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MASTER THESIS

TITLE IN LITHUANIAN	TITLE IN ENGLISH
Skaitmenizacijos poveikis Lietuvos energetikos sektoriaus įmonių verslo modelių inovacijoms	**The impact of digitalization on business model innovation in Lithuanian energy sector companies**

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INTRODUCTION

Customer expectations shit as to what we expect from companies. Enhanced customer experiences from areas such as travel, retail, food services and media sets new standards and raises the expectations in other sectors such as energy providers. In the energy sector, areas such as energy choices, billing, payment, metering and outages see increased innovation and digitalization. Digitalization and automation, combined with developments in clean energy and energy management is opening up new opportunities for enhanced customer service, value add and new business models.

With the help of digitalization, many companies try to adapt to constantly changing market demands by improving their processes and systems for faster delivery (Stoldt et al., 2018). New market entrants offer innovative solutions and raise customer expectation standards in recent times. In order to attract new customers and retain existing customers, incumbents need to improve and think of their business model innovation (BMI).

Digitalization and changing customer needs are not the only reasons that companies increasingly focus on digital transformation and innovating business models. Globalisation today is one of the main drivers for innovating business models. Accelerated and increased data and information flows, digital solutions characterize digital globalization, which is mainly boosted by customers' and investors' expectations. New innovative technologies help to increase the operational efficiency and reduce costs, as well as allow cheaper, better and faster production in line with a transformed way of communicating and interacting with consumers (Schiliro, 2020). There is a need to constantly follow new market trends and try to improve the business model along with products and services if there is a wish to remain competitive in the market.

Energy sector is not an exception when it comes to the need for constant transformation and innovation. Digitalization-based businesses progress whenever incremental or technical bottlenecks are faced in this sector (Loock, 2020). But how can companies, heavily regulated by the government, adapt to changing needs to deliver time-to-value, time-to-market and sometimes even customisation? Various researches performed within the European energy sector found out that many countries can actually benefit from the actions of the governments if they are aimed to improve and innovate (Duch-Brown, Rossetti, (2020)). According to Jansson, Andervin, (2016), successfully adapting digital

solutions heavily depends not only on the implementation of the new technologies but also from the companies' capability to get all the benefits from the changes.

The focus of this research is on the newest technological trends and how they impact business models innovation in the energy sector companies by analysing digitalization, BMI, sustainability and changing customer needs in order to provide recommendations for energy providers wanting to go hand-in-hand with the changing trends in the market.

There has been prior research performed on how the energy sector could innovate their business models. Dellerman et al. (2018) research on German energy sector innovation, found out that there are three interdependent innovation actors (the regulatory, the technological and the collaborative) associated with new digital models. They also explored the literature from the management perspective to find out what kind of framework could be created in order to comply with risk management. The innovative business models could be described as being of complex value (Hall, Roelich, 2016) and governments make it even more difficult to comply and remain competitive, researchers turn towards sustainable energy and how it is perceived by consumers (Loock, 2020). Digital platforms are one of the main contributors when it comes to how energy industry is going more digital (Kloppenburg, Boekelo, 2019) and the number of digital energy platforms appears to be making a positive impact on the overall digitised regional energy infrastructure (Duch-Brown, Rossetti, 2020).

All in all, "Digitalization is perceived as a force that can positively impact the business model of <...> companies from the inside through selected applications of this technology" (Maffei et al., 2019). Seeing this, authors still see a lack of research performed when it comes to how outside factors like digitalization (Loock, 2020), globalisation, Industry 4.0 impact energy suppliers' way of working in order to provide them with recommendations on improvement of their business models.

The novelty and problem. Energy suppliers are under pressure because of many changes in the environment. Many customers shift towards a more sustainable type of energy and its production so companies need to find how to remain competitive and use the technological advantages. With the liberalisation and decentralisation of the energy market, consumers can also become energy producers, existing energy companies feel challenged and forced to improve their business models with a clear focus on customers and sustainability.

Since this topic has been previously heavily investigated from the scientific literature perspective, this master thesis provides the new outlook for this research question by combining the perspective of leaders working in the energy sector and perception of customers towards the new solutions provided by the energy providers. There is a need for further future investigation on how energy system solutions can be fundamentally redeveloped towards a sustainable future of energy by bridging the value of new and complex business models and industry-based challenges (Hall, Roelich, 2016). Thus, the main problem analysed in this Master thesis is how companies in the energy sector can continuously innovate business models when facing possibilities and barriers brought by an era of digitalization.

The object of this thesis is the relation between business model innovation and digitalization, and company's performance.

The aim is to analyse how digitalisation enables Lithuanian energy sector companies to innovate business models and its effect on overall performance.

In order to achieve this aim, **the main objectives** of the thesis are:

1. to examine the existing business models in energy sector companies and analyse their main elements in order to see the theoretical side of newest trends in the market.
2. to explore main drivers, opportunities and barriers that new technologies create for innovation in the energy sector which act as a guide for other companies, trying to change their ways of working.
3. to study the perception of firms in Lithuanian energy sector on digital transformation as a key factor for business model innovation and business results.

Research methods. The main research method is quantitative data analysis where empirical study is performed on 14 companies registered as operating in Lithuanian energy sector. Results of the analysis helped form understanding on how energy sector businesses innovate in the digital era. This research is additionally supported by the questionnaire conducted with three industry experts to strengthen the understanding of current trends and future outlook. Combination of survey results and answers from experts helped derive recommendations for leaders towards digital future in the energy sector.

The description of the structure of the Master thesis.

1. Literature review. Scientific literature is systematically analysed and provided in the following sequence: business models in the energy sector, changes in companies operating in the energy sector due to digitalization, relation between the digital era and business model innovation in the energy sector. This provides the explanation for the research gaps and relevance of this topic.
2. Research methodology. The main goal and research objectives, design of the research is stated in this part and supported with the details about the interviewing methods.
3. Empirical research results. The gathered data and survey results were collected and analysed.
4. Discussion and conclusion. Results of the research, recommendations for the Lithuanian energy sector and insights for future analyses are provided.

Research limitations/ implications. The findings of this study have to be seen in light of some limitations. One of the main ones is the limited number of energy companies in Lithuania. The overall sample for this study is selected from statistical data of registered companies in Lithuania, however, most of them were difficult to reach. Companies provide only their email addresses, which makes it difficult to follow-up or ask additional questions, if needed. Additionally, COVID-19 created some limitations regarding planned interviews, which had to be transformed into questionnaires. For any future research, it would be beneficial to investigate more countries and make a comparison in order to understand how Lithuania is doing in the context of other comparable countries.

1. LITERATURE REVIEW

Currently there is an increased number of studies performed within the field of Business Model Innovation (BMI) even though the topic is still quite young. Authors (Osterwalder, Pigneur, 2010, Boons, Lüdeke-Freund, 2013) approach different parts of business models, analysing different industries but the main research topic from a theoretical perspective remains the same. Thus, there is a need to connect similar papers where the impact of digitalization on business model innovation was investigated. Figure 1 provides a network map based on the topic similarities, where huge concentrations of different authors can be seen, their research topics and how these are connected and positioned closely. Additionally, the color intensity of the bubble indicates how new the research is based on the year of the research (the darker the bubble, the newer the research). The figure illustrates that older papers (Teece, 2010, Hall, Roelich, 2016) were investigating digitalization and business model innovation, whereas newer ones (Parida, 2019, Rachinger, 2019, Bygstad, Ovrelid, 2021) move towards sustainability, renewables, Internet of Things, Energy 4.0, etc. From the network map, it can be seen that the BMI topic is very diverse, popular among researchers and is continuously being explored.

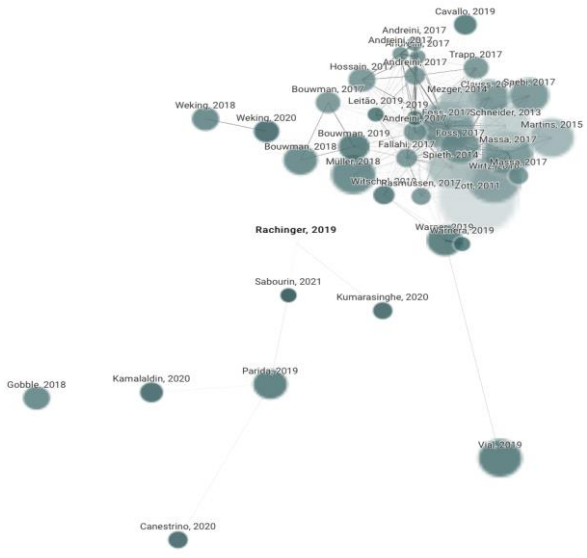

Figure 1: Researchers who investigated digitalization's impact on business model innovation and their research interconnectedness during the period 2011-2021.

Source: *created by author*

1.1. Theoretical reasoning process

The framework, which applies for this thesis topic, provides the freedom to adjust directions and systemise and validate the results. It includes three different data sources (literature analysis, survey with the questionnaire and "yEd" digital methods) and can be viewed in the figure 2.

The process contains extensive analysis and systemisation of various scientific literature regarding topics "business model and innovation", "digitalization", "energy sector" and others to achieve a comprehensive overview of the theoretical research, which is explained more deeply in the next section. It was clear that there are many directions this research topic could flow. Empirical research has been conducted with the representatives of companies operating in Lithuanian energy sector in order to reveal how applicable theoretical findings are in the real-life example. Finally, the "yEd" method is applied to analyse the similarities and common discussions around the same topic.

Finally, the connection between theoretical and empirical methods creates a place for systematic combining, which is a crucial part to eventually reach the understanding of the theoretical basis and gap around the digitalization and BMI topic. This will be explained more broadly in section 1.4.

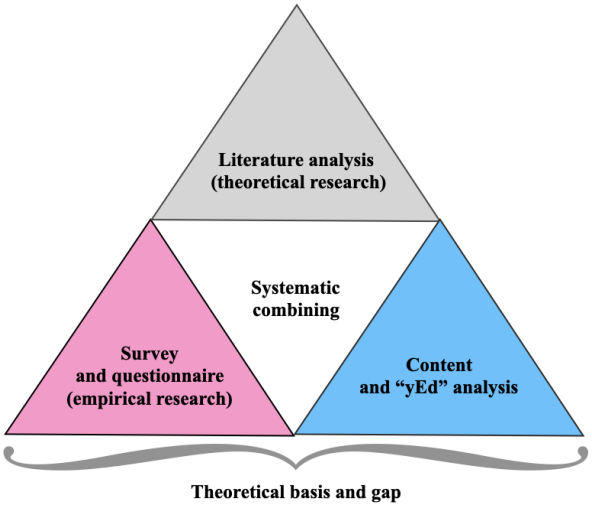

Figure 2: Theoretical reasoning process framework.

Source: *created by author*

1.2. How do companies innovate business models?

1.2.1. The definition of the business model

The way technology and processes work together in a company to deliver value via products and services for customers and society could be described as a business model. With the help of BMI, companies focus on four key aspects: value creation, resources, capital and financial resources and organisation and value chain (Tohanean et al., 2020). According to (Osterwalder, Pigneur, 2010), nine main elements should be taken into consideration when improving existing or creating new business models. They are, key partners, activities and resources, customer value proposition, relationships and segment, channels, revenue and costs structure. Various sectors connect existing processes with new strategies and rethink the whole value creation and delivery (Teece, 2010, Boons and Lüdeke-Freund, 2013).

Business models could also be called as innovations as the result of it is new product or service placed into the market (Rachinger et al., 2019, Tohanean et al., 2020). Additionally, companies can innovate not only what they deliver, but how they deliver. This means changing internal companies' processes, customer journeys, IT systems, etc. Business model innovation does not necessarily need to be something completely new in the market, it can also be the improvement of AS-IS situation towards desired TO-BE. Additionally, when analysing literature, the most common parts of business model innovation were: strategy, technology and organisation (Boons, Lüdeke-Freund, 2013). BMI theory has been analysed by many authors during 2017 - 2020 but the newest topics are around renewable energy and new emerging energy sector business models (the darkest bubbles in the figure 3). This paper analyses the topic of new business models in section 1.2.2.

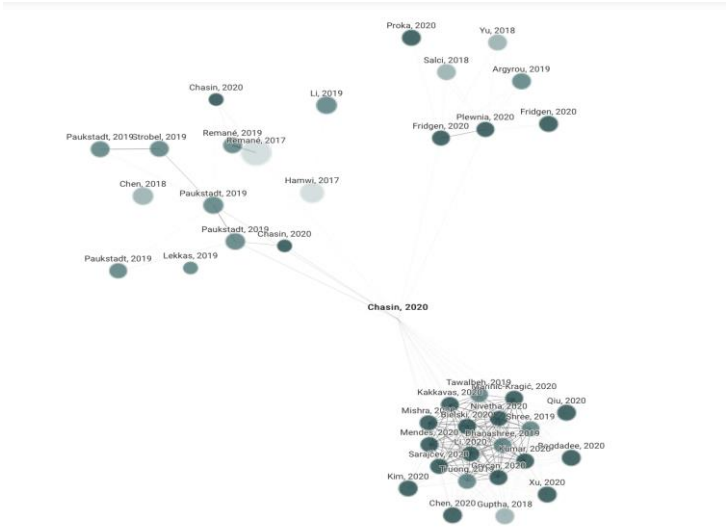

Figure 3: Research connections around BMI in the energy sector. Interconnectedness based on research performed 2017-2020.

Source: *created by author*

Energy sector is not an exception and also needs to innovate businesses in order to stay competitive. Electricity being a service provided to the consumers, Tohanean et al. (2020) states that the service sector is the main one to use business model innovation and find new ways to improve their ways of working. Hall and Roelich (2016) performed research on new kinds of opportunities being created by the BMI in the energy sector in order to identify what kind of challenges stop companies from innovating and how policy makers could help. Additionally, one of their goals was to understand if there is a place in the market for the innovation of renewable energy and its demand management, electricity value chain and efficiency. One of the main deliveries of their research is opportunities identified for the complex business model innovation for companies in energy sector (figure 4): (1) identification of deliveries and possible business models within the energy sector which could engage main stakeholders, (2) mapping and analysis of the the customer journey within the energy system to connect how technologies can help in delivering more value, (3) investigation of the how the value can be proposed, captured and monetised within the new BM, (4) knowledge around how to use technology in a way that the value would be brought not contradicting with the company's

goals, (5) concentration on the overall solution and change should be done rather than on the new solutions or business models solely (Hall, Roelich, 2016).

In general, most common categories that has been researched within the energy creation/delivery field are: what are the main motives for customers choosing a competitor, what are the main challenges for the new entrants (Littlechild, 2005) and how final prices affect the competition within the market (Defeuilley, 2009). Nevertheless, authors state that there is still very little research done on how BMI and new technologies could deliver the highest value in the energy sector. For example, smart loads and the response towards the demand can be a value proposition for a generated electricity distribution as one of smart technologies (Cesena et al., 2015). Since most of the existing electricity systems are drop-down control-based (Mithcell, 2008), and the local energy production proposes the need a need to leverage generation and consumption optimisation within the regional generation (Foxon, 2013), the balance is needed between the supply and demand for the centralised energy generation business model. Hall and Roelich (2016) notes that "In order to make space for this complexity of values, and unlock potential of local supply models, energy policy makers and regulatory authorities should adopt a process of complex value identification."

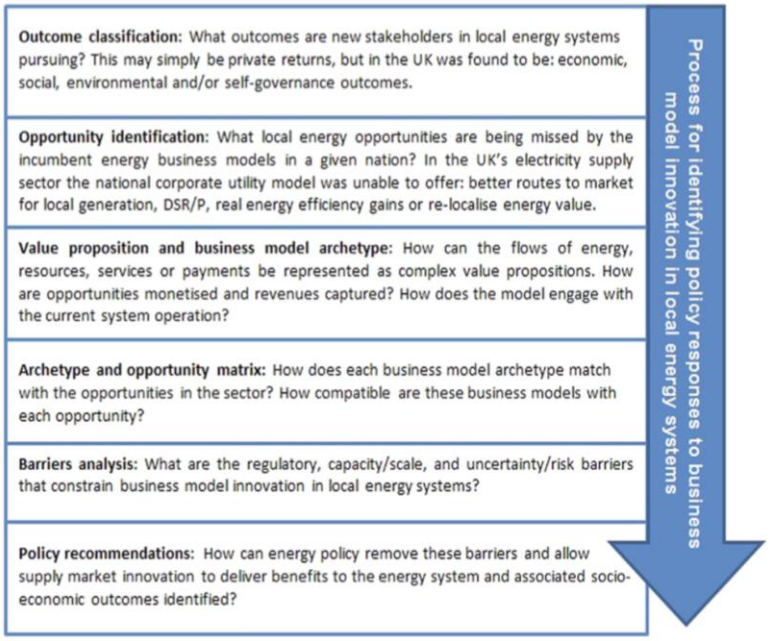

Figure 4: Complex business model innovation process for energy sector.
Source: *Hall, Roelich, 2016.*

1.2.2. Traditional energy supplier and its value proposition

These days new companies enter the market creating competition for the existing traditional ones. When it comes to the energy business model, most of the companies hold quite a simple energy supply value chain while trying to keep the profit gained when the demand of kWh units is increasing (Hall, Roelich, 2016). Authors note that dominating national utilities have been providing energy to the consumers in liberalised markets and business models that bring "unsustainable practices" to the users when trying to compete with the new competitors in the market.

Most of the energy supply providers are using the traditional energy business model (figure 5) (Richter, 2013, Bryant et al., 2018), however, authors (Richter, 2013, Hall, Roelich, 2016) agree this business model is giving the gross revenue only from the sales of energy to the end-consumers. Additionally, while energy can be distributed into heat, electricity or gas, companies perform heavy regulatory projects to comply with the law and gain the profit at the same time rather than improve business models via technological innovations (Thomas, 2018). Energy consumers pay for the amount of energy used, this traditional business model being relatively inexpensive and reliable over the long period of time due to the centralisation of power plants and ensures that this business model will work and generate the revenue (Hall, Roelich, 2016).

