Software is released on the LEAN principle with a Minimum Viable Product, the constant R&D and regular updating is the key activities. Intangible resources, such as reputation, know-how and cloud BMS Software (BMS SaaS), are the company's strengths, as well as tangible one - networking of domestic customers. The company is going to avoid any partnership, except foreign sales agents. Although many processes are planned to be fully automated, the largest part of costs consists of the programmers' salaries, less of the agents' commissions. Revenues are streamed from installation payments and subscriptions. The company's differentiation will be reached by the best combination of various differentiators. Due to the lack of financial resources, the business development is planned in three stages: the domestic market penetration, the foreign country-by-country penetration with the support of agents and, in case investors are willing to invest, the aggressive marketing and sales would be proceeded. Even though the company is delivering technologically excellent products, the maximum prices are limited by global players that manufacture licensed BMS softwares, but this situation is acceptable as the cloud computing based business requires less resources utility. To sum up, the cloud computing adoption makes BMS business routines more similar to cloud computing ones than the traditional HVAC BMS sector.

And finally in this study, the strategic design is supplemented with guidelines of strategic objectives for three years.

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Santrauka

Debesų kompiuterijos intervencija į ŠVOK (šildymo, vėdinimo ir oro kondicionavimo) industrijos PVS (pastatų valdymo sistemų) sektorių, kai integruojamos debesų kompiuterijos technologijos į tradicines pastatų valdymo sistemas, ir debesų technologijomis paremto PVS programinio paketo pasirodymas rinkose lemia gana revoliucingą ir galimai žaidimo taisykles keičiantį verslo modelio atsiradimą. To pasekoje debesų technologijomis paremto PVS programinės įrangos paketo kūrėjai, kurdami verslo modelio inovacijas ir verslo strategijas, susiduria su iššūkiais, nes trūksta praktinių ir teorinių žinių, kaip sujungti daiktų interneto, debesų kompiuterijos ir civilinės inžinerijos ŠVOK verslo modelius. Be to, trūksta informacijos apie debesų kompiuteriją iš konkrečių verslo ir rinkos prizmių, nes net 71% verslo straipsnių ši tema analizuojama globaliu mastu. Taigi, labai svarbu ištirti pagrindinius veiksnius, darančius įtaką debesų technologijomis paremto PVS verslo modelio kūrimui ir palaikančius sėkmingą strategijos įgyvendinimą rinkoje.

Šio magistro darbo tikslas - pagrįsti debesų kompiuterijos koncepcijos integravimo į ŠVOK PVS verslo modelį strategiją.

Mokslinių straipsnių analizė atskleidė ŠVOK rinkos specifiką ir tendencijas, taip pat debesų kompiuterijos specifiką ir iššūkius. Kokybiškos, į praktiką orientuotos, nuodugnios Lietuvos PVS programinio paketo, pagrįsto debesų kompiuterijos technologijomis, teikėjo atvejo analizės rezultatai rodo, kad ši įmonė turi puikias galimybes įsiskverbti į nišinę PVS rinką, dėl rinkos augimą įtakojančių faktorių, tokių kaip augantis naujų statybų mastas, poreikis pastatus modernizuoti, griežtėjančios aplinkos apsaugos taisyklės, metinės temperatūros kilimas, ekonomikos augimas ir kt. Įmonės stipriosios ir silpnosios pusės rodo, kad debesų kompiuterijos industrijos socialiniai, technologiniai, teisiniai ir ekonominiai iššūkiai yra žinomi PVS programinės įrangos kūrėjams, todėl kuriant produkto technologinius sprendimus, buvo atsižvelgta į teisinių ir ekonominių problemų neutralizavimą. Socialiniai iššūkiai, tokie kaip žinių stoka ir baimė, turi įtakos klientų nenorui įsigyti debesų technologijomis paremtą PVS programinį paketą, tačiau rinkos lūžio taškas yra netoli, nes maži ir vidutiniai vizionieriai jau ieško įperkamų PVS alternatyvų, kurių negali pasiūlyti didieji PVS gamintojai. Reikšmingiausia PVS rinkos stiprybė yra “know-how”.

Šio projekto tyrimo duomenų analizės rezultatai atskleidė debesų technologijomis paremto PVS programinio paketo vertės reikšmingumą klientui, šio produkto rinkoje retumą, plagijavimo prevencijos ir organizacinių aspektų įgyvendinimą, todėl galima daryti išvadą, kad įmonė turi tvarų konkurencinį pranašumą. To pasekoje, kaip galutinis šio tyrimo rezultatas, yra pateikiami verslo modelio inovacijos ir strategijos dizainai.

Tyrimas patvirtina, kad egzistuoja tikslinis klientas, kuris nėra pilnai patenkintas dabartinių didžiųjų PVS gamintojų PVS sprendimų pasiūlymais - tai maži ir vidutiniai BMS integratoriai, dirbantys su pastatų renovacijomis. Siekiant įveikti klientų prieštaravimus, kurie kyla dėl produkto kompleksiškumo ir naujumo, tiesioginiai pardavimai arba pardavimai per agentus yra tinkamiausias sprendimas. Tam, kad padidinti klientų pasitikėjimą ir stiprinti ryšius, rekomenduojama sistemos patobulinimus kurti kartu su klientu, taip pat, pasirašyti abipusių įsipareigojimų sutartį (angl. Service Level Agreement). Kadangi programinis paketas rinkai bus pristatytas LEAN principu su mažai išvystytu produktu (ang. Minimal Viable Product), įmonės pagrindinė veikla bus orientuota į tyrimus ir produkto vystymą bei reguliarus programos atnaujinimus. Nematerialieji ištekliai, tokie kaip reputacija, “know-how” ir debesies technologijomis paremtas PVS programinis paketas bei materialinis išteklis - platus vietos klientų tinklas - yra įmonės stiprioji pusė. Organizacija yra apsisprendusi neturėti partnerių, išskyrus užsienio pardavimų agentus. Nepaisant, kad daugelis įmonės procesų bus visiškai automatizuoti, didžiąją išlaidų dalį sudarys programuotojų atlyginimai, kiek mažesnė išlaidų dalis atiteks agentams. Pajamos bus generuojamos iš programinės įrangos diegimo ir abonento mokesčių. Organizacijos išskirtinumas planuojamas per įmonės išskirtinių savybių ir priemonių rinkinį. Dėl finansinių išteklių trūkumo verslo plėtra planuojama trimis etapais: skverbimasis į vidaus rinką, skverbimasis į užsienio šalis, padedant agentams, ir, atsiradus investuotojams, būtų pradėta agresyvi rinkodara ir pardavimai. Nors įmonė yra orientuota į technologiškai išdirbtą ir kokybišką produktą, galutinę kainą riboja pasauliniai rinkos žaidėjai, gaminantys licencijuotas PVS programas. Tačiau ši situacija yra priimtina, nes debesų kompiuterijos technologijomis paremtam verslui reikia mažiau išteklių. Apibendrinant galima pasakyti, kad debesų kompiuterijos intervencija suteikia PVS verslui daugiau panašumų su debesų kompiuterijos nei su tradiciniu ŠVOK PVS sektoriaus verslu.

Šio darbo pabaigoje verslo strategijos dizainas yra papildytas trejų metų strateginių uždavinių gairėmis.

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BMS - Building Management System;

BMS SaaS - Building management system software-as-a-service;

HVAC - Heating, Ventilating and Air Conditioning;

IaaS - Infrastructure-as-a-Service;

IoT - Internet-of-Things;

PaaS - Platforms-as-a-Service;

SaaS - Software-as-a-Service;

SLA - Service level agreement.

Introduction

Essence. This study is an in-depth analysis of cloud servitization business. The study investigates the possibility of the Lithuanian *Building Management System (BMS) Company,* acting in HVAC industry, to create business model innovation by merging HVAC, IoT and cloud computing business models and to deliver strategic design. Due to the fact that HVAC BMS is not explored by scholars from a business perspective, and cloud computing from a business perspective is mainly explored on a global scope, the research project has been carried out. Analysis of theoretical scholarly literature provides business knowledge of cloud computing industry, analyses its trends and challenges. Due to the fact that the cloud computing intervention into the HVAC BMS field is revolutionary and there is a gap of market experience in adopting cloud computing, an in-depth empirical study is conducted in order to collect industry-related background information for business strategy creation. The HVAC and BMS market analysis is highlighting market trends and challenges with the focus on the European market. The *BMS Company* strengths, weaknesses, opportunities, threats are explored as well. The sustainability of competitive advantage is tested by VRIO analysis, while the Key Success Factors (KSF) are compared with competitor KSF. On the basis of the research findings, the business model and strategic design is created.

The relevance of the topic. The Lithuanian *Building management System (BMS) Company* has developed cloud-based BMS software - BMS Software-as-a-Service (SaaS) and is facing challenges in creating successful business model innovation and strategy.

HVAC industry is vastly investigated by scholars from the technical perspective, but scanty attention is presented from the business perspective. There is a gap of knowledge about HVAC industry business models in general, especially in the niche BMS field (Senyo, 2018, Addae, 2018, Boateng, 2018). Therefore, this gives rise to **the main research problem**: the lack of knowledge about practical and theoretical recommendations of merging digital IoT and cloud with civil engineering HVAC business models into an innovative one. So, it is crucial to investigate the key factors influencing the BMS cloud servitization business model creation and supporting successful strategy implementation into the market.

The subject is the digitalization (SaaS) strategy in the HVAC industry BMS sector.

The aim is to ground the strategy of integrating the cloud computing concept into the HVAC BMS business model.

The objectives are as follows:

1. to explore the essence of HVAC BMS industry and its key trends;
2. to reveal the main social, technical, legal and economic aspects of cloud computing servitization;
3. to substantiate research methodology for conducting empirical research (in order to reveal the readiness of a particular company to integrate that system into a business model);
4. to propose a novel business model and strategy for a *BMS company*.

The methods of research. In order to ground the BMS company business strategy, based on the BMS company business model innovation rooted by conventional HVAC BMS conjunction with the digital IoT and Cloud computing business models, a theoretical analysis of academic articles and conference papers has been performed. The HVAC and Cloud computing industry trends and challenges are investigated in the theoretical part of the study. The qualitative, practice oriented, in-depth, on-field empirical research has been performed in order to investigate the key factors influencing the customer's willingness or reluctance to adopt BMS SaaS. The research was carried out in three stages. Firstly, the statistical analysis of BMS and HVAC industry progress at the European level was conducted. Secondly, semi-structured in-depth interviews of cloud BMS founders and potential customers were taken in order to gain real-market knowledge about the current market situation and facing challenges. Thirdly, the focus group of BMS SaaS founders and external experts was organized in order to proceed "idea mining" for possible strategic solutions of BMS SaaS commercialization and penetration into the market. The interviewees and focus group participants were selected by generic purposive sampling. The collected data content analysis was performed by applying the deductive approach.

The structure. The Master thesis consists of five main chapters. Chapter One, "Problem analysis", highlights the main business model and strategy creation challenges that a BMS Company faces due to the revolutionary cloud computing technology integration into a conventional BMS. Chapter Two, "Theoretical part", briefly describes HVAC BMS current trends and challenges, as well as the specific characteristics and challenges of the cloud computing concept. Considering the fact that the BMS Companies Business model innovation is related to IoT, Cloud computing and HVAC business models, the comparison of the mentioned business models has been processed and the business logic of cloud integration into the BMS is described. Chapter Three, "Research methodology", raises the main research problem, briefly describes the applied design, methods, organizational processes and highlights limitations. Chapter Four presents the empirical research results: business model innovation and business strategy. Chapter Five concludes this thesis by providing recommendations for further research concerning the BMS SaaS business extension.

1. Problem Analysis

Penetration of digital technologies into various industries has become a catalyst for merging different industries, thus leading to novel product solutions and business models. The Lithuanian *Building Management System (BMS) company,* acting in HVAC industry tightly related to the niche BMS sector, is developing a cloud-based BMS sofware - BMS software-as-a-service (BMS SaaS). The BMS SaaS invention is rather revolutionary in HVAC industry as it has a possible game changing technical and business concept, integrating cloud computing into traditional BMS service business. Hereby, it allows the BMS sector to become autonomous from HVAC business.

The *BMS Company* project BMS SaaS is currently under the product development and testing stage, and on a short-term basis needs to be commercialized. Although the first cloud computing commercialization steps started a decade ago globally (Senyo, Addae, Boateng, 2018), there are still a lot of uncertainties of "how to handle digitization challenges" (Laudien, 2019, Pesch, 2019). The BMS SaaS founders are experienced automation engineers with a minimal business acumen. Hence, they face dual challenges: BMS SaaS technological development and issues related to BMS SaaS as autonomous digital business development. Despite these challenges, the BMS company needs to find a sound business way how to commercialize its development, revealing the challenges and opportunities of how to make such a concept a successful business model with an opening potential for internationalization. This is the aim of the Master thesis.

As this project's aim is to ground the business strategy of integrating cloud computing into the novel BMS business model, it will be investigated only in terms of business-acumen-related problems:

1. *The lack of business and market academic knowledge about HVAC industry's BMS sector in general*. There is a gap of knowledge about the current HVAC industry business specifics in general, especially in the niche BMS field. No academic paper has been found analyzing business issues of the niche BMS field, while technical experimentations and simulations are widely explored and described. The reason of non existing business knowledge about the BMS as an autonomous business is due to the fact that BMS has never been considered as a separate sector from the vast HVAC business. Even HVAC industry is poorly analyzed from the business perspective, either locally or globally. The real-market business experience investigation in HVAC BMS industry would compensate the academic knowledge gap. In order to build the novel BMS Company business strategy as an autonomous business, the HVAC BMS market, especially its readiness for the cloud BMS adoption, needs to be explored and evaluated.

2. *Not available comprehensive BMS business model innovation with integrated cloud solution examples*. Traditionally, the BMS sector is tightly related to the HVAC industry activities and has never been considered as a separate business. The BMS is always sold to contractors as an integral component of the whole HVAC system. Internet of Things and Cloud computing technologies have opened the gates to the niche BMS business autonomy from the vast HVAC.

Although there are many technical articles and patents describing cloud computing concept integration into the BMS field from the technological perspective, information about real-market cloud BMS projects and business models is not found. According to *Computlors* marketing manager Scott Holstein, "building automation industry is slow to adapt to new technology, wanting to see it proven in other fields before implementing it in large-scale commercial applications" (Smyers, 2017). Since currently there is "no comprehensive business model available" (Ali, 2017, Warren, 2017, Mathiassen, 2017) for inspiration, a *BMS Company* needs to build the novel business model innovation by integrating digital IoT and cloud computing technologies into BMS without the existing market experience pre-history. Therefore, an in-depth analysis of strengths and weaknesses of the BMS Company, target market and potential partners' identification, guidelines of future perspectives may be valuable.

3. *Lack of cloud computing business-related, market-focused investigations, the gap of cloud computing business knowledge from the provider's perspective*. Due to the fact that there is an intention to merge the engineering HVAC business model with the cloud computing one, the knowledge of the cloud computing business may be beneficial. Unfortunately, the practical experience about cloud computing is widely spread in different industries, yet not available in the BMS sector. Senyo (2018), Addae (2018) and Boateng (2018) have analyzed the academic literature stock concerning cloud computing of 7 years' period and found that 67% of literature is of engineering nature and only 32% is business-minded articles, mostly globally generalized and analyzed from the users' perspective. Based on the last 3 years academic articles about cloud computing, Senyo (2018), Addae (2018), Boateng (2018) have classified literature into four main categories (Figure 1):
   – cloud computing business issues;
   – conceptualization of cloud computing;
   – cloud computing domains and applications;
   – cloud computing technology issues.

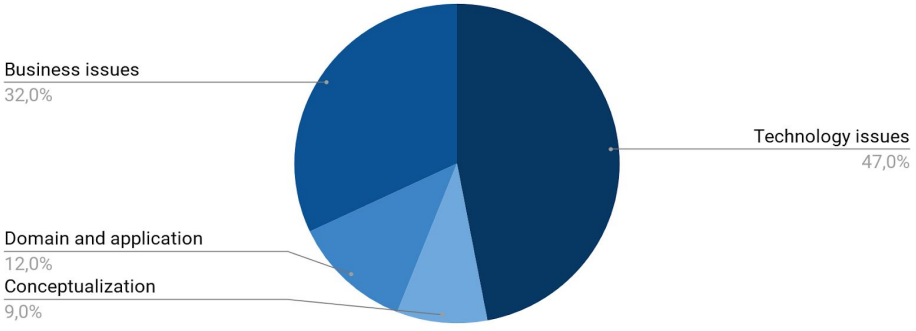

Figure 1. Distribution propositions of cloud computing literature themes (Senyo, Addae, Boateng, 2018)

From Figure 1 it is evident that 47 percent of scholarly articles are dedicated to technology-related fields of cloud computing industry, such as technical infrastructure, cloud system performance, data monitoring, control and analytics, security, technical resource and

security management, and SaaS development. 32 percent of cloud computing articles are dedicated to business issues, such as cloud computing market awareness, adoption issues, implementation, business performance, trust and relationship building, legal compliance and ethics issues, financials and value proposition. Business issues are considered from the users' perspective. The domain and application theme is mainly related to cloud computing utility by society, for example, e-government, e-health, e-education, mobile applications, social media, and similar issues. Conceptualization consists of two fundamental and trend investigations (Senyo, 2018, Addae, 2018, Boateng, 2018).

According to Senyo (2018), Addae (2018), Boateng (2018) cloud computing-related literature review, cloud computing is mainly discussed on a very generalized global scope (71,2%) and not many articles are market-specified (Figure 2).

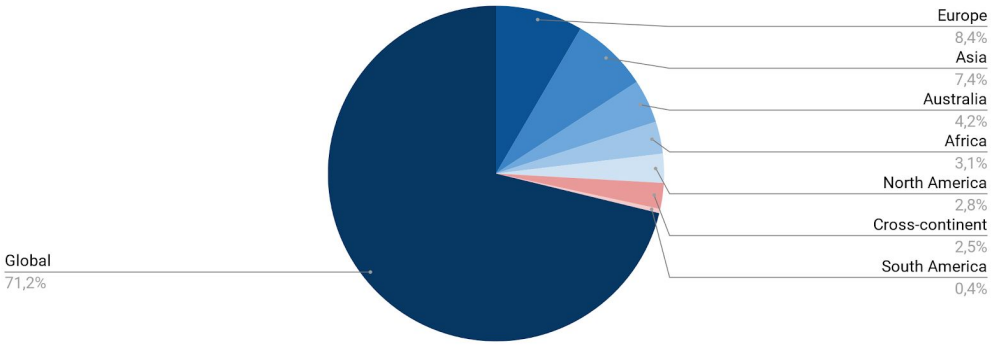

Figure 2. Geographical focus of cloud computing research (Senyo, Addae, Boateng, 2018)

Since the *BMS Company* is going to reveal its BMS SaaS in the Lithuanian market at the initial stage, with prospects for internationalization, it is strategically important to reveal the main social, technical, legal and economic aspects of cloud computing servitization and to collect knowledge about the target market readiness for the cloud BMS adoption not only from the customer's, but also the provider's perspective.

4. *Purification of the customer value proposition.* The clarification of the customer value proposition is at the core of the business model and is tightly related to the key success factors stimulating the customers' purchase decisions. The ways of how this value is created, delivered and captured are equally important. No less significant is evaluating the strengths and weaknesses of the *BMS Company* and revealing the challenges and opportunities of the market. The acquired clearance may benefit in business model innovation by clarifying nine business model elements, most suited to win the BMS target customer. om the customer's, but also the provider's perspective.

5. And finally, *the strategic choice challenges.* In addition to customer winning aspiration, the BMS company core focus is on "how company will win against competitors" (Braun, 2019, Latham, 2019, Cannatelli, 2019). Hambrick (2001) and Fredrickson (2001) in their article "Are you sure you have a strategy?" have identified five core strategy elements that business development needs to focus on:

– Arenas or scope where the BMS company is going to act;
– Vehicles or entry modes describing how the company will get these arenas;
– Differentiators or competitive advantage identifying how the company will differentiate itself from competitors;
– Staging that settles the sequence of the company expansion steps and the speed of this expansion;
– Economic logic that explains how the company will obtain the return.

Therefore, the analysis of research findings should lead to the clearance of strategic choices, such as the target customer portfolio, geographic scope, the best option of the entry mode. Furthermore, there is an open question of how the company will differentiate itself, how the company is going to build its brand recognition, will it produce customized or standardized products, will it play on low or premium pricing model. In case the most popular option of cloud computing freemium model would be selected, the research task is to deliver a solution of "how users of the free version of a service can be converted into paying premium users" (Trenz, 2019, Huntgeburth, 2019, Veit, 2019). It is critically important that all the mentioned above should be evaluated through the provider's and the potential customer's eyes.
The empirical research findings would benefit in deciding about the *BMS Company* expansion speed and sequence options:
– Does the *BMS Company* intend to gain its brand recognition and a strong background in a limited market first, and then to expand aggressively on a wider scope (Variant A in Figure 3);
– Does the *BMS Company* plan to spread its activities on a wider scope at the initial stage in order to collect a larger number of customers and to invest its resources into the brand recognition strength, which would lead to sustainable growth afterwards, as it is presented in variant B of Figure 3;
– Should the BMS company expand by focusing on a different option, not described in this chapter.

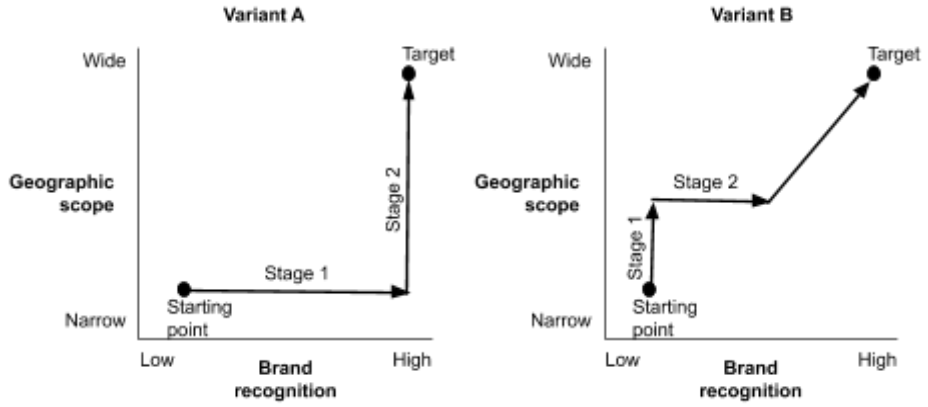

Figure 3. Presumption of BMS SaaS expansion stages (Hambrick, 2001, Fredrickson, 2001)

To sum up the problem analysis chapter, due to the lack of business and market knowledge about HVAC industry's BMS sector in general, the task of this Master thesis, accordingly, is to analyze

the marketplace trends and challenges. Due to the gap of available comprehensive BMS business models, the lack of cloud computing business-related investigations and due to the gap of cloud computing business knowledge from the provider's perspective, the research of cloud computing challenges, identification of strengths and weaknesses, recognition of challenges and the discovery of opportunities of merging engineering HVAC BMS business model with the IT IoT and cloud computing business models may benefit in winning a customer. In addition, identification of the key success factors characterizing HVAC BMS industry and clearance of strategic direction options are important for making strategic choices.