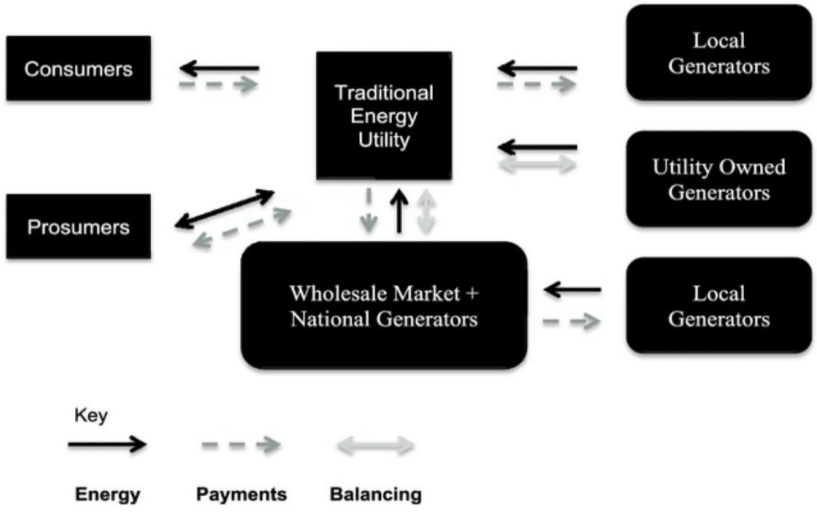

Figure 5: The traditional energy sector business model.

Source: *Bryant et al., 2018*

Furthermore, nowadays society is used to the present-time communication with various companies that provide services or products people use. In the energy sector, an energy provider is the one to take care of the communication between the company and customer. The reality is that energy suppliers most often only provide the monthly bill to the customer and answer "burning" questions when something is not working (Richter, 2013), rather than providing insights and teaching on the sustainable energy usage and a possibility to switch towards renewable energy possibilities. However, more and more companies offer green energy possibilities for users where they can not only be a consumer but also a producer, due to this, companies change business models which are described in detail in the next section.

1.2.3. Emerging energy sector and its business models

These days the whole energy sector has been under the pressure to change ways of working and business models to more sustainable ones. Since there is a lot of disruption when it comes to new startups and innovative companies entering the market and providing new products and services to energy consumers, the main driver of all of this is renewable energy. Additionally, the push for companies to develop new BM is also because of trying to "achieve climate goals and to reduce global warming" (Fauser et al., 2019). Thus, more and more authors started researching sustainability and renewable resources in the context of BMI.

When it comes to sustainable business models, their goal is to save the natural environment by lowering the effect of business on them (Hogevolt et. al., 2014). This can be used to define why it is important for businesses to move towards sustainability. Elkington (2004) provides his guidelines for the companies to be able to restructure their ways of operating, which is called the "Triple Bottom Line". This approach is what the author calls a switch towards the "global cultural revolution" (Elkington, 2004) which can be achieved by turning old paradigms into the new ones. There are seven revolutions that impact sustainability (e.g. markets, values, etc.) and can be seen in the figure 6. During the analysis of other research, it was noticed that most of the papers use these revolutions as a core of the research (Ludeke-Freund, 2010, Bocken et al., 2014, Hogevolt et al. 2014).

	Old Paradigm	→	New Paradigm
1 Markets	Compliance	→	Competition
2 Values	Hard	→	Soft
3 Transparency	Closed	→	Open
4 Life-cycle technology	Product	→	Function
5 Partnerships	Subversion	→	Symbiosis
6 Time	Wider	→	Longer
7 Corporate governance	Exclusive	→	Inclusive

Figure 6: Sustainability revolutions and paradigms.
Source: *Elkington, 2004.*

Another very important thing, which came after environmental issues became a very important part of doing business, is Corporate Social Responsibility (CSR). When aiming for sustainable economic development, companies should focus on achieving results without causing damage to the environment that future generations will use (Hogevold et al., 2014). Author also mentions that companies must pay attention to three dimensions such as profit, people and planet (Hogevold et al., 2014) in every step they take. Additionally, earlier Ludeke-Freund (2010) has provided the framework for companies to create value based on the same three topics. Author proposes companies to create sustainable value for (1) individual customers and main shareholders, (2) society, (3) customers and society in general, (4) multiple stakeholders. Both authors agree that sustainability should become a strategy of every firm and change common ways of working into new innovative ones. Others (Tohanean et al., 2020) add that the companies set both sustainability and innovation as the highest priority when it comes to the change. Additionally, "Approached separately, it is possible that the two areas will contradict each other and the result will have a negative impact on the company: financial losses, conflict of interest, incorrect market positioning. If approached together, innovation is used to increase the company's profitability through sustainable solutions, and the company grows perfectly and manages resources optimally (Wagner, 2017 found on Tohanean et al., 2020).

Therefore, when authors talk about sustainable BMs, they always mention that one of the ways to enhance the company's sustainability is through technological innovations (Ludeke-Freud, 2010) but the whole process also creates some opportunities and barriers (Engelken et al., 2016, Herbes et al., 2017). This is where renewable energy also comes into place and plays a huge role towards the cleaner-energy based future. Richter (2012) proposes to improve the business models within the

energy value chain on both generation and consumption parts (figure 7). It is easier to manage the expectations regarding the positive results of improving BMs on the utility-side as it does manage large-scale renewable energy projects and can provide the outcome faster, even though based on the BMI it should switch towards smaller-scale projects that would be closely related to the consumers. Customer-side is still heavily maintained by the governments of countries, which help to accelerate the development by providing subsidies to the customers who now might be not only energy consumers but also producers in the environment of decentralised energy value chain.

Figure 7: Business models on generation and consumption sides.
Source: *Richter, 2012*

When incorporating sustainability and renewable energy strategies into services and products brings many advantages for the companies, researchers also try to analyze what are the main roadblocks for innovating renewable energy-based business models. Lawmakers have different intent than the actual companies who innovate the way they operate and while management is concerned about what kind of impact each new BM has on the environment, policy makers still do not pay enough attention towards lowering barriers for the companies to ease up the growth (Herbes et al., 2017). Engelken and others (2016) agree that there is a lack of legal frameworks that would consider the challenges of the renewable energy providers. Additionally, authors state that since the value chains get more complex over time, there is a need for collaboration between energy and technology companies to overcome the technological barriers that existing energy companies can hardly solve solely. Moreover, Richter (2013) found out that renewable energy-based business models can be created with the help of technological innovations. According to Maffei et al. (2019) new technological solutions and digitalization are stamina that can have a worthwhile effect on BMI. The connection between new technologies and business models are explained in the next section.

1.3. Digitalization and business model innovation in the energy sector

Currently many new inventions come to the market as customers' expectations continuously rise. Three main processes happening in the nowadays energy sector could be called "3D's": Decentralisation, Decarbonization and Digitalization (Di Silvestre et al., 2018, Frei et al., 2018). Decentralisation is about simplifying the management of the whole energy infrastructure by distributing the generation of various cooperatives within the energy sector. When it comes to decarbonization, it examines how clean and renewable energy resources can help in lowering the intensity of the carbon used to produce the energy. It also refers to how the energy is stored and how to optimise the existing power plants. Lastly, digitalization is connected to new technologies changing business models and creating new possibilities within the sector (Di Silvestre et al., 2018). Since this paper concentrates on digitalization impact on business model innovation, only this topic out of 3D's is examined more broadly.

1.3.1. Latest trends in the energy sector: Energy 4.0

Digital technologies have an increasing impact on companies, society and the whole world. It creates revolutions within various sectors where the energy industry is not an exception and the world sees an ongoing change called "Energy 4.0" which is coming from the broader change called "Industry 4.0". For energy producers and consumers this means opportunities for new business models, renewable energy and new strategies for distributed power generation and delivery.

Since digitalization is one of the main drivers of changes within the energy sector and being the enabler of the new developments within the industry, it uses Internet of Things (IoT), automation, Industry 4.0, big data and other advanced solutions to offer new energy related possibilities for tech-savvy clients (Parida et al., 2019). Additionally, these new advanced technologies can both create "winners and losers" and make the path where things like hyper-connectivity and hyper-automation might appear (Soni et al., 2020). To support this, Rachninger et al. (2019) state that companies who are major players in the market can now longer remain the same because of the new entrants, which bring disruption and shake up the whole industry while being innovative and suggesting digitised products for customers.

Some of the aspects that require most of the attention from companies are people, working methods and technological solutions (Tohanean et al., 2020). Due to constant new solutions appearing in the market, the whole digital world is very dynamic and requires focus not only on which things are being offered for customers, but also how they are made. This is where agility and new ways of working come into place and changing organisational structures and processes by replacing old business models with the new innovative one (Lambert et al., 2018). Big Data driven business model innovation framework has been created by Cheah and Wang (2017) where authors suggest by connecting market, strategic and economic perspectives together with the applicable BM procedure (value discovery, creation or realisation) create new business models that would be based on Big Data and deliver the highest value possible (figure 8). Additionally, this framework brings up the fact to the light that a properly connected perspective and BM process will deliver different results (e.g. when combining strategy with value creation, the BMI will be on product, process, marketing and organisation innovation, whereas connecting economic outlook with the value realisation - the overall operational efficiency, utilisation will be improved). It is very important that all new innovations come together with the clearly identified demand from the market and new strategy of the company (Tohanean et al., 2020). Digitalization is creating new jobs, improving the quality of internal processes and products or services, as well as reducing risks (Sahut, Peris-Ortiz, 2014, Ungureanu et al., 2016).

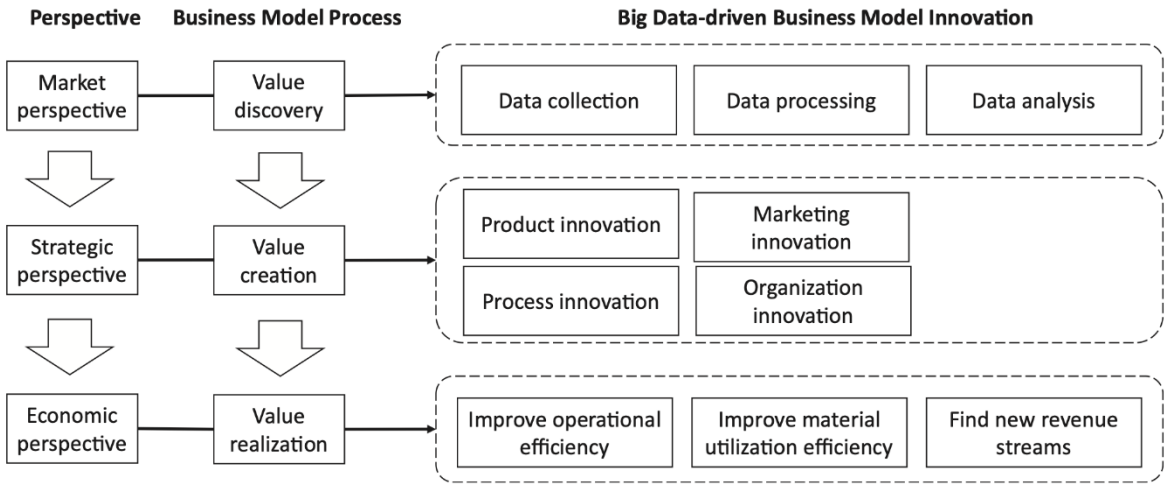

Figure 8: Business model innovation framework based on usage of Big Data.

Source: *Cheah, Wang, 2017*

One of the new trends that digitalization creates within the energy sector is the circular economy (CE). CE has linguistics (turning natural resources into waste during the production process) and descriptive (process of cycles) (Murray et al., 2017). Antikainen et al. (2018) states that "Combination of the cyber physical systems, Big Data, data mining, data analytics, Internet of Things (IoT) and new business models could provide major opportunities towards more sustainable industrial value creation, value capture and CE". Sustainability in the energy sector also comes from technological innovations and has a relation with circular economy, but it is much more than the blurred contours that each of them have which makes them unclear for the researchers, energy sector and also the policy makers (Geissdoerfer et al., 2017). Others refer to digitalization being the one of the main points that enables the circular economy to provide traceable products and services via the process of utilisation of artificial intelligence (AI) or other technologies and a clear product life-cycle (Antikainen et al., 2018). Authors note that business models based on digitalization and circular economy have also bigger comparative advantages. With the help of intelligent solutions, circular business models use fewer resources and improve the quality (Antikainen et. al., 2018).

Additionally, Industry 4.0 (I4.0) could be called as one of the main contributors towards the more digitised energy sector. Different authors have been investigating how I4.0 appeared by the increasing need of sustainability and usage of intelligent technologies like Big Data, AI, cloud computing to connect people with technologies and other resources used to produce energy (Kagerman et al., 2011, Tjahjono et al., 2017, Bonilla et al., 2018). Khan et al. (2021) connects I4.0 and sustainable development and produces the workflow (figure 9) on how the outcomes of Industry 4.0 connected with actors of sustainable development create new business models within various industries. Furthermore, it helps companies to track and monitor data, enables data-driven decision-making and provides real-time information for customers and other energy producers.

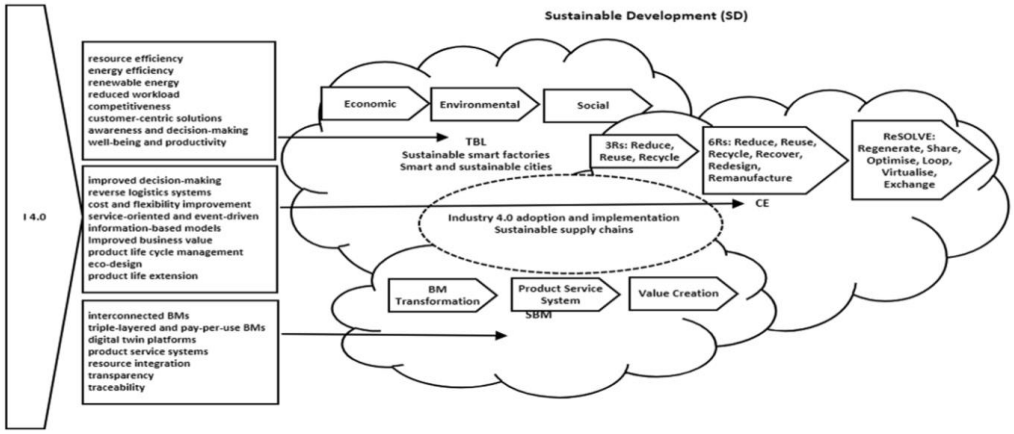

Figure 9: Sustainable development and Industry 4.0.

Source: *Khan et al., 2021*

Apart from continuously improving internal processes and ongoing projects connected with the need of new solutions for customers and energy producers, the latest technological trends that come from digitalization are systems for demand management, virtual power plants and smart grids. Authors (Valocchi et al, 2014, Lund et al., 2015, Kies et al., 2016) agree that there is a need to manage the demand in order to have a flexible way of storing energy when also connecting suppliers with the customers. On one hand, it can monitor or control the energy demand (reduce or increase it) or shift the energy where demand is higher which is the most useful as it does not change the quality or discontinues the process (Lund et al., 2015). On the other hand, authors (Lisovich et al., 2010, Kim et al., 2011) identify barriers such as lack of data privacy, attention of policy makers to adapt policies as per changes, lack of stakeholders and management involvement and unknown level of security (Tohanean et al., 2020). When it comes to virtual power plants and renewable energy (solar, wind, water power), the need for system and process flexibility comes from the increasing green way of producing energy in order to provide optimisation via remote automation and digitised technologies (Huber et al., 2014). However, same as demand management systems, virtual power plants and the process of setting them up, maintaining and controlling them also lacks some standards and is being heavily affected by the new market entrants and technical data-related barriers (Lampropoulos et al., 2018). Lastly, smart grids provide the possibility to manage and control resources, maintain renewable energy machines in the grid and optimise supply/demand value chain (Gerpott, Paukert, 2013,

Tuballa, Abundo, 2016, Shomali, Pinkse, 2016). Additionally, it gives a chance to energy consumers to also become energy producers (prosumers) and help companies achieve their sustainability strategies (Geelen et al, 2013, Camarinha-Matos, 2016). Nevertheless, authors specify that smart grids can also have some barriers. Smart houses and solar power plants require high investment when the actual payback time is unknown and can only be predicted (Cometta et al., 2010). Additionally, having some data and privacy issues, despite blockchain potential being identified, there are very few examples where the technology has been used in reality (Mengelkamp et al., 2018, Andoni et al., 2019). However, Bryant et al. (2018) provides the prosumer based business model for energy companies, which can help in dealing with variable renewable energy (VRE) (figure 10). Authors also suggest that new market entrants or existing energy providers when changing business models and including renewable or off-grid energy, empower customers to try to become prosumers themselves and provide all needed support and knowledge to make it happen.

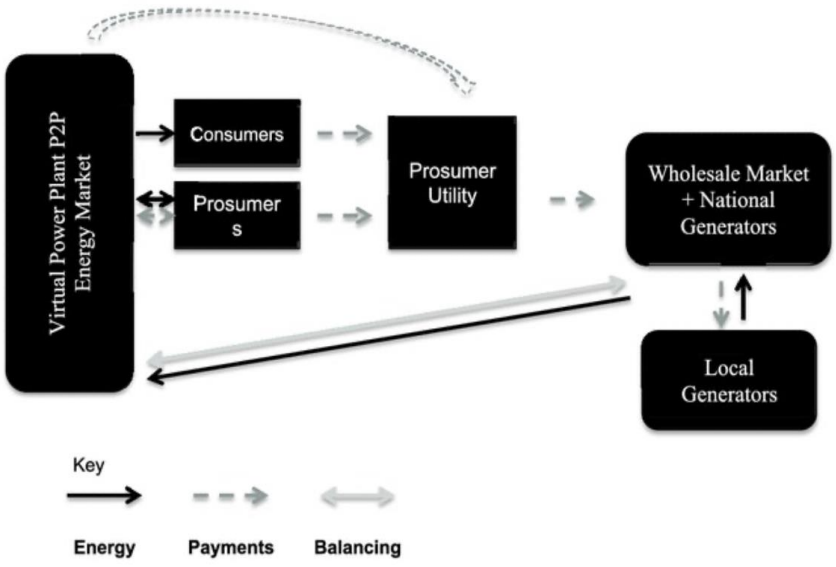

Figure 10: Prosumer value based business model.
Source: *Bryant et al., 2018*

The overall need for digitalization to be an enabler for Energy 4.0 is coming from a data-based world where customers are connected on a daily basis with the technologies such as smartphones or watches and are able to track information there. When it comes to the energy sector, customers want

to get insights and be able to follow current information on how much energy is generated from renewable resources (Römer et al., 2012) or how the energy costs change (Curtius et al., 2012). Since decentralisation allowed energy consumers also to become energy producers and re-sell the excess energy beyond their own consumption, more startups enter the energy market to provide latest intelligent technologies-based businesses with better service prices and digitised solutions (Specht, Madlener, 2018).