Cloud computing and IoT technologies has already brought BMS industry to a break-even point. Therefore, the BMS SaaS revolutionary development may write a new history of the niche BMS sector as independent from HVAC digital business. Hence, this motivates to bring a well worked out business model and supportive business strategy with a clear direction guidance that are crucial for the startup *BMS Company*.

2. HVAC BMS industry: specifics, challenges and best practices

This chapter presents a review of scholarly articles, conference papers and other scientific literature needed to build the background of theoretical knowledge that is already explored from business management perspective about HVAC industry's BMS sector and Cloud computing industry in order to investigate the key drivers for business strategy creation.

2.1. Trends, challenges and specifics of HVAC BMS industry

The task of this chapter is to provide general knowledge and current insights about Heating, Ventilation and Air Conditioning industry's Building Management System sector's business trends and challenges.

2.1.1. HVAC BMS industry specifics

Heating, Ventilating and Air conditioning (HVAC) plays a significant role in Civil Engineering industry. HVAC is an umbrella for all integrated engineering facilities and softwares that are used to provide heating, ventilation and cooling of buildings. HVAC industry covers two segment categories: residential HVAC, whose target market is mostly dwellings, and Commercial HVAC, responsible for commercial buildings. (Globenewswire, 2019)

HVAC systems' performances are automatically monitored and controlled by integrated Building Management Systems (BMS), often called Building Automation Control Systems (BACS) or commercially "smart" building systems. Further in this thesis, the Building Management Systems (BMS) term is used.

BMS is an extremely niche sector, usually strongly dependent on and developed by the same HVAC system manufactures and installed by HVAC system integrators. BMS is a network of hardware and licensed software connected to the building's HVAC system devices (*KMC Controls*, 2020), whose main function is to monitor and control the performance of HVAC facilities connected to it. In practice, HVAC and BMS projects are one-time projects.

The HVAC sector is divided into 2 segments - HVAC Equipment and Aftermarket & Service (Globenewswire, 2019). HVAC Equipment activities relate to developing, manufacturing, selling and installing HVAC systems, including BMS part of the licensed software development and licensing. Aftermarket & Service segment is related to HVAC system maintenance and reparation activities, where the BMS plays the main part of the first violin by monitoring HVAC systems performance and delivers information of the system malfunctioning.

Typically, the system's functioning is monitored and controlled on the premises by building administrators. Less usual practice is when the third party maintenance service companies have direct connection to BMSs. The scheme of typical Aftermarket & Service activities is presented in Figure 4.

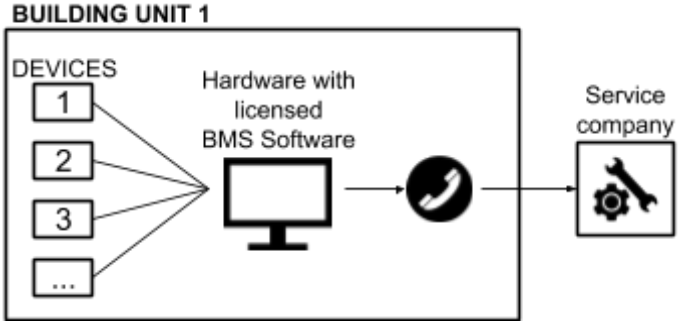

Figure 4. Typical buildings HVAC system monitoring, control and maintenance service activities

The licensed BMS software is the main tool, despite the human factor, of the third party service companies for delivering service excellence of HVAC system maintenance for their customers. However, the reality is different, as many of building owners or administrators do not have accurate knowledge of the building's service life, deterioration and prevention. Around 70% of companies managing real estate do not have or have poorly developed proactive maintenance policies (Silva, 2019, Brito, 2019). It often happens that administrators are not fully competent to notice slight malfunctioning or are not able to explain issues properly, so the third party service companies face time-consuming actions of additional travels to objects in order to collect all the necessary information about HVAC system malfunctioning. Thus, poorly developed proactive maintenance policies lead to reactive maintenance activities when urgent and more costly repair is inevitable (Silva, 2019, Brito, 2019).

Although HVAC facilities are installed in almost all buildings, automation BMSs are mostly integrated only in commercial objects. BMSs are also being installed in new commercial and residential constructions, or replace obsolete control systems during the building renovation.. (*KMC Controls, 2020).* Traditionally, the ownership of BMS together with all HVAC facilities is transferred to contractors or end users just after the integration, which makes BMS integration projects a one-time deal.

2.1.2. HVAC BMS industry trends and challenges

HVAC industry is a promising industry due to the **technological and socioeconomic trends**. "Zero carbon", "nearly zero energy" (Zhao, 2016, Pan, 2016, Lu, 2016, *United Nations Environment Programme*, 2018) building trends and worldwide governmental promotions have a significant impact not only on the usage of construction materials, but also on HVAC openness to new technologies like **Internet of Things (IoT)** and **Cloud Computing concept** developments.

There are many engineering studies that stress the importance of **eliminating the gap between HVAC system modelling and its operational practice** due to building administrators' or end users' behaviour (Ovallos-Gazabon, 2017, Gomez-Charris, 2017, Pacheco-Torres, 2017, Celin, 2017). According to the *United Nations report* (2018), energy usage in buildings (mainly for HVAC maintenance) accounts for around 40% of the total global energy consumption (Ovallos-Gazabon, 2017, Gomez-Charris, 2017, Pacheco-Torres, 2017, Celin, 2017, Lazarova-Molnar, 2019, Mohamed, 2019), that results in "one third of global greenhouse effect of gas emission" (Ovallos-Gazabon, 2017, Gomez-Charris, 2017, Pacheco-Torres, 2017, Celin, 2017).

Hence, not only responsibly chosen construction materials, but also the proper operational practice in energy consumption for HVAC maintenance could minimize building footprints (Ovallos-Gazabon, 2017, Gomez-Charris, 2017, Pacheco-Torres, 2017, Celin, 2017, Lazarova-Molnar, 2019, Mohamed, 2019).

The modern non-residential buildings are equipped with state-of-the-art BMS equipment, which monitors, collects, analyzes and stores all the necessary data. Residential houses and older commercial buildings retrofitting activities are slow.

Despite the slow retrofitting processes, the **building automation market is emerging** rapidly due to the new opportunities to merge HVAC engineering together with digital information technologies (IT). For example, with the **appearance of IoT** technologies integrated in HVAC devices, sensors and meters (Lazarova-Molnar, 2019, Mohamed, 2019), the number of HVAC service enterprises, which "are looking to hop on the automation band wagon in pursuit of business excellence" (Gupta, 2017, Bumezai, 2017), has started to rise. The IoT in HVAC is "a system of interrelated computing devices [...] that are provided with a unique identifiers and equipped with the ability to transfer data via network automatically" (Gupta, 2017, Bumezai, 2017). The main challenge of HVAC state-of-the-art devices with integrated IoT is **heterogeneity of standards** used by manufacturers, thus it is complicated just simply to make devices "plug and play" (Veenstra, 2016, Kaashoek, 2016) without additional input for synchronizing their work.

The appearance of **cloud computing technologies** lifted the BMS sector to another dimension, leading to novel digital business models of servitization. IoT has gained the merger of HVAC and cloud computing role. The HVAC BMS industry faces **new opportunities for digital servitization** - "a new model by which hardware and software can be turned into service" (Ojala, 2016) by sharing it in scale without the need for licensing expenditures.

Since numerous scholarly engineering articles describe the concepts of cloud computing integration into BMS, and the **amount of registered patents is rising,** companies working with the BMS and service companies providing HVAC maintenance need to review their business models. The merge of physical and digital worlds presents novel exciting business model opportunities (Garyaev, 2019, Garyaeva, 2019).

Laudien and Pesch (2019) have conducted a 3-year long (2014 -2017) empirical qualitative research in order to understand the digitalization impact on service enterprise business models, and have identified **four business model archetypes of digital service enterprises (**Laudien,2019, Pesch, 2019):

1. *Digital beginner service enterprise* business model's main purpose is efficiency;
2. *Customization-focused service enterprise* digital business model's aim is to match customer needs;
3. *Distance-bridging service enterprise* digital business model's purpose is an extension of the geographic scope;

4. *Full scale digital service firm* business model's main aim is flexibility and ability to respond to market needs.

The first two archetypes were more common in 2014; later on, closer to 2017 and later, the third and the fourth archetype dominate **(**Laudien, 2019, Pesch, 2019). There is no study that would suggest which business model archetype would be most suitable for BMS Software servitization.

One of the business model concepts of cloud computing technology integration, created by the Lithuanian *BMS company*, presented in Figure 5, is a combination of the third and forth digital business model archetypes.

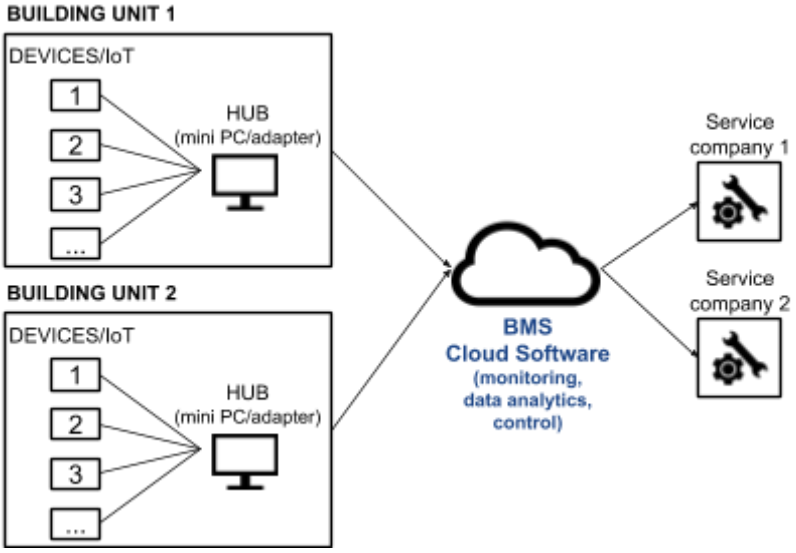

Figure 5. Scheme of cloud computing integration in BMS and HVAC servitization business

This servitization scheme, compared with the typical BMS and HVAC system maintenance in Picture 4, differs so that the BMS software, including hardware and servers, are not needed to be purchased and stored on the premises, as there is a possibility to use BMS software from the cloud. The standard PC is replaced by a less expensive mini PC, which has a HUB's role (collects all the data from IoT and transmits it to the cloud BMS for further data analysis). The cloud computing provides a possibility to scale the same BMS software for a lot of buildings and give an access to various HVAC maintenance companies. So, this scheme offers benefits for three stakeholders: 1) for the building owners that may acquire a less expensive BMS option; 2) HVAC maintenance service companies, which may have a tool to detect failures or predict HVAC component failures, or avoid reactive maintenance issues, and to work more cost-effectively due to the minimized need to travel to objects, and thus raise planned activities (Silva, 2019, Brito, 2019, Lazarova-Molnar, 2019, Mohamed, 2019); 3) The BMS Software provider, who may transform typically a one-time BMS integration deal to a long-term relationship by sharing BMS software on the time-base.

A lot of cloud BMS servitization concepts have been offered in scholarly articles, but all of them raise the issue of the existing standard heterogeneity, which leads to the necessity of "clustering buildings and BMS systems" (Lazarova-Molnar, 2019, Mohamed, 2019) according to the building physical and functional similarity, e.g., school cluster, hospital cluster, etc., otherwise these

concepts are applicable only for totally new constructions (Lazarova-Molnar, 2019, Mohamed, 2019).

Although the IoT and cloud computing idea was conceptualized a decade ago, only now this idea concept has accelerated its transformation into the physical material by its integration into various businesses (Smyers, 2017, Shankar, 2018, Duraisamy, 2018), including HVAC industry (Garyaev, 2019, Garyaeva, 2019). As long as "the dominant standards" (Krotov, 2017) are not established, cloud computing business is considered to be in the embryonic stage and faces a tremendous number of challenges that are discussed in the following chapters.

2.2. Cloud computing industry specifics and challenges

This chapter is dedicated to the review of Cloud Computing industry specifics and current challenges from a business management perspective.

2.2.1. Cloud computing concept

Cloud computing is the IT industry's most promising and the fastest growing business concept (Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016), its adoption in various business fields becoming increasingly important.

Cloud computing can be considered as "a new paradigm of servitization" (Ojala, 2016). *National Institute for Standards and Technology* (2011) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell, 2011, Grance, 2011). Shortly, "cloud computing is a technology that provides services through the Internet to share resources such as networks, servers, storage, applications, and services" (Ali, 2017, Warren, 2017, Mathiassen, 2017).

According to Mell (2011) and Grance (2011), the cloud computing servitization concept has five key characteristics (Mell, 2011, Grance, 2011):

1. *On-demand self-service.* The user can settle the needed computing capabilities automatically, without any human interaction (to register the user account, to reserve the network storage space, to set the timing on-demand basis).
2. *Broad network access.* Via network available computing capabilities that can be accessed through various platforms such as personal computers, smart phones, specialized work stations.
3. *Resource pooling*. The ability to share the same resource for different customers or users, called tenants, according to their demand.
4. *Instant elasticity*. The resource supply capabilities can be scaled in and out at any time. Theoretically scalability capabilities are infinitive.

5. *Measured service*. Cloud system resource usage can be automatically monitored, controlled and optimized by providing transparency of delivered services to both stakeholder sides: service tenant and provider.

Cloud computing reduces entry barriers and enables various size organizations to enter target markets, even those which are strictly regulated or require vast investments (Heaton, 2019, Hafeez-Baig, 2019, Gururajan, 2019). With respect to the fact that cloud computing is becoming one of the key technological drivers and the main reason of enterprises' digitalization (Hentschel, 2018, Leyh, 2018, Petznick, 2018), the advantages and disadvantages of cloud computing delivery and deployment models are reviewed in the next chapter.

2.2.2. Cloud computing delivery and deployment models

The cloud means the complexity transfer from the client's IT on-premise infrastructure to the cloud provider's infrastructure (Nieuwenhuis, 2018, Ehrenhard 2018, Prause, 2018).

Cloud computing has **three delivery models**:

- Infrastructure-as-a-Service (IaaS);
- Platform-as-a-Service (PaaS);
- Software-as-a-Service (SaaS).

SaaS is the most dominant cloud computing delivery model, covering around 60% of the total cloud computing services, Paas and IaaS share around 20% each (Shimba, 2010, Hentschel, 2018, Leyh, 2018, Petznick, 2018).

Infrastructure-as-a-Service (IaaS)

Infrastructure-as-a-Service is a mechanism which provides the customer with virtualized critical computing resources, such as servers, operating system, computing power, storage space, network transmit capabilities, through the Internet (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018).

The benefit of this service is that the customer can adjust the storage space or other selected components according to the demand (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017), that allows it to be functional and financially flexible (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017). IaaS resources are shared with the contracted customers on pay-per-use pricing models, thus minimizing the customer's initial investment which would occur in case of purchasing own hardware (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

The disadvantage of IaaS is that only the basic security, such as the firewall of the perimeter, is provided by the vendor, while customers do not have control of the underlying infrastructure (Mell, 2011, Grance, 2011, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017). Due to this fact,

the customer needs to select the IaaS provider carefully, as IaaS is a kind of a "metal" skeleton, on which other cloud computing delivery model layers are built.

Platform-as-a-Service (PaaS)

Platform-as-a-Service is the second layer of cloud computing delivery model, where the vendor provides a platform and supports tools for application developers (Shimba, 2010, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017, Senyo, Addae, Boateng, 2018). According to Nedeltcheva (2017) and Shoikova, (2017), the most popular currently existing platforms are: Google, Amazon, Microsoft Azure, IBM Watson. By using the vendor's rented programming language (interface), developers create their own applications or software and deploy them as their own cloud services. Deployment of acquired applications or software on a cloud infrastructure is possible as well (Mell, 2011, Grance, 2011).

The benefit of PaaS is that it provides an environment for application and software creation and deployment, it allows developers to focus on the product features and monetizing options eliminating configuration challenges (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017). The other strong benefit of PaaS is that the provider offers "complete software or application development life cycle management" (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

The disadvantage of PaaS is that the user is able to control only application or software deployment, but not the cloud infrastructure, such as servers, operating systems or storage (Shimba, 2010, Senyo, Addae, Boateng, 2018). Due to the technical specifications, PaaS works as IaaS, just with the provided additional functionalities, such as programming language interface. This can cause a vendor lock-in fact (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

Despite the disadvantages, PaaS is an attractive environment for the application or software developers to work with programming languages supported by a PaaS provider (Senyo, Addae, Boateng, 2018), without worrying about the programming configurations and concentrating of product features. The most important aspect is that no high initial investment is needed for PaaS.

Software-as-a-Service (SaaS)

Software-as-a-Service is the highest layer of the delivery model (front-end) which contains applications and softwares remotely accessible and utilized by the end user as Internet-based services (Ali, 2017, Warren, 2017, Mathiassen, 2017). The most common is the renting option: pay-as-you-go subscription (Ojala, 2016, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

The cloud software benefits for customers are the possibility to rent it on-demand without the need for software licensing expenditures, the possibility to access it from various client's devices through the web browser or special program interfaces, the high scalability possibilities that impact lower costs (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018). The customer does not need to acquire his own physical IT infrastructure, there is no need to manage and maintain the software or application as it is the provider's responsibility to

guarantee lifetime software control, functioning and updates (Shimba, 2010, Ojala, 2016, Bokhari, 2016, Shallal 2016, Tamandani, 2016). The installation and utility of software or application do not require special IT competencies (Davids, 2017, Van Belle, 2017). The provider faces lower software maintaining costs as SaaS is "designed to support many concurrent users at once" (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

The user cannot control the main infrastructure or program functionalities related to IaaS and PaaS delivery model levels, but is able to set a concrete software or application configuration according to its customized needs. Saas is a novel tool presenting opportunities to compete in the agile market, this model allows providers to create new revenue models and to offer attractive pricing models to customers (Ojala, 2016).

Besides cloud service delivery models, service deployment is described by **four deployment models**:

- The Public Cloud;
- The Private Cloud;
- The Community Cloud;
- The Hybrid Cloud.

The Public Cloud

The Public cloud means that the cloud infrastructure is available for both individuals and enterprises in a public mode, it can be owned by business, governmental, academic organizations or their combinations (Mell, 2011, Grance, 2011, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017). It is frequently used for self service purposes over the Internet or via special applications, and is more standardized (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

The ownership of the resources and responsibility belong to the cloud provider (Ali, 2016, Ammar, 2016). This deployment model can be used for low risk workloads (Davids 2017, Van Belle, 2017) as it is open to public and complicated to guarantee trusted security (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017).

The Private Cloud

The Private cloud deployment model is utilized by a single organization, which has different departments, and can be located on-premise or off-premise (Mell, 2011, Grance, 2011, Soni, 2017, Hasan, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018). Due to the fact that the general public do not have an access to it, this deployment model is trusted and can be used for the leakage-sensual information processing.

The resource ownership and all the related responsibilities can be those of the organization, the third party, or a combination of both. It is trusted and can be used for sensitive data as the full control of data management, security policy and system maintenance is taken (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018).

Community Cloud

Community cloud is used by organizations or communities that are related by common interests and needs, such as security, mission, data sharing, etc. The infrastructure can be located on-premise or off-premise and can be managed by one of the community organizations or by the third party (Ali, 2016, Ammar, 2016, Soni, 2017, Hasan, 2017).

Hybrid Cloud

Hybrid Cloud combines two or more deployment models (public, private, community) that retain their autonomy, but are bounded by standardized or customized technologies (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Soni, 2017, Hasan, 2017). In this model, the general public cannot access an organization's private cloud in order to ensure trustful security.

Figure 6 presents the cloud services delivery and deployment model's availability for service combination and distribution to customers.

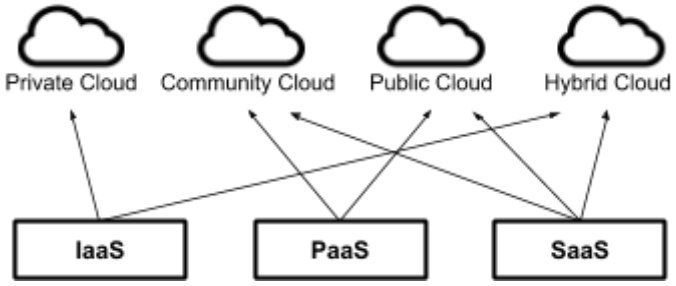

Figure 6. Cloud service delivery and deployment models (Soni, 2017, Hasan, 2017)

Due to the hybrid, public or community cloud deployment models, the cloud computing services benefit in lowering costs of development, maintaining and utilization. This reduces barriers for entering the markets and innovative business models for various sized enterprises (Heaton, 2019, Hafeez-Baig, 2019, Gururajan, 2019). With the appearance of the cloud service providers, **new roles have emerged** (Hentschel, 2018, Leyh, 2018, Petznick, 2018):

- *Cloud consultants,* having in-depth knowledge about cloud service offerings related to industry specifics;
- *Aggregators,* often called value-added retailers, who transform the existing services into value-added services adapted to certain customer needs;
- *Integrators*, whose main role is to support users by transferring the existing on-premise data to the cloud.

The emerging cloud servitization trend intensifies. This is the reason why "customers probably cannot avoid using one or more cloud solutions in the medium to long term" (Hentschel, 2018, Leyh, 2018, Petznick, 2018), despite the current challenges regarding cloud computing the market faces. These challenges are reviewed in the next chapter.

2.2.3. Cloud computing challenges

Despite the digitalization boom and cloud computing benefits, the customer's readiness to adopt cloud computing services is tightly related to many issues that still need to be solved. The conceptualized summary of the challenges related to cloud computing services adoption discussed in scholarly literature are listed in Table 1.

Table 1. Challenges Influencing Cloud Computing adoption

Category	Challenges	Discussing authors
Socio-cultural	Awareness of cloud computing	Carcary, 2014, Doherty, 2014, Conway, 2014, McLaughlin, 2014, Ojala, 2016, Ali, 2017, Warren, 2017, Mathiassen, 2017, Assael, 2017, Le, 2017, Chang, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Laudien, 2019, Pesch, 2019
	Fear	Shimba, 2010, Ojala, 2016, Garg, 2017, Varshney, 2017, Rajpoot, 2017, Jyotsna, 2017, Brown, 2020
	Trust	Shimba, 2010, Ojala, 2016, Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Garg, 2017, Varshney, 2017, Rajpoot, 2017, Jyotsna, 2017, Davids, 2017, Van Belle, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Medvedev, 2018, West, 2018, Chu, 2018, Crooks, 2018, Bradley-Ho 2018
	User confidence	Senyo,2018, Addae, 2018, Boateng, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018
	Transparency, Audits	Davids, 2017, Van Belle, 2017, Shimba, 2010, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018
	Innovation culture of enterprise	Davids, 2017, Van Belle, 2017, Brown, 2020
Technological	Security	Shimba, 2010, Ojala, 2016, Ojala, 2016, Opara-Martins, 2016, Sahandi, 2016., Tian, 2016, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Davids, 2017, Van Belle, 2017, Ali, 2017, Warren, 2017, Mathiassen, 2017, Garg, 2017, Varshney, 2017, Rajpoot, 2017, Jyotsna, 2017, Gupta, 2017, Bumezai, 2017, Soni, 2017, Hasan, 2017, Nedeltcheva, 2017, Shoikova, 2017, West, 2018, Chu, 2018, Crooks, 2018, Bradley-Ho 2018, Senyo, 2018, Addae, 2018, Boateng, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Lee, 2019, Brown, 2020
	Vendor Lock-in	Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016., Tian, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Ali, 2017, Warren, 2017, Mathiassen, 2017, Soni, 2017, Hasan, 2017
	Standards heterogeneity	Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016., Tian, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Nedeltcheva, 2017, Shoikova, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018

	Portability	Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Gupta, 2017, Bumezai, 2017
	Interoperability	Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Gupta, 2017, Bumezai, 2017, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Lee, 2019
Legislative	Location of data center	Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016, Davids, 2017, Van Belle, 2017, Gupta, 2017, Bumezai, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Senyo, 2018, Addae, 2018, Boateng, 2018
	Legal compliance to regulations	Opara-Martins, 2016, Sahandi, 2016, Tian, 2016 Veenstra, 2016, Kaashoek, 2016, Davids, 2017, Van Belle, 2017, Garg, 2017, Varshney, 2017, Rajpoot, 2017, Jyotsna, 2017, Senyo,2018, Addae,2018, Boateng, 2018, Lee, 2019, Brown, 2020
	Service level agreement	Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Davids, 2017, Van Belle, 2017, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Senyo, 2018, Addae, 2018, Boateng, 2018
	Data Protection	Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Alshammari,2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Senyo, 2018, Addae, 2018, Boateng, 2018
Economic	Resource management	Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017, Singh, 2018, Senyo, 2018, Addae, 2018, Boateng, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Mashonova, 2019, Jimenez-Bescos, 2019, Brown, 2020
	Pricing models and sales	Macías, 2011, Guitart, 2011, Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Ojala, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Ali, 2016, Ammar, 2016, Davids, 2017, Van Belle, 2017, Nedeltcheva, 2017, Shoikova, 2017, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017, Soni, 2017, Hasan, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018,West, 2018, Chu, 2018, Crooks, 2018, Bradley-Ho 2018, Lai, 2018, Jackson, 2018, Jiang, 2018, Priem, 2018, Wenzel, 2018, Koch, 2018
	Switching costs	Ojala, 2016, Medvedev, 2018, Hentschel, 2018, Leyh, 2018, Petznick, 2018, Silva, 2019, Brito, 2019

The categories of socio-cultural, technical, legislative, and economic challenges are tightly intertwined. There is a critical need to identify solutions to overcome these challenges in order to raise the level of customer willingness to adopt cloud services in various industries. A more detailed description of how these challenges can be overcome is described in the following chapters.

2.2.3.1. Socio-cultural challenges

Although the cloud computing term has been heard by many, the familiarity and awareness of the cloud concept is low. Cloud-based services need more time for gaining visibility, awareness and recognition from the market. Many companies are sceptic about purchasing and utilizing cloud services because of many uncertainties, such as tenuity of practical cloud servitization examples on the market (Ali, 2017, Warren, 2017, Mathiassen, 2017, Hentschel, 2018, Leyh, 2018, Petznick, 2018). There is no common opinion regarding the key drivers motivating cloud adoption. According to Garg, (2017), Varshney, (2017), Rajpoot (2017) and Jyotsna (2017), cloud software "adoption is more related to subjective risks than technical ones", while Munkácsi, (2018) and Simon (2018) state that customers are "mainly driven by financial and functional factors", including investment costs. Hentschel (2018), Leyh (2018) and Petznick (2018) contradict that "financial aspect is not the critical reason" and state that the main drivers are auditability, ease of use, functionality and flexibility, security and privacy, competitive pressure, transparency, trustworthiness, top management support. The scholarly literature highlights six key socio-cultural aspects influencing the customer willingness for cloud computing adoption: awareness about cloud computing, fears of it, the customer's confidence and trust, transparency, innovation culture of the enterprise.

Awareness of cloud services

The process of cloud service adoption starts with the customer's awareness of cloud servitization opportunities (Hentschel, 2018, Leyh, 2018, Petznick, 2018, Laudien, 2019, Pesch, 2019). The cloud servitization awareness is about the potential customer's knowledge or perception of the cloud computing concept applicable to the related industries. Although many people have heard the cloud computing term, only a handful of them, mostly IT competent employees, have an in-depth cloud computing understanding.

The business decision procedures in many companies are designed in a way that financial decisions of purchase have to be approved by the top management. Unfortunately, not many top managers consider cloud-based servitization as an investment, since additional time is required until cloud servitization gains market visibility and will be accepted by it. The impulse for pursuing cloud services can be propelled by an increased number of successful business examples (Ali, 2017, Warren, 2017, Mathiassen, 2017).

The BMS cloud service business model faces a paradoxical situation: two stakeholders, service engineers and building owners, administrators or contractors need to make a decision on IT cloud technology adoption. To overcome this paradox, specially trained service engineers or BMS integrators can play the mediator's role between the BMS provider and the building owner/contractor, and occupy an essential part in the total value chain as they have a direct contact with the building owners/contractors and are able to recommend BMS options (Munkácsi, 2018, Simon, 2018).

Hentschel (2018), Leyh, (2018) and Petznick (2018) argue that "raising awareness plays a large part in the sale process". Their empirical study confirms that customers face difficulties in

understanding the cloud computing technical and legal aspects, and larger enterprises are more open to cloud solutions. The training course implementation and sharing the relevant information provision would raise the awareness level (Hentschel, 2018, Leyh, 2018, Petznick, 2018). Hentschel (2018), Leyh (2018), Petznick (2018), Laudien (2019) and Pesch (2019) agree that unawareness is a "cognitive constraint as a serious barrier" (Laudien, 2019, Pesch, 2019) to cloud servitization and the enterprise business model change, but only at the initial stage of decision making. To reach a break-even point in cloud service acceptance decision "communication strategies play a crucial role" (Penna, 2019, Schweigkofler, 2019, Brozzi, 2019, Marcher, 2019, Matt, 2019).

Fears of cloud services

Fear in the cloud computing context could be described as being afraid of cloud integration into the business routine. The reasons are lack of knowledge, lack of security, fear of losing control and the job, especially from the IT specialist side, fear of business model failure.

The biggest challenge is to convince HVAC and BMS companies to adopt cloud strategy as they address fear of "heavy dependence" (Hentschel, 2018, Leyh, 2018, Petznick, 2018) on the BMS cloud service provider and fear of "loss of power [...] resulting ownership" (Hentschel, 2018, Leyh, 2018, Petznick, 2018). Due to the lack of trust, there are worries about losing overall control of BMS monitoring functions, data secure management and storage in the cloud (Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016, Tian, 2016).

According to Ali (2017), Warren (2017), Mathiassen (2017), many companies suspend their pursuing of cloud technologies due to "the lack of successful business models" (Ali, 2017, Warren, 2017, Mathiassen, 2017), related to security or even bancurpcy issues.

Despite the current fears, stakeholding companies understand that the digitalization era can make the present business models obsolete and they need to overcome the barrier of fear by raising trust and confidence.

Confidence in cloud services

Confidence in cloud computing could be defined as a customer's self-assurance feeling arising from the appreciation of IT knowledge and ability to manage cloud innovations.

IT knowledge is the key factor impacting the managers decisions of adopting cloud services (Ojala, 2016). Therefore, specialized training courses could benefit in raising confidence in technology and would lead to a higher level of acceptance (Hentschel, 2018, Leyh, 2018, Petznick, 2018).

The SaaS developers should be aware of BMS software non-complexity: ease-of-use design and ability to "set-up and use devices without IT background" (Nedeltcheva, 2017, Shoikova, (2017).

Special demo or trial versions are a great tool for confidence improvement and higher cloud service acceptance. The freemium model for the beginning plays a trust builder's role (Hentschel, 2018, Leyh, 2018, Petznick, 2018).

Trust in cloud services

Trust in the cloud business context means belief in the cloud provider‘s reliability and the customer’s willingness to depend on it, “willingness to accept possible risks” (Shimba, 2010).

With the BMS cloud servitization, we have a situation when the customer puts his data and monitors the system functioning “on someone else‘s hard disk” (Garg, 2017, Varshney, 2017, Rajpoot, 2017, Jyotsna, 2017), consequently, overcoming the main trust barriers in security, legislation, technical infrastructure is crucial.

Välikangas (2016) and Gibbert (2016) highlight the importance of overcoming the not-invented-here attitude importance in trust, while Shimba‘s (2010) empirical study results show that the cloud service provider’s location is important only to 28% of customers, while 76% of cloud customers highlight reputation as the key factor. The cloud service provider’s reputation can be damaged by a wrong selection of the third party IaaS provider, causing security, legislation issues, too (Shimba, 2010). This is the reason why some authors argue about the relevance of certification, especially from IaaS partners (Hentschel, 2018, Leyh, 2018, Petznick, 2018), because the customer has to feel confident how his data is managed: if this data is not revealed to third parties or what purpose is of the cloud service provider’s data mining procedures. ISO standards ISO 27001 and ISO 27002, regarding the information security management system implementation, maintenance and improvement, benefit in trust building as well.

Trust is a psychological reaction, and can be built by strengthening the loyal partnership between cloud stakeholders, which can be built via professional communication with the customer and company transparency policy (Hentschel, 2018, Leyh, 2018, Petznick, 2018).

Transparency and audits

Transparency in the cloud context can be understood as the provider’s willingness openly share information with the customer about the customer data related procedures.

According to Deloitte authors Openshaw (2014), Hagel (2014), Wooll (2014), Wigginton (2014), Brown (2014) and Banerjee (2014), the trust level can be increased by maximizing transparency. It means that the cloud provider’s honest information about what data and for what purposes it is collected, what country and jurisdiction for data storage is chosen, what is the provider’s policy regarding data recovery and security, how risk appearance will be managed, what are the exit and contract retraction options, should be known to customers (Openshaw, 2014, Hagel, 2014, Wooll 2014, Wigginton, 2014, Brown, 2014, Banerjee, 2014, Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016, Gupta, 2017, Bumezai, 2017).

Trust can be significantly fostered by giving the consumer an ability to monitor and analyze his data in real-time manner and by allowing third party companies to audit the provider’s security level and compliance with the customer requirements (Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016).

Innovation culture of enterprises

Innovation culture in the cloud service context can be defined from two perspectives: from the cloud provider's and the customer's. From the cloud provider's perspective, innovation culture could be understood as the enterprise ability to utilize the employees' creativity for innovation creation, development and implementation. The worldwide known example of the company practicing innovation culture is the *Google* having "20% time policy" dedicated to value creation. From the customer's perspective, innovation culture could be described as willingness to adopt innovations in order to be able to compete in rapidly changing markets and prevent its competitive differentiation. The belief in innovation culture is a matter of everybody within the company. It is not the matter of the top management only. In order to reach the efficiency of cloud service implementation, stakeholders need to collaborate in creating new operational processes related to cloud computing adoption and maintenance (Shimba, 2010). Otherwise, mismatch of both sides company cultures and the customer's company top management's scepticism become an obstacle towards the cloud service adoption as well as lack of strategic insights and managerial skills of innovation implementation (Davids, 2017, Van Belle, 2017, Singh, 2018).

It is important that companies seek to prevent their business models from becoming obsolete and trying to bring truly novel solutions of cloud servitization options into the market (Collis, 2016). Innovation culture and flexibility also assist in "relationship-building behaviours" (Davids, 2017, Van Belle, 2017) between the cloud provider and the adopting company.

2.2.3.2. Technological challenges

Scholarly literature highlights that the root technological challenges influencing willingness to adopt the cloud are the following: security of cloud service, standards heterogeneity, portability and interoperability causing a vendor lock-in.

Cloud security

Cloud computing is the fastest growing IT industry sector (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017). Its growth increases the data amount stored in cloud, thus causing security risk concerns. Security is the most cited challenge, embracing a bouquet of issues, such as security of the perimeter, cloud system vulnerability, data security from prone attacks, browser security, thefts of equipment, etc. Security plays the key role in adopting cloud services.

According to the empirical study by Hentschel (2018), Leyh (2018) and Petznick (2018), 81% of respondents are concerned about data security. Ali (2017), Warren (2017), Mathiassen (2017), Alshammari (2017), Alhaidari (2017), Alharbi (2017) and Zohdy (2017) propose a technical security prevention solution as follows:

1. *Cloud security*. XML signature wrapping is the most frequent attack on cloud servers. The digital signature should be used for cloud servers' security.
2. *Browser security*. For the web browser security prevention, a single identity for the user should be applied. In order to strengthen security from unauthorized users, data interception or

malicious insiders, the web browser identification should be accompanied by an end-to-end data encryption.

Peter Savitti (2020), the chief technologist of Boston College, and Wayne Anderson (2020), Microsoft's M365 Center of Excellence security and compliance architect, state that despite cloud security incidents, security ignorance still faces companies, as cloud service providers and cloud customers leave their companies vulnerable because of the made mistakes or poor data sanitation. (Brown, 2020)

By adopting cloud services, the customer loses full control over the underlying infrastructure, such as PaaS and IaaS. For this reason, it is extremely important to choose reliable PaaS and IaaS partners. "There is no 100% security" (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017), but cloud providers and customers must cooperate in creating security policies in order to maximize the protection of security vulnerable points (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017).

The fact that security in not only the reality, but also "a feeling" (Shimba, 2010), all the possible steps taken for security prevention raise the customer's trust in the cloud service provider.

Heterogeneity, interoperability and portability of standards

The lack of worldwide accepted standards leads to heterogeneity of cloud service solutions, from hardware infrastructure to software and service (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016). The variety of cloud solutions cause the cloud systems interoperability issue due to desynchronization because of different data formats (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Lee, 2019). Interoperability (called connectivity by other scholars) in the cloud computing context can be defined as an ability to interact and exchange information between seperate cloud systems.

Introduction of standardization would solve cloud interoperability challenges (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017), but due to the fact that cloud computing is still at the emerging stage, time is needed for cloud computing service standards to be laid on the table.

Interoperability affects portability issues. Portability in cloud computing means "the ability to port data, application or software" (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016) to another cloud system, for example, in case of switching cloud providers or sharing data with another organization. It is quite a usual practice that interoperability and portability are limited due to the outdated framework of data set, in which case human interaction for reconfiguration and redeployment is needed (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Gupta, 2017, Bumezai, 2017).

The interoperability and portability limitations created by the cloud service provider can be seen as an abuse in order to monopolize the cloud service providers' positions in the market. Therefore, portability should be considered as the key element for the cloud service provider selection in order to avoid sticking to a single cloud provider technologies and be locked-in with it. The risk of the

vendor lock-in is a vast obstacle of cloud service adoption (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016).

Taking into account all the listed facts regarding interoperability and portability, there is a need for balancing the cloud servitization standardization with the specific customer requirements (Hentschel, 2018, Leyh, 2018, Petznick, 2018). For example, in 2015, the European Commission initiated The Alliance for Internet of Things, consisting of 200 corporate members from various industries (Lee, 2019). The main Alliance task is to create an ecosystem between the European players and to support the IoT interoperability standards. As IoT is an important physical element of cloud technologies, it is very realistic that IoT standards will be displaced to cloud servitization field as well.

Vendor lock-in

The lack of standardization leads to the vendor lock-in. The vendor lock in cloud computing is defined as the customers‘ dependency on the same cloud service provider and difficulty to replace it by a different one due to technical or financial constraints (Opara-Martins, 2016, Sahandi, 2016., Tian, 2016).

According to the empirical study by Opara-Martins (2016), Sahandi (2016) and Tian (2016), only 3 % of customers have deep knowledge about the lock-in risk, 44% - only a basic understanding, while many enterprises are not aware of the lock-in problem. It is extremely important that business retain the cloud provider exchange option in order to prevent their business from the lock-in risk.

New technologies by themselves do not solve the vendor lock-in problem due to the standard heterogeneity or outdated frameworks of data (Killip, 2017, Owen, 2017). The cloud software adapters benefit in this case. Software adapters are devices which recognize the third party application components and remove or reconfigure mismatching parts in order to make the cloud service interoperable (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017).

Cloud software providers have to be aware of the platform layer selection because different platforms use different tools and programming languages. In case of willingness to adopt a novel offering by competing the platform provider, migration from one platform to another causes tremendous endeavors (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017).

Opara-Martins (2016), Sahandi (2016) and Tian (2016) provide the following recommendations for cloud service providers and customers regarding the lock-in risk minimization:

1. Due-diligence before contacting the cloud service provider benefits in making well-informed decisions;
2. Selection of the cloud provider from the open environment with the existing continuous competition brings alternatives of other cloud providers;
3. The use of widely accepted softwares or applications maximizes interoperability and portability.

No company would adopt cloud service if it is concerned about the availability of exchanging cloud providers due to limited interoperability and portability (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Hentschel, 2018, Leyh, 2018, Petznick, 2018). Therefore, customers need to figure out in advance the exit strategy before stepping in a line with the cloud service.

2.2.3.3. Legislative challenges

The cloud service adoption is influenced by the customer trust level, and trust can be raised by respecting legislative requirements. Cloud servitization legislative concerns exist worldwide. The most frequent concerns quoted by scholarly literature are about the data location, legal compliance to regulation, data protection and Service level agreement.

Data Protection

Literature states that data security is the key factor influencing the customer's willingness to adopt cloud services. Customers need guarantees that the cloud service provider procedures follow the right policy of data collection, management and storage. In addition to data security from prone attacks, the customer should raise the following questions: what happens after the data is deleted from the provider‘s servers, is it deleted completely, for what purpose the customer's data will be used in data mining processes, will the customer’s data not be revealed to third parties (Shimba, 2010).

According to Lee (2019), the government's role can be significant in creating regulations regarding security concerns. The European Commission declares that more than 90% of Europeans admit that the same data protection rules in Europe would be a huge support.

There are two main documents issued by the European Parliament and the Council applicable to the European market and one - to the application process:

1. *The General Data Protection Regulation (EU) 2016/679* “on the protection of natural persons with regard to the processing of personal data and on the free movement of such data” has been applied since 25 May 2018.
2. *The Data Protection Law Enforcement Directive (EU) 2016/680* “on the protection of natural persons regarding processing of personal data connected with criminal offences or the execution of criminal penalties, and on the free movement of such data” applied since 6 May 2018.
3. *The Regulation (EU) 2018/1725* “on the protection of natural persons with regard to the processing of personal data by the EU institutions, bodies, offices and agencies” entered the application process on 11 December 2018.

The latest update of “The world map of data protection and privacy regulation current status in key markets”, updated by *World Federation of Advertisers* in January 2020, is presented in Annex 1.

To sum up, in order to be able to guarantee data protection compliance to the regulations, the cloud service provider should carefully choose the IaaS provider’s country and the jurisdiction where the

data is located. The customer should choose the provider performing applicable legislation meeting the customers‘ requirements to data protection (Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016).

Location of data center

Data location in the cloud computing context means a country or jurisdiction where the data is stored in cloud providers servers (Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016). To secure the data, it is extremely important to select cloud service providers locating servers in countries with trustworthy jurisdictions. For example, enterprises that are located in Europe and adopt a cloud provider from the countries where data protection legislation does not match the European Union law, may be jeopardised (Shimba, 2010). According to Hentschel, (2018), Leyh (2018) and Petznick (2018) empirical study, Europeans are willing to adopt local cloud providers with the priority for Germany-located infrastructure.

The choice of the data storage location affects compliance with legislation regarding data protection and has to be a well-informed decision (Shimba, 2010, Opara-Martins, 2016, Sahandi, 2016., Tian, 2016).

Legal compliance with regulations

The cloud computing technologies design the future of IT, and industries are adopting it, but the legal compliance with various county regulations is a challenge (Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017), especially in the situation of transborder data (Shimba, 2010). The legal compliance with regulations in the cloud context means that cloud provider meets legislation standards (regulations). So, cloud service providers need to comply with the countries where business regulations are the latest (Brown, 2020). “A defence-in-depth strategy” (Brown, 2020) and compliance with the existing legislations build the customer‘s trust in the cloud service provider.

Service Level Agreement

The customer‘s cloud adoption brings lots of trust uncertainties as the client passes his data to the control of the cloud provider, and the customer needs some confidence about his data security. In addition to the governmental regulations described above, a reciprocal stakeholder’s agreement regarding fulfillment of both sides’ obligations should be negotiated and signed as well (Davids, 2017, Van Belle, 2017, Senyo, 2018, Addae, 2018, Boateng, 2018).

Service Level Agreement (SLA) is a contract between the consumer and the cloud provider ensuring cloud service availability, performance, reliability and quality for the agreed price from the cloud provider and guaranteeing that the customer fulfills his financial obligations to the cloud provider (Ali, 2016, Ammar, 2016, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

SLA should include the following components (Ali, 2016, Ammar, 2016, Davids, 2017, Van Belle, 2017):

- Agreement parties;
- Cloud service description;

- Pricing models;
- Duration of agreement;
- Agreement objectives;
- Applicable law;
- Outline of cloud computing resources;
- Service guarantee and other obligations;
- Violation measurement;
- Rebates, penalties and exclusions, highlighting condition limitations until which the agreement is enforceable.

SLA shows the cloud service provider's commitment to guarantee its service and positively impacts his reliability and trustworthiness benefitting in cloud computing adoption by customers.

2.2.3.4. Economic challenges

The economic challenges most cited by scholars are: cloud service resources management, price model proposals motivating to adopt cloud services, cloud computing adoption switching costs barriers and commercialization challenges.

Resource management

Effective resource management and opportunities of cost saving are strong drivers of cloud service adoption. Resource management in cloud computing is defined as processes of cloud, human and financial resources utility in the most efficient and effective way.