1.3.2. Digitalization as a business model enabler

When companies decide to adapt to a constantly changing environment by re-evaluation of current processes, technologies in place, new customer requests, they start adapting new technologies and rethink the whole value chain and customer journey (Teece, 2010, Chesbrough, 2010, Foss, Saebi, 2015). Lately, different authors explain the notion of digitalization differently (table 1). Parida et al. (2019) states that the whole digitalization process is not only adoption of new technologies but also adds that "use of digital technologies to innovate a business model and provide new revenue streams and value-producing opportunities in industrial ecosystems." Digitalization provides various digital opportunities for the companies to create new products by using intelligent technologies such as cloud computing, sensors, robotisation and others (Rachinger et al., 2019).

Teece (2010) states that the highest value can be achieved by combining digital solutions with the BMI. Additionally, many researchers agree that BMI theory includes innovation that comes from technology where the BMI needs to set the base for digitalization to happen. (Teece, 2010, Zott et. al., 2011, Baden-Fuller, Haefliger, 2013).

Table 1: *Definition of digitalization by different authors*

Reference	Definition
Gardner glossary, 2018	Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.
Gobble, 2018	Digitization is the straightforward process of converting analog information to digital. Digitalization refers to the use of digital technology, and probably digitized information, to create and harvest value in new ways.
I-scoop.eu, 2018	Digitalization means turning interactions, communications, business functions and business models into (more) digital ones which often boils down to a mix of digital and physical as in omnichannel customer service, integrated marketing or smart manufacturing with a mix of autonomous, semi-autonomous, and manual operations
Luz Martín-Peña et al., 2018	Industry 4.0 is being encouraged by the introduction of digital technologies that push the specialization of the value chain and also connectivity between actors. Industry 4.0 heralds greater operational efficiency and the development of new products, services, and business models.
MITSloan Management Review, 2018	Digitalization is the innovation of business models and processes that exploit digital opportunities.
Rachinger et al., 2018	Digitization (i.e., the process of converting analogue data into digital data sets) is the framework for digitalization, which is defined as the exploitation of digital opportunities. Digitalization by means of combining different technologies (e.g., cloud technologies, sensors, big data, 3D printing) opens unforeseen possibilities and offers the potential to create radically new products, services and BM.

Source: Parida et al., 2019

In order for companies to remain sustainable and keep a fast changing environment within the market dynamics, they need to start enhancing fast-phase technological improvements. Technological developments allow firms to understand the market and customer needs better; also to react quicker to quickly changing regulations coming from governmental institutions. Kijl et al. (2005) provides a framework (figure 11) which represents previously described scenarios and allows companies to innovate by applying dynamic business models. The model represents four pillars (offering, customer interface, infrastructure management and financial aspects) (Osterwalder, Pigneur, 2010) of business models as four small boxes within three bigger ones. Blocks around them represent the external factors (opportunities and barriers coming from the market, new technological solutions, policies or new regulations) that might have an impact on how companies will perform BMI. The figure ++ means possibly huge impact, + medium impact, and ± low expected impact. Different stages of the framework might be impacted more or less by different factors but in industries where technology based solutions can create new products and services and make a company more competitive, it is crucial to be interested in what kind of opportunities digitalization and new technologies create. Additionally, another possibility is to improve ways of working (WoW) while using two-speed innovation. This is the process where companies need to examine existing resources and identify the

need for new ones, and improve intelligent infrastructure and customer journeys using slow and fast-phase innovations (Bygstad, Ovrelid, 2021).

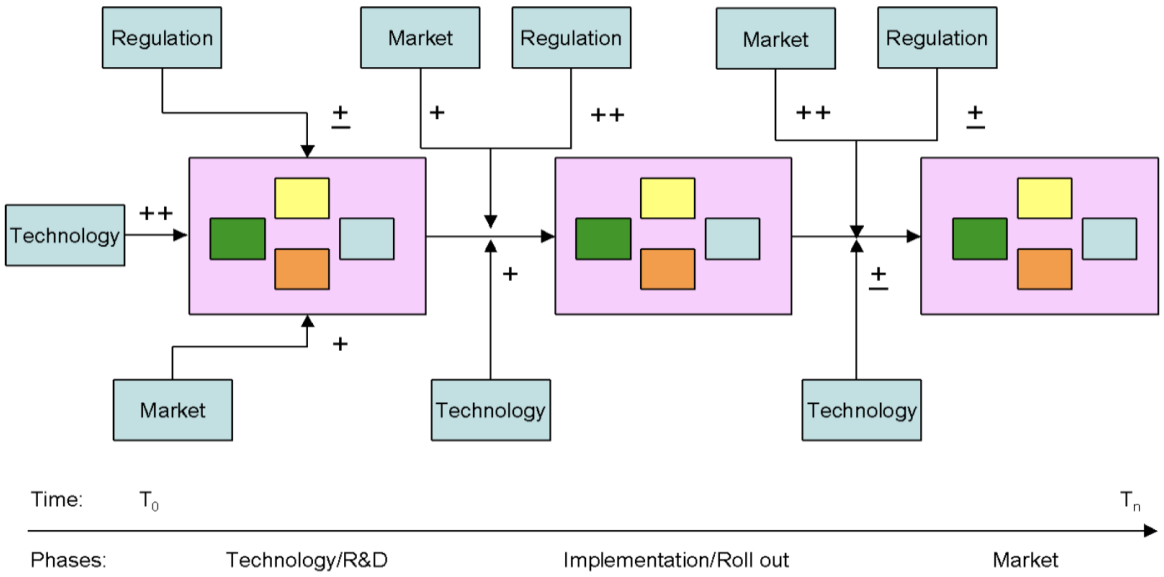

Figure 11: The framework of a dynamic business model.
Source: *Kijl et al., 2005*

Different authors (Casadesus - Masanell, Ricart, 2010, Foss, Saebi, 2015) agree that the value creation for customers comes from new technologies and changing the user experience in a way that it would be aligned with latest market trends. Moreover, Parida et al. (2019) note that "Digitalisation creates a high demand for new technologies, skills, and processes throughout". Thus, digital transformation process is heavily connected with type of innovation of product, processes and organisation, where majority of companies focus on improving products and services they offer, without considering that process innovation with the heavy investments into digitalization can bring the most benefit for the company and improve overall performance (Schaltegger et al., 2012). When companies apply new digital solutions, it is very important to create new strategies and use innovation and creativity in order to keep the competitive advantage (Tohanean et al., 2020). Additionally, authors suggest that digitalization should be connected with the goal of the company to eliminate as many repetitive manual processes and optimise end-to-end procedures, and not only to focus on the reduction of the costs. Innovation provides the ability to become more flexible and agile while

applying digital solutions to create new sustainable processes and products or services which eventually will bring more profit (Tohanean et. al., 2020). Antikainen et al. (2018) also remarks that "Digitalization also enables more efficient processes in companies, helps to minimize waste, promotes longer life for products and minimizes the transaction costs."

Furthermore, there are some challenges that digitalization creates while enabling businesses to make a change. Parida et al. (2019) identifies that analytical, connection and intelligent capabilities stop companies from transforming via the help of digital solutions. Additionally, these authors state the fact that companies often make mistakes when not properly assessing the risks closely related with privacy and security (Tohanean et al., 2020) while developing or integrating new smart products which have access to endless corporate data. Furthermore, companies do not perform proper research or case studies with customers in order to understand their needs and capabilities (Parida et al., 2019) to pay the price for product and service while making very advanced and intelligent solutions. Authors also note that new entrants as competitors are big and powerful threats which existing companies underestimate and start their own digital transformation too late or not at all. During that time disruptors shake the market by offering innovative and performance-based solutions. Schaltegger et al. (2012) identify that if companies buy outside built solutions and try to adapt to the company and internal processes, it might affect the activity level of the company and increase the risk to fall behind the competitors. Additionally, managers also need to adapt to the digitised changing environment (Rachinger et al., 2019), while keeping the understanding that the new and more intelligent solutions will constantly enter the market so there is a need to be curious and try to get insights from competitors and other industries (Bygstad, Ovrelid, 2021). Authors note that "digital transformation is not an endpoint, but will be a continuous process" (Bygstad, Ovrelid, 2021).

1.3.3. Drivers, opportunities and barriers of digital transformation within BMI field

Digital transformation heavily affects the energy sector and its traditional business models by pushing companies to reevaluate and reorganise the energy value chain in order to meet the current and future expectations of energy consumers. Since customers switch from a "passive" towards an "active" role in managing energy generation and retail, and adopting new technologies, companies need to understand how digitalization can help in creating new business models. Digitalization may

impact not only the scope of the business but also overall performance on the BMI (Rachinger et. al., 2019). This part of the thesis is examining the drivers, opportunities and barriers that new technologies provide for companies undergoing a change based on the literature review and is later on used during the interviews to assess whether companies follow them in practice.

Drivers. Companies can benefit a lot from using new technologies like cloud computing and big data in order to change their business models. The ability of enterprises to notice changes in the environment, seize impending opportunities, and adapt, integrate, and reconfigure their current resource base is critical to success in a disruptive (digital) world. The strategic management literature refers to these abilities as dynamic capabilities, and they are seen as the key means for businesses to deal with new digital realities (Konopik et al., 2022). Additionally, the main aspects which impact how successfully a company can adapt to new ways of working are: customer feedback, changes in infrastructure and managerial behaviour (Chean, Wang, 2017). Authors explain that it is crucial nowadays to include customers' opinions and experience with the products or services in order to get some inspiration for the generation of new business ideas. Additionally, energy providers need to examine customer behaviour and their future needs, think how issues can be solved before the consumer notices there is a problem. Since not all customers are tech-savvy, companies need to think of the best channels to approach customers in order to interact with them. When it comes to the "future" infrastructure, adapting new technologies in the era of Internet of Things (IoT), digital front-end and back-end solutions can help to innovate business models in a robust phase. These technologies help to provide real-time data monitoring and balance the consumption and temperature by saving costs. In order for new business models to work, companies need to be open for a rapid experimentation and scale process that can only be achieved while having proper organisational structure and strategy. It is expected that this kind of infrastructure will also provide a lot of insights regarding energy affordability, level of decarbonization which is crucial for some customers and companies which want to go more "green" (Hall, Roelich, 2016). Management and their outlook towards change is a very important part for any organisation changing the business model with the help of digital transformation. Most of the time, when the whole organisation is empowered and enabled to use their creativity and insights for new business model creation, customers feel like they are understood better (Caliendo et al., 2014) and new products and services are more aligned with their needs and overall strategy of the company.

Opportunities. When the chances to use technological solutions are seen and companies adapt new changes to their businesses, digital transformation provides suitable circumstances for flexibility and product/service personalisation. Almost no human intervention is needed to monitor and coordinate various sensors to receive operational data and configure the system based on the latest customer behaviour. Having this in place, data analysis can be performed in order to create new possibilities for the BMI and value creation within the company with the help of optimisation and automation (Parida et al., 2019). New intelligent technologies additionally open the space for companies to collaborate and perform hackathons, case studies with other industries like IT, marketing where the result of them can be not only more available data and insights but also an increase in overall productivity of the company or even new and innovative business models (Antikainen et al., 2018, Happonen et al., 2020). Digital transformation also provides the possibility to transform current traditional channels (e-mail, bills, and phone calls) into digital ones (apps, 360-degree overview systems, etc.) through which companies interact and communicate with customers (Antikainen et al., 2018).

Because of their significance, literature around digital transformation and the BMI field has developed a number of definitions for dynamic capabilities. The detection of technical opportunities in the external world (sensing), the mobilisation of a company's own resources to exploit these chances (seizing), and the ongoing renewal of the organisation by adapting, restructuring, and renewing the current resource base are central to all definitions (transforming). Konopik et al. (2022) performed excessive research and provided a framework which is heavily oriented on processes, and stated the significant relation to seven identified topics on digital transformation-related organisational capabilities (see figure 12). It also shows what kind of steps companies should take in order to continuously adapt to a constantly changing digital environment.

Theme	Mechanism		
	Sensing	Seizing	Transforming
Strategy and Ecosystem	Setting a long-term vision and strategies, establishment of long-term relationships	Managing and leveraging long-term relationships by creating a network for value creation	(Re)defining the organization's role in the collaborative ecosystem and alignment of business activities
Innovation Thinking	Monitoring changes in society, technology, and business environments	Developing open, flexible, and innovation-friendly processes	Embracing open and collaborative innovation
DT Technologies	Acquiring comprehensive knowledge of (disruptive) technologies	Adopting appropriate technologies	Managing technical knowledge and staying open-minded for new technologies
Data	Generating data-driven insights	Ensuring the protection of innovation and leveraging data-driven insights	Preparing for effective handling of data volume
Operations	Managing existing operations efficiently	Leveraging external insights to improve operational performance	Interconnecting operations with other business lines
Organizational Design	Supporting information and knowledge flows	Establishing a supporting organizational structure	Continuously adapting internal structures to changing requirements / market needs
DT Leadership	Promoting experimentation and the readiness for change	Embracing an innovation-promoting culture	Incentivizing entrepreneurial behavior

Figure 12: Important insights from the digital transformation topics.
Source: *Konopik et al. (2022)*

Furthermore, digital transformation may impact BM via cost optimisation, transformation of current business models and products/services or inventing new business models and products/services (Rachinger et al., 2019). Authors also note that while companies change offers, solutions, commodities with the help of digitalization, the BM changes at the same time. Business model innovation is also being accelerated with the opportunities that digital transformation creates when digitising products or services, processes and results (by the help of I4.0, AI and etc.) and value delivery (Berman, 2012, Matzler et al., 2016). Social benefits coming from new technological inventions and having an impact on BMI are reduction of errors and increased work safety, bigger job satisfaction, rewarding tasks and even potential for regional and national development (Parida et al., 2019). Finally, companies should assess the current situation with the desired one and analyse strengths and weaknesses when keeping a positive approach towards the digital change and BMI (Tohanean et al., 2020).

Barriers. Even though digitalization provides endless opportunities, it also creates challenges for companies to innovate their business models. The way digital transformation impacts BMI is blurry because the usage of technological and strategic solutions challenges companies to make additional steps which might be unknown and involve risks (Rachinger et al., 2019). Due to the decentralisation process, consumers become energy producers and corporations are challenged on how to innovate business models in order not to be replaced by existing competitors and new market disruptors while adapting intelligent solutions (Hall, Roelich, 2016). Nevertheless, not all customers are eager to use the newest technologies, this is why organisations need to identify the proper channels to interact with the energy consumers.

However, as socio-technical systems theory explains, digital transformation affects personnel, structures, tasks, and organisational procedures in addition to digital technologies. As a result, digital transformation must be viewed as a "holistic socio-technical issue" with far-reaching implications for economies, societies, businesses, and individuals. This approach implies that a company's competitiveness is determined not only by how successfully it integrates new technology, but also by how well it addresses other areas such as customer and partner interactions, organisational routines, and the formation of an acceptable organisational culture (Konopik et. al, 2022). Antikainen et al. (2018) states that digitalization creates financial, structural, attitudinal and technological barriers when implementing new business models. Authors explain that companies face challenges to get financing for new innovative ideas where new digital solutions need to be adopted, since then the whole organisational mindset and behaviour needs to switch from product-oriented to service-based BM. Furthermore, major players in the energy sector are most often complex organisations where placing an ownership of the data and technological solutions might be tough. Lastly, digitalization being a constantly changing and improving process, companies do not hold proper knowledge on how to utilise new solutions and business models to achieve best results. All level employees need to be taught why digital transformation is important and needed, and empower people to think of innovative ideas themselves, otherwise, if a change-mindset is not in place, this kind of BM will always remain just a part of some strategy (Antikainen et al., 2018). Not only do employees not always hold the knowledge around digitalization, customers need to be taught as well. Energy consumers should be included into the communication and knowledge sharing around environmental and cost benefits of the change, as well as including some of them into piloting programs in order to help them adopt new solutions faster and get immediate feedback to improve.

Placing intelligent solutions and changing organisational structures might be challenging and involve higher complexity, needed adjustments by the policy makers, however, if people are informed about the technological possibilities (Rachinger et al., 2019), companies might be able to turn barriers into opportunities and think of innovative business models with the help of daily energy consumers.

1.4. Theoretical gap

Theoretical gap being a part of the empirical research and its gap, represents findings and questions that show what has not been addressed and tested in theory. The results of this thesis provides a basis for understanding how business models in the energy sector are impacted by digitization. The analysis of scientific literature connects topics like BM, digitalization, automation, sustainability, renewable energy.

Study shows that most of the changes within the innovation process happens not only on the company's side, but also on the customers' side. However, there is a lack of research done within the literature on how customers can become the actual drivers of business model innovation when using and adapting digital technologies. Many agree that consumers now become a crucial part of the electricity value chain and that this situation already creates challenges for companies on how to change the behaviour, organisational structure, products and services to remain competitive and profitable. There is a need to investigate how customers react to certain changes in the energy sector, what is their perception towards sustainability and green energy.

Furthermore, theoretical analysis shows a lack of adequate research performed on the IT department's role within the change. IT and its transformation towards agility is one of the main drivers of BMI within the energy sector, though the question on how IT should manage ongoing traditional operational maintenance and future developments in tandem is not revealed. Additionally, many research papers provides (Parida et al., 2019, Tohanean et al., 2020) insights on the new solutions (e.g. solar power panels, smart grids, thermostats) and how they impact companies trying to become more digitised, however, the actual optimisation and automation of internal operations within various departments (e.g. HR, Finance, Procurement) could be explored to contextualize with the topic of BMI.