From the cloud provider's perspective, the cloud service resource management benefits as follows: economies of scale due to the cloud technologies scaling capability of resource optimization, lower cost of IT infrastructure (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Lai, 2018, Jackson, 2018, Jiang, 2018), lower development costs (Ojala, 2016) and lower management and maintenance of infrastructure costs (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017) due to the cloud service infrastructure and platform renting option, neutralization of "capital expenses" (Shankar, 2018, Duraisamy, 2018) needed to acquire own hardwares and platforms. It leads to the possibility to offer the customer to rent the cloud service at a competitive price, compared with the traditional business model of on-premise software licensing. Renting means the contractual agreement for trading short- or long-term possibility to use the cloud service which is owned by the cloud service provider (Ojala, 2016). Adoption of cloud services leads towards operational excellence (Senyo, 2018, Addae, 2018, Boateng, 2018).

By renting cloud services, customers gain an advantage of the following: a possibility of resource pooling, on-demand self service (Senyo, Addae, Boateng, 2018, Agostini, 2019, Galati, 2019, Gastaldi, 2019), capabilities of remote monitoring and collecting data, speed up and improve efficiency of business processes (Laudien, 2019, Pesch, 2019), there is no need for end customers to employ costly IT experts, having special IT knowledge to manage cloud softwares, no need for long term capital expenditure (Ojala, 2016, Hentschel, 2018, Leyh, 2018, Petznick, 2018).

The rent of cloud service solutions is attractive to small companies, since renting software can "shift their capital investment onto operational costs" (Ojala, 2016). The renting option does not require high initial investments, which would be challenging for small companies.

Despite the listed cloud servitization benefits, under some circumstances software licensing is crucial due to the customer's security concerns, internet availability, readiness for novelties and the internal IT policy and, of course, the existing IT infrastructure within the company (Ojala, 2016).

Regardless of the cloud servitization optimization benefits, the cloud provider faces some financial issues concerning additional sales professionals' employment, as the market still struggles cloud servitization awareness and potential customers need continuous support in the cloud adoption process and after-sales services (Jaehyeon, 2016, Mi-Seon, 2016, Jae-Hyeon, 2016, Hentschel, 2018, Leyh, 2018, Petznick, 2018).

Switching costs

Switching costs in cloud computing is defined as tangible and intangible losses resulting from migrating from an on-premise business model to that of the cloud, or replacing one cloud service provider by another.

As it was mentioned in Chapter 2.2.3.2, there is no common opinion regarding the key drivers motivating cloud adoption: according to Mlecnik (2019), Straub, (2019), Haavik, (2019), customers are "mainly driven by financial and functional factors", including investment costs, while Hentschel (2018), Leyh (2018), Petznick (2018) contradict that "financial aspect is not the critical reason". Despite these contradictions, tangible or intangible switching cost challenges exist and both the cloud provider and the customer need to be aware of it.

For example, cloud service providers have to be aware of the platform layer selection because different platform providers use different tools and programming languages. In case of willingness to adopt a novel offering by a competing platform provider, migration from one platform to another can cause not only intangible endeavors, but also financial spendings (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017).

From the cloud servitization customer's perspective, it is common that cloud customers are searching for a good price and quality balance of cloud services (Ali, 2016, Ammar, 2016). According to the empirical study by Opara-Martins (2016), Sahandi (2016) and Tian (2016), only 3% have an advanced understanding and 44% - a basic one of lock-in due to the lack of standardization, interoperability and portability, which can raise switching costs tremendously. So, responsible judgement of cloud providers' offers is crucial in order to be sure that switching costs are acceptable according to gaining benefits before the it-is-too-late moment (Opara-Martins, 2016, Sahandi, 2016, Tian, 2016, Garg, 2017, Varshney, 2017 Rajpoot, 2017, Jyotsna, 2017).

In order to prevent enterprises from lock-in with high switching costs traps, Opara-Martins (2016), Sahandi (2016), Tian (2016) provide the following recommendations:

1. Selection of standardized platforms is a must;
2. Choice of standardized programming interfaces is crucial, too.

In summary, adoption of cloud services should be judged not only by the purchasing process or owning costs, but it also has to be evaluated by switching costs, under which cloud service installation, employee training, cloud system maintenance, "psychological risk and uncertainty of switching suppliers" (Medvedev, 2018) are hidden.

Pricing models and sales specifics

Digitalization, including cloud services, has "rendered old pricing and revenue models obsolete" (Rayna, 2016, Striukova, 2016) and is changing traditional business models together with monetization approaches (Rayna, 2016, Striukova, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017). Due to the balance of interests of the customer's willingness to pay the price for the value he gets and the service provider's aspiration to maximize his profit, a settlement of optimal pricing leads to dual satisfaction of the customer and the service provider (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016). Traditional "price wars" (Soni, 2017, Hasan, 2017) between software service providers will be replaced by transparent and unique pricing schemes (Ojala, 2016). An attractive pricing model can benefit in encouraging customers to adopt cloud services (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016).

Currently, the most popular pricing schemes used for software renting are static pay-per-use and subscription models (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017). Besides, a freemium model is widely practiced in order to generate the numbers of players and to gain a vaster market share, but empirical studies show that freemium model players "play less time and yield less top-line revenues" (Priem, 2018, Wenzel, 2018, Koch, 2018) on the long-term perspective, because they are not committed (Priem, 2018, Wenzel, 2018, Koch, 2018, Trenz, 2019, Huntgeburth, 2019, Veit, 2019).

There are two types of pricing models: fixed (static) and dynamic. Some pricing models are practically implemented and widely used, while others are theoretical investigations (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017). Table 2 presents the systemized list of the pricing models.

Table 2. Pricing models (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017)

Implemented		Theoretical
Fixed (static)	Dynamic	
Pay-per-use Pay-as-you-go Subscription Pay-for-resources Hybrid pricing (can be dynamic as well)	Value-based pricing Cost-based pricing Competition-based pricing Customer-based pricing	Dynamic resource pricing Dynamic auction pricing Double auction bayesian game-based pricing Double sided combinatorial auctions to resource allocation Pricing algorithm for cloud computing resources Genetic model for pricing in cloud computing markets A novel financial economic mode

Pay-per-use is a pricing model, when the charged fixed price depends on the storage or bandwidth size, mostly used for IaaS and PaaS (Soni, 2017, Hasan, 2017).

Pay-as-you-go: the customer pays a set price for what he uses (time, quantity). The key advantage of this pricing model is that the customer is aware of resources consumption as they are reserved for the paid duration. The disadvantage is that the price is not adjustable in the case of unutilized resources (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Subscription model defines payment in advance for the cloud service for the agreed period. The issue with this model is that the customers may overpay or underpay for the cloud service (Soni, 2017, Hasan, 2017). Therefore, this model is beneficial for the customer when resources or services are utilized extensively. (Ali, 2016, Ammar, 2016)

Pay-for-resource pricing model means that the customer pays for utilized resources. This model is fair to both sides: the customer and the cloud provider. Utilization of resources is maximal (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Hybrid pricing means a combination of several pricing models, e.g., subscription plus pay-per-use (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Value-based pricing price is dynamic, fluctuating according to the customer's perceivings. It is difficult to implement, but generates maximum revenue for cloud providers (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Cost-based pricing model means that the price is changing according to the cloud provider's costs in order to prevent profit. This model is risky for the customer as the costs can be found after the price fixation fact (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Competition-based pricing means that prices are fluctuating according to the existing competitor's prices. It is easy to implement (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Customer-based pricing is fluctuating according to the customer's willingness to pay for the cloud resources or services. The advantage is that this model takes into account the customer's role, but the disadvantage is that it is difficult to set the price due to interpretations (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Dynamic resource pricing is a theoretical model that offers to set the price according to the cloud resources' demand and supply. During peaks, this model does not support scalability (Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Dynamic auction pricing is a theoretical model when pricing is set with dynamic adjustment with a limit of a fixed price (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Double auction bayesian game-based pricing theoretical model is particular in that customers can purchase resources from different cloud providers. The implementation would be complicated (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Double sided combinatorial auctions to resource allocation. The theoretical pricing model proposing price dealing through double sided combinatorial auctions (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Pricing algorithm for cloud computing resources. The theoretical study with a simulation offering real-time pricing, increasing revenues and decreasing costs for cloud providers. The disadvantage of this model is that the price fluctuates slower than changes in the resource demand and supply (Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

Genetic model for pricing in cloud computing markets. The theoretical study with a simulation offering real-time pricing, can be easy implemented and generates maximum revenue. This model consists of three main steps: 1) defining elements (relevant data) having an impact on the price; 2) evaluation of these elements' output and comparison with the actual price; 3) the most productive elements are selected for pricing calculation. The disadvantage of this model is that it is not suitable for too low or too high demand of resources ((Macías, 2011, Guitart, 2011, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Soni, 2017, Hasan, 2017).

A novel financial economic model is theoretical and offers to set optimal prices according to the resource usage. The price is set between the top and bottom boundaries (Soni, 2017, Hasan, 2017).

According to scholarly literature, fixed models benefit in easy understanding of the model and simple estimation of profit (Ojala, 2016, Ali, 2016, Ammar, 2016, Soni, 2017, Hasan, 2017), but it is not fair for customers as they overpay for the resources or services that they do not use, while dynamic prices change "according to the market market quo" (Ali, 2016, Ammar, 2016).

Mazrejak (2016), Shabani, (2016), Sejdiu (2016), Soni (2017), Hasan (2017) declare that the simulation results with the genetic pricing model show promising results: genetic pricing generates up to 100% higher revenues than other dynamic models and up to 1000% higher revenue than fixed models.

In addition to the acquired pricing model, the price size is affected by other factors as well (Macías, 2011, Guitart, 2011, Ali, 2016, Ammar, 2016, Mazrejak, 2016, Shabani, 2016, Sejdiu, 2016, Ali, 2016, Ammar, 2016, Soni, 2017, Hasan, 2017): initial investment for acquiring or renting data centers, annual costs for resource purchase, agreement duration, resource age and depreciation level, quality of service, maintenance cost, cloud service provider and customer reputation, customer history regarding data loss review, monitoring of service, SLA, and the type of the cloud deployment model.

Despite the cloud computing socio-economic, technical, legal and economic challenges reviewed in this chapter, the enterprise adoption of cloud services and willingness to go digit is a matter of mid- or long-term perspective due to a giant bouquet of benefits, such as economies of scale, operational excellence, cost-effective management, functionality, flexibility and similar opportunities. The appearance of digital technologies and their penetration into the market revolutionize entire industries and well-established business models by making them obsolete. Smart integration and effective utility of digital technologies enable enterprises to "do new things" (Agostini, 2019, Galati, 2019, Gastaldi, 2019) in order to create sustainable competitiveness.

2.3. Comparative analysis of existing business models

"A better business model often wins over a better idea or technology" (Heaton, 2019, Hafeez-Baig, 2019, Gururajan, 2019). The appearance of digital technologies such as Internet of Things and Cloud computing has streamed plenty opportunities for businesses. Enterprise digitalization is becoming a fast accelerating trend. Digital transformation of usual business forces managers to rethink "new ways of how to create, deliver, and capture value" (Laudien, 2019, Pesch, 2019). This chapter consists of two subchapters. The first compares and describes three different HVAC, IoT and cloud computing industries business models, the second explains the logic of merging these business models.

2.3.1. Theoretical comparison of HVAC, IoT and cloud computing business models

A business model is "an early strategic prototype" (Haggege, 2019, Vernay, 2019) supporting the projection of companies' interwoven value creation, delivery and capture routines, leading enterprises to differentiation from competitors and delivering competitive sustainability. Digitalization with its benefits becomes a tool to reach the enterprise uniqueness and sustainable competitiveness. That is the reason of its accelerating penetration in all industries, including deep engineering-minded HVAC. Figure 5 presents the new concept of HVAC BMS servitization with the cloud integration business model with two key players HVAC BMS equipment and cloud computing provision, where IoT technology-based devices play the merger's role between them.

The comparison of HVAC, IoT and cloud computing business models based on scholarly literature findings are presented in Table 3.

Table 3. Business models of current HVAC, IoT, Cloud Computing industries

HVAC BMS	IoT	Cloud computing
Zhao, 2016, Pan, 2016, Lu, 2016, Ovallos-Gazabon, 2017, Gomez-Charris, 2017, Pacheco-Torres, 2017, Celin, 2017	Jaehyeon, 2016, Mi-Seon, 2016., Jae-Hyeon, 2016, Jae-Hyeon 2016, Lee, 2019, Mashonova, 2019, Jimenez-Bescos 2019	Labes, 2016, Hanner, 2016, Zarnekow, 2016, Soni, 2017, Hasan, 2017, Ali, 2017, Warren, 2017, Mathiassen, 2017, Hafeez-Baig, 2019, Gururajan, 2019, Heaton, 2019
Target customer		
Contractors Companies of tertiary sectors (schools, hospitals, hotels, etc.) Commercial real estate stakeholders	Contractors Companies of tertiary sectors (schools, hospitals, hotels, etc.) Commercial real estate stakeholders Global market	Mass market Large and SME enterprises Niche, branch market
Value proposition		
Customization Climate control	The job-to-be-done Convenience due to automation “Smart” control Customization Data sharing Possibility to update Safetiness	The job-to-be-done Computing service “Smart” data monitoring and control Customized product portfolio Cost effectiveness Continues automatic updating Safetiness Data privacy Flexibility Interoperability Individual support Administration
Key activites		
Consulting Commercialization HVAC installation and BMS integration Maintenance Technical service	Product development Hardware and software installation and reconfiguration Hardware and software monitoring and maintenance Business continuity activities	Consulting Service identification Service assemblement into the value proposition Software development and release Service monitoring and maintenance Regular updating Business continuity activities
Key resources		

Talent engineers Machinery and equipment Physical infrastructure	Talented software engineers Security specialist Product team Hardware, software, application IoT network and technologies Certificates Brand	Know-how Software engineering teams Network and security specialists Product teams Technologies-as-a-service Reliable infrastructure Network/ecosystem Certificates Data
Partnership		
HVAC equipment manufacturers Electric service providers Other outsourced subcontractors	Device manufacturers/ suppliers IoT integrators Software developers Hardware providers Data analysts	Cloud service provider within ecosystem Consultants Integrators and aggregators Partners in similar field
Channels		
Commercial team Customer service offices Internet	Direct to customer or partner Contractors Traditional channels: media, internet	Direct to customer or partner Ecosystem Cloud marketplace
Customer relationship		
Exclusive customer assistance	Co-creation Self-service Real-time feedback Limited promotion and customer services Video consultations for installations Membership	Customer interaction Real-time feedback SLA Fully support Community
Revenue structure		
Payment for the installation works Payment for the service Payment for the maintenance	Product sales Subscription fee Usage fee	Initial installation payment Product sales Subscription Pay-as-you-go Pay-per-use Pay-for-resources
Cost structure		
Human Talent (internal and outsourced) Purchase of equipment and machinery	Upfront investment in technology Manufacturing Marketing and sales Device maintenance Commision fee to contractor IoT application platform subscription Membership subscription	Talent payroll Try-before-you-buy (freemium) Operating expenses Hardware, platform fee External services (security, disaster recovery)

When comparing the three business models presented in Table 3, it is evident that HVAC business is oriented towards a one-time-project with the ability to order maintenance service, while IoT offers a membership option in order to keep relationship with the customers in a long-term

perspective, while the cloud computing service provider is the most advanced in long-term bounding the customer by "renting" its own cloud services of hardware, platform or software.

It is worth mentioning that during the empirical research by Labes (2016), Hanner (2016), Zarnekow (2016), three business models of cloud service providers have been identified (Labes, 2016, Hanner, 2016, Zarnekow, 2016):

1. *Newcomers,* who utilize the existing cloud strategies by aggregation service for partners. Their revenue models are frequently conjuncted with the partner's. Their service portfolio is limited, but customized. They focus mainly on the niche market. It is recommended that after the newcomers gain experience and credentials, partnership dependency should be neutralized.
2. *Experienced players* provide standardized public cloud services. They offer a wide cloud service portfolio for the mass and individual market, what benefits in scalability. Cloud service development is based on their proprietary know-how. Hardware and software are their property. Revenues are generated from subscription. Due to the fact that the business model is oriented to the mass market, it is recommended to proceed sound marketing and branding in order to raise the trust level. They challenge to increase transparency level and establish an attractive pricing model. In order to gain the market share, they offer freemium models and generate revenues from premium customers.
3. *Specified providers* offer high trusted level cloud services of infrastructure, platforms and software deployed on a private or hybrid model. The target market is branch-specific and public customers, to whom"data processing, administration and marketplace" (Labes, 2016, Hanner, 2016, Zarnekow, 2016) services are offered. Specified providers tightly cooperate with the consulting partners and integrators, helping customers to install or migrate to cloud services. Relationship strengthening is recommended through a "high degree of customer orientation" (Labes, 2016, Hanner, 2016, Zarnekow, 2016), SLA and transparent monitoring. providers must secure their business models from being imitated.

According to Labes (2016), Hanner (2016), Zarnekow (2016), the specific cloud providers are most "linked to success" (Labes, 2016, Hanner, 2016, Zarnekow, 2016), while newcomers are least successful due to competition.

In summary, digitalization penetration into industries has brought headache about business model revisions. Knowing the fact that "disruption sometimes emerges from just one subcomponent of business model" (Rayna, 2016, Striukova, 2016), it is worth reviewing the ordinary HVAC BMS model and finding the best merging combination of HVAC, IoT and cloud computing.

2.3.2. Business logic of cloud integration into HVAC BMS

The comparison of HVAC, IoT and cloud computing business models in Table 3 highlights the key weakness of HVAC business specifics, as it is oriented towards one-time-project activities, while IoT and cloud businesses are oriented to long-term relationship with their customers. Orientation to one-time-projects challenges the HVAC BMS company sustainability.

The analyzed scholarly literature soundly declares that digital technology penetration into the market fades out the sustainability of many existing business models and "requires rethinking how organization creates, captures and delivers value" (Bock, 2017, Iansiti, 2017, Lakhani, 2017). Hence, some "adjustment or radical change in the business model" (Laudien, 2019, Pesch, 2019) is crucial.

The cloud business model components' integration into a HVAC BMS may disrupt ordinary BMS business models by **bonding customers for a long-term relationship**. In this case, IoT business model is mainly interesting from the technical/functional perspective as IoT devices play a merger's of HVAC and cloud role. Figure 7 visualizes the conjunction of civil engineering industry's HVAC, IT industry's IoT and cloud computing business models in order to create a novel competitive business model for a HVAC BMS company.

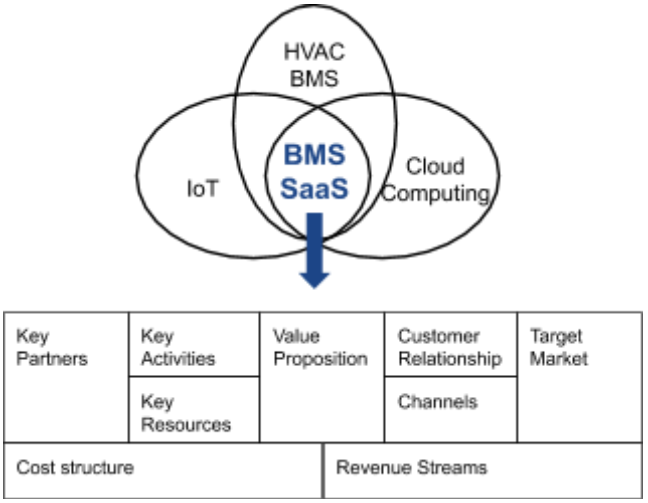

Figure 7. BMS SaaS Business model background

Scholars state that even a minor change in a business model creates competitive advantages delivering a "positive market outcome" (Rayna, 2016, Striukova, 2016). The change of more business model components "tend to be more disruptive in the long run" (Rayna, 2016, Striukova, 2016). Business model innovation is the "fuel of power growing forward" (Dobni, 2017, Klassen, 2017, Sands, 2017), helping company to **differentiate, to gain competitive advantage** and **to strengthen sustainability** (Dobni, 2017, Klassen, 2017, Sands, 2017).

"Many companies succeed by adopting new business models at the right time by reconfiguring their value propositions, internal and external organisational processes" (Haggege, 2019,Vernay, 2019). The merge of HVAC, IoT and cloud computing business model supports **decomposition of value proposition** and opens the gates to "radically change the fundamental ways that the organisation deliver value to their customers" (Heaton, 2019, Hafeez-Baig, 2019, Gururajan, 2019). Cloud technology integration into the HVAC BMS supports **ecosystem creation** (Figure 8), where trustful relationship is built through transparency and SLA.

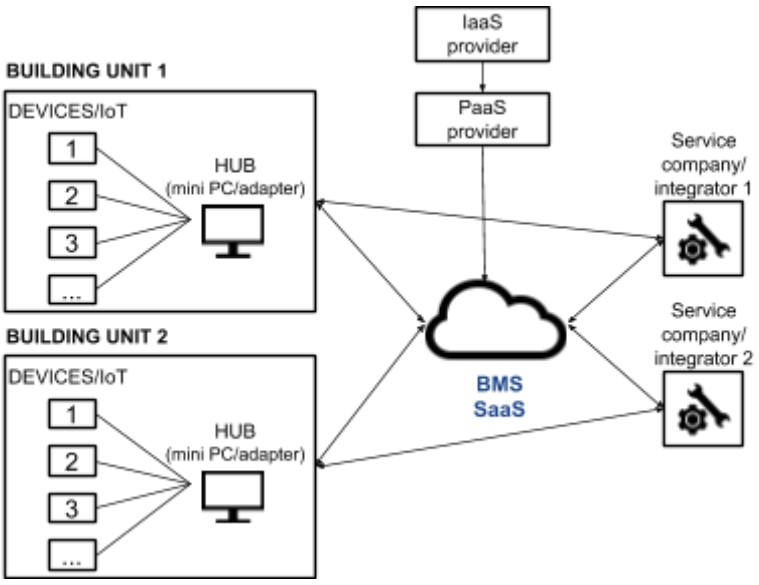

Figure 8. BMS SaaS ecosystem

Academicians suggest focusing on the stakeholders' ecosystem instead of a single company's point-of-view, as it "**maintains long-term relationship perspective**" (Lai, 2018, Jackson, 2018, Jiang, 2018) and creates "handshake and **lock-in business models**" (Lai, 2018, Jackson, 2018, Jiang, 2018). An ecosystem allows a HVAC BMS company to transform a one-time project revenue to **regular yearly/monthly incomes** built on one of the pricing models listed in Table 2.

Adoption of the novel BMS SaaS benefits for customers in possibilities to improve **operational excellence and efficiency**, because their usual practice is "reactive maintenance" (Silva, 2019, Brito, 2019) action, which is "only performed after the failure" (Silva, 2019, Brito, 2019) of BMS. "Reactive maintenance" (Silva, 2019, Brito, 2019) leads to poor cost management, due to urgent service higher costs. Implementation of BMS SaaS may lead to "everything connected-analyzed-acted" (Gupta, 2017, Bumezai, 2017) prevention in advance. This attitude is called "proactive maintenance" (Silva, 2019, Brito, 2019), leading to **cost and resource effective management solutions**.

Thus, with the digital technology appearance in the market, whole industries are "back to zero" (Dobni, 2017, Klassen, 2017, Sands, 2017), "time is right to become more experimental and less traditional" (Dobni, 2017, Klassen, 2017, Sands, 2017). As there are no ideal business model recommendations created to follow them, entrepreneurs must arm themselves with their know-how, experience, creativity and intuition in order to design novel business models with the competitive value propositions leading to the company sustainability.

2.4. Summary of the theoretical part

Due to the IoT and cloud computing technologies, HVAC industry's BMS sector faces digitalization opportunity with the ability to become an autonomous business from HVAC. Although cloud computing counts only a decade, there are still many socio-cultural, technological, legislative and economic challenges that are investigated in this chapter and need to be considered

for the BMS digitization project processing. Accordingly, due to legislative reasons and the requirements for data protection, it is critically important to consider the location where the customer data is stored. Therefore, it is extremely important to select a correct partner of IaaS and PaaS. Respectively, depending on the data sensitivity to its leakage, the deployment model - public, private, community or hybrid - may be selected. Having in mind that most scholarly articles describe cloud computing from the user's perspective, not from that of the provider's, and are globally generalized, **further empirical investigation of the potential target market moods, trends and challenges from BMS SaaS provider's perspective is requisite**.

In addition, this chapter is providing guidelines of available cloud service provider business models types (Labes, 2016, Hanner, 2016, Zarnekow, 2016). Labes (2016), Hanner (2016), and Zarnekow (2016) indicate that the specific cloud providers are most "linked to success" as they offer high trusted level cloud services of infrastructure, platforms and software deployed on a private or hybrid model. Besides, the specific cloud provider's target market is branch-specific, to whom "data processing, administration and marketplace" (Labes, 2016, Hanner, 2016, Zarnekow, 2016) services are offered, which goes in line with the initial BMS SaaS concept. Furthemore, it is emphasized that specified providers tightly cooperate with the consulting partners and integrators, helping customers to install or migrate to the cloud services. Therefore, considering the fact that BMS due to its complexity is hardly understandable for the end user without engineering background and due to the lack of trust in cloud computing technologies, the further empirical in-depth research should **clarify the potential partners providing trust via the user consultant's role**. Moreover, Labes (2016), Hanner (2016), and Zarnekow (2016) recommend to strengthen relationship with the customers through SLA, transparent monitoring and "high degree of customer orientation". For this reason, **the final identification of the customer and the final BMS SaaS user** is beneficial in defining the true meaning of the customer orientation concept that is crowned by the **customer value proposition**.

The socio-cultural, technological, legislative and economic challenges concerning cloud computing technology adoption are briefly described in this chapter. The further task of the research is to identify the potential customer's **readiness level of cloud BMS adoption**, to **investigate what technological challenges** are the core for the potential customers and need to be solved by the company, to clarify what legislative issues should be strictly considered and, finally, to find an answer **what resources and how the *BMS Company* is going to utilize them** (to rely on its own resources completely or acquire it from the third parties) **in order to proceed activities and generate revenues**. In this chapter, pricing models are briefly described, therefore, **the best option of the pricing model** needs to be considered.

The further research needs **to identify what elements** of Table 3, presenting generalized business models of HVAC, IoT and Cloud computing industries, can be used for the BMS SaaS **business model innovation**: who is the customer, what should be the customer value proposition, what standardized or customized product should be, how to communicate and to overcome customer objections, how to sustain relationship with the customer, who are the potential partners, what resources are needed in order to proceed activities, what revenue models could cover the costs.

A business model cannot stand alone, therefore, further empirical research findings should benefit in grounding the business strategy by covering its five main elements (Hambrick, 2005, Fredrickson, 2005) described in Chapter 1: arenas or scope, vehicles or entry modes, differentiators or competitive advantage, staging, economic logic.

In order to find correct answers to the questions raised in the theoretical part and the problem analysis chapters, empirical research is proceeded. The empirical research methodology is described in the next chapter.

3. Research methodology

Due to the lack of knowledge about business models in HVAC industry (Senyo, 2018, Addae, 2018, Boateng, 2018), the gap of studies about BMS business as an autonomous one, the gap of knowledge about business experiences of cloud integration into the HVAC BMS business model, and the gap of recommendations regarding strategies, the empirical research is proceeded in order to investigate the key factors that may influence the BMS SaaS business model innovation and strategy implementation into the market.

3.1. Research problem

The BMS Company has developed the cloud BMS software, which faces a challenge of being commercialized. **The main research problem** - the lack of empirical evidence about the key factors having an impact on designing a successful business strategy for any company operating in the HVAC BMS industry. The research **aim** - to gain in-depth knowledge about the key factors influencing the BMS cloud servitization business model creation, supporting successful strategy implementation into the market.

The research focuses on the following aspects:

1. The real market situation analysis in HVAC BMS industry;
2. The challenges facing BMS SaaS commercialization;
3. The possible solutions that may minimize barriers of BMS SaaS commercialization and penetration into the market.

3.2. The research design, methods and organizational process

Due to the fact that the BMS field is an extreme niche and there is a scarcity of knowledge about the emerging cloud business models and strategies in general, the qualitative, in-depth, practice-oriented, empirical research has been conducted.

A cross sectional case study was carried out from the BMS business development perspective. The research took part in three stages:

1. **The statistical analysis** of BMS and HVAC industry situation with the focus on the European scope was conducted by reviewing statistical data, research companies' reports, commercial and scientific articles, HVAC BMS manufacturers and cloud BMS service providers websites.
2. **A single instrumental (exploratory) case study** was carried out by taking semi-structured in-depth interviews from BMS SaaS developers/company founders (further called founders) and potential customers/integrators in order to gain an in-depth understanding about the BMS sector and to obtain real-market knowledge about the current market situation and challenges;
3. **A discussion** of BMS SaaS founders and one external BMS business development expert was organized in order to proceed "idea mining" for possible solutions of BMS SaaS commercialization and penetration into the market. The discussion was moderated by a researcher.

The interviewees and the external BMS business development expert were selected by generic purposive sampling. Two BMS SaaS founders were interviewed first in order to gain full understanding of the BMS SaaS business idea and vision. Afterwards, the semi-structured questionnaire was amended and additional interviews with the founders were arranged in order to collect in-depth information about the BMS business environment and perspectives. The two potential customers/integrators were interviewed afterwards in order to gain knowledge about the BMS market and their pilot experience with cloud BMS. The key criteria for the eternal interviewees' selection was their purchasing decision power and their pilot business experience with the cloud BMS. The interviewees were recommended by BMS SaaS founders. The interviews were taken by phone and lasted 60-90 minutes with founders and around 30-45 minutes with potential customers.

The discussion group consisted of three persons, excluding the moderator (researcher): two BMS SaaS founders and one external BMS business expert. The external BMS business development expert was recommended by BMS SaaS founders. The key criteria for the expert was experience in HVAC servitization business development and pilot experience with the cloud BMS. The discussion was arranged remotely via "Skype" and lasted around 180 min.

The sample size is impacted by a limited number of BMS integrators and business developers on the market, because the BMS sector is an extreme niche not only in Lithuania, but also on a global scale.

The interviews were recorded and transcribed. All the interviewees were informed about recording. No objection was expressed. The discussion with the external BMS business expert was outlined on paper interactively.

The obstacle encountered during the data collection and analysis was the COVID-19 crisis as several potential external interviewees refused to participate in the research due to their increased workload.

3.3. Data analysis methods and tools

The collected data content analysis, performed with the deductive approach as guidelines of the coding system, was clear for the business model and strategy creation. The focus of the analysis was how to propose a strategy and a business model for a firm seeking to establish a BMS business in the market, including an international one, therefore, the strategic analysis was performed in four stages (Figure 9):

1. Analysis of external and internal factors influencing HVAC BMS market and BMS SaaS.

The global and European market analysis in Chapter 4.1 was conducted by exploring the research firms' *Research and Markets* (2019), *Statista* (2019), *Prescient & Strategic Intelligence Private Limited* (2020) and *Market Watch* (2020) publicly available reports on the HVAC industry. The HVAC market situation regarding retrofitting, its drivers, barriers and challenges were identified by analysing *Energy Performance of Buildings Directive (EU) 2018/844 of the European Parliament*

and of the Council and research reports of *Buildings Performance Institute Europe (2015), United Nations (2018),* etc. Official information was supplemented with interviewees' insights about the BMS field. Information about the current market players and new entrants was provided by the interviewees and supplemented with the data found in these companies' websites.

The company's strengths and weaknesses, market's threats and opportunities (SWOT) were analyzed in Chapter 4.2.

2. VRIO Analysis.

The BMS SaaS' valuability, rarity, inimitability and organizational aspects have been discussed with founders and an external BMS business development expert during an "idea mining" session and described in Chapter 4.2.

3. BMS SaaS maintaining and improvement solutions

As the VRIO analysis was positive, further investigation followed direction "A" - BMS SaaS maintaining and improvement solution. Chapter 4.3 analyzes the Key Success Factors (KSF). The KSF comparison of current global market players and new entrants of cloud BMS (Table 5) was done, as well KSF reconciliation with the *BMS Company*'s strengths (Table 6).

In order to prepare a framework of maintaining BMS SaaS business, Business Model innovation was created and presented in Chapter 4.4.

4. Strategic design

The *BMS Company*'s strategic design (Chapter 4.6) was built according Hambrick's (2005) and Fredrickson's (2005) Strategic Model based on five major elements of strategy: arenas or scope, vehicles or entry modes, differentiators or competitive advantage, staging, and economic logic.

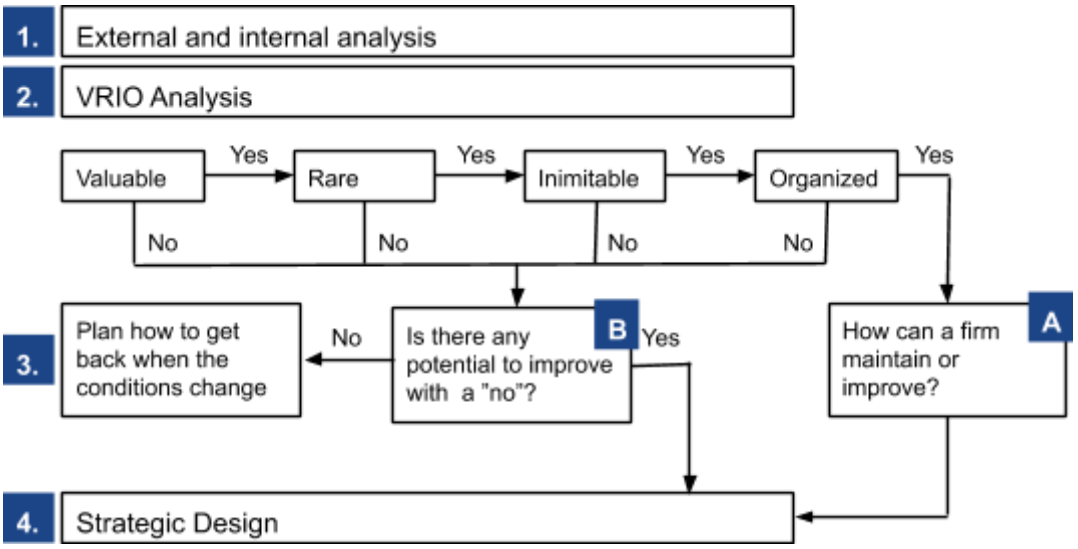

Figure 9. Data analysis stages for strategic planning (*BCD Designer*, 2020)

3.4. Research limitations

The research has been conducted mainly in Lithuania with the focus on the Lithuanian market and it may not be fully applicable for other countries.

The qualitative research was processed with interviewees and experts by generic purposive sampling selection based on the existing business relationship and consist of a small number of participants. This can be an issue of a non generic market situation analysis and the results cannot be generalized.

Due to that fact that there is a lack of awareness about cloud integration in BMS, the group discussion was based on the participants' existing pilot knowledge and intuition of how BMS SaaS business should be developed. This is a big concern regarding data validity and reliability as it may be applicable only for a small group of BMS visioneers, but not the mass market.

Having in mind that BMS SaaS commercialization is at its embryonic stage and is going to be based on Lean startup strategy principles, when the market and service is tested by a minimum viable product in order to secure the "venture from going down the wrong path" (Collis, 2016), the data collected from a small number of sample units can be applicable for further analysis and discussions.

4. Grounding the strategy for the *BMS Company*

This section consists of two chapters. The first chapter analyses strategic aspects, necessary for the development of business strategy, and the second one - the proposal of the business model and strategy design.

4.1. Analysis of key strategic aspects necessary for strategy design

This chapter analyses empirical research data collected during the statistical analysis, in-depth interviews and discussions. The target market is analyzed through the perspective of HVAC BMS business interests. According to the research data, the BMS Company strengths and weaknesses have been identified, threats and opportunities investigated. Furthermore, the key success factors are highlighted and evaluated.

4.1.1. Market analysis

The HVAC industry is rising significantly on a global scale. According to *Statista* (2019) projections, it will reach about 208.6 billion U.S. dollars by 2024 (Figure 10). The annual growth rate (CARG) is 2.6 percent between 2018 and 2024 due to the steady growth of the construction sector impacted by publicly and privately funded projects.

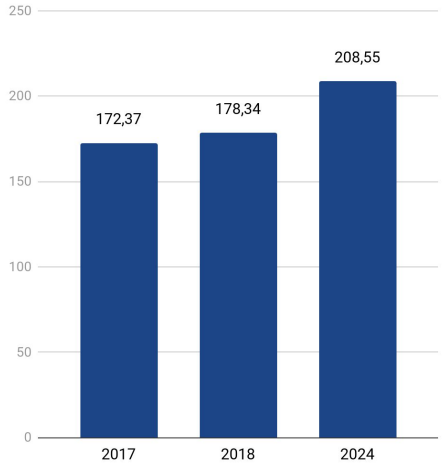

Figure 10. Projected market size for the global HVAC market size projected from 2017 to 2024, in billion U.S. dollars (*Statista*, 2019)

According to the research companies *Prescient & Strategic Intelligence Private Limited* (2020) and *Research and Markets* (2019), the Asia-Pacific (APAC) market is the major one due to the spectacular number of growing constructions mostly in India and China and HVAC equipment import by Asia Pacific countries. Whereas, *Research and Markets* declares that the fastest growing market is the United States because of an increasing trend of sustainable HVAC systems adoption. The first six leading HVAC companies are *Johnson Controls International PLC, Daikin Industries Ltd., LG Electronics Inc., Mitsubishi Electric Corporation, Gree Electric Appliances. Inc. of Zhuhai, Danfoss A/S*, which shared over 70% of the global market in 2019 (*Prescient & Strategic Intelligence Private Limited*, 2020). They mostly gain their market by producing mass market

HVAC equipment for dwellings that become technologically advanced due to the use of wireless technologies (IoT).

According to the research company *Market Watch* (2020), HVAC equipment companies in Europe should register a CAGR of more than 4% by 2022.

The research companies declare the following **main HVAC industry market drivers** (Wang, 2019, *Research and Markets*, 2019, *Market Watch*, 2020):

- Increasing number of new constructions due to the growing population;
- Growing need of HVAC system retrofitting because of the equipment and technology obsolescence;
- Governmental regulations regarding new and old building operational effectiveness and proactiveness towards the installation of HVAC systems;
- Constant rise of annual mean temperature as a result of global warming;
- Economic growth;
- E-commerce retail sales.

ENCORE project coordinator Sebastian Scholze (2019) enlightens that "the stock of residential buildings in the EU is growing old very fast, with more than 40% of them built before 1960, and 90% before 1990". This is a huge problem, because "buildings account for 40% of the EU's energy consumption, 36% of its CO2 emissions and 55% of its electricity consumption" (Scholze, 2019), from which heating and cooling are responsible for 80% of energy consumption (*United Nations*, 2018). The Union's aim is to develop a decarbonized energy system by 2050 in 3 stages: the short-term (2030), mid-term (2040) and long-term (2050) renovation strategies**.** *Energy Performance of Buildings Directive (EU) 2018/844 of the European Parliament and of the Council,* which entered into force on 9 July 2018, obliges the EU countries to amend national laws in 20 months accordingly and develop financial mechanisms and incentives by mobilizing financial institutions for building renovations. The long-term goal is a current buildings transformation in to "nearly zero-energy buildings". Additionally, due to the fact that people spend from 60 to 90% of their life-time indoor, the *Buildings Performance Institute Europe* (2015) pursues that indoor air quality, thermal comfort and daylight aspects would be taken into account by the Energy Performance Certification. *The World Health Organisation* (2009) announces that indoor air quality and building operational performance impact people's health. *The European Commission* (2018) recommends to control building energy efficiency and air quality by using "information and communication technologies and electronic systems" and states that "building automation and electronic monitoring of technical building systems [...] are the most cost-effective alternative to inspections in large non-residential and multi-apartment buildings of a sufficient size" (*European Commission*, 2018). The building automation systems in conjunction with European regulations regarding building energy efficiency and air quality control have a vast positive impact on the HVAC equipment market development.

It is worth mentioning that *Energy Performance of Buildings Directive (EU) 2018/844* obliges the EU countries to provide guidelines and guarantee equal access to renovation financing to all

building stock segments, including energy-efficient and worst performing objects, household objects and social housing. The largest retrofitting challenge is with the rental property as stakeholders are not motivated to invest in retrofitting. According to Scholze (2019) recommendations, in order to overcome an unwillingness to renovate rental buildings, the EU countries should apply requirements of energy performance for the rental stock of building, too.

Despite *The European Union* ambition to renovate at an average 3% of total building stock, the actual renovation rate is only 0.4-1.2 % per year (Scholze, 2019). **The barriers that impact low renovation rate** are the following (Mlecnik, 2018, Straub, 2018, Haavik, 2018, Scholze, 2019, *The Buildings Performance Institute Europe*, 2020):

- Low technological solution knowledge of contractors (construction companies, construction site managers and others);
- Retrofitting design phase is expensive and time consuming;
- Renovation process needs frequent revisions as the state of the building during the design stage is uncertain in most cases;
- Absence of retrofitting-related comprehensive financing programs and unavailability of a long-term loans;
- Building owners' unwillingness to invest into the rental stock.

Retrofitting barriers are tightly related and impacted by the **following challenges of HVAC market** (*Research and Markets*, 2019, Thomas, 2019, *Market Watch*, 2020):):

- Lack of understanding of retrofit capabilities of how novel HVAC technologies can be conducted with the existing ones in order to obtain proactive monitoring of system functioning;
- Insufficient integration of different BMS as historically building management operations and services have been kept as separate entities, each with its individual monitoring, management and maintenance;
- Improper planning and maintenance of a building automation system, poor proactive system maintenance policies, which leads to reactive costly maintenance;
- Shortage of skilled HVAC personnel due to increasing requirement for competencies, which require an expensive and constant knowledge updating;
- Investment challenge due to the lack of understanding how this investment benefits in a long-term perspective, such attitude leading to reluctance of novel "smart" technology adoption;
- Growing raw material prices negatively impact HVAC equipment prices;
- Lack of product differentiation;
- HVAC specialists are inclined to work with the conventional systems they are used to, despite the fact that the shift towards novel technologies when HVAC can be managed with the modern technologies available in daily life is crucial in order to attract new generation HVAC specialists.

The listed HVAC challenges cover the whole HVAC industry: HVAC Equipment and HVAC Aftermarket & Service. According to the empirical research interviewees, a niche HVAC BMS sector that requires advanced knowledge about **BMS faces** similar to HVAC industry, but more **specific challenges:**

1. The number of experienced HVAC BMS engineers decreases. Due to the sector complexity, a new generation is not interested in HVAC BMS engineering studies. According to an interviewee, "in America 70-80% of HVAC engineers will be retired soon" and the fast growing HVAC industry needs to be prepared for the **lack of talented engineers.**
2. Historically, the BMSs have never been treated as an independent HVAC sector and always **go in line with the complete HVAC system one-time installation projects won during procurements**. Therefore, small or medium size BMS integrators are limited to participate in the large procurements as they do not have their own programmers. As an interviewee has explained, it happens that there is no object for a year, but the staff must kept, since, in case of success, competent people are needed. This business tradition requires „a financial resources in order to maintain your employees without objects", what small and medium integrators are challenged by.
3. Only a small number of large BMS integrator companies, such as *Eltalis ir Co, Caverion*, *Fima* and several others, can afford to employ full-time BMS programmers. "Lithuania is small. There are 3, 4, 5 large companies, which could manage the big objects like "Akropolis": to install and to programme BMSs", an interviewee gives an example. Therefore, s**mall and medium HVAC integrators are challenged to outsource BMS programmers,** which the market lacks.
4. The whole HVAC system installation requires enormous investments. Therefore, it is common practice that the **lowest price wins** as different HVAC manufacturers' portfolio is identic.
5. *The European Union amendment (2018/844/EU) to the Energy Performance of Building Directive*, which supports building retrofitting acceleration due to 2050 plan to reach "energy efficient and decarbonized building stock" (United Nations, 2018), **does not make an expected impact on the building retrofitting scale as many buildings in Europe are rental properties** and stakeholders are not willing to invest. An interviewee explains that "the BMS is mostly affected by green movement driving forces, because countries that pay huge attention to air and environmental quality are ready to invest in monitoring and control systems".
6. The situations requiring advanced HVAC BMS competence are the cases of the building renovations or reconstructions. The ideal case is when the customer decides to change the whole current HVAC system to a novel and more technologically advanced one. Unfortunately, such a situation is more an exception than the principle. The usual practice is that procurements are arranged only for a certain part of the whole HVAC system, which results in the existence of **various systems in one building that do not communicate** between each other as they are installed in different years with different technologies that do not support each other. Therefore, it is extremely challenging and expensive to retrofit such systems.
7. The IT technology integration into the HVAC devices faces a challenge of IT and engineering technology life-cycle discrepancy. The **BMS software life-cycle is around 5 years**, while HVAC facilities remain in a proper condition for many years. Customers are not aware of these

life-cycles discrepancies, therefore, the frequent practice is when the **BMS software is utilized even after some system monitoring malfunctioning,** which leads to a risk of the system breakdowns and reactive maintenance.