There is a lack of understanding and research on the ownership and roles within the company and the identification of the main responsibilities when it comes to innovation. Many propose that IT takes the responsibility for digitalization, however, what is lacking is the literature with best practices on the particular roles and positions within the company for the actual decision making on BMI and digitalization strategy.

In conclusion, there are two main gaps identified and should be communicated. First of all, there is a clear need for companies to digitise their products and service offerings while innovating new business models brought by changing customer needs and energy sector transformation, at the same time remaining efficient with the internal processes. Secondly, there is a lack of analysis on the energy sector, with the customer playing a more important role in the energy supply value chain. After the systematic analysis of scientific literature and the identification of unexplored areas within, it is useful to later address related questions within the empirical research part when performing case study in order to assess the real-life situation and help companies improve.

2. METHODOLOGY AND RESEARCH DESIGN

2.1. Research design

The main goal of this research is to analyse what kind of opportunities and barriers are created for the business model innovation in the energy sector by the continuing digitalization. To achieve this, following steps were performed: 1) systematic scientific literature analysis, 2) the review of non-academic documents (energy sector industry and company reports), 3) empirical research based on surveys answered by representatives of energy sector companies, as well as questionnaires answered by energy sector experts, 4) analysis of secondary data. More detailed data collection and analysis methods are described later in this section of the Master thesis.

This paper aims to find the connection between the theoretical and empirical part of how digitalization impacts BMI in the energy industry, and for this reason the abductive inference is selected to be used. The reason behind this decision is that different authors (Greener, 2008 & Lipscomb, 2012) claim this to be the most effective way to both recognise the value of the positivism and comes from the natural science (inductive methods), and the interpretivism that comes from the social science (deductive methods). The combination of two approaches and abduction creates variety within the examination of literature around the BMI topic and empirical case study of this thesis.

Due to the diversity and youth of the research and BMI literature, the views on it are very broad, connected to different paradigms. The thesis attempts to use mixed methods (analysis of existing literature and market reports, survey, “yEd”, which is explained later) based on the notation of Yin (2009): “(...) mixed methods research can permit investigators to address more complicated research questions and collect a richer and stronger array of evidence than can be accomplished by any single method alone", which is a primary steps to afterwards compare the data and make the triangulation.

Additionally, quantitative research is used for the theoretical reasoning part of the thesis. This helps to generalise the results of a large amount of the data which is crucial in order to provide a better overview on the main object of the thesis. Quantitative research design is not expected to direct the whole study, thus it is accepted more widely within social science and business research lately (Greener, 2008). However, there are some drawbacks within this type of research, where one of the

main ones is that it might ignore the essence and themes of the study, as well as it takes out the main context of the research, compared to the empirical qualitative research. This method is used just for the theoretical findings and is not used for quantifying the data of the case study company. As per the aspects and best practices from other researchers provided above, the empirical research method was selected as the main one in order to describe the results from the literature review and analysis based on the survey answers, and questionnaire answers and the expected steps of this research is provided in the figure 13. Together all this makes an overview of theoretical literature, energy companies' outlook to the changes and digitisation-based business models.

The quantitative research is selected in this master thesis research part as it suits the need to find the answer to the main research question, as well as identify the relationship between dependent and independent variables within the selected population. This type of analysis is more scientific than qualitative research and allows to almost erase bias, and aims to be more objective. Making this study a potential for future studies, the analysis can predict future results, make predictions and since it collects numerical data, it is easier to interpret results for the larger population if needed. Since other researchers (see annex 1) working on questions within the energy sector use both qualitative and quantitative studies, it was decided to analyse Lithuanian energy sector companies and finalise the paper with more generalised and overall results rather than interpreting behaviour and opinions of separate companies.

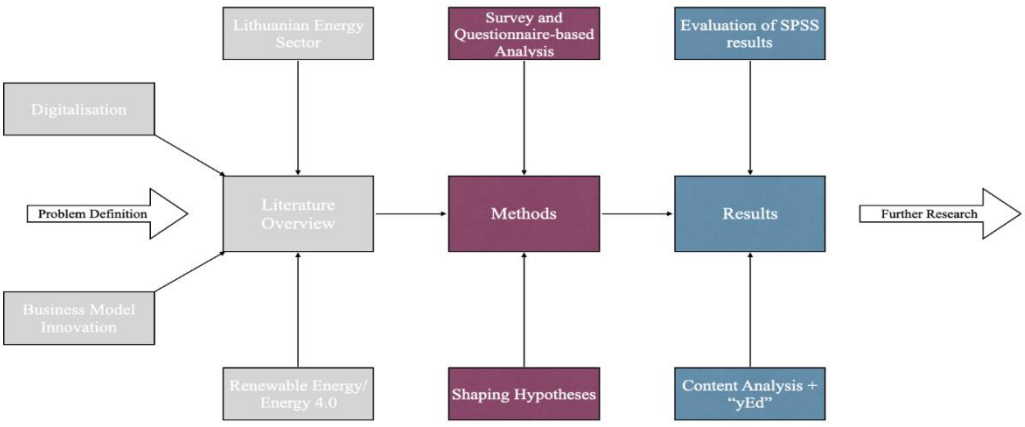

Figure 13: The conceptual framework for the research based on Attoye et al., 2018.

Source*: created by author*

2.2. Development of the hypothesis for empirical research

The conceptual model for the empirical research presents the proposition of the research on different factors within the companies. The model states that strategy implementation, market competition, technological disruption and pilot projects affect the company's level of innovation and overall performance through the new business model creation. The study proposes that business models are directly positively influenced by both internal (strategy implementation, pilot projects) and external (competition of the market, technological disruption) factors, since it is both a theoretical and practical task that most of the companies which want to stay in the market perform. Moreover, the study posits that the level of innovation and company's results are positively influenced by new business model creation, experimentation and implementation, as well as overall performance is positively influenced by the innovations happening in the company. Figure 14 shows the proposed conceptual model with hypotheses for the study.

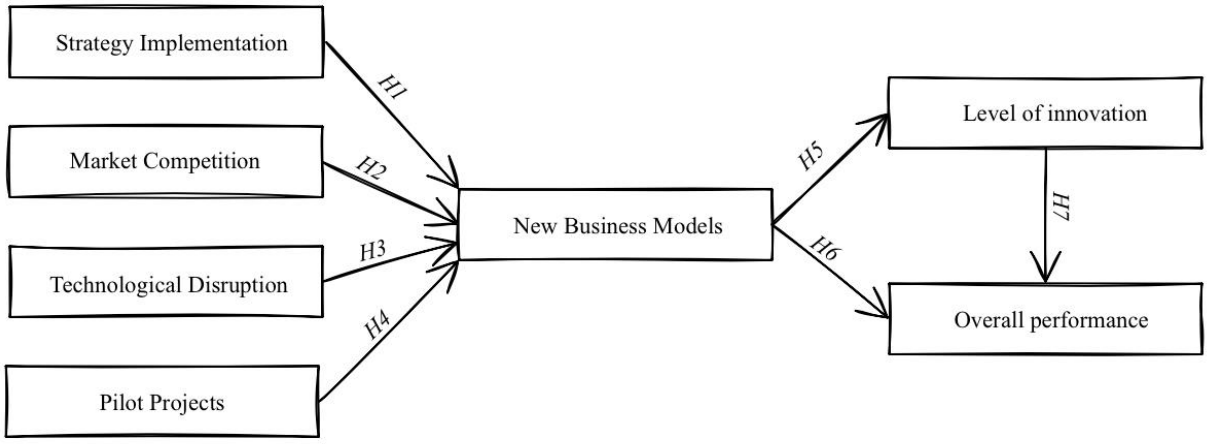

Figure 14: The conceptual model of the research

Source: *created by author*

Hypotheses and their explanations:

- *H1: Strategy implementation has a direct impact on new business models.*

Strategy creation and implementation is one of the most crucial aspects for companies to start working in a different way than before. When new strategies are implemented, new BMs are coming along the way since companies are changing their ways of working on a high operational level. Company's goals to create new strategies and focus on new product and service proposals will translate into its outlook and steps performed to implement new business models.

- *H2: Market competition has a direct impact on new business models.*

The overall market competitiveness is a good push for companies to rethink their actions towards how business should work. When competitors are strong on the innovation side and they provide new products and services, companies are forced to change their business models and focus more on the improvements of the company.

- *H3: Technological disruption has a direct impact on new business models.*

Technological disruption directly impacts all businesses all around the world nowadays. With more advanced technologies coming up, companies start offering new digitised products and services for their customers, which goes hand-in-hand with needed changes on the way of working (business models).

- *H4: Pilot projects have a direct impact on new business models.*

New pilot projects are a good way to test innovative ideas on a small scale and quickly check if it is something that a company should pursue in the long term. Companies which have dedicated budget and resources are often experimenting a lot with their BMs as well in order to find how to remain competitive in the market and improve the overall company's performance.

- *H5: New business models have a direct impact on a company's level of innovativeness.*

New business models include various types of activities performed in a company starting from creation, experimentation, all the way till implementation and retrospective maintenance. Level of

innovation of the company is seen as an independent variable which states the outcome of the innovation that happens in a particular firm. As a result, when companies invest to innovate they become more digitised and change their BMs.

- *H6: New business models have a direct impact on a company's overall performance.*

Lately innovation has been perceived as one of the main drivers to gain competitive advantage in the market; however, it cannot be done when not changing BMs of the company. Many companies state that business model activities are directly affecting the firm's performance, its profit and image in the market.

- *H7: The level of innovativeness has a direct impact on a company's overall performance.*

The result of changes within the company influences how a company is seen and perceived in the market by its competitors and customers. Companies are pushed to do this because of market situations, entrepreneurial behaviour and a wish to become different than they were before. Becoming more wanted in the market where there are many similar companies, will improve the firm's results.

Empirical research has been performed to test all hypotheses by the conceptual model in order to reject or prove the dependencies between different variables.

Because of the energy industry nature of being very competitive and dynamically changing, this empirical research is eager to follow market trends and constantly improve. Even though the whole energy market is heavily impacted by external conditions set by governmental policies, various energy transitions and their aims, another part of requirements come from the energy consumers who get more and more tech-savvy themselves. Disruptors of the energy market provide more digitised solutions based on mobile technologies as well as clean energy-based solutions, and existing companies are forced to improve their digitalization in order to stay competitive. This research additionally aims to provide recommendations for the next steps the company could take in order to create and capture the value.

2.3. Data collection methods

2.3.1 Development of the measurement model and Administration of survey

The literature review was performed in order to gain more knowledge about the BM and digitalisation topics. The aim of literature analysis was to understand how broadly the topic is recognised, problems are well-known and challenges already identified and started being solved by the authorities and companies. The review is performed using multiple sources because of the youthness of the topic, where main elements to search about were strategy, IT and technology, digitalisation, market competition, business models, energy sector, etc. The main platform used to gain knowledge is Google Scholar.

The links between analysed topics were found with the help of the Connected Papers platform, which serves as a guide on common topics around different papers written in specific periods. Various information from articles and studies were compared, conclusions and insights made and written in the literature analysis part of this master thesis. Overall findings of the review of literature in a combination with content analysis were used for survey-based empirical research. Finally, the knowledge gained helps to answer the main research question.

Analysis of the content

To gain more insights about Lithuanian energy sector, what are the main companies operating and what the latest changes were, the content analysis was performed. It is based on internal documents of Lithuanian energy companies, financial statements, websites and reports of different authorities in Lithuanian such as Agency of Lithuanian Energetics (LEA), Lithuanian Ministry of Energy, Council of State Energy Regulation (VERT) and others. This analysis aimed to get more knowledge on who are the main drivers in Lithuania to set the law and requirements for energy companies to operate, how main actors and even changing consumer behavior impacts strategies and focus of authorities, as well as to understand most common, often traditional business models among Lithuanian energy companies. Additionally, it helped to understand how changes in law fice energy companies to change their BMs and how to formulate questions of the survey based on the latest market trends.

Empirical research with experts of the area

The survey is composed in a way to cover BM and digitalisation topics, as well as to understand the behavior of companies within the last 4 years. Companies were asked to answer a questionnaire by evaluating results of 2018 - 2021. Firstly, the question whether firms had a goal to increase the level of digitalisation is provided, followed by the goal to know whether it concentrated on creating and providing new products and services to the clients. These first two questions were crucial to identify a company's strategy and thoughts regarding the innovation, which is closely related to business model innovation. Later companies were asked to evaluate whether they felt the technological pressure from the overall market improvements, if the current BM is closely related to the strategy and firm's goals. Finally, respondents were asked if they are happy with the overall performance of the company over the last 24 months and whether the higher level of digitalisation and innovation would result in better financial results in upcoming periods.

The survey for companies was created via Google Forms and has been sent to representatives (questions and the example of the questionnaire can be found in annex 2). 43 companies which have been registered to be doing business in Lithuanian energy sector have been contacted to provide their insights on the BM and digitalisation topic. The initial survey was developed in English and then translated to Lithuanian to reach respondents in an easier way. Additionally, the main topic (section) that question covers has an overall explanation and abbreviation to introduce the respondent and make it more clear in which way a person should think. The responses were monitored and collected over the Google Forms solution and downloaded in an excel file to be used for the regression analysis. Table 2 states items used in the analysis.

The model and the measurement of all survey items is based on previously examined literature on business, strategy, digitalisation, business model innovation topics. When responding to survey questions, respondents were provided with questions where answers are based on Likert-type scales where 1 is "totally disagree" and 7 is "totally agree". This type of measurement is selected in order to understand the behaviour of the company, attitude of the respondent or his/ her beliefs. Additionally, it does not force survey participants to choose only between "yes" or "no" and gives more freedom for different opinions regarding different questions. Likert-type scales were used in many similar research thus it is relevant for this study as well.

Table 2: *Question items used in the study analysis*

The construct	***Items***
Strategy implementation	- Level of digitalisation as a goal - Focus on new product offering and adapting to clients needs
Market competition	- Adjusted prices of products and services - New innovative products and services - More digitised competitors
Technological disruption	- Improved technological side of manufacturing - Changes in business models because of increased technological development
Pilot projects	- Experimenting with business models - Specific dedicated team to manage changes - Allocated budget for experiments
New business models	- Competitive advantage via BMs - BMs based on changing market circumstances - BMs' relationship with the strategy
Level of innovativeness	- Goal to become more innovative - Innovations completely new to the market - More than one innovation creation at a time
Overall performance	- Annual sales growth - Annual profit growth - Performance based on digitalisation and innovation

Source: created by author

In order to support the results of the survey, three electricity sector experts were contacted and asked to fill in the questionnaire. This part covers the qualitative research, which was decided to be needed because not all energy companies responded to the request to fill in the survey. In order to later understand the actual situation in the market and provide recommendations for Lithuanian energy sector companies, it is needed to enhance the insights of the current view by experts in the area.

Questionnaire was sent to five experts of the energy sector, who work in Ignitis Group, Energus and Energus Group, Elektrum Lithuania, Perlas Energija, where their positions differ from head of department, product development manager till C-level, such as COO, CEO. Initially the idea was to perform interviews, however, due to Covid-19 situation and data sensitivity, it was decided to perform remote contact and ask to answer several questions. However, only three respondents came back. Regarding the questionnaire, the same constructs were used as in the survey and respondents were allowed to respond in an open-ended way in order not to limit their insights. Since all of the respondents are Lithuanians, questions were sent in both Lithuanian and English languages as provided in the table (see table 3) and offered to answer based on their language preference.

2.3.2 "yEd" method

This method is being used in order to understand the linkages between the most used terms in the field of BMI from the literature point of view. Later, the recommendations were provided taking into consideration the results of interviews, data analysis and this digital method of literature analysis.

Table 3: *Questions sent to energy sector experts*

Topic	Question in English	Question in Lithuanian
Strategy Implementation	In your opinion, what are key success factors when including digitalisation as one of the key company goals?	Kokie, jūsų nuomone, yra pagrindiniai sėkmės faktoriai skaitmenizacijos įtraukimo kaip vieno kertinių įmonės tikslų?
Market Competition	How do you see energy consumers who are also producers increasing their level of competitiveness in the market?	Kaip matote energijos vartotojus, kurie kartu yra ir energijos gamintojai, padidinančius konkurencingumą rinkoje? Ar tai įmanoma? Jei taip, kaip įmonės turėtų elgtis?
Market Competition	Where do you see your company compared with competitors regarding the level of digitalisation and innovativeness when it comes to products and services in the upcoming few years?	Kaip matote savo įmonę lyginant su rinkoje esančiais konkurentais, kai kalbama apie skaitmenizacijos ir inovatyvumo lygį kuriant produktus ir paslaugas, kalbant kelių ateinančių metų kontekste?
Technological Disruption	What kind of opportunities and barriers your company faced when trying to improve its business models because of increased technological development?	Su kokiomis galimybėmis ir barjerais jūsų įmonė susiduria bandydama tobulinti verslo modelius dėl padidėjusio technologinio vystymosi rinkoje?
Pilot Projects	What are motivational leavers (KPIs, Strategic goals) for employees to think and act in terms of sustainability and digitalisation topics in the company?	Kokie motyvaciniai elementai darbuotojus skatina galvoti ir elgtis taip, kad atitiktų tvarumo, skaitmenizacijos aspektus įmonėje?
Pilot Projects	What obstacles does your company encounter when experimenting with new business models and their implementation?	Kokius iššūkius jūsų įmonė patiria eksperimentuodama su naujais verslo modeliais ir jų įgyvendinimu?
New Business Models	How are changes regarding business models initiated and managed in your company?	Kaip Jūsų įmonėje inicijuojami ir valdomi verslo modelių pakeitimai?
New Business Models	In your opinion, what are the main customer needs in regards to energy which would push your company to experiment more with new business models?	Jūsų nuomone, kokie yra pagrindiniai elektros energijos rinkos vartotojų poreikiai, kurie paskatintų įmonę labiau eksperimentuoti su naujais verslo modeliais?
Level of Innovativeness	What tools does your company use in order to offer new innovations for the market?	Kokius įrankius jūsų įmonė naudoja norėdama būti inovatyvesne ir pasiūlyti naujus sprendimus rinkai?
Overall Performance	Will revenue streams increase if your company pays more attention towards digitalisation and innovation? If yes, what kind of benefits would it bring? If not, what does need to improve to start performing better?	Ar įmonės pajamas padidėtų, jei jūsų įmonė skirtų daugiau dėmesio skaitemenizacijai ir inovacijoms? Jei taip, kokią naudą tai atneš? Jei ne, kas turi pakeisti, kad įmonė pradėtų veikti sėkmingiau?
Strategy Implementation	Did your company strategy change because of the current situation in Ukraine and Europe?	Ar Jūsų įmonės strategija pasikeitė dėl dabartinės situacijos Ukrainoje ir visoje Europoje?