8. Additionally, the fast developing IT technologies lead to a situation that the **BMS software is not supported by the supporting software provider anymore** due to security or technology obsolescence reasons, or it faces situations when the retrofitted part of the BMS does not communicate with the old part.
9. Interviewees raise the standardization issue as currently different manufacturers produce HVAC BMS according to their or the customer's standards. "Mini devices, IoT - they make the building management easy. This needs **a unified platform**. Therefore, **standardization is needed**." - an interviewee argues.
10. Due to the fact that HVAC BMS manufacturers face low competition, and technological development is based on customer solutions, the **BMS sector's innovations stagnate**. The fact that "nobody brings BMSs to exhibitions" indicates that the BMS area is left to self-sufficiency. The *Computrols Inc* marketing manager Scott Holstein explains the situation: "Building automation industry is slow to adapt to new technology, wanting to see it proven in other fields before implementing it in large-scale commercial applications" (Smyers, 2017). Despite this state, the BMS integrators give the first signals of their readiness for more technologically advanced BMS solutions because they started to face the need to **change outdated HVAC installations of construction boom before the 2008-2009 economic crisis**.
11. Currently there are a **handful of HVAC BMS manufacturers that share the global market** and **have the market price setting power**.

According to interviewees, the major HVAC product manufacturers which produce BMS softwares are *Johnson Controls International, Honeywell, Siemens, Schneider Electrics*. "They do not differ. They copy-paste everything from each other. They have the identical product portfolios. [...] The product prices are similar. They are global players. They set the market prices. These manufactures offer complete portfolios. BMS software is included in their product packs", an interviewee briefly describes the current BMS market situation. Due to the product complexity, current BMS manufacturers realize their production via BMS integrators who customize every BMS software by programming it at their clients' premises according to their specific needs.

An interviewee explains: "Most often, everybody works with large suppliers, who have a complete list of products from A to Z. All our competitors, integrators, including us, cooperate with 1-3 global manufacturers and suppliers. They buy complete solutions, starting with devices and ending with the BMS softwares". Herewith, another interviewee complements that "all integrators marry one supplier and do not migrate, because workmanship is done. It is complicated to change the supplier and to adopt new technologies because firms need to change the qualification of their engineers. It costs a lot. That is the reason why integrators have one supplier and try to sell its products for ages". Therefore, only few BMS manufacturers share the majority of the market, which is split according to the integrators' choices and historical HVAC purchases. Thus, the niche HVAC BMS market develops slowly, because, according to an interviewee, "the global players

amend their products, technologies, simplifications according to the feedbacks from customers or users", but not by their own initiative.

According to an interviewees, there are around 10-25 small and medium HVAC integrators who outsource BMS programmers and only 3-4 large ones who have employed BMS programmers. All of them purchase *Johnson Controls International, Honeywell, Siemens* or *Schneider Electrics* HVAC equipment and BMS softwares. The software is produced by the manufacturer with a standard configuration and needs to be reprogrammed according to the customer needs on-premises. The smaller players do not have human resources for such service, so, they usually outsource BMS software programmers via the BMS integrators' network, which informally exists in every country. Due to the lack of BMS programmers, small and medium integrators are placed in a queue, therefore, they face a risk of late completion of the projects.

Even though the existing IT technology (IoT) has enabled customers to control HVAC processes, such as ventilation, through smartphone applications, and mobile technologies have enabled proactive maintenance, the integrators still face a challenge to find BMS programmers who could prepare this smart system for proper remote control.

During the recent years, HVAC BMS engineers have been developing cloud BMS concepts, BMS engineers register patents and large BMS companies apply for these patents. Some of the patents are active already, some of them are still under the pending stage. For example, in 2018 *Johnson Controls* applied for a patent "Building management system with alarm generation, cloud storage, and visualization" registered by Duraisingh (2017), Strand (2017) and Palzewicz (2017), which is under the pending status, *Siemens* application for a patent "Cloud enabled building automation system" (Wei, 2017, Darie, 2017, Ji, 2017, Song, 2017) was granted in 2017, *Honeywell International*'s application for a patent "Cloud computing system and method for advanced process control" (Pandurangan, 2017, Manjunath, 2017, Dave, 2017) was granted in 2017.

While large companies are busy with the acquisitions of the patents, the emerging small and agile companies are already introducing their own cloud BMS solutions to the HVAC BMS market. Excluding the *BMS Company*, an empirical research investigated four emerging companies, whose business models or marketing campaigns are based on the cloud computing technology. The emerging cloud BMS companies are:):

- *Piscada AS*, Norway
  Started its activities with a SINTEF project in 2007. This project was sponsored by Norwegian industrial companies in order to proceed a feasibility study of availability to integrate IT platforms into monitoring, control and reporting in aquaculture. In 2009, *Piscada AS* was registered as a company. Since 2017, the company activity has been strongly oriented to software development of cloud based process management for automation and industrial IT in water treatment, building automation, aquaculture fields. Piscada is widely known in the domestic Norwegian market, but not outside its borders.

- *Evolo AS*, Norway

The Norwegian startup *Evolo* was established in 2017. According to the company's website, it provides cloud based BMSs software solutions, which allows to monitor and manage heating, lightning and ventilation systems. The fact that the webpage is available only in the Norwegian language and the projects' portfolio consists of Norwegian brands suggests that *Evolo*'s target market is Norway at this stage.

- *R8 Technologies*, Estonia
  R8 Technologies was established in 2017. The company provides the cloud BMS software that aims to decrease energy consumption in commercial buildings. They have in their portfolio the shopping centre Viru Keskus (Estonia), the first in the world, where its operational efficiency is controlled by mathematical algorithms in order to find the most efficient way of controlling heating, ventilation, air conditioning by including weather forecast data, energy prices, every premise demand into calculations. *R8 Technologies* portfolio consists of 9 commercial and governmental buildings in Estonia and 2 commercial buildings in Finland. In addition to the domestic Estonian market, the company has established the sales network in Latvia, Finland, Netherland, Portugal, moreover, they have an advisor in Germany.

- *WideSky*, Australia
  According to the *WideSky* website declaration, the company counts over 30 years experience in delivering IoT solutions for construction, industry and energy sectors in Australia. The company's product portfolio contains a cloud software solution. The company is strongly dependent on partners in order to implement customized BMSs.

Although some of the emerging cloud BMS companies have a decade or longer experience in HVAC, they are all novice regarding cloud solutions. "They all are under development. There is not a single company who would be the cloud BMS solution leader", - an interviewee has explained the current situation, - "it is just a question, who will reach the break-even point" of BMS SaaS public acceptance. HVAC BMS business is on the threshold of transition to cloud, therefore, the next chapter will analyze the *BMS Company* strengths and weaknesses, opportunities and threats coming from the market in order to understand its positioning and capabilities to release its BMS SaaS to the market successfully.

4.1.2. SWOT and VRIO analysis

The *BMS Company* existence is based on one product BMS SaaS and its maintenance, therefore, the company's strategic business analysis is tightly interwoven with the product development activities. During the interviews with the founders and discussion between the founders and an external expert, the strengths and weaknesses of the *BMS Company* were identified. The threats and opportunities described in the Market analysis chapter (Chapter 4.1) are reviewed from the *BMS Company* perspective in this chapter. Table 4 presents the key elements of strengths, weaknesses, opportunities and threats (**SWOT**).

Table 4. SWOT analysis of BMS Company

Strengths	**Weaknesses**
- Favorable reputation of the *BMS Company* founders as BMS programming experts within the domestic network - Wide domestic network of integrators - Know-how in BMS and in IT whose synergy is hardly imitable - The test BMS SaaS installments have positive feedback from customers - Precise development of BMS SaaS and technological excellence - Maximum security - Interoperability to any BMS standard - Low competition due to the fact that BMS is a niche product in the growing vast HVAC industry - Flexibility to customer needs - "Plug-and-play" installation - User-friendly interface is positively accepted by consumers - Independence from suppliers	- Lack of financial resource for programmers employment - Limited geographical extension - Unknown brand name outside the domestic market - New customer's fear to adopt cloud BMS due to its novelty - Procurement requirements with the included BMS part into holistic HVAC systems (no option to participate only with BMS proposal, need to collaborate with a partner) - Small and unattractive domestic market - Unconventional pricing model of subscription in the HVAC market
Opportunities	**Threats**
- Raising BMS demand due to growing constructions globally - Low competition of BMS providers in small and medium construction and retrofitting segment - Innovation-minded integrators are already looking for cloud solutions - Fast growing stock of residential buildings in the EU - EU environmental regulations - EU retrofitting funding programs - Decreasing number of BMS specialists on a global scale impacts an increase of "plug-and-play" solutions - COVID-19 health crisis highlights the importance of indoors air quality which should be monitored and controlled by BMS softwares	- Emerging cloud BMS providers having vaster financial resources and aggressive marketing - Public procurement for the lowest price do not separate BMS from the whole HVAC - COVID-19 crisis negative impact on finance industries, construction and retrofitting sector - Short technological life-cycle - Patents of cloud computing acquired by global BMS manufacturers - Market price setting power of global HVAC BMS manufacturers - Fast technological evolution making existing technologies obsolete

Strengths

The *BMS Company* founders have 17 years experience in HVAC and building automation industry within the largest Lithuanian and international HVAC and BMS integration companies. During this period, the network of large, medium and small HVAC integrators has been built because of many subcontract projects, especially for BMS programming work that medium and small companies lack competences for. The quality of programming work has earned the founders a favourable reputation as one of the most experienced BMS programmers in the domestic market. Therefore, the message about BMS SaaS as an alternative of a local BMS is passively spreading within the domestic network on a "reputation-based" principle without any sound advertisement.

An in-depth understanding of heating, ventilating, air conditioning physics and it's automation processes in the buildings with the synergy of IT programming skills have built a strong and inimitable know-how foundation, thus setting the company in the foreground compared with the other emerging cloud BMS providers, which are skilled IT performers first. A Founder states: "Our advantage is that we have know-how, others have deep knowledge in automation or IT, but we have both: automation and IT. Of course, it is possible to hire two separate specialists. In this case, two separate competences need to be matched. There is a big difference when all the know-hows are in one head. This protects us from miscommunication of two competencies." Despite the fact that the *BMS Company*'s BMS SaaS is under the development and the testing stage, and no active sales are performed, the pioneer customers, who previously had collaboration experience with the founders, are willing to cooperate for the BMS SaaS project already at the testing stage.

During many years of programming practice with the global manufacturers' licensed BMS softwares, the *BMS Company* founders have noticed that these softwares have many tools and features used only once for installation and programming purposes, but never used by end users, who have paid for them full price. Usually the installation of a BMS software requires advanced competence and skills in order to customize standard software package and integrate it into a customer HVAC system. Therefore, the need for special skills and advanced competencies during BMS installation challenges small and medium integrators' companies that lack such competencies. Thus, the novel BMS SaaS is developed in the way that installment is on a simple "plug and play" principle, which does not require any special knowledge in order to install it. Security issues are precisely analysed and all possible prevention actions taken, in order to guarantee maximum possible data security. The BMS SaaS interface is user-friendly and has been praised by pilot customers for a minimal design as there are only those features that are used by end users. The product interoperability and portability challenges described in Chapter 2.2.3.2 are solved as well, since the BMS SaaS is developed in such a way that it can match any HVAC system standard and can be integrated into any customized HVAC system with no or with a minimum programming intervention. Thus, interoperability delivers vast flexibility possibilities. The end users' vendor lock-in issue is also solved, as this product is technologically developed in the way that different standart systems are interoperable and any new object can be connected to BMS SaaS. The BMS SaaS differs from conventional BMSs that it is universal for all HVAC systems. Other cloud BMS software emerging creators develop BMSs according to IoT equipment requirements, while the BMS Company is not dependent on any equipment supplier due to their universality.

The gained HVAC and IT know-how, in a combination with the founders as experts' reputation within the network of integrators, has a strong power at the cloud BMS concept presentation and the potential customers' willingness to adopt it. The knowledge about the market need is benefitting in product development, which is already positively evaluated by test users. Although competition is low due to the niche specifics of the BMS market, the *BMS Company*'s ambition is to gain a competitive advantage with the technological excellence, what differentiates it from other cloud BMS providers, who are focused on matching IoT equipment available in the market. The first positive feedbacks about the BMS SaaS together with the *BMS Company* reputation and the

network of integrators have a powerful impact on the BMS SaaS recognition potentiality and spread at the early stage.

Weaknesses

The financial resources are the most challenging of all the weaknesses that *BMS Company* faces. Shortage of finance hinders the BMS SaaS development because it is a barrier to hire programmers. The founder during the interview declared that founders "are developing everything on their own resources", they utilize their "own ideas and personal time", therefore, fast BMS SaaS development and speedy geographical extension is limited. An option of gaining financial resources through investors is not explored as the BMS SaaS product is still at the development stage. In order to accelerate business, a financial injection would be beneficial in providing a possibility to employ talented programming specialists. Currently the *BMS Company* faces a closed-circle situation when, in order to become interesting to investors, the portfolio of subscribers must be collected, while the network of subscribers can be collected after the product is developed and geographical extension processed, yet, the product development and geographical extension can be performed faster with a larger number of programmers, and programmers may be employed when having proper financial resources.

Although both founders have highlighted the only one - financial issue and "nothing more", the research shows that there are many more weak points that need to be overcome. The domestic market is rather small by its size and has low purchasing power, the foreign market could become an attractive solution. Contrary to the domestic market, the *BMS Company* is poorly known abroad. Knowing the fact that HVAC business is a "reputation-based" one, the poor brand recognition abroad may impact the lack of trust and willingness to adopt. The limited financial resources are a barrier for sound marketing campaigns. Therefore, at this stage when the company performs only passive sales, foreign customers find the *BMS Company* through Lithuanians partners and recommendations. But this does not generate a promising number of new foreign customers. The other BMS related challenge is that "those, who see presentations usually do not understand about it (BMS SaaS, the author's note)" as it is a novel concept in the market. The founders are still under the investigation process of their true customers: integrators and service companies or building owners. The founders have found that customers express uncertainty of BMS adoption due to the fact that nobody have had any experience with cloud BMS. In order to accelerate willingness to adopt cloud BMS, according to the founder, there is "a need to find a way how to present this product in very simple way".

According to the founder, "a killer of a cloud concept is the public procurements", which mainly have the same requirement line "a BMS has to be", which is included in the holistic HVAC equipment purchase. The mentioned issue is a huge barrier for participation in tenders as an independent BMS providing company. On top of everything, the BMS SaaS concept is transforming the conventional BMS purchasing model from one-time purchase to many years subscription, and it requires a huge jump in customer thinking, in order to persuade him to be tied to a subscription fee. The usual practice is that the customer has a certain budget for the whole HVAC and BMS equipment and its installation. The customer is willing to purchase the whole HVAC

equipment and BMS at once. The founder states that it is a great "challenge to tie the customer to a subscription fee [...], how to motivate a customer to pay subscription if he never did it". This could be overcome by presenting a comparative case study of 5 years' licensed BMS and cloud BMS utility results through financial, functional and deterioration perspective.

Threats

Despite the fact that HVAC BMS is an extremely niche sector in the vast growing HVAC industry and the new cloud BMS entrant described in Chapter 4.1 is still under development, while the market investigation stage or the existing global players stagnate, the market situation exposes several threats that need to be considered as well.

The HVAC BMS market competition rules are settled by the four global players *Johnson Controls International, Honeywell, Siemens, Schneider Electrics* as they dictate the market prices of the products. The BMS integrators are "married" to one of them, and are not prone to exchange the BMS supplier due to the high switching costs related to the engineers' qualification certification. Likewise, the end users are locked-in because of the HVAC equipment and IoT historical purchases as different manufacturing systems are not interoperable. Therefore, neither the end users, nor integrators are inclined to exchange BMS suppliers. The new cloud BMS providers face a challenge to reach a break-even point in untying the long-life "marriage" stamped by vendor lock-in and switching costs issues. Despite the strong lock-in bonds of the end users, integrators and the global BMS manufacturers, the global convectional BMS providers do not ignore technological evolution and are purchasing patents of cloud BMS concepts in order to sustain technologically advanced. According to interviewees, the patent purchase is not a dangerous threat as these companies' business models are based on product or license sales without after-sales maintenance. Either, every company existing in the market or a new entrant develop their own cloud BMS solutions. While large BMS manufacturing companies are busy with bureaucracy of acquiring the cloud BMS patents, "the smaller and medium size contractors seem more flexible to introduce new solutions" (Veenstra, 2016, Kaashoek, 2016).

The new cloud BMS entrants *Piscada* and *Widesky* have strong financial background from their daily activities and workmanship in the market, *Evolo* and *R8 Technologies* have been financially injected by investors and funding programs. Financial resources open the possibilities to faster and more experimental product development and ability to proceed active sales with the support of sound marketing in order to gain a market share from conventional BMS. In order to realize the *BMS Company'*s ambition to be a part of the cloud BMS markets as other new entrants, it needs to find solutions how to make itself visible on the stage outside its network as well.

According to Veenstra (2016) and Kaashoek (2016), the public procurements and cooperation with municipalities would be a great opportunity in accelerating extension, however, the threat is that these procurement tenders are organized with the aim to be offered the lowest price, but not the most optimal technological solution. Usually the procurement requirements are created by the municipality contractors who have low HVAC BMS technological knowledge. The other part of potential customers with a high technological knowledge that may be willing to adopt cloud BMS,

express fear that it is “problematic to predict the future of a particular technology” (Krotov, 2017) and their willingness to adopt cloud BMS is minimized by shortening the technological life-cycle. According to founders, “a technological obsolescence risk exists in both local and cloud BMSs”, and they provide an example that end users face currently: “The BMSs can not work just because an encryption technology has changed, it can not be opened just because it is not supported anymore by the manufacturer”. In this case, the innovation culture and technological literacy of a company play the main role in novel technology adoption.

Nowadays, uncertainty comes from the COVID-19 crisis, which has a huge impact on finance. The retroffing funding mechanisms obliged by the *Energy Performance of Buildings Directive (EU) 2018/844 of the European Parliament and of the Council* may be sustained for a while. Today it is difficult to speculate about COVID-19 impact on the various industries in different markets as the scale of the crisis is not known yet.

Regardless of the fact that the BMS market has four giant BMS players and emerging small cloud BMS entrants, where “everybody finds its place as the market is huge”, the founders highlight the most dangerous threat in the coming 10 years: “In case the cloud BMS market will rise and a higher scale will be reached, larger players will come [...], in case there will be many devices connected to the Internet, *Google* will develop something”.

Despite the described *BMS Company* weaknesses and possible threats coming from the market, the businesses always search for all possible opportunities in order to overcome barriers and to succeed.

Opportunities

The cloud computing technology penetrates into whole industries. The HVAC industry is not an exception, as well as the pilot cloud BMS software projects appearing in the market. Chapter 4.1 describes the opportunity trends and drivers benefiting in HVAC industry success, while in this chapter they are more deeply analysed from the *BMS Company* perspective.

With the cloud computing technology, new cloud BMS entrants appear in the market, but they have not traveled a long way towards gaining the market share. All of their strategic directions are fluctuating as all their cloud BMS development processes are maximum 2 years old, and currently they are at the product release stage. According to the founder, “there is no company which would be the cloud BMS solution leader”. All BMS developers have different directions and their business models are differentiated. Therefore, every cloud BMS provider may find its customers according to their needs. According to the empirical research interviewees, the cloud BMS “platforms are created for IoT by those, who sell them, [...] producers make single platforms for their devices and they have to suit in all cases”, this fact opens a great opportunity for the *BMS Company* as it has taken the opposite direction - to develop flexible BMS SaaS which is interoperable with all the HVAC system standards. This was reached by the software technological development excellence, what had not been done by other emerging BMS providers. The most potential new entrant *Piscada* made a strategic mistake by choosing a wrong technological solution, which has become an obsolescence already, therefore, all their time and financial resources are focused on redeveloping their software framework “from zero”. That is a great opportunity for foreign brands to enter the

Scandinavian market, which is known as extremely loyal to its local brands and extremely attractive to BMS integrators due to its high environmental requirements.

Despite the fact that the issued *The European Union amendment (2018/844/EU) to the Energy Performance of Building Directive* has not reached its desired impact on the renovation volume, the growing attention in separate countries to outdoor and indoor air quality, especially in tertiary sectors, brings a lot of benefit. Municipality projects can also be an option, as most of their buildings (schools, hospitals, governmental premises and etc.) have many engineering systems in a building, which do not communicate. "There are plenty of versions produced by different manufacturers in 10-20 years. The main headache for the users is that systems do not talk to each other. And everybody knows this problem, but nobody invests in it, because it is an enormous amount of money. The problem is that nobody gives money for the system retrofitting, but retrofitting is necessary" - an interviewee explains the situation. BMS SaaS can be an option to merge all these old and new systems into a holistic system. The BMS SaaS flexibility delivers the ability to renovate old buildings by stages without switching the HVAC system functioning.

The cloud computing penetration into the HVAC BMS has opened the collaboration gates for small and medium companies as well. Before the cloud era, BMS software integration was a privilege of large companies. According to the founder, the *BMS Company* develops the "product to that market segment which did not have any choices [...], any suitable solution", because the BMS production was oriented only to large and strategic objects. "A cloud solution is needed in the market" and the founders need to exploit their reputation for their BMS SaaS promotion to integrator's firms.

The COVID-19 health crisis may leave its impact on prioritising regarding the tertiary sector renovations and its importance to guarantee the high quality of indoor air in public buildings, such as kindergartens, schools, social houses, hospitals, etc.

Despite the BMS Company's weaknesses and market threats, the strengths and opportunities in gaining a competitive advantage sound realistically optimistic. Currently, the company is at the product development stage and uses its own financial resources, but it lacks larger financial injections for rapid geographical expansion as the brand is not known abroad yet. The founders' know-how, skills gained through many years of experience and the built domestic network of BMS integrators support the company's potentiality to win the market, as well as its own developed cloud BMS software - BMS SaaS. In order to identify tangible and intangible resources and capabilities having the highest potential of the company's sustainable advantage, the **VRIO framework** presented in Table 9 is used:

1. *Value*. The BMS SaaS enables the company to exploit the opportunities of small and medium integrators' market saturation. For example, BMS SaaS development benefits in value creation of small and medium BMS integrators and small companies who have no affordable BMS tool in order to deliver advanced "smart" service for their customers currently. A lower initial investment and payment of subscription is a solution for integrators or service with lower financial resources. An important and valuable fact about BMS SaaS is that installment is based on a simple "plug and play" principle and the interface is user-friendly, positively evaluated by

test users. Due to the BMS SaaS cloud nature, all cloud computing benefits of data analysis can be performed without any additional software purchase that a conventional BMS usually requires. The fact that BMS SaaS will be updated on time-manner and the customer will not face a software obsolescence issue increases the total value, which the customer perceives as well.

2. *Rarity*. Although the global demand of BMSs is rising and the global market lacks novel BMS solutions, the existing ones are expensive and inflexible. The research has identified only four emerging cloud BMS providers on the global scale, apart from the *BMS Company*. All new entrants of cloud BMS have different strategies and product development solutions, mainly oriented to the IoT devices of BMS systems. The BMS SaaS is developed differently - it synchronizes all the existing systems into one standard.
3. *Imitability*. The *BMS Company* know-how can be hardly imitated as the deep HVAC and BMS engineering knowledge of 20 years' experience is interwoven with the IT skills and strongly prevents from miscommunication of the two competencies. The founders have considered all the prevention steps so that the back-end of technological development could not be explored by imitators. To a research question about plagiarism the founder ensured: "You can copy the user's interface, but you cannot copy the backend. You can say that you can copy *Google*, it takes 5 min. to change the logo. Can it filter the necessary data from million sources?"
4. *Organization*. Due to the fact that BMS SaaS founders are already working in the HVAC BMS market, the systematic processes of the industry are known. The creation of the precise "innovative structure" is more challenging (BSD Designer, 2020): management systems, policies and processes. The BMS SaaS is created in the way, that minimal impact from the BMS provider is needed, therefore, the provider can focus on software maintenance and updates with a minimal number of employees. All the processes have been arranged so that the customer could manage everything himself or they are automated, except customization required intervention. The cloud computing nature by itself ensures automated processes where a minimal number of employees is needed.

To sum up, the SWOT analysis highlights the fact that, although four global BMS software producers dictate the market terms and several new agile entrants are coming, the *BMS Company* has many strengths, such as low competition in the market, network, reputation, precisely developed BMS SaaS, to overcome all possible threats. The company weaknesses can be neutralized by opportunities: the EU regulations and environmental programs accelerate the BMS market, therefore the company's perspective to extend its geography and to gain brand recognition outside domestic market rises. The fact that small and medium size integrators are not in the focus of large BMS software producers, the BMS SaaS nature and subscription fee makes the BMS solution affordable to this vast group of customers. VRIO analysis approves that the BMS SaaS is valuable, rare, hardly inimitable, and the company's processes are thoughtful and organized to capture value. Therefore, it is reasonable to think that the BMS SaaS has a competitive advantage. The BMS SaaS version is already in the test stage and the customer feedbacks delight. The pioneer steps of the cloud BMS invention in the market deliver a promising perspective as the *BMS Company* can utilize the first mover's advantages. Before presenting the business model innovation

and how the company can maintain and improve its competitive advantage, the key success factors are analyzed in Chapter 4.3.

4.1.3. Analysis of Key Success Factors (KSF)

The Key Success Factors (KSF) could be defined as the company proposals to customers in order to attract them to acquire the BMS softwares. According to the founders and interviewees, the main HVAC and BMS key success factors by priorities from the most important at the top to the less important at the bottom are:

1. Price;
2. Security;
3. Reliability;
4. Know-how;
5. Flexibility.

Price. Due to the fact that conventional HVAC BMS global manufacturers have identic portfolios of their production, the procurements are arranged for "the lowest (usually!) price", which do not differ much because of low competition. Due to the fact that the cloud computing pricing models differ from the historical licensed BMS one-time payment, it is challenging to introduce the subscription pricing model (described in Chapter 2.2.3.4) to the the market used to conventional payment models. Due to the fact that the *BMS Company* competes in the same market as conventional BMS providers, the BMS SaaS price has to be not higher than the conventional BMS's one. Considering the fact that the licensed BMS Software life-cycle is around 5 years, the subscription fee sum of 5 years needs to be at least the same as the licensed BMSs. An interviewee has shared his negotiation experience with one cloud BMS provider who has proposed a cloud BMS service for a subscription fee, the sum of which for 5 years is double compared with the licensed software purchase, that caused doubts regarding the cloud benefit as its functions do not differ from conventional. Therefore, the interviewee advises to keep the same level or lower price than the conventional BMS. The subscription fee is influenced by many factors. All factors should be considered: BMS Company reputation, its programmers' know-how, expenses, technological excellence, market feedbacks, security level and interoperability.

Security. The scientific articles described in Chapters 2.2.3.2 and 2.2.3.3 state that security is the most cited challenge. The founders and interviewees highlight that the "customers make an accent on security" as well. The term "security" covers data protection, technological security and compliance with regulations, law and social values. Information security is related to the prevention of data loss and unauthorized access to data. Since "there is no 100% security" (Alshammari, 2017, Alhaidari, 2017, Alharbi, 2017, Zohdy, 2017), it is extremely important to choose reliable PaaS and IaaS partners as the data location center needs to meet data protection requirements of the specific country. The selection of the cloud computing private deployment model, described in Chapter 2.2.2, is strategically important for security issues as well. The legislative security issues and regulations are described in Chapter 2.2.3.3. The customer trust level can be raised by respecting legislative requirements and Service Level Agreement (SLA). The founders supports the security

prevention by transparency: " there have to be security certificates or technologies, documentation where everything is described [...], employees could check documentation and recommend or not recommend collaboration".

Security in not only reality, but also "a feeling" (Shimba, 2010), all the possible steps taken for ensuring security raise the customer's trust in the cloud service provider.

Reliability. During the empirical research, reliability has singled out as one of the more significant factors by the founders and all the interviewees. Thereupon, the company's reputation and trust within the networks is built on top of reliability. The term "reliability" means a company's trustworthiness and eligible continueds performance.

Despite the fact that the test version is already installed by a small group of customers in order to collect feedbacks and to amend the BMS SaaS, the founders are willing to develop technologically excellent BMS SaaS with minimalistic front-end (interface) solutions, and only then to start active sale in order to sacrifice the company's reputation by delivering the truly reliable product to the market. There is a deep understanding of impeccable product development, and it is the priority.

Know-how. The current BMSs have many complex issues, such as interoperability and inflexibility, complicated and cost consuming integration process, additional software purchase from other software providers for data analysis. The BMS SaaS solves the mentioned issues due to the know-how based decisions. The software is developed in the way that synchronizes different systems to communicate. The installation of the software is based on "plug and play principle', which does not require additional costly programming work from integrators, therefore, integrators are free from BMS programmers' search. The interface is user-friendly, no special training is needed to manage this software. The cloud computing and machine learning technologies provide a possibility not only to monitor and control the system functioning, as it is in conventional BMS, but also to analyse and stock data without any additional software and server purchase. The machine learning delivers process-effectiveness and more precise proactive BMS maintenance. Obsolescence is overcome by constant updating.

Flexibility. Flexibility is the fifth key success factor highlighted by the founders and interviewees. According them, flexibility means "functionality, universality", "mobility, an easier access to the system" and user-friendliness. A product design must reflect the "simplicity without any over-engineering". As the founder states "in reality we compete for functionality, universality. We need to be focused on the end user and not over exceed by features". The technological solution of a universal product communicating with all the HVAC BMS standards is the ideal example of flexibility.

Table 5 presents the Key Success factors' comparison between the MBS market players: licensed and cloud ones.

Table 5. Key Success Factors comparison by competitors

Key Success Factor	Importance	Company					
		BMS Company	Licensed BMS software companies	Piscada	R8 Technologies	Evolo	WideSky
Price	0.3	4 → 1.2	5 → 1.5	4 → 1.2	5 → 1.5	N/A	N/A
Security	0.2	5 → 1.0	5 → 1.0	5 → 1.0	5 → 1.0	N/A	N/A
Reliability	0.2	5 → 1.0	5 → 1.0	5 → 1.0	4 → 0.8	N/A	N/A
Know-how	0.15	5 → 0.75	5 → 0.75	5 → 0.75	4 → 0.6	N/A	N/A
Flexibility	0.15	5 → 0.75	1 → 0.15	4 → 0.6	2 → 0.3	N/A	1 → 0.15
Total	1	4.7	4.4	4.55	4.2		

Due to the fact that information about *Evolo* and *WideSky* performance is least available, these companies are excluded from calculations in Table 5. The licensed BMS software companies *Johnson Controls International, Honeywell, Siemens, Schneider Electrics* have a strong positioning in the market as they have global dominance, but their weak point is their flexibility because they produce local BMS softwares according to their own standards what locks-in clients to their HVAC equipment purchases in order to have a properly functioning HVAC system. Despite the fact that BMS software is expensive and the global licensed BMS software manufacturers set the global prices, their prices can be considered as a reference point for comparison with other companies. *R8 Technologies* have the same level of prices as licensed BMS softwares, but their value proposition: the cloud BMS software which is fully controlled by the company remotely in order to manage the HVAC system in the most financially efficient way. According the website description, there is a reason to assume that *R8 Technologies*' have a genetic pricing model described in Chapter 2.2.3.4. According to the interviewee who has collaboration experience with *R8 Technologies*, the disadvantage of such a business model is that in order to receive the maximum efficiency, the system flexibility and comfort of final users are lost as machine learning based data analysis settles the HVAC BMS operating mode, ignoring the human factor. Additionally, *R8 Technologies* cloud BMS is supported by a certain type of IoT devices. R8 Technologies know-how is deeply advanced in cloud computing and data analytics, but still missing experience in the HVAC know-how, the local BMS software manufacturers have strong know-how in local BMS softwares, but not in IT. *Piscada* and *BMS Companies* are the most advanced companies having a set of know-hows in building automation and IT.

Piscada has a similar positioning with the *BMS Company*, because their business idea and cloud BMS softwares are similar. Both companies' customer portfolio is small, therefore they can not offer a more attractive price to the market at the current stage. The strategic mistake of wrongly chosen PaaS is impacting *Piscada*'s flexibility, and currently it faces challenges of redeveloping

the cloud BMS software from zero. In summing up the key success factors, calculation shows that the *BMS Company*'s BMS SaaS is mostly advanced at the current stage.

Table 6 demonstrates how KSF are compatible with the BMS Company strengths.

Table 6. *BMS Company*'s Strengths and Key Success Factors Reconciliation

Strengths	Valuation	Key Success factors					Importance
		Price	Know-how	Reliability	Security	Flexibility	
Favourable reputation	5	2 → 10	3 → 15	3 → 15	3 → 15	1 → 5	60
Know-how	5	3 → 15	3 → 15	3 → 15	3 → 15	3 → 15	75
Technological excellence	5	3 → 15	3 → 15	3 → 15	3 → 15	3 → 15	75
Positive feedback	4	2 → 8	2 → 8	3 → 12	3 → 12	3 → 12	52
Maximum security	4	2 → 8	2 → 4	3 → 12	3 → 12	1 → 4	40
Interoperability	3	2 → 6	3 → 9	3 → 9	1 → 3	3 → 9	36
Flexibility	2	2 → 4	3 → 6	3 → 6	1 → 2	3 → 6	24
"Plug and play'	2	1 → 2	3 → 6	1 → 2	1 → 2	3 → 6	18
User-friendly	1	1 → 1	2 → 2	1 → 1	1 → 1	3 → 3	8
Importance		69	80	87	77	75	

Table 6 demonstrates that BMS Company's strengths as know-how and technological excellence most strongly support the Key Success factors: price, know-how, reliability, security, flexibility, while the reputation and positive feedbacks are the secondary important strengths supporting KSFs. The price is least dependent on the company's strengths, but needs to be considered in order to offer an adequate price and attractive pricing model to the market.

To resume, the SWOT, VRIO and KSF analysis have highlighted factors that need to be considered for gaining competitive advantage. Due to the fact that the emphasis of the research data analysis is on how to offer a *BMS Company* a strategy and business model to establish itself in the market, including internationally, the next chapter represents the Business model innovation of the *BMS Company.*

4.1.4. Generalization of the strategic analysis results

The strategic analysis has briefly described the HVAC and BMS market trends, drivers and challenges. The HVAC industry is one of the fastest growing industries globally, mostly impacted by increased new construction in the Asia-Pacific market. The European HVAC market is driven by new constructions, environmental regulations, climate annual temperature change, economic-growth and rising demand for retrofittings due to *Energy Performance of Buildings*

Directive (EU) 2018/844 of the European Parliament and of the Council, which entered into force on 9 July 2018.

Due to cloud computing penetration in various industries, the BMS market is revolutionising as well: a handful emerging cloud BMS software creators step the first trial steps in trying to gain some market share from 4 global licensed BMS software manufactures *Johnson Controls International, Honeywell, Siemens* or *Schneider Electrics.*

The *BMS Company* has developed the cloud BMS software - BMS SaaS, and is going to win some market share as well. Therefore, the SWOT analysis has been processed which highlighted that, despite the lack of financial resources, gap in foreign brand recognition, and carefully emerging new entrants, company‘s strengths such as domestic reputation of founders between network of customers, know-how and opportunities of raising environmental requirements has a strong power for business acceleration.

The VRIO analysis has shown that the company's BMS SaaS development is valuable for a customer, rare in the market as it is niche and revolutionary solution, hardy imitated due to developer‘s 20 years historical collection of HVAC know-how and prevention steps taken to software back-end protection. The organizational processes of a company are focused on fully automations of maintenance. The VRIO analysis of value, rarity, inimitability and organizational processes shows that *BMS Company* has a sustainable competitive advantage.

The Key Success Factors analysis has highlighted the importance of BMS software price, security, reliability, know-how and flexibility, where the Table 5 presents that BMS SaaS flexibility is the most impactful differentiator from other BMS providers. The reliability, know-how of how to solve BMS specific problem and what services are the key once, security and flexibility mainly are supported by the company‘s strengths such as know-how and technological excellence.

The strategic analysis shows that the company's BMS SaaS has a great potential to penetrate the international market, consequently, the next chapter presents the company's business model and strategy design.

4.2. Propositions for Business Model and Strategy design

There are 2 separate subtopics in this chapter: the first presents the business model and the second presents the design of the business strategy.

4.2.1. Key aspects of innovative Business model for *BMS Company*

Table 3 in Chapter 2.3.1 is the comparison table of HVAC, IoT and cloud computing business models. The SWOT, VRIO and KSF analysis has highlighted what key elements from Table 3 need to be transferred into a novel business model in order to innovate and maintain the *BMS Company* performance. Therefore, every Business model canvas element - the target customer, value proposition, channels, customer relationship, key activities, key resources, partnership, cost and revenue structure - is described in this chapter.

Target customer. The founders state that cloud computing technologies have provided an opportunity to grab the "middle customer" who has never been supported by larger BMS software manufacturers as BMSs have not been affordable. "Middle" means the whole group of small and medium-sized customers excluding the bottom line of individual dwellings not using BMSs and the top line of large and strategic objects where "special functions are needed and the system should be offline", therefore, using local conventional BMSs. For example, target customers may be BMS service and integrator companies of tertiary sectors (schools, municipalities hospitals, hotels, petrol station, stores, etc.). Additionally, it is important to indicate that the *BMS Company* are not going to focus on new constructions due to procurement terms where the BMS Software is included as an integral part of the whole HVAC system and are not going to focus on built objects where the BMS is not installed. The founders see a huge potential in retrofitting business as the stock of obsolete BMSs is rising on a yearly basis. Therefore, at this stage, the focus is on the BMS service and integrator companies, which maintain old, BMS retrofitting required buildings, corresponding to the "middle" definition.

At second market penetration stage could be focused on a group of people governing many buildings and responsible for their maintenance and energy efficiency.

Value proposition. Although the main BMS function is "climate control", the BMS SaaS value proposition is mostly based on cloud computing benefits, which make monitoring and control "smart". The founders state that "IT advantages, such as mobility, reporting, unlimited history, history analysis" deliver added value. The remote access to a system grants mobility, which benefits in operativeness of service.

Additionally, the BMS SaaS is developed so that it communicates with different standard systems, which grants high flexibility. Therefore, customers are able to "become unlocked with minimal switching costs".

Any BMS SaaS malfunctioning is maintained by the BMS Company, including regular automatic software updates. To compare with the situation of licensed on-premise BMS softwares, which usually become obsolete in 5 years, the regular cloud software update is timeless. Despite the fact that the software is based on cloud computing technologies, the maximum possible security is guaranteed because the IaaS and PaaS providers have been carefully chosen.

The last, but not least value proposition point is "plug and play" installation that does not require special competencies from integrators, and no programming work needs to be done, either. The user-friendly interface can be managed by users without special trainings.

Communication channel. Due to the HVAC BMS complexity, the BMS SaaS presentation to the market needs a direct customer interaction with the question-and-answers sessions between stakeholders. The founder explains that "nobody brings BMSs to the exhibitions", therefore specialized conferences, seminars within the networks of integrators or building managers would benefit in spreading the knowledge and building the network of potential customers. The founders

“are ready to go to every potential customer to present [...] the product personally by highlighting features that are the most important for the specific client.”

Relationship. According to Medvedev (2018), customers who are only satisfied with the product attributes can leave if their goal and motivation are better served by competitors, but the BMS sector reality is different as “it is not so easy to change the BMS provider” due to high switching costs. Although the founders state that the BMS is a “super niche product where end users are stewards, technicians” and “they do not need super communication, they need functions”, in order to satisfy customers, life communication must be practiced due to the BMS technical maintenance and episodical system amendments. The reporting about the BMS system functioning and machine-learning-based recommendations for proper system management efficiency will be provided on the real-time base. The subscription fee and SLA (briefly described in Chapter 2.2.3.3) lock the customer for a long-term relationship.

Key activities. The *BMS Company* is developing BMS SaaS, whose development status is 70 percent. Since the IT technologies’ life-cycle is very short, regular research and development (R&D) activities are needed permanently. The BMS SaaS will be released on LEAN startup principles, when software amendments are made according to the customer’s feedback. In order to provide proper functioning of BMS software, hardware and software monitoring and maintenance are managed on a daily basis. Due to the fact that IT technologies’ life-cycle is extremely short, regular updating is critical. At the early stage of a company, when the subscriber’s portfolio is small, additional BMS programming activities and integration work are proceeded with the plan to minimize these activities during the following stages. In the further perspective, the unpersonalized data sales for research companies may be added to the list of activities as well. Currently, the passive sale of the test BMS SaaS version is performed, but sound commercialization, including marketing and sales, is a part of the near future plan.

Resources. The combination of unique activities with the unique resources and capabilities translates into the long term competitive advantage, therefore, there is a strong need for talented and willing to learn software programmers as BMS is an extremely niche and complex field. Employment of a cloud security specialist is planned in the near future.

The founder states that having a “constant customer network” helps to “collect critical mass” which opens the “freedom of maneuver”, where other tangible resources that the company disposes of are physical infrastructure, such as IaaS, PaaS. The value creating intangible resources are their own developed technology BMS SaaS, know-how and reputation.

The security and quality certificates may benefit in foreign markets due to the trust gaining reasons, therefore they should be added to the resources list.

The data collected from objects may be sold to various research companies, but additional investigation regarding data protection and compliance to regulations needs to be investigated.

Partnership. The BMS Company’s philosophy is to sustain maximum independence from partners. The IaaS and PaaS provider is chosen by security, data location and an easy possibility to switch

provider criteria. The company is not dependent on any IoT (HUB) supplier, either, and IoT devices may be purchased from any supplier.

After the test BMS SaaS stage, in order to penetrate into the foreign markets and to proceed active sales, partnership with foreign agents should be developed.

Costs. The talented software engineers' (programmers') salary takes the largest part of the whole costs. IaaS and PaaS rental costs are a trifle compared with the programmers' wages. Additionally, the marketing and sales, including commissions to foreign agents, generate costs as well. The fact that the BMS SaaS is novel in the market, and the fear is a barrier for cloud BMS adoption, the founders declare that a free demo version of BMS SaaS will be available in order to "try-before-you-buy", which is usual practice in cloud computing industry.

Information about retrofitting procurements is announced via communities of specialists, therefore, the membership of such communities can benefit in building networks of target customers. So, in the near future, the membership subscription fee needs to be included in the costs as well.

Revenue structure. The revenue structure consists of subscription fees, BMS SaaS initial installation fees, BMS SaaS customization work. Due to the fact that the BMS Company's R&D is proceeded on its own resources and does not have any investor, it is extremely important that revenues from the BMS SaaS installation would cover at least the first year expenses in order to minimize the risk of negative profit.

Table 7 presents the key Business Model Canvas elements that support the BMS Company's innovation.

Table 7. Business Model Innovations of BMS SaaS

Target customer	Small and medium BMS integrator and service companies supporting old buildings
Value proposition	"Smart" data monitoring and control Regular software updates Security "Plug and play" installation and flexibility User-friendly interface
Channels	Direct sales
Customer relationship	Co-creation of system amendments Machine-learning based recommendations SLA
Key activities	R&D Regular updating Customized BMS programming services and integration works
Key resources	*Tangible*: Talented software engineers (programmers) Network and security specialists (near future) Network of customers *Intangible*:

	BMS SaaS Know-how Reputation
Partnership	Foreign agents (near future)
Cost structure	Human talent salary Commissions to foreign agents (near future) Try-before-you-buy demo version (freemium)
Revenue structure	Installation payment Subscription fee Payments for customized and additional programming work

To resume this chapter, the HVAC BMS company's novel business model by its nature is far from the conventional HVAC business model (Table 3), and rather close to the cloud computing business model with some ideas integrated from IoT business model.

The BMS SaaS business model represents the processes of how the company is going to maintain its business, the next chapter will present the strategic choices of how the *BMS Company* are going to win some market share in the near future.

4.2.2 Integral model of *BMS Company* strategy

The *BMS Company*'s strategic design is built according Hambrick's (2001) and Fredrickson's (2001) Strategic Model based on five major elements of strategy (Figure 10): arenas or scope, vehicles or entry modes, differentiators or competitive advantage, staging, and economic logic.

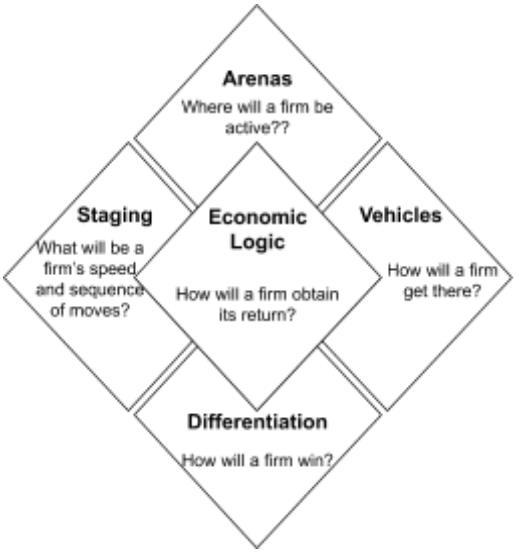

Figure 11. Five major elements of strategy (Hambrick, 2001, Fredrickson, 2001)

Arenas

The *BMS Company* plays in the huge HVAC industry's niche BMS sector. The company has developed cloud computing technology based BMS software - BMS SaaS, whose main task is

"smart" monitoring, control and data analysis of building BMS. The founder explains the background of the idea: "We can not compete with big players that produce conventional on-premise and offline BMSs, we will not win against them. Therefore, we have developed a cloud platform for small and medium customers who do not have any affordable BMS choices currently." According to an in-depth analysis, the developed BMS software service is going to be provided for small and medium size integrators who do not have their own BMS programmers and are responsible for building BMS maintenance, which needs to be retrofitted. The scholars Veenstra (2016) and Kaashoek (2016) propose to concentrate on small and medium-sized contractors for retrofitting as they are more flexible to adopt new technological solutions as well.