Source: created by author

"yEd" is an open source software system, which provides the possibility to transform data models into complex networks by visual analysis and visual explorations. The tool is adopted by many scientists and is used in this research to analyse the keywords used by various researchers in the BMI context.

To summarise the data collection methods and the purpose behind each of them, table 4 is created. It also shows the importance of the connectivity between different methods to eventually use the results to provide the recommendations.

Table 4: *Overview of data collection and motives for it.*

No.	(Sub-)question or objective	Data collection method	Source of the data	Motive
1.	Main BMIs in energy sector	Analysis of scientific literature	Academic papers from Google Scholar and other websites	To gain knowledge around BMI within the energy industry
2.	Opportunities and barriers that digitalization creates	Analysis of scientific literature	Academic papers from Google Scholar and other websites	To gain knowledge within the digital transformation field
3.	New digital solutions within the energy sector	Analysis of scientific literature	Academic papers from Google Scholar and other websites	To understand the new solutions based on the various research work that happened within the energy sector
		Analysis of the content	Annual reports, websites and strategy reports of various energy providers	To gain knowledge around new business models, startups, innovative ideas and disruptions that are digital within the energy industry
		Survey with closed-ended questions	Answers by representatives of 43 Lithuanian energy sector companies	To gain knowledge whether new solutions provided by the scientific literature analysis are actually acknowledged in real life examples
4.	Drivers, opportunities and barriers that new technologies create for BMI	Analysis of scientific literature	Academic papers from Google Scholar and other websites	To gain knowledge around the main drivers, opportunities and barriers that digitalization creates for BMI from the theoretical analysis
		Survey with closed-ended questions; Expert questionnaires	Answers by representatives of 43 Lithuanian energy sector companies	To gain knowledge whether drivers, opportunities and barriers identified in theory are acknowledged in real company life and taken as best practices
5.	Main research question: how digitalization impacts BMI	Analysis of scientific literature	Academic papers from Google Scholar and other websites	To provide the impact of digital solutions on BMI within the constantly changing environment
		Survey with closed-ended questions; Expert questionnaires	Answers by representatives of 43 Lithuanian energy sector companies	To gain knowledge whether findings from literature analysis are actually seen in practise and gain new insights on how the company is adapting to the need of BMI being impacted by digitization
		"yEd" Digital method	Software system	To validate the connection between theoretical and empirical findings

Source: created by author

2.4. Data coding and analysis

Data coding and analysis were performed after responses of questionnaires had been collected. The idea behind the whole process is to code the answers and go from the broad concept towards the actual findings of the study. The main focus of using this method is to create a path for assessing the connection between theory and the empirical part of the research by interpreting the results of the survey and questionnaires, incorporating the results of content analysis.

When it comes to the data analysis part, all answers were separately documented and the data set is prepared for the software. This analysis was performed with an Excel tool. Since all the answers are being selected as per Likert-type scales, they will be latent variables, often considered as a continuous form of data. The following analysis were performed:

- *The correlation analysis* is to use a given quantity of sample data, extract variables from two types of sample data, analyse the degree of linear correlation between variables, and finally display the linear correlation as a converging relationship between two variables. The Pearson Correlation Coefficient is the most prevalent element in correlation analysis. The linear correlation between variables can be separated into four tiers based on the number of Pearson correlation coefficients r: $0.8<r<1$ indicates high relevance; $0.5<r<0.8$ indicates moderate relevance; $0.3<r<0.5$ indicates low grade relevance; and $0<r<0.3$ indicates weak relevance. Variance analysis techniques such as the Mann-Whitney test or the Kruskal Wallis test are popular methods for analysing answers. For the empirical study a correlation using a t-test was performed.

- *The regression analysis* is based on a set of sample data, selects the independent and dependent variables from the data sample, and then uses a set of mathematical statistical procedures to arrive at a conclusion about the regression relations between the independent and dependent variables. In general, there are four steps to regression analysis: The first step is to identify the independent and dependent variables; the second step is to confirm the mathematical relationship based on the samples; the third step is to identify the regression equation's parameters and then check that the checksum matches; and the final step is to estimate and forecast using the regression equation. All dependent control variables should be convertible to dichotomous variables for this regression and perform logistic regression.

Additionally, since parametric tests (t-test, linear regression) were performed, there is a need to pay attention to the final assumptions made since the data may not be marginally normal or homoscedastic. Sample size and statistical power issues were seen to be having a significant importance in current day life. The reliability will be analysed using Cronbach alpha (more about reliability can be found in the next chapter 2.5).

2.5. Data validity and reliability

This part describes how valid and reliable the data is. Additionally, it provides the concerns about the present tense and possible changes if repletion of the case study is performed after some time.

The focus of the research has been to provide well-supported theory reasoning with the help of scientific literature analysis and case study. Yin (2003) notes that the quality of the empirical research can be evaluated based on four tests: construct validity, internal validity, external validity and how reliable the research design is.

When it comes to validation of a construct, it examines if operational measures for the concepts and constructs were selected correctly (Yin, 2003). This paperwork analyses a huge amount of different documents and researches performed in order to gain the needed knowledge on the developments and activities happening within the energy industry. Additionally, various articles with information about Lithuania's energy sector, its latest trends, and new inventions are analysed in order to make the research less biased. Furthermore, the triangulation is used to validate the quantitative matter and the construct validity of the theoretical results when connecting interviews, literature analysis and "yEd" method. Finally, the internal reliability and consistency are measured by Cronbach's alpha test.

Secondly, the internal validity is described as the one establishing the causal relations where some events eventually lead to other exact events (Yin, 2003). The average variance extracted (AVE) is analysed and presented in the results section to cover the validity of convergents and test it. Even though it is said to be hard to attain the high level of internal validity, this research performs the pattern matching to keep it as high as possible.

Furthermore, Yin (2003) states that to have the external validation, is to understand to what extent the generalizability is limited or not. This paper investigates the outlook of companies registered as operating in Lithuanian energy sector. That being said, the sample size is small and generalisation is limited, there is a need to perform future research in order to explore this topic more broadly.

Lastly, the main focus of the research is to try to understand the current moment of reality within a specific time frame. Because of this, reliability is harder to trust and is getting weaker when including the uncertainty of investigating a topic for a very limited period of time. At the same time, the more time study and procedures were repeated, the more reliable it could be and could be supported by the notion of Yin (2009): "The general way of approaching the reliability problem is to make as many steps as operational as possible and to conduct research as if someone were always looking over your shoulder". Therefore, every step of data collection and analysis is documented, processes during the data coding were operationalised. All people within different Lithuanian energy sector companies were provided with the same instructions about the process of answering the questions and data storage and data protection rules. Additionally, questions within the survey are the same for c-level managers and other leaders. To sum up, the study results can represent only the present time and any upcoming experience might impact and change them and provide different results, if the study was about to be repeated. However, the whole digitalization process also has some barriers, which were closely connected to data insecurity, risks and lack of knowledge among employees and customers in regards to why companies do need changes and how it will impact the existing daily routine of energy production and consumption.

Business model innovation is now a part of every energy producer's life as it is needed to improve if a company wants to remain competitive in the market. It is important to be curious about the newest trends in the market and new technologies that can help to make a company more efficient in this constantly changing world.

3. RESEARCH RESULTS

3.1. Empirical research with energy sector companies

The empirical study was performed with the Excel software due to some limitations and SPSS unavailability. Additionally, 14 out of 43 companies answered the questionnaire so far, thus, the empirical research is performed using data from these companies. Since every construct (i.e., strategy implementation, pilot projects, new business models) contain a few questions each in the survey, the mean was calculated for each construct of every company (see table **5** below).

Table 5: *Data for the statistical analysis*

COMPANY	STRATEGY_IMPLEMENTATION	MARKET_COMPETITION	TECH_DISRUPTION	PILOT_PROJECTS	NEW_BUSINESS_MODELS	LEVEL_OF_INNOVATIVENESS	OVERALL_PERFORMANCE
UAB "Ramus Baltic"	1	3,33	1	1	3	1,33	3
UAB "All in Container"	5,5	5,33	5,5	4,67	7	5	5
AB "ESO"	7	5,33	5,5	4,67	6,67	6,33	5
UAB "Egto Energija"	5,5	4	6	3,67	6	6,33	4,67
UAB "Ignitis"	4,5	6,67	4,5	4,67	7	5,67	4,67
UAB "Enodus"	5	5,33	5,5	6,67	6,67	6,67	3
UAB "Samperna"	2	4,67	3	2	4,33	3,33	2,67
UAB "Dažnis"	6,5	6	6,5	7	6	6	4,67
UAB "Solmina"	2,5	7	3	2	5,33	2	6
AB "Panevėžio energija"	5,5	4,33	3,5	6,33	6	6,67	5
UAB "Energus Group"	4	5	3,5	2,33	4,67	4	3,67
UAB "Energus LT"	6,5	6,33	7	6	6	6,67	5,67
UAB "Elektrum"	7	5	4,5	2,67	4,67	5,67	6,33
UAB "Perlas Energija"	7	6	7	7	6	5	5

Source: created by author

To approach the impact of digitalization on business model innovation in Lithuanian energy sector companies, linear regression analyses were performed to evaluate the prediction of overall performance of the company from strategy implementation, market competition, technological disruption, pilot projects, new business models and level of innovativeness, where last two ones are also acting as mediators.

Firstly, the correlation analysis was performed, in order to find out which independent variables are connected (see table 6 below). The results show that there is a very strong relation between the strategy implementation and technological disruption (r=0.883), pilot projects (r=0.829), new business models (r=0.826) and level of innovativeness (r=0.896). Additionally, technological disruption has a high positive correlation with pilot projects (r=0.736) and a very high positive one with new business models (r=0.811) and level of innovativeness (r=0.809). There is also a strong

positive connection between pilot projects and new business models (r=0.739) and a very strong connection with level of innovativeness (r=0.874). Finally, the new business models have a strong relation with the level of innovativeness (r=0.799). This means that all these variables impact each other in a way, that if one increases, other impacted ones increase as well. Only market competition and overall performance constructs have no strong relation with any other variables. It is important to mention, that since most of the variables are so correlated, there might be the multicollinearity issue when evaluating the results of regression analysis.

Table 6: *Variables' correlation summary*

	STRATEGY_IMPLEMENTATION	*MARKET_COMPETITION*	*TECH_DISRUPTION*	*PILOT_PROJECTS*	*NEW_BUSINESS_MODELS*	*LEVEL_OF_INNOVATIVENESS*	*OVERALL_PERFORMANCE*
STRATEGY_IMPLEMENTATION	1						
MARKET_COMPETITION	0,207274376	1					
TECH_DISRUPTION	*0,883700913*	0,316326545	1				
PILOT_PROJECTS	*0,829001526*	0,245593644	*0,73673999*	1			
NEW_BUSINESS_MODELS	*0,826017984*	0,529558412	*0,81117111*	*0,73946098*	1		
LEVEL_OF_INNOVATIVENESS	*0,896665253*	0,070910199	*0,80934098*	*0,874266251*	*0,799399113*	1	
OVERALL_PERFORMANCE	0,448871181	0,540183687	0,306098538	0,19021593	0,499267017	0,177234837	1

Source: created by author

Secondly, in order to quantify the idea of statistical significance of evidence to the null hypothesis, the t-test with paired two samples for means was performed (see table 7). Initially, the null hypothesis states that one variable does not affect the other one – they have no relationship. The results of the t-test reveal that at the $\alpha = 0.05$ level of significance, in many cases there is not sufficient evidence to reject the null hypothesis. However, there is a significant difference between strategy implementation and new business models ($p = 0.003$), technological disruption and new business models ($p = 0.0009$), pilot projects and new business models ($p = 0.004$). Additionally, the null hypothesis can be rejected for significance of results of pilot projects and level of innovativeness ($p = 0.035$) and new business models and level of innovativeness ($p = 0.027$). The conclusions can be stated, that even though the correlation between most of the independent variables are high, there is a significant difference between previously mentioned independent variables and mediators (new business models and level of innovativeness), as well as between two mediators themselves, which is the most important part of the t-test results.

Table 7: *Summary of t-test analysis results*

	STRATEGY_IMPLEMENTATION	TECH_DISRUPTION	PILOT_PROJECTS	NEW_BUSINESS_MODELS
TECH_DISRUPTION	0,371729454	O		
PILOT_PROJECTS	0,277853096	0,388149947	O	
NEW_BUSINESS_MODELS	*0,003565446*	*0,000929342*	*0,00403619*	O
LEVEL_OF_INNOVATIVENESS	0,08287786	0,092915974	*0,035558156*	*0,027051684*

Source: created by author

To prove or reject hypotheses, linear regressions were performed for independent variables. Additionally, the mediation analyses were performed since there were two mediators in the research model.

- *H1 hypothesis:*

Table 8: *Summary of regression analysis for first independent variable*

Regression Statistics								
Multiple R	0,826017984							
R Square	0,682305711							
Adjusted R Square	**0,642593924**							
Standard Error	0,764968625							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	10,05418403	10,05418	17,181441	**0,003230873**			
Residual	8	4,681415972	0,585177					
Total	9	14,7356						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,421875	0,62263935	5,495758	0,00057662	1,986066084	4,857683916	1,986066084	4,857683916
STRATEGY_IMPLEMENTATION	**0,528472222**	0,127494771	4,14505	**0,00323087**	0,234468754	0,822475691	0,234468754	0,822475691

Source: created by author

When testing the relationship between the first independent variable and mediator, the results show that 64% (Adjusted $R^2 = 0.642$) of the new business models can be explained by strategy implementation. Since the Sig.F = 0.003 < 0.05, the model is valid and correct. F(1) = 17.181.

H1 – is proved. Strategy implementation has a direct positive impact on new business models. p = 0.003, p < 0.05 – good coefficient.

*NEW_BUSINESS_MODELS = 0.528*STRATEGY_IMPLEMENTATION*

- *H2 hypothesis:*

Table 9: *Summary of regression analysis for second independent variable*

Regression Statistics								
Multiple R	0,529558412							
R Square	0,280432112							
Adjusted R Square	**0,190486126**							
Standard Error	1,151263684							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	4,132335431	4,132335	3,117783512	**0,115435799**			
Residual	8	10,60326457	1,325408					
Total	9	14,7356						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	2,757499057	1,761129458	1,565756	0,156038339	-1,303672755	6,818670869	-1,303672755	6,818670869
MARKET_COMPETITION	**0,585208875**	0,331427031	1,765725	**0,115435799**	-0,179063228	1,349480979	-0,179063228	1,349480979

Source: created by author

When testing the relationship between the first independent variable and mediator, the results show that 19% (Adjusted $R^2 = 0.190$) of the new business models can be explained by market competition. The Sig.F = 0.115, F(1) = 3.117.

H2 – is **rejected**. There is no correlation between market competition and new business models. $p > 0.05$.

- *H3 hypothesis:*

Table 10: *Summary of regression analysis for third independent variable*

Regression Statistics								
Multiple R	0,81117111							
R Square	0,657998569							
Adjusted R Square	**0,61524839**							
Standard Error	0,793693603							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	9,696003717	9,696004	15,391715	**0,004398377**			
Residual	8	5,039596283	0,62995					
Total	9	14,7356						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,158364312	0,718589781	4,395226	0,0023014	1,501293306	4,815435319	1,501293306	4,815435319
TECH_DISRUPTION	**0,600371747**	0,153030057	3,923228	**0,0043984**	0,247483803	0,953259691	0,247483803	0,953259691

Source: created by author

When testing the relationship between the first independent variable and mediator, the results show that 61% (Adjusted R^2 = 0.615) of the new business models can be explained by the technological disruption. The Sig.F = 0.004, F(1) = 15.391.

H3 – is proved. p < 0.001. Technological disruption has a direct positive impact on new business models.

*NEW_BUSINESS_MODELS = 0.600*TECH_DISRUPTION*

- *H4 hypothesis:*

Table 11: *Summary of regression analysis for fourth independent variable*

Regression Statistics								
Multiple R	0,73946098							
R Square	0,546802541							
Adjusted R Square	**0,490152859**							
Standard Error	0,913655876							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	8,057463526	8,057464	9,6523496	**0,014515095**			
Residual	8	6,678136474	0,834767					
Total	9	14,7356						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,867346248	0,685889725	5,638437	0,0004879	2,285681706	5,449010791	2,285681706	5,449010791
PILOT_PROJECTS	**0,452824216**	0,145751529	3,106823	**0,0145151**	0,116720586	0,788927845	0,116720586	0,788927845

Source: created by author

When testing the relationship between the first independent variable and mediator, the results show that 49% (Adjusted R^2 = 0.490) of the new business models can be explained by pilot projects. The Sig.F = 0.014, F(1) = 9.652.

H4 – is proved. p < 0.001. Pilot projects have a direct positive impact on new business models.

*NEW_BUSINESS_MODELS = 0.452*PILOT_PROJECTS*

- *H5 hypothesis:*

Table 12: *Summary of regression analysis for first mediator*

Regression Statistics								
Multiple R	0,799399113							
R Square	0,639038941							
Adjusted R Square	**0,593918809**							
Standard Error	1,270543771							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	22,8631582	22,86316	14,16306	**0,005517573**			
Residual	8	12,9142518	1,614281					
Total	9	35,77741						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-2,291573143	1,961296037	-1,1684	0,276283	-6,814329915	2,231183629	-6,814329915	2,231183629
NEW_BUSINESS_MODELS	**1,245616059**	0,330983024	3,763384	**0,005518**	0,482367837	2,008864281	0,482367837	2,008864281

Source: created by author

When testing the relationship between two mediators, results show that 59% (Adjusted R^2 = 0.593) of level of innovativeness of the company can be explained by the new business model construct. Since Sig.F = 0.005 < 0.01, the model is valid and correct. F(1) = 14.163

H5 – is proved. New business models have a direct positive impact on the level of innovativeness. p = 0.005.

*LEVEL_OF_INNOVATIVENESS = 1.245*NEW_BUSINESS_MODELS*

- *H6 hypothesis:*

Table 13: *Summary of second regression analysis for first mediator*

Regression Statistics								
Multiple R	0,499267017							
R Square	0,249267554							
Adjusted R Square	**0,155425998**							
Standard Error	1,004919283							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	2,682457885	2,682458	2,65626	**0,141790708**			
Residual	8	8,078902115	1,009863					
Total	9	10,76136						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,893368495	1,551260374	1,220536	0,257014	-1,683844343	5,470581334	-1,683844343	5,470581334
NEW_BUSINESS_MODELS	**0,426660604**	0,261786513	1,629804	**0,141791**	-0,177020176	1,030341385	-0,177020176	1,030341385

Source: created by author

When it comes to the relationship before the first mediator and dependent variable, the results show that only 15% (Adjusted $R^2 = 0.155$) of the overall performance can be explained by the new business models. Sig.F = 0.141, F(1) = 2.656

H6 – rejected. There is no correlation between new business models and overall performance. p = 0.141

- *H7 hypothesis:*

Table 14: *Summary of second regression analysis for second mediator*

Regression Statistics								
Multiple R	0,177234837							
R Square	**0,031412188**							
Adjusted R Square	-0,089661289							
Standard Error	1,141453139							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	0,338037859	0,338037859	0,259447	**0,62424952**			
Residual	8	10,42332214	1,302915268					
Total	9	10,76136						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,888499198	1,008209778	3,856835434	0,004831	1,56356328	6,213435116	1,56356328	6,213435116
LEVEL_OF_INNOVATIVENESS	**0,097202676**	0,19083307	0,509359704	**0,62425**	-0,342859173	0,537264525	-0,342859173	0,537264525

Source: created by author

When it comes to the relationship before the second mediator and dependent variable, the results show that only 3% ($R^2 = 0.031$) of the overall performance can be explained by level of innovativeness. Sig.F = 0.624, F(1) = 0.259

H7 – rejected. There is no correlation between level of innovativeness and overall performance. p = 0.624

Additionally, Cronbach's Alpha was calculated (see Annex 3), and the result is 0.887, which means that internal consistency of the survey is good and results are reliable.

Results of the empirical analysis

The overall performance is explained by the variance of 3 per cent, level of innovativeness is explained by the variance of 63 per cent and new business models is explained by the variance of 68 per cent. Different statistics were computed in order to analyze the data and test hypotheses. The conceptual research model was created, however, results of the research show that the model either

has not enough samples – answers of the questionnaire, or it is invalid and needs to be changed. Four out of seven hypotheses were proved and three rejected (see table 15 below). Additionally, variables have a strong correlation, so there is a need to rethink if they should be changed with any other additional variables. Finally, all variables had to be tested by the linear regressions. Some of the variables have $p>0.05$, this is because there is not enough data collected for the research yet – 10 companies provided answers out of 43. In order to test independent variables properly, there had to be at least 24 responses (at least 6 times more than number of independent variables, this is why 4*6=24). Due to this reason multiple regression analysis could have not been performed for the research and linear regressions where one independent variable is investigated at once were performed.

The aim of the study was to analyse how new business models in Lithuanian energy sector companies impact the level of innovativeness in those companies and their overall performance. The study shows that only the level of innovation is being impacted by the new business models, but overall performance is not influenced neither by level of innovativeness nor by new business models.

This kind of situation could be explained also by the sector that is analysed. Since innovation and BMs are not the main drivers of the company's results as an empirical study showed, it might be that most of these companies generate better results by investing more into infrastructure, as well as energy prices – as it is based purely on supply and demand. As literature and content analysis shows, political factors and environmental conditions are also playing a big role in the results of every energy company. Finally, decentralisation and more influential customers who can now be energy providers themselves influence a lot on how companies operate and what kind of results they achieve.

Table 15: *Summary of hypothesis testing results*

No.	Hypothesis	Result
H1	Strategy implementation has a direct impact on new business models	Proved
H2	Market competition has a direct impact on new business models	Rejected
H3	Technological disruption has a direct impact on new business models	Proved
H4	Pilot projects have a direct impact on new business models	Proved
H5	New business models have a direct impact on level of innovativeness	Proved
H6	New business models have a direct impact on overall performance	Rejected
H7	Level of innovativeness has a direct impact on overall performance	Rejected

Source: created by author

3.2. Content analysis

Content analysis is performed in order to reveal the current situation in Lithuanian energy sector, which would help to deliver the final conclusion of the research. Lithuania has gone through several energy transformations in the last decade. Lithuania went from being a net exporter of electricity to a net importer of electricity after the closing of its only nuclear power facility (Ignalina's two reactors shut down in 2004 and 2009). Imports of electricity, natural gas, and biofuels have all increased since then. Lithuania currently imports more than 70% of its electricity, with bioenergy assuming the lead in domestic energy supply. The majority of Lithuania's cogeneration, district heating, and home heating systems have transitioned to biomass from natural gas. Lithuania is committed to the EU's climate neutrality target and is beginning to place a larger emphasis on climate change mitigation while enhancing economic growth and technological innovation.

Lithuania is said to be the world's first country to develop an online platform for purchasing solar energy. Consumers can buy a share of solar energy generated by remote solar panels through the site. This means that people in one section of the country can benefit from solar energy generated in another. On October 1, 2019, the Lithuanian Ministry of Energy introduced a new rule allowing inhabitants of apartments to install solar plants. The first 1 MW remote solar farm at Elektrenai, which

will provide electricity for around 300 families, was inaugurated on April 29, 2020. Lithuania is one of the first countries in Europe to make renewable electricity accessible to all residents and households by producing electricity from renewable energy sources in one location that can be utilised in another (Kaliunaite, N.d.).

Lithuania's new National Energy Independence Strategy aims to produce all of the country's power and heat energy from renewable and non-polluting sources within the next 30 years. Wind power plants will become Lithuania's principal generator of electricity, contributing significantly to the growth of clean energy. According to the policy, energy produced in Lithuania should account for 70% of the final power consumption in 2030. Renewable energy sources will be required to provide 45 percent of electricity and 90 percent of heat energy. Wind power facilities will generate more than half of Lithuania's electricity by 2030, according to projections (see figure 15). The remainder will come from other renewable energy sources, with solar energy accounting for 22%, biofuels for 16%, hydropower for 8%, and biogas for 1%. With these intentions, Lithuania has joined countries like Denmark, the Netherlands, Germany, Sweden, Portugal, Spain, and Ireland in growing wind power. Wind should produce more than 30% of the electricity our country needs by 2030 if the National Energy Strategy's goals are met, and help significantly to lower CO2 emissions in the atmosphere (Lvea, 2018).

In general, the main three principles that this Strategy is based on are (Seimas of the Republic of Lithuania, 2012):

- Energy autonomy. Lithuania's domestic energy demand will be met by a variety of local and diverse sources. This is a prerequisite for the energy system's reliable operation and the avoidance of energy supply interruptions;
- Competition. Lithuania will enter European energy markets and restructure existing monopolies in the energy sector. This will provide lower energy prices for consumers and sufficient investments in the energy sector to build the missing energy infrastructure;
- Sustainability. The concepts of sustainable development must be applied to both the production and consumption of energy. When it comes to ensuring sustainability, boosting energy production, transmission, and consumption efficiency, as well as encouraging energy production from environmentally friendly resources, will help to reduce greenhouse gas emissions (renewable energy sources and nuclear energy).

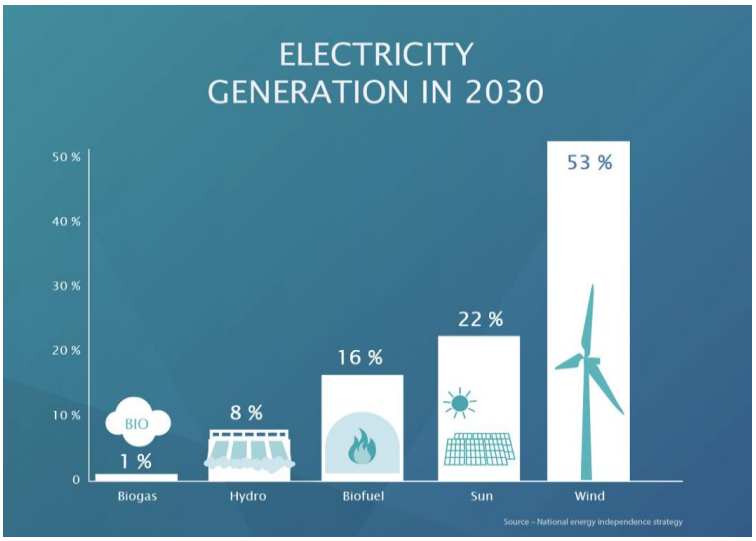

Figure 15: Electricity generation in 2030.

Source: *Lvea, 2018*

A new and promising field is increasing investments in clean energy technology innovation. The International Energy Agency (IEA) applauds the Action Plan for an Energy Innovation Ecosystem, which aligns with the IEA's technology and innovation framework. The International Energy Agency (IEA) recommends Lithuania to establish a regular framework for tracking energy innovation results and funding. The action plan is an opportunity to enhance energy sector investments in the context of Lithuania's new Innovation Promotion Fund, which was developed by the Ministry of Economy and Innovation, the Ministry of Finance, and the Investment and Business Guarantees (Invega).

Energy security is more crucial than ever in the Baltic region, despite escalating geopolitical tensions. A robust renewables strategy based on bioenergy and wind energy is at the centre of Lithuania's security policy, as part of a commitment to reduce electricity imports by half by 2030 and to zero by 2050. Regional integration, rather than independence, now underpins energy security. Lithuania is a part of the Baltic-Nordic power market, which is highly integrated. A primary policy goal is to achieve even deeper integration with the EU energy system, with the goal of obtaining full synchronisation with the European continental electrical grid by 2025. Other power security problems that Lithuania coordinates with regional partners include the implementation of the Baltic Energy

Market Interconnection Plan and investments in new electricity and gas infrastructure, which are co-financed through the Connecting Europe Facility. One of Lithuania's current key challenges is to ensure that no electricity from Belarus, where the Astravets nuclear power station was just commissioned, enters the Baltic States' market. The facility has been declared dangerous by Lithuania's Special Law, since it poses major hazards to nuclear safety, the environment, and national security across the Baltics, particularly in Vilnius, Lithuania's capital (IEA, 2021).

Technology innovation is a complex process, and decision-makers must consider a number of factors that distinguish successful energy innovation systems (IEA, 2020). These factors are divided into four categories by the IEA: 1) resource push; 2) knowledge management; 3) market pull; and 4) socio-political support are all examples of resource push (see figure 16).

While the appropriate policy measures to address each function can vary greatly depending on the size and structure of a country's economy, the technologies it prioritises, and the strength of its existing R & D base, successful energy innovation ecosystems can have effective policies in each of the four areas. Policies may operate at several levels, such as local, national, or municipal, in some circumstances. The government of Lithuania should:

- Develop and regularly adjust a cross-ministerial energy-related R&D strategy to support the national energy and climate policy objectives, identify funding needs, and align key priority areas across government;
- Establish a methodology to continuously monitor the performance of the energy innovation ecosystem along the action plan, including public and private energy-related R&D expenditure, and to adjust the implementation accordingly.
- Increase the level of public funding as a share of the GDP in order to further develop national core competencies and strengthen and direct energy-related R & D.
- Incentivise private investments by identifying and removing regulatory barriers, creating regulatory sandboxes and providing matching public funding through auctions, contracts-for-difference or public procurement.
- Introduce suitable institutional and human resource capability to speed knowledge and technology transfer within the energy innovation ecosystem and to the business sector, in order to maximise the utilisation of publicly financed R&D results and expand international partnership activities.

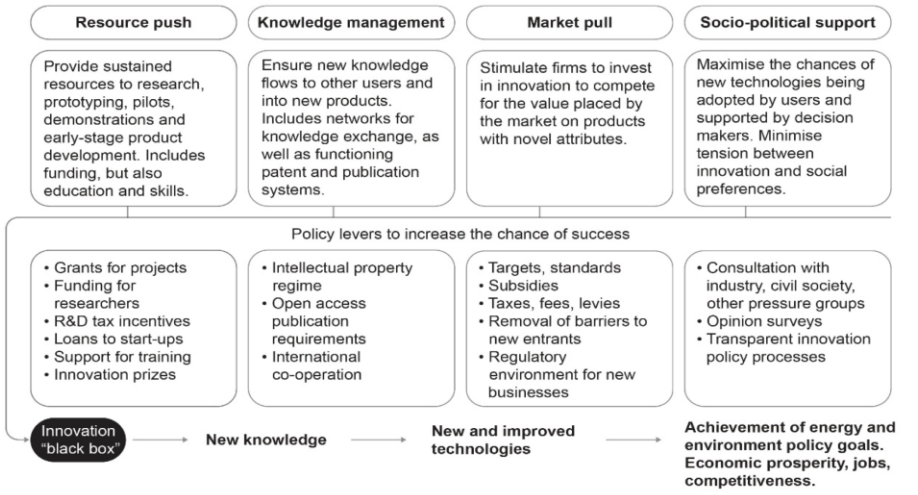

Figure 16: The IEA's four functions of a successful innovation ecosystem for energy.
Source*: IEA, 2020*

People in industrialised countries consume the most energy, despite the fact that they have numerous chances to actively participate in the energy market, ranging from purchasing rooftop solar and becoming a prosumer to selling flexibility services with personal electric vehicles or home storage. Utility companies struggle to persuade customers to embrace energy-saving measures in order to improve the market. As Lithuania prepares to synchronise with continental Europe in 2025, Ignitis Group, like other providers, is attempting to involve consumers in a future energy market. Lithuania will need to ensure that it has the power capacity to execute flexibility and other demand response services once it begins. Lithuania will be forced to ensure its network balancing capabilities as its energy network synchronises with Western Europe. Ignitis Group is searching for various customer engagement programs that would provide consumers with the necessary incentives to use flexibility services. Also, customers should be educated about the prospects of being more than just end-market buyers. Implementing the correct technology and innovative business models, as well as foreseeing economic incentives to encourage active engagement in Demand Side Response services, are all crucial steps in coming up with solutions (Sedziniauskiene, 2020).

When it comes to consumers and their needs, around 89% of Lithuanians indicated they would be very interested in generating their own electricity from the sun, and 60% said they would seriously

consider it if they did not have to worry about the solar power plant's installation. Because of the potential to lower electricity costs, the majority of the population would like to make electricity from the sun. According to a nationwide opinion poll conducted in 2019, support for environmental conservation and energy independence is also a key motivator (Kaluinaite, n.d.). Overall, the industry's traditional consumer focus has been on "performance-based satisfaction." Customer tactics that addressed basic issues such as dependability, safety, affordability, information delivery, and problem resolution were sufficient. A new set of issues has emerged as a result of the combination of energy transformation and technology innovation (Schwieters, 2016). Companies must have a clear strategy for how far they want to go in producing new products and services in this ecosystem, as well as the enhanced customer connection mechanisms that go along with them (see figure 17).

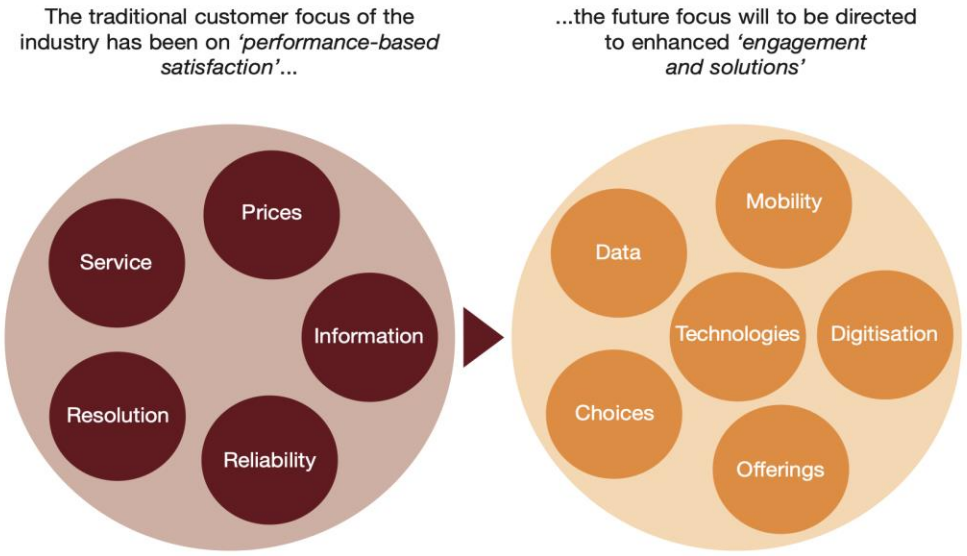

Figure 17: Changing electricity consumer challenges.

Source: *Schwieters, 2016*

Future energy consumers will adopt and adapt digital systems that allow them to regulate their energy footprints, resulting in new energy-as-a-service business models. Energy companies will encounter many business disruptions and will need to act in new and innovative ways to stay ahead of the "game".

3.3. Expert questionnaires

Three experts from Lithuanian energy sector were asked to respond to questionnaires instead of being interviewed due to the COVID-19 situation all over the world. People from UAB "Ignitis", UAB "Energus Group" and UAB "Elektrum Lithuania" agreed to share their knowledge on how current companies work in decentralised energy setup. The overall aim of questionnaires was to get a deeper understanding of similarities and differences between competitors and get ideas on the future perspective for these companies. Additionally, main keywords were collected in order to later use for the discussion of overall research results and understand key objectives of the target companies.