The research results propose to focus on the markets where "the requirements for the environment of public places is high" as "those countries that follow regulations strictly are willing to invest in prevention." The SWOT analysis has highlighted the opportunities to exploit those markets that have high stock of obsolete BMS systems. Therefore, taking into account market attitudes towards the environment and the existing number of old buildings, according the *United Nations* Global Status Report (2018), the most advanced countries regarding actions "towards a zero-emission, efficient and resilient buildings and construction sector" are Scandinavian countries, Germany, the Netherlands, France, Switzerland, the United Kingdom and Spain. The mentioned countries may be the focus markets for the geographical extension as the founder confirms that "the advantage of these markets is that people know how much it costs to retrofit old BMS systems" because usually these markets have many BMSs. The advantages of the listed countries is their purchasing power as they own some of the highest GDP per-capita in Europe. The fact that the founders have contacts in the Netherlands and Norway impacts the first entry choice, for this reason deeper investigation regarding the country's compliance is needed. The domestic Lithuanian market is interesting from the BMS SaaS test market perspective.

Vehicles

The BMS SaaS is fully developed internally. The R&D is performed on the company's own financial and human resources. Since the BMS Company has limited financial resources, it uses the Lean Startup approach for its product development when the development of minimum viable products is tested continuously, that prevents the company from huge losses and failures because the processes are centered around product development.

Due to the fact that cloud BMS is a novel concept, the international expansion should proceed on the green-field startup principle.

Differentiation

As the market is agile, and every moment a new cloud BMS entrant can appear, the *BMS Company* has chosen to follow the best combination of differentiators' approach.

According to Chapter 4.3, the Key Success Factor analysis shows that prices, security, reliability, know-how, flexibility are the main factors influencing the BMS sector success. The KSF comparison in Table 5 shows that BMS SaaS differentiate by offering flexibility, while other

criteria do not differ much. Flexibility means "functionality, universality", "mobility, an easier access to the system" and user-friendliness. According to the founders, the BMS SaaS solution differs from other emerging cloud BMSs by the idea to provide a total software management freedom for users. The BMS SaaS user has a complete management control of the BMS functioning, while other cloud software providers control the client's systems themselves by taking a part of the service company functions.

The BMS SaaS is developed in the way that is interoperable with all BMS systems, this means that software communicates with any BMS standard available in the market, thus ensuring a possibility to perform expensive retrofittings by stages, which is a revolutionary and valuable achievement in the HVAC and BMS sector. The founder stated that the *BMS Company* "will not play marketing games, it will focus on technical realization" and reliability, therefore the technical excellence and know-how play the key role in reaching differentiation.

Despite flexibility and the company's focus on cloud computing benefit from data analysis and machine learning, when the most resource-efficient management recommendations are generated by machines, the research results show that totally automated BMSs sometimes are disadvantaged, as the human factor is not calculated in, therefore, the BMS SaaS flexibility in making system management decisions is left to the operator.

Even though the back-end of the software is a high-end development, the front-end development is user-friendly with a minimalistic interface design.

Staging

Despite the fact, that "in business strategy there is no universally superior sequence" (Hambrick, 2005, Fredrickson, 2005), the initial plan of business development speed and sequence must be prepared.

Considering, that the BMS Company's weakness is a lack of financial resources and programmers, and the company is at the testing stage of its BMS SaaS, the LEAN startup principle dictates the rhythm of staging. According to the research data of the current *BMS Company* circumstances, the most realistic staging plan is as follows:

1. The minimal viable product sales in the domestic market in order to gain domestic market recognition;
2. International expansion on an object-by-object, country-by-country principle with a support of agents in order to achieve credibility and attain thresholds in arenas and differentiators and to attract resources and stakeholders;
3. Financial injection from investors in order to accelerate international expansion.

The Figure 11 presents a visualization of the staging plan.

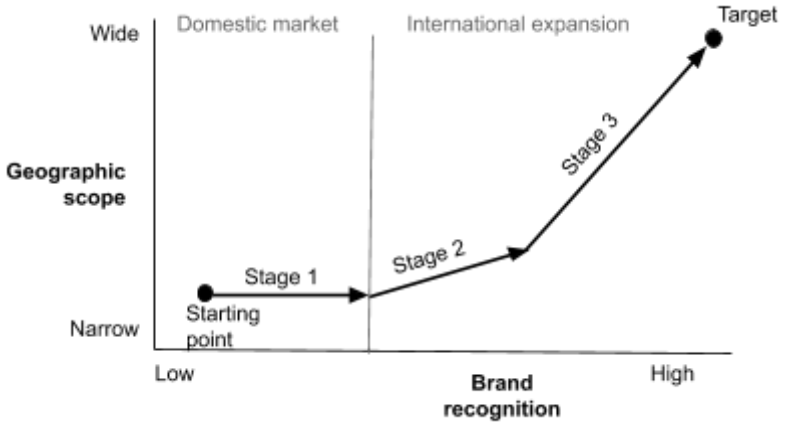

Figure 12. BMS SaaS expansion stages

In order to accelerate the brand recognition in the domestic market, the founders "are ready to go to every potential customer to present [...] the product personally by highlighting features that are the most important for the specific client." Due to the fact that in Lithuania there are many state buildings that need to be retrofitted according to the EU "nearly zero-carbon' programme, the budgetary authorities are planned to be included as well, as they "employ consultants to arrange public tenders". The common practice is that procurements are won by medium or large companies, which can offer whole sets of HVAC products including BMS, but cloud computing technologies have revolutionized whole industries, including HVAC. Therefore, in order to reach procurement terms amendment, the BMS Company has to put an effort to present to these consultants a novel, cost effective BMS SaaS solution in line with the EU environmental directives.The domestic Lithuanian market may be the break-even point market which may be the first market in Europe where the procurement of state buildings retrofitting terms exclude the cloud BMS option from the whole HVAC purchase.

Economic logic

According to Hambrick (2001) and Fredrickson (2001), the "most successful strategies have a central economic logic that serves as the fulcrum for profit creation", which is "to obtain premium prices by offering customers a difficult-to-match product".

Although the BMS SaaS follows the best combination of differentiators and seeks technological excellence, the setting of premium pricing is hardy available, as the HVAC market prices are set by the global BMS manufacturers and there exists a historical background of procurements for the lowest price. Therefore, the BMS SaaS top price is limited by the conventional BMS market prices. So, the sum of the BMS SaaS installation payment and a 5 years' subscription fee (5 years is a life-cycle of a conventional BMS) cannot be higher than the conventional BMS's price. The research confirms that cloud BMS providers who ask for a premium price above the standard market price experience rejection by the market. Therefore, in order to motivate the customer to adopt a novel cloud BMS, the suggestion is to set the maximum available price for the sum of installation and a 5 years' subscription fee equal to the conventional BMS market prices by highlighting the perceived add-on value like constant software updates and "smart" data analytics

advantages. It is worth mentioning that in the conventional BMS case, data analysis can be proceeded with the additionally purchased tools, which have to be customized to BMS specifics and the life-cycle is only 5, maximum 7 years, while BMS SaaS theoretically is timeless, the "smart" data analysis tools are included in the price as well. The company should emphasize its perfect price and high and "smart" BMS software quality offer.

Besides, due to the fact that the BMS Company has limited financial resources and cannot afford to face a huge negative profit, the founders have calculated that the installation and first year subscription fee covering 1 year maintenance costs/per customer are least risky. Therefore, in order to balance profit, the scalability reached by geographical expansion is critically important.

Currently, the key BMS company revenues are generated from customized BMS programming work, which is premium priced. Yet, the plan would be to phase out customized BMS programming work in parallel with increasing scalability.

To sum up the few last chapters, the BMS Company's mission is "to provide affordable, reliable and flexible "smart" monitoring and control solution for BMS small and medium integrators and service companies that act in retrofitting field", therefore, the company's strategic design and business model is supported by the **Critical Success Factors (CSF)**: planning, people, process, customer, finance are listed in the form of goals and tasks in a 3 years' perspective. Before listing the CSF for business planning, the BMS Company 3-year goals are highlighted as follows:

1. To finish the testing stage and to release the Minimum Viable Product to the market in the first year;
2. To expand to two European countries;
3. To employ two additional programmers;
4. To sign contracts with agents from two countries;
5. To turn profit from negative in the first year to positive in the third year.

Planning

The first year goal is to finish the BMS SaaS development and testing phase by penetrating into the whole Lithuanian market. The long-term BMS retrofitting contract for one, but large building, or a group of buildings owned by the government or corporation is important. In order to win procurements, an education session should be organized for consultants who create terms .

The second year goal is geographical expansion to the Norwegian market.

The third year - geographical expansion to the Dutch market.

People

The first year task is to employ a programmer and to train her or him to program and maintain BMS in the domestic Lithuanian market. The search for a Norwegian agent should be proceeded.

The second year task ir to employ the second programmer, who will be responsible for the Lithuanian market under the supervision of the first employed programmer. The first employed programmer's responsibility field becomes the Norwegian market under the founders' supervision. The search for a Dutch agent should be proceeded.

The third year - expansion to the Netherlands. The task is to employ one more programmer who would be trained in the domestic market under the colleagues' supervision. The responsibility of the Netherlands market goes to the programmer employed in the second year and supervised by the founders. The search for a German agent should be proceeded.

Processes

During the first year, the goal is to finish the BMS SaaS testings. The main goal is to have fully automated company processes, including the system alarming, data analysis reportings, software updating, etc.

The Certification should be processed during the first year as well. The legal compliance documentation and certification should be prepared for the Norwegian market.

The second year BMS SaaS development continues on the LEAN principle. The legal compliance documentation and certification should be prepared for the Dutch market.

The third year BMS SaaS development continues on the LEAN principle. The legal compliance documentation and certification should be prepared for the German market.

Customer

During the first year, the sales process should be rather passive in order to focus on available human resources to product development. The only effort should be done in searching for a retrofitting contract of one large building or a group of buildings. The demo versions of the BMS SaaS should be presented to the domestic potential customers' objects.

The second year task is the sound marketing campaign in Norway within the network of integrators, participation in seminars and conferences for integrators. The demo versions of the BMS SaaS should be presented for Norwegian potential customers' objects.

The third year task is the sound marketing campaign in the Netherlands within the network of integrators, participation in seminars and conferences for integrators. The demo versions of the BMS SaaS should be presented for the domestic potential customers' objects.

Finances

The first year investment in the BMS SaaS development is covered by the income from customized conventional BMS programming work. The contracted pioneer BMS installments are financially self sufficient.

It is critically important that the BMS Company geographical expansion financial outcomes would be equal at least to zero profit. The beginning of the third year is the year of break-even point when profit becomes positive.

The company's only assets are PSs, the purchase of them are related to the increasing number of employees.

To sum up, despite the BMS automation is an extremely niche sector of whole HVAC industry, the *BMS Company* exceptional focus is only on building retrofittings and collaboration with small and medium integrator and service companies. Due to limited financial resources, the BMS Company needs to follow the LEAN startup approach by releasing to the market a Minimum Viable Product, whose development will be amended with every perceived object. The carefully measured geographical expansion steps are strongly recommended till the company starts to generate positive profit in year 3.

The created business model innovation and strategic design supports the *BMS Company* mission, vision and values.

Mission

To provide affordable, reliable and flexible "smart" monitoring and control solution for BMS small and medium integrators and service companies that act in retrofitting field.

Vision

To become a technologically excellent and "smart" BMS software solution leader in building retrofittings in Europe.

Values

Simplicity, Preciseness and Trustworthiness.

Conclusions and recommendations

1. The cloud computing penetration into various industries, as well as into the HVAC, has a revolutionary and possible game changing effect on the BMS sector, but it faces an uncertainty of how business should be developed and what business strategy should be followed, due to the following problems:
   - There is a lack of business and market academic knowledge about HVAC BMS industry in general, as BMS is a point of interest of civil engineering scholars exceptionally, and it is analysed widely from the technical perspective, but not from the business one.
   - There is a gap of available comprehensive BMS business models' innovation by merging IT and civil engineering industries.
   - There is a lack of cloud computing business-related, market-focused investigations and the gap of cloud computing business knowledge from the provider's perspective. For example, even 71% of business-related articles about cloud computing are explored on a global scope (Senyo, 2018, Addae, 2018, Boateng, 2018) and generalized.
   - It is not clear what purification of the customer value proposition and strategic choices are critical in order to lead a successful BMS business.

2. The HVAC industry plays a significant role in Civil Engineering industry as it is an umbrella for all integrated engineering facilities and softwares that are used to provide heating, ventilation and cooling of buildings, the performances of which are automatically monitored and controlled by integrated Building Management Systems (BMS). HVAC is mainly accelerated by the Internet of Things (IoT) trend. The cloud computing boom impacts the fact that a decade-old cloud BMS concepts turn into real projects, thus, the knowledge about cloud computing business specifics is critical. Therefore, the theoretical review presents the following cloud computing delivery models:
   - Infrastructure-as-a-Service (IaaS),
   - Platform-as-a-Service (PaaS),
   - Software-as-a-Service (SaaS).

   The SaaS is covering around 60% of the total cloud computing services, Paas and IaaS share around 20% each (Shimba, 2010, Hentschel, 2018, Leyh, 2018, Petznick, 2018). The four deployment models - public cloud, private cloud; community cloud; hybrid cloud - differ by their structure and security level. Due to the cloud computing, the following new roles have appeared in the market: cloud consultants, aggregators and integrators.

3. The challenges influencing cloud computing adoption are grouped into four categories:
   - Socio-cultural challenges are related to the market awareness of cloud services, customer fears of job loss due to technological development, missing confidence in exploiting cloud services. The scholarly literature states that such a socio-cultural issue as trust is related to data security issues, therefore, it proposes to practice transparency and audits. The other problem, which is an anchor of the cloud computing penetration into various industries, is the company's innovation culture.

- Technological challenges appear due to security issues and to the standards' heterogeneity, which cause interoperability, portability and lead to the vendors' lock-in and high switching costs.
- Legislative challenges are mainly related to data protection as the regulations become more strict, therefore the location of a data center becomes critically important. The scholarly articles highlight the importance of the Service Level Agreement (SLA).
- Economic challenges affect cloud computing processes, human and financial resource management. The scholarly literature widely analyzes the implemented (fixed and dynamic) and developed theoretical cloud computing pricing models. According to the literature, the Subscription and Pay-per-use pricing models are the most popular. The theoretical Genetic model for pricing in cloud computing markets is the most promising as genetic pricing generates up to 100% higher revenues than other dynamic models and up to 1000% higher revenue than fixed models.

4. The qualitative, practice-oriented, in-depth case study empirical research allowed to obtain the following data:
   - The data about the external HVAC market's current situation, challenges and drivers were collected from the statistical analysis of statistical data, research companies' reports, commercial and scientific articles, HVAC BMS manufacturers and cloud BMS service providers' websites.
   - The data about the niche BMS field's specifics, trends, challenges and future perspectives of cloud BMS concepts were collected from external interviewees.
   - The *BMS Company's* specific data, such as its strengths, weaknesses, threats and opportunities, BMS SaaS product and business development-related data, were collected from the founders.

5. The data analysis has revealed that the HVAC industry has a big potential for growth and it is growing fast globally, with the leading Asia -Pacific market. The main HVAC and BMS sector's drivers are increasing constructions, growing need for HVAC and BMS systems retrofitting due to *Energy Performance of Buildings Directive (EU) 2018/844 of the European Parliament and of the Council*, environmental regulations, constant rise of annual temperature, and economic growth.

   The BMS software market is mainly shared by four key BMS manufacturers: *Johnson Controls International, Honeywell, Siemens, Schneider Electrics,* who set the market price.

   The digital technology penetration into the BMS has impacted the emergence of cloud BMS providers. The research has identified four cloud BMS providers: *Piscada, Evolo, R8 Technologies, WideSky*. The cloud BMS market is only at its embryonic stage and faces the same socio-economic, technological, legislative and economic challenges as the cloud computing market.

   Despite the lack of financial resources, the lack of brand recognition in foreign markets, and emerging new cloud BMS entrants, the *BMS Company* has a strong business acceleration due to

its strengths, such as the domestic reputation of the founders among the network of customers, know-how and opportunities of rising environmental requirements.

The data analysis shows that the flexibility solution of BMS SaaS is differentiating the *BMS Company* from other emerging cloud BMS providers. Due to the fact that the BMS SaaS is valuable for the customer, rare in the market, hardy imitated, and the organizational processes are going to be developed in a fully-automated mode in parallel with the product R&D, the *BMS Company* has a sustainable competitive advantage.

6. The Business model innovation by merging HVAC BMS, IoT and cloud computing business models brings the cloud BMS business model much closer to cloud computing than its rooted HVAC business model. The key aspects of innovative Business model for the BMS Company are:
   - The target customer is a small and medium integrator and service company maintaining old buildings or retrofitting them.
   - The value propositions are focused on "smart" data monitoring and control with the regular automated software updates, software flexibility, security, its simplicity like "plug and play" installation and user-friendliness being at the core of the target customer needs.
   - Due to BMS SaaS products' complexity, direct sales will be practiced.
   - Co-creation of the system's amendments supports keeping a live contact, it benefits in relationship building. The machine-learning based automated recommendations regarding the system's effective management builds stronger relationships. The Service Level Agreement (SLA) ties the BMS Company with the client via mutual obligations as well.
   - Due to the fact that BMS SaaS is going to be released on the LEAN startup principle, the key activities are Research and Development (R&D) and regular software updating. Customized BMS programming is in the list of key activities with a plan to minimize it gradually.
   - The company's tangible resources are programmers, network and security specialists and networks of customers. Intangible resources are cloud BMS software - BMS SaaS, know-how, reputation within the domestic market.
   - Partnership with foreign sales agents is planned. The BMS Company's aim is to minimize any need for partnership as much as possible.
   - The revenues are generated from the installation payment, subscriptions and customized programming in order to cover the costs of the employee's salaries, commissions for agents and demo-versions.

7. The integral model of the BMS Company strategy is built on Hambrick's (2001) and Fredrickson's (2001) Strategic Model, based on five major elements of strategy:
   - The company brings BMS software to the cloud - BMS SaaS, whose main task is "smart" monitoring, control and data analysis of old building BMS, which are maintained and retrofitted by small and medium sized service and integrator companies.

- The BMS SaaS is developed internally and will be released to the market as a Minimum Viable product. The geographical expansion to foreign countries will be proceeded on the green-field startup principle.
- The BMS Company has chosen a combination of differentiators, such as flexibility, which means "functionality, universality", "mobility, an easier access to the system" and user-friendliness. The BMS *Company*'s focus is technological excellence.
- Business development is planned in three key stages: 1) the Minimal Viable Product sales in the domestic market; 2) gradual international expansion; 3) fast international expansion due to financial injection from investors.
- The economic logic is based on setting the maximum available price for the sum of installation and a 5-year subscription fee equal to conventional BMS market prices by highlighting the perceived add-on value like constant software updates and "smart" data analysis advantages. The price top limits are dictated by the current large conventional BMS market players. The bottom line of the price is set according to negative profit risk minimization.

The guidelines of three-year long strategic objectives are presented as well.

8. The recommendations for further researches would be:
   - to analyze European countries and identify the ones that are most ready for BMS SaaS adoption;
   - to explore the working principles of cloud providers, integrators and end users;
   - to explore if the genetic model for pricing in cloud computing markets can be adopted by the BMS Company.

   The later research could take a part in:
   - analysing cloud BMS software providers' competitive environment;
   - analysing how business models of cloud BMS providers have changed with time;
   - analysing opportunities and methods of how to protect the business from *Google* or another giant player's appearance in the market which may come with the same product.

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Appendices

Appendix 1. World Map of data protection and privacy regulation current status

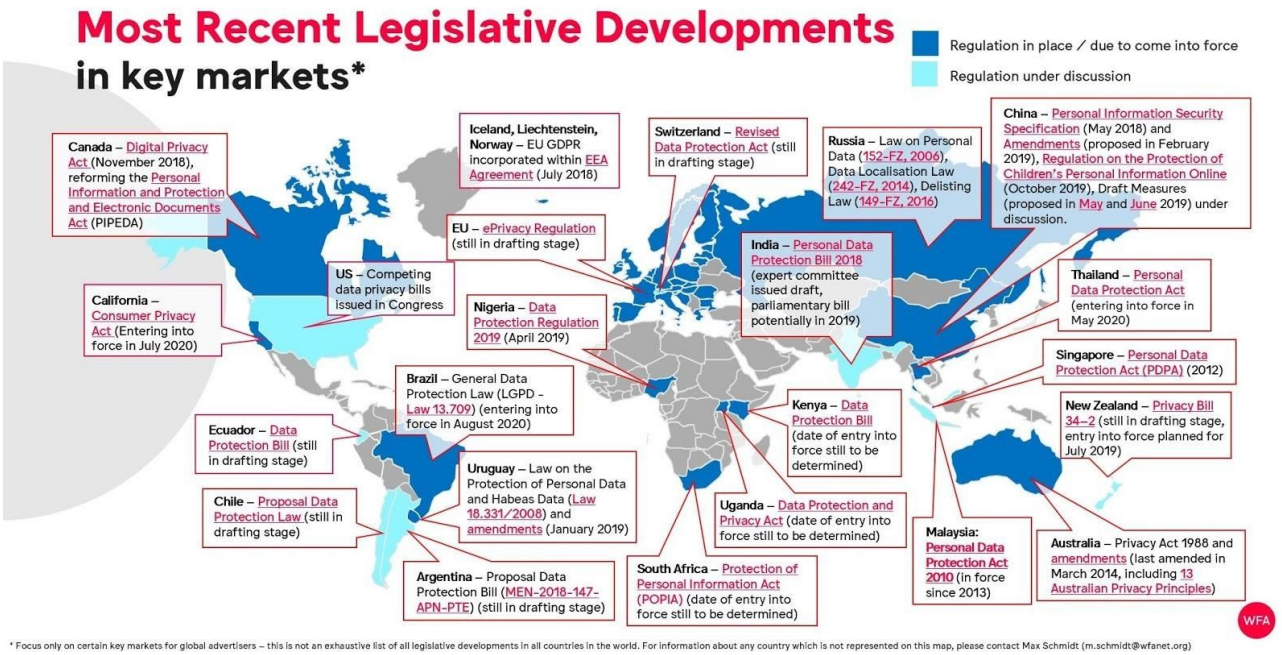

Figure 1. The worldmap of data protection and privacy regulation current status (World Federation of Advertisers, January 2020)