Table 16: *1st question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Strategy Implementation	In your opinion, what are key success factors when including digitalisation as one of the key company goals?	Conditions are dictated by the market - if the company does not adapt and does not digitise its processes and/ or services - very quickly will be left behind even from the average of the market. It is the opposite when companies invest into innovation, they gain a competitive advantage.	By digitising processes, the costs are being lowered as well as the comfort for the customer and competitive advantage is being created.	N/A

Source: created by author

As it is shown from the answers to the first question "In your opinion, what are key success factors when including digitalisation as one of the key company goals?", it is clear that companies focus on reducing the price for the customers in order to improve customer experience, as well as to stay needed and wanted in the market. Both respondents from UAB "Energus Group" and UAB "Ignitis" share similar opinions, where an expert from UAB "Elektrum Lithuania" did not respond to this question. *Main keywords identified: digitalise, competitive advantage, costs*.

Table 17: *2nd question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Market Competition	How do you see energy consumers who are also producers increasing level of competitiveness in the market?	In my opinion - the vision of future energy are autonomous areas and/or cities and/or communities. Companies must adapt and think to offer even higher autonomy energy resources based solutions.	Our company deploys and encourages the source for electricity from renewable energy sources, as well as we create processes where users are energy providers. They can decide what to do with the created but not used amount of energy. In the future biggest amount of electricity created in Lithuania should be from renewable energy sources, where big part will be played by producing customers.	When customers became also producers, the new type of competition appeared as well as new types of customers whose yearly income regarding the electricity is much more difficult to predict and calculate the payback time.

Source: created by author

Answers to the second question "How do you see energy consumers who are also producers increasing their level of competitiveness in the market?" reveals that all three companies focus on the future of the energy and liberalised market, which brought a new type of energy producers - electricity users. UAB "Ignitis" also focuses a lot on renewable energy, where UAB "Elektrum Lithuania" suggests difficulties regarding the payback time calculation. *Main keywords identified: vision, future energy, producing customers, renewable energy and payback time.*

Table 18: *3rd question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Market Competition	Where do you see your company compared with competitors regarding level of digitalisation and innovativeness when it comes to products and services in upcoming few years?	Currently the level is higher than the average of the market. In order to keep it and get higher, there is a need for capital which is dedicated only to innovation.	Currently our company which dedicates time for digitalisation and innovation is the leader when in comes to electricity market. I think that in the context of few upcoming years nothing will change.	Digitalisation and innovation are priority areas in our company with the help of which we will try to keep our competitive advantage and keeping the clients, as well as the profit throughout the customer lifecycle.

Source: created by author

When asked "Where do you see your company compared with competitors regarding level of digitalisation and innovativeness when it comes to products and services in upcoming few years?" experts definitely focus on digitalisation and innovation topics in order to remain competitive in the market. All representatives explicitly mention that their companies are competitive leaders of the market, where "Elektrum Lithuania" also explains the focus on the lifecycle of the energy consumer. *Main keywords identified: digitalisation, innovation, time, profit, customer lifecycle, capital.*

Table 19: *4th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Technological Disruption	What kind of opportunities and barriers your company faced when trying to improve its business models because of increased technological development?	Opportunities - more effective services and products sales management, which rise from the project-type of activity management level. Threats - the lack of people resources and huge investments needed into re-qualification/ training of current employees	Opportunities - make activities more effective and become even more convenient for our customers. Threats - lack of human resources in technology sector, lack of solidity in the regulated part.	Threats - long experience and settled processes prevent from competing and be able to be as fast as "start-up" type of companies where it is very easy to change orders, processes and systems.

Source: created by author

While discussing barriers and opportunities that appeared due to technological development of the market when the target companies of this research tried working on their business models, "Energus Group" and "Ignitis" experts' effectiveness as a pushing force, however, about lack of resources and training when it comes to some stoppers. Expert from "Elektrum Lithuania" explained

that the biggest barrier for a company is not to be able to change as quickly as some startups. Thus, the result is clear that companies both need to be flexible as well as to focus on their employees. *Main keywords identified: effective services, human resources, solidity, easy to change.*

Table 20: *5th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Pilot Projects	What are motivational leavers (KPIs, Strategic goals) for employees to think and act in terms of sustainability, digitalisation topics in the company?	More convenient work, easily understandable digitised processes.	Standardised and easily understandable business processes, Kaizen.	Sustainability itself is a highest motivation for employees, a possibility to work in a company which by real and tangible actions changes environment and allows all citizens of the country to use energy from renewable sources. Digitalisation is the tool that allows company to provide sustainable energy solutions to the wider customer audience.

Source: created by author

When experts were asked about pilot projects, more precisely "What are motivational leavers (KPIs, Strategic goals) for employees to think and act in terms of sustainability and digitalisation topics in the company?", two respondents stated better process handling, as well as Kaize, while the third respondent stated that people feel empowered and motivated by knowing that a company has a sustainable way of working and digitalisation is one of the key drivers for it. *Main keywords identified: easily understandable processes, Kaizen, sustainability, digitalisation.*

Table 21: *6th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Pilot Projects	What obstacles your company encounters when experimenting with new business models and their implementation?	Unpredictable market and current situation in construction sector because of war in Ukraine	Inconsistency of stock exchange because of geopolitical reasons.	Biggest challenges are connected with the data collection and analysis.

Source: created by author

Sixth question on the obstacles a company encounters when experimenting with new business models and their implementations revealed that companies are actually affected by the current situation in Ukraine. Additionally, experts talk about inconsistency of the market, the process of data collection and analysis, thus, it is understandable that an unsure situation makes the market difficult to predict. *Main keywords identified: geopolitical reasons, war in Ukraine, data collection and analysis.*

Table 22: *7th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
New Business Models	How are changes regarding business models initiated and managed in your company?	First of all - detailed market analysis and best practices adaption. Later - constant education of employees.	In certain scenarios business model changes are being initiated by law basis changes, when energy sector is highly regulated by the government. In other occasions, detailed market analysis is being prepared where they are based on best practices, sometimes market testing is performed as well as trainings for employees.	N/A

Source: created by author

Experts were also asked how normally ideas of changing to the new business model are brought up and then implemented (if agreed) later on. Expert from "Elektrum Lithuania" decided not to answer this question, where the other two answers were very similar. Both "Energus Group " and "Ignitis'' focus on latest news and common practices of the market with the proper pre-analysis before. This drives the conclusion that companies trust that the market is mostly a knowledgeable place for new ideas and improvements, thus everyone looks there for new ideas and how to make a company different/better. *Main keywords identified: market analysis, best practices, education, law basis.*

Table 23: *8th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
New Business Models	In your opinion, what are the main customer needs in regards to energy which would push your company to experiment more with new business models?	In my opinion - the vision of future energy are autonomous areas and/or cities and/or communities. Companies must adapt and think to offer even higher autonomy energy resources based solutions.	Primary need is to optimise costs of energy consumption when there is a tendency that the price and the amount of used electricity is growing.	Sustainability and renewable energy for household consumers. Lithuania has an exceptional regulation which allows to provide energy from different geographical points. This kind of regulation is exceptional in Europe, this is why there is still minimal experience and all business models need to be tested, this is why there is no methodology of testing.

Source: created by author

When answering the question "In your opinion, what are the main customer needs in regards to energy which would push your company to experiment more with new business models?" experts had a different view. "Energus Group" seems to mostly focus on providing autonomy to their customers via new solution creation, whereas "Ignitis" tries to lower the costs since after decentralisation electricity prices increase. "Elektrum Lithuania" expert states that the company tries to provide renewable energy based solutions which follow sustainability principles, however there is a lack of best practices regarding the implementation. This answer shows that companies understand customer needs very differently and see different market challenges. *Main keywords identified: vision of future, higher autonomy, optimise costs, sustainability, renewable and need to be tested.*

Table 24: *9th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Level of Innovativeness	What tools does your company use in order to offer new innovations for the market?	BIM model usage in whole construction process; BMS system development and deployment; energy saving solution supply and maintenance.	Company invests into interactive solutions which includes the client, e.g. the calculator for solar panel for the roof, where client can mark the size of the roof based on the satellite picture and receive preliminary offer for the solar panel from our company. The aim is not only to provide information to the client, but to provide it in a convenient and interactive way. We constantly monitor the customer experiences and perform changes, that the experience would become better.	N/A

Source: created by author

Experts were also asked regarding the various tools their companies use when creating new solutions and providing to the market. Expert from "Elektrum Lithuania" decided not to answer this question and a person working in "Energus Group" explained they use BIM (building information modelling) models and BMS (building management systems) when providing electricity and creating innovations for their customers. Employee of "Ignitis" explained how their whole product development lifecycle is based on customer experience improvement which shows their partial business plan of acquiring more customers. This question also helped understanding how Lithuanian electricity companies improve their business models via usage of different tools, methods and focus points. *Main keywords identified: BIM model, energy saving, provide information, monitor, and experience.*

Table 25: *10th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Overall Performance	Will revenue streams increase if your company pays more attention towards digitalisation and innovation? If yes, what kind of benefits would it bring? If not, what does need to improve to start performing better?	In a long run - yes. Big part of innovations that we adopt are inert to the results of the company and the benefit can be seen only in a long period. Top startup product/ service creation would in general change the position of the company in the market.	Currently the company is paying high attention to digitalisation and innovation. Part of it is connected with momental cost saving, another - creates the competitive advantage, another one is a longterm investment of the company.	Digitalisation and innovation deployment would increase the profit, however we see that as a long-term perspective and revenue increase could potentially be seen after 2 or more years.

Source: created by author

Tenth question "Will revenue streams increase if your company pays more attention towards digitalisation and innovation? If yes, what kind of benefits would it bring? If not, what needs to improve to start performing better?" challenged experts to think differently on how their companies could perform if their focus point was based on digitising customer experience and internal processes as well as offering innovative solutions. All three respondents agreed that the revenue would increase

in the long run, if companies' behaviour and thinking changes. Additionally, experts from "Energus Group" and "Ignitis" mentioned that it would create a competitive advantage within the market. *Main keywords identified: innovation, digitalisation, startup product, position of the company, competitive advantage, increase the profit, revenue increase.*

Table 26: *11th question to the experts*

Topic	Question	Respondent no.1 UAB "Energus Group"	Respondent no.2 UAB "Ignitis"	Respondent no.3 UAB "Elektrum Lithuania"
Strategy Implementation	Did your company strategy change because of current situation in Ukraine and Europe?	Yes. Higher attention on risk management. Material and component price indexation in agreements.	Yes, it changed. There is now more attention paid towards the SGD terminal, which generates energy not only for internal, but external markets. Also more focus in on the risk management, vendor selection, better employee satisfaction and heath improvement.	No, strategy has not changed. Our strategy is being mostly regulated by the regulations from law side of Lithuania, which limits or sets arms free. Because of situation in Europe and Ukraine, the issuers of Lithuanian law are investing much more into the energy independence, which will encourage to work even more.

Source: created by author

The last question has been provided to the customers in order to help understanding how the current situation in the world changes the way energy companies operate. While an "Elektrum Lithuania" employee stated that the war situation in Ukraine did not change the strategy of the company (which is set by the governmental institutions), both respondents from "Ignitis" and "Energus Group" provided different information. They stated that exceptional attention is being paid to risk management, additionally, "Ignitis" seems to pay a huge focus on their employees. *Main keywords identified: risk management, SGD terminal, employee satisfaction, health improvements, energy independence.*

Overall findings of the expert questionnaires state that energy companies in Lithuania focus on digitalisation, innovation, sustainability as one of the main drivers for new business models. Additionally, companies try to focus on customer experience, lowering costs and offering best solutions, while still being heavily regulated by the government in a decentralised electricity market. All three companies are eager to constantly analyse the market and suggest renewable energy-based customer centric solutions in order to stay competitive among other companies in Lithuania. Findings of experts' answers additionally goes in line with main focus areas founded from content analysis. Whole energy sector in Lithuania circulates around the new product creation which would focus on the end customer.

3.4. Results of "yEd" analysis

After performing regression analysis as well as analysis of expert questionnaires and market content, the "yEd" analysis is performed in order to find patterns between different keywords identified in literature and empirical research. Additionally, the figure shows the connection and dependencies between different topics, which are analysed in this paper (see figure 18).

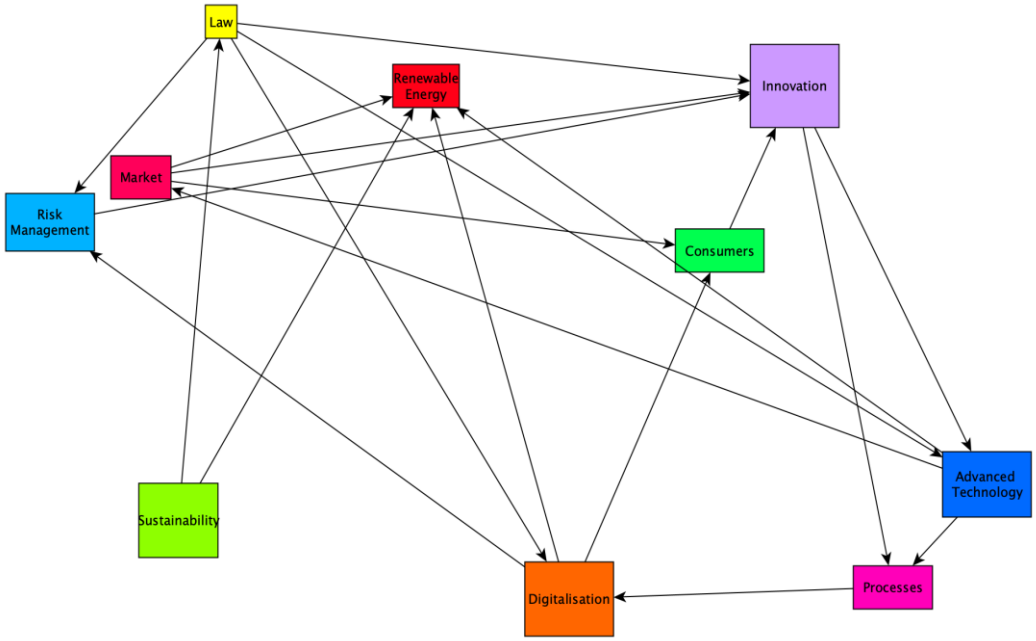

Figure 18: Results of "yEd" analysis

Source: *created by author via "yEd" tool*

This figure summarises the findings and shows how all things are important and affecting one another in the current energy market. The main driver of market rules is law, which sets goals and environment for energy sector players to work at. As shown in the figure, the strongest connections with other topics have renewable energy, advanced technology and innovation. This means not only the importance of these aspects to be considered when implementing new products in the market but also how much it can be affected by other things happening in the market. Sustainability is closely connected to law and renewable energy and is one of the goals of companies in Lithuanian energy

sector which shows that in the upcoming future the way electricity is produced will change and improve being more renewable and clean. As analysed in expert questionnaires, companies pay huge attention to it and understand that they cannot improve without using more innovative and advanced technology. Additionally, content analysis shows a clear vision of Lithuania to become independent in energy and produce it inside the country. That said, the company's processes are immediately affected and need to be updated accordingly, which implies changes in overall employee behaviour. This is why some of the companies, as explained in questionnaires, focus a lot on employee well-being and investing into training.

Lithuanian companies help the country in trying to achieve energy autonomy as well as to keep a high level of competition, which is useful for the customers. Strategy of the country lands into the strategies and goals of companies, which pushes energy players to innovate their business models using digitalisation and advanced technology when thinking in terms of sustainability and overall market needs.

CONCLUSIONS

The energy sector has always been under the pressure to always improve and succeed with the changes. However, during the past decade, the importance and need for this sector to become more efficient, sustainable and renewable increased even more. Most of the companies cannot perform changes without going more digital when it comes to changing not only products and services but also internal processes, as well as improving business models. This paper examines how digitalization affects the process of business model change in Lithuanian energy sector companies within the continuously changing environment.

Results of the scientific literature analysis shows that digitalization plays a huge role when it comes to major changes happening in the energy industry. Currently the whole sector is moving more and more towards being more sustainable, providing renewable energy, being socially responsible and using Internet of Things (IoT), Energy4.0 to improve the technological side of energy creation. Even though there are three major trends currently happening within energy companies (decentralisation, decarbonization and digitalization), and energy creation is based mostly on competition, new entrants, literature analysis shows that the energy sector is highly regulated and this process creates many challenges for companies. Most often business model innovation is a result of strategy, technology and organisational changes, and has the actual impact of the new technologies towards the innovations of the companies. The main driver of the BMI in the energy sector is coming from the digitalization – new technologies. Cloud computing, AI, Blockchain, automation and other intelligent innovative solutions change the way companies work, create and provide products and services. When it comes to opportunities, companies were provided with the possibility to be more flexible, optimize the costs and provide personalisation for their customers with the help of digital transformation. While bringing benefits, companies face some challenges while including digitized solutions into their daily life, such as lack of knowledge, huge complexity and additional risks.

Empirical research where impact of independent variables (strategy implementation, market competition, technological disruption, pilot projects, new business models and level of innovation) on overall performance of the company (dependent variable) was analysed, showed results that overall performance was not impacted neither by level of innovativeness nor new business models. This brings attention to the number of questionnaire responses collected – only 14 out of 43 sent, even

though to get statistically significant results there was a need to collect at least 24 responses. Four hypotheses out of seven were proved and showed that strategy implementation, technological disruption and pilot projects have a direct positive impact on new business models, as well as new business models positively influencing level of innovativeness. This part of research shows that digitalisation and business model innovation does not impact the overall performance of the company.

Due to lack of respondents of the survey, additionally experts' questionnaires and content analysis were performed. When it comes to current Lithuanian energy market analysis, the results show increased attention to digitalisation and the need of companies to improve, change, while keeping consumer and renewable energy as a key focus point. Questionnaires were answered by three people out of five sent and gave better understanding on what three companies "Ignitis Group", "Energus Group" and "Elektrum Lithuania" focus at the moment. Results show that all of them try to become more innovative by changing business models and applying new technologies in their daily work. Additionally, they all focus on the market needs while incorporating the requirements provided by the Lithuanian government. Lastly, all respondents mentioned sustainability and renewable energy which connects a lot with the results of regression analysis as well as content analysis and gives the perspective of the future of energy in Lithuania.

To sum up digitalization impacts the way businesses operate in energy sector of Lithuania. Business models have to adapt accordingly and together with them – products and services, as well as employees of the company. If high attention is paid to what is happening in the market, analysis done and lessons taken into consideration, Lithuanian energy sector companies will, very likely, become even more sustainable and lean towards producing clean energy.

RECOMMENDATIONS

Several recommendations for Lithuanian sector companies were provided in order to help them stay competitive in the market and contribute to overall Lithuanian energy sector goals by incorporating digitalisation into their business models.

- In order to accomplish long-term business model innovation, business models must coexist in a continual process. Companies must learn to develop dual business models to attain self-sustaining BMI and maintain a healthy balance of exploitation and research between the two BMs. Leveraging a capital influx does not reveal the true capabilities required for long-term business model innovation. However, they must first ensure a robust organizational design capable of carrying out these capabilities in order to achieve long-term business model innovation.
- Companies should invest more into understanding their technological gaps in order to accelerate testing of new business models and product creation. A lot of companies in the market have digital transformation departments where experts were analysing and suggesting how a company can improve not only from the view of internal processes, but also considers the possibility to involve external vendors and use their services. This also brings clarity to the management on what main focus points should be and brings attention to what can become their company's competitive advantage. Even though currently a lot of companies focus on how to acquire more new customers, sustainability and renewable energy topics should not be forgotten either.
- The leaders of companies should pay attention to requirements of the government, try to follow best market examples from other countries and even attend conferences and partnership with people from other sectors in order to create a better energy future for Lithuania and its people. Most of the companies already look into the needs of the market, however, since the liberalized energy sector in Lithuania is so young, the real expertise lays in the hands of other countries which Lithuania should follow (e.g. Scandinavian countries). This brings the needed knowledge for future planning and vision into the companies and provides different ways of thinking about what firms should focus on next.

SKAITMENIZACIJOS POVEIKIS LIETUVOS ENERGETIKOS SEKTORIAUS ĮMONIŲ VERSLO MODELIŲ INOVACIJOMS

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Darbo vadovė Doc. Dr. A. Laužadytė, Vilnius, 2022

SANTRAUKA

67 puslapiai, 26 lentelės, 18 paveikslų, 99 nuorodos.

Pagrindinis šio darbo tikslas yra išanalizuoti kaip skaitmenizacija įgalina Lietuvos energetikos sektoriaus įmonių inovacijas ir paveikia bendrus rezultatus.

Magistro darbas susideda iš literatūros analizės, tyrimo metodologijos ir rezultatų bei išvadų ir rekomendacijų.

Literatūros analizė peržiūri pagrindinius verslo modelių inovacijų aspektus bei pateikia pagrindines energetikos sektoriui atliktų tyrimų išvadas, kartu išryškina pagrindinį fokusą atsinaujinančiai energetikai ir tvarumui, kurie gali būti pasiekti naujų technologijų pagalba.

Lietuvos energetikos sektoriaus ekspertai buvo apklausti, kaip įmones paveikia verslo modelių inovacijos, kurių pagrindinė varomoji jėga yra skaitmenizacija, kaip esminis modernaus organizacijų dizaino aspektas, atlikti empirinį tyrimą. Rezultatai rodo, kad svarbiausias dalykas yra strategija, kuri dažnai nustatoma Lietuvos vyriausybės, ir paveikia kaip įmonės veikia rinkoje. Norint patapti autonomine energetikos šalimi, Lietuva leido elektros naudotojams tapti elektros gamintojais, kas sukūrė dar didesnius iššūkius rinkoje veikiančioms įmonėms.

Išvados ir rekomendacijos išryškina pagrindinius literatūros apžvalgos ir empirinio tyrimo rezultatus ir teikia pasiūlymus, kaip verslai gali elgtis su ilgo laikotarpio verslo modelių inovacijomis pakeisdami tradicinės organizacinės architektūros dizainą. Darbo autorius tiki, kad šis darbas gali būti naudojamas Lietuvos energetikos sektoriaus įmonių kaip gairės tobulėjimui.

THE IMPACT OF DIGITALISATION ON BUSINESS MODEL INNOVATION IN LITHUANIAN ENERGY SECTOR COMPANIES

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Master Thesis

Global Business and Economics Master Programme

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SUMMARY

67 pages, 26 tables, 18 figures, 99 references.

The purpose of this thesis is to analyse how digitalisation enables Lithuanian energy sector companies to innovate business models and its effect on overall performance.

The Master thesis consists of literature analysis, research methodology and its results, conclusions and recommendations.

The literature analysis reviews main aspects of business model innovation, presents main findings of research performed in the energy sector and outlines the main current focus which is renewable energy and sustainability, possible to achieve only with the help of new technology.

Experts of Lithuanian energy sector companies were asked questions about how firms undergo business model innovation while taking digitalisation as one of the main aspects of a modern organisational design in order to perform empirical research. Findings show that the most important thing is strategy, which is often set by Lithuanian government, and it impacts the way companies work and the energy market operates. In order to become more autonomous in energy, Lithuania allowed energy consumers to become producers of renewable energy, which created additional challenges for existing companies.

The conclusions and recommendations outline the findings from literature review as well as empirical research and suggest how businesses might deal with long-term business model innovation by redesigning the traditional organisational architecture. The author believes that this thesis could be used as guidelines for Lithuanian energy sector companies to improve.

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ANNEX 1

Table 27: Summary of researches performed and research methods used on digitalisation and BMI topic.

Author, year of the paper	Aim of the paper, Main Research Question, Hypothesis	Dependent variables**	Independent variables**	Main methods
Parida et al., (2019)	The aim of the paper: to propose a research agenda for advancing academic discussion about how industrial companies can leverage digitalization for business model innovation. Main research question: to perform literature review and make a synthesis of special issue contribution, as well as to develop a framework for setting and communicating the director for the future research to be done on the linkage between digitalization, business model innovation and sustainability.	Sustainability	Digitalization; business model innovation	Systematic analysis of scientific literature
Dellermann et al. (2017)	Aim of the paper: to address the critical gap by offering insights that can guide organizational decision makers in managing the process of digital business model innovation. Main research question: if the innovation of a digital business model required coordinated contributions for many organizations, how should managers deal with risks related to this sort of innovation?	Digital business models	Innovation risk	Systematic analysis of scientific literature, interviews and participant observation
Hall, Roelich (2016)	Aim of the paper: to investigate new business models which rely on more complex value propositions than the incumbent utility model	Electricity supply markets	Business model innovation	Systematic analysis of scientific literature, interviews, qualitative questionnaires, focus groups
Happonen et al. (2020)	Aim of the paper: to investigate a digitalization-related business model as a result from the university-SME collaboration. Main research question: how does the commercialization process 's impact the success and original business model?	Sustainability	Business model innovation	Interviews, secondary data analysis
Tohanean, Weiss (2019)	Aim of the paper: to present how lean startup approaches can innovate green business models Main research question: how can companies further develop their existing business model or establish successful new business models that will be based on new technologies?	Business model	New technologies; innovation	Disruptive research; case study; secondary data
Rachinger et al. (2019)	Aim of the paper: to discuss the digitalization pressure on companies to reflect on their current strategy and explore new business opportunities as well as digitalization's influence on various business activities that enables new forms of cooperation between companies.	Business model innovation	Digitalization	Qualitative empirical data analysis (received from interviews)
Tohanean et al. (2020)	Aim of the paper: to support Eastern European companies in the updating process of the business model, by using appropriate strategies to transform the business into a more sustainable and digitized on with the help of technology.	Business model innovation	Digital technologies	Face-to-face questionnaires
Maffei et al. (2019)	Aim of the paper: to focus on the promising technological trend of the digitalization and its potential impact on the dimension of sustainability. Main research question: the related scientific contribution through the lens of the concept of Business Model and Business model innovation as understood by leading economic literature?	Sustainability; Business model innovation	Digitalization	Systematic analysis of scientific literature
Stoldt et al. (2018)	Aim of the paper: to discuss how tools of the Digital Factory enable decision-makers to access digitalization measured during the planning process to take full advantage of newly available technologies.	Digitalization	Digital factory; New technologies	Systematic analysis of scientific literature; simulation case study with experiments
Soni et al. (2020)	Aim of the paper: to investigate the overall impact of AI - from research and innovation to deployment.	Organizational transformation; business innovation	Artificial Intelligence (AI)	Systematic analysis of scientific literature; secondary data analysis
Khan et al. (2021)	Aim of this paper: to map the broad field of sustainable development and investigate the key research areas which comprises the perspectives under Industry 4.0 framework.	Sustainable business models; circular economy	Industry 4.0; sustainable development	Systematic analysis of scientific literature and mapping
Bygstad, Ovrelid (2021)	Aim of the study: to propose a fruitful approach for understanding and managing digital innovation and transformation for the concept of two-speed innovation. Main research question: how does two-speed innovation support digital transformation and how can managers leverage two-speed configurations?	Digital transformation	Two-speed innovation	Systematic analysis of scientific literature and case study
Proka et al. (2020)	Aim of the paper: to examine the potential impacts of the neighborhood battery on the contribution of REIs to the Dutch energy transition. Main research question: the opportunities and constrains for a collaborative business model for the neighborhood battery in the Netherlands, as well as the challenges and tensions that emerge for the main parties involved?	Local energy storage	Business model	Systematic analysis of scientific literature; case study with interviews

Source: created by author

ANNEX 2

Questions for the questionnaire:

Name of your company:

Position/title:

Date:

SECTION 1: STRATEGY IMPLEMENTATION

A business strategy is a set of guiding principles that, when communicated and adopted in the organisation, generates a desired pattern of decision making.

Q1: During the years of 2018 to 2021, did your enterprise include increased level of digitalisation as one of the key goals when creating new strategies?

Q2: During the years of 2018 to 2021, did your enterprise focus on the product offering and adapting to the clients needs and newest market trends?

SECTION 2: MARKET COMPETITION

*The level of possible product or service differentiation is an important **competition** factor in an industry.*

Q1: Did your enterprise have to adjust the prices of products and services due to increasing competition in the market during years 2018 to 2021?

Q2: Did you have to offer new innovative products and services after competitors started to offer similar ones to market?

Q3: Do you think that competitors are more digitised and innovative than your company when it comes to products and services?

SECTION 3: TECHNOLOGICAL DISRUPTION

Technological disruption refers to changes in mode of production, introduction of new products, etc. Conventionally, technological disruption has been hypothesised to have a negative effect on market orientation- performance relationship.

Q1: During the years of 2018 to 2021, did your enterprise improved the technological side of the manufacturing of products and services due to the increased technological pressure in the market?

Q2: Did your company have to change its business model because of the increasing technological development during the years of 2018 to 2021?

SECTION 4: PILOT PROJECTS

Pilot projects are small-scale and cost-effective ways to test the underlying theories and hypotheses about the desirability, feasibility and viability of a new ideas and business model.

Q1: During the years of 2018 to 2021, did your enterprise experiment with various business models and their implementation?

Q2: Does your company have a specific team dedicated to to manage the changes of business models?

Q3: Did your company have an allocated budget to experiment with new business models during the past 4 years?

SECTION 5: NEW BUSINESS MODELS

Business model practices refers to a plan and activities for the successful operation of a business, identifying sources of revenue, the intended customer base, products, and details of financing.

Q1: Do you agree that in your enterprise new business models are used to gain competitive advantage against other companies in the market?

Q2: Do you agree that your company's business models are designed in a way to respond to the changing market circumstances (i.e. digitalisation, sustainability)?

Q3: Do you agree that your company's current business model has derived from the enterprise's strategy?

SECTION 6: LEVEL OF INNOVATIVENESS

Innovativeness is the company's ability and determination to create new things, which speaks to the duality of the attribute but just scrapes the surface of the importance of innovativeness to business growth and sustainability.

Q1: Does your company have a goal to become more innovative and digitised?

Q2: Do you agree that your enterprise aims to introduce innovations that are completely new to the market?

Q3: Is it a common practice in your company to create more that one innovation at the same time?

SECTION 7: OVERALL PERFORMANCE

Overall performance encompasses social and economic organisational performance.

Q1: Are you satisfied with overall company's performance in regards to the annual sales growth during the year 2018 to 2021?

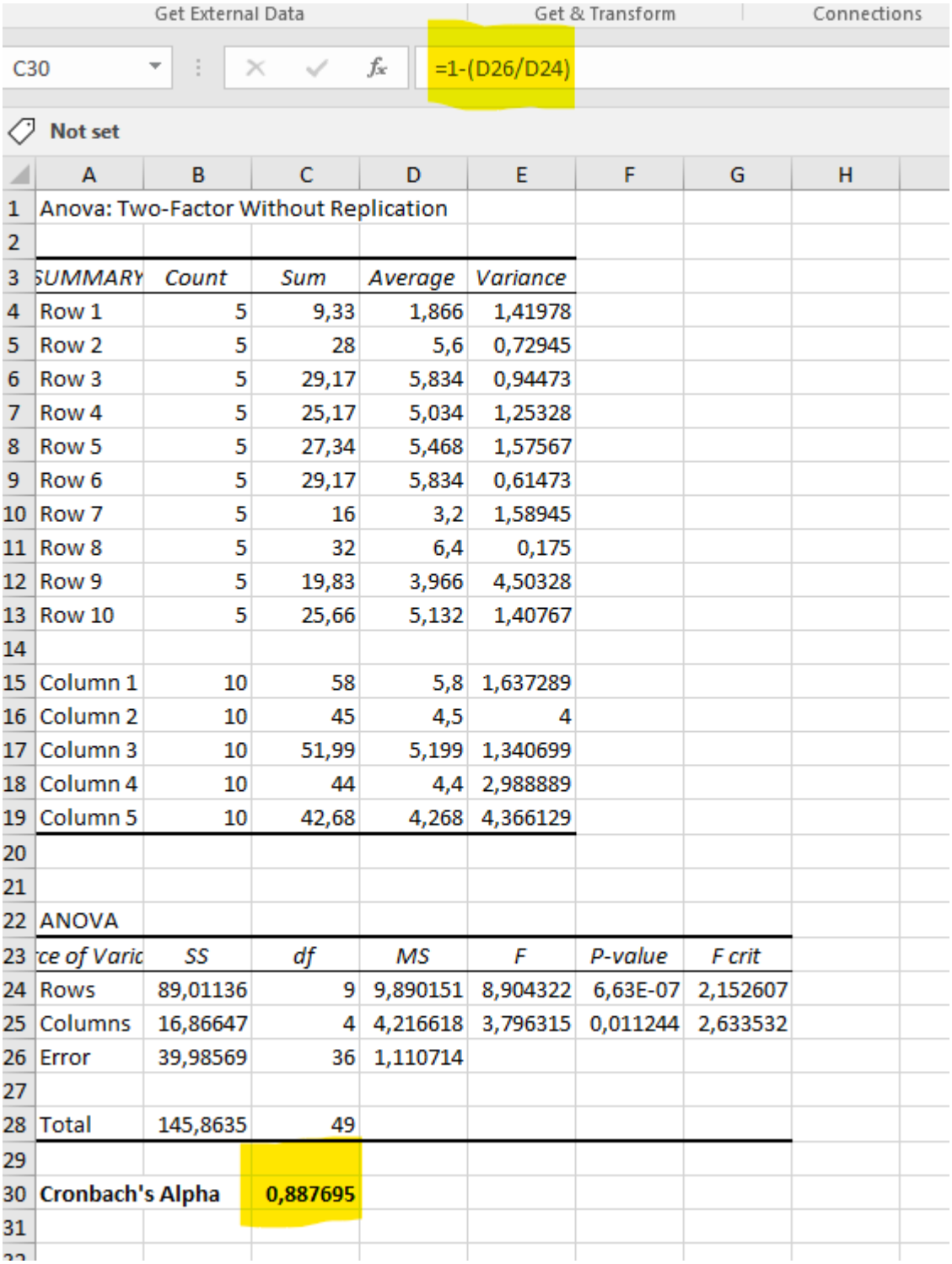
Q2: Are you satisfied with overall company's performance in regards to the annual profit growth during the year 2018 to 2021?

Q3: Do you think your enterprise would perform better if it focused more on the digitalisation and innovation?

Figure 19: Questionnaire sent to Lithuanian energy sector companies
Source: *created by author*

ANNEX 3

Table 28: *Calculation of Cronbach's Alpha*



	A	B	C	D	E	F	G	H
1	Anova: Two-Factor Without Replication							
2								
3	*SUMMARY*	*Count*	*Sum*	*Average*	*Variance*			
4	Row 1	5	9,33	1,866	1,41978			
5	Row 2	5	28	5,6	0,72945			
6	Row 3	5	29,17	5,834	0,94473			
7	Row 4	5	25,17	5,034	1,25328			
8	Row 5	5	27,34	5,468	1,57567			
9	Row 6	5	29,17	5,834	0,61473			
10	Row 7	5	16	3,2	1,58945			
11	Row 8	5	32	6,4	0,175			
12	Row 9	5	19,83	3,966	4,50328			
13	Row 10	5	25,66	5,132	1,40767			
14								
15	Column 1	10	58	5,8	1,637289			
16	Column 2	10	45	4,5	4			
17	Column 3	10	51,99	5,199	1,340699			
18	Column 4	10	44	4,4	2,988889			
19	Column 5	10	42,68	4,268	4,366129			
20								
21								
22	ANOVA							
23	*ce of Varic*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
24	Rows	89,01136	9	9,890151	8,904322	6,63E-07	2,152607	
25	Columns	16,86647	4	4,216618	3,796315	0,011244	2,633532	
26	Error	39,98569	36	1,110714				
27								
28	Total	145,8635	49					
29								
30	**Cronbach's Alpha**		**0,887695**					
31								

Source: created by author