Handbook on Doing Business Using the BalticLSC System

Business models for the BalticLSC system

Version 2.00

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2. Executive summary

On the one hand small actors across the Baltic Sea region such as startups, SMEs, research institutions and small data and innovation centers are striving to develop innovative engineering products, services, and solutions. Such activities involve processing of large amounts of data necessitating access to high performance computers. On the other hand, a lot of large-scale computation service providers have unutilized computation resources that remain idle due to the lack of knowledge of small actors about the use of large-scale computation and their benefits. This situation creates a significant business opportunity thus necessitating the need to develop a business model. BalticLSC is aiming at the development of a large-scale computing environment that helps small actors to create and develop significantly state-of-the-art data and computation intense products and services by connecting them to the providers of large-scale computation power through an online platform.

Therefore, the primary intent of this research is to establish a suitable business model for the creation of a large-scale computation network connecting computation power providers and end-users across the Baltic Sea region. To achieve the defined goal, the present document is guided by a thorough literature review on the concepts of business models and multi-sided platforms and a well-defined research methodology. The research uses the theoretical framework developed by Osterwalder and Pigneur (2010) to develop the business model. The empirical data for the same was collected by organizing a focus group interview with the representative partners from the consortium built for the project. Based on the analysis of the obtained empirical data and considering the reviewed literature, a coherent business model is developed.

The developed business model is discussed in terms of how it can create, deliver, and capture value through the BalticLSC platform. It is developed keeping in mind to assure wide usage of the computation environment around the region as a part of overall business strategy.

3. Table of contents

4. List of figures

5. List of tables

6. Introduction

6.1 Background

Small and medium scale enterprises are the backbone of European economy. Nine out of every ten enterprises in Europe are SMEs and generate two out of every three jobs. They play a major role in driving the economic growth, assuring social stability and creating new jobs (European Commission, 2015). Particularly SMEs across the Baltic Sea region contribute to 99% of the economy of the region. This refers to mainly the startups and small and medium scale enterprises across the Baltic Sea region comprising of Baltic countries namely Poland, Sweden, Latvia, Germany, Denmark, Lithuania, Finland, and Estonia. The small actors are striving to develop innovative solutions to survive in the ever-growing competitive market. Among several, one such innovative solution is the inclusion of large-scale computing or high-performance computing in the business model of the (Gigler et al., 2018).

Large-scale computing consists of computational systems that can perform complex calculations. It refers to all the computations that need high processing power and memory capacity. In the digital age, high performance computing has become indispensable. It enables researchers, academia, government, industry including SMEs the ability to process and analyze high amount of data. With recent advancements in technology such as Digitalization, Industry 4.0, Internet of Things, Big data, Artificial intelligence etc., supercomputing becomes very essential to drive innovation and increase competitiveness (Gigler et al., 2018).

However, such environments are mostly available to big global companies and large research institutions that can afford building them. Small actors such as startups, SMEs and other small data and innovation centers across various engineering domains and technologies dealing with innovative products and services that require high-performance computing face considerable problems due to lack of capital and necessary expertise involved in the use of supercomputing (Eurich & Boutellier, 2014). On the other hand, many large-scale computations service providers have unutilized computation resources that remain idle due to the lack of knowledge of small actors about the use of large-scale computation and their benefits. Even small actors possess idle resources due to underutilization of available capacities whose computation power when combined can be utilized to offer processing power at a large scale. Hence, it is identified that there are two major groups who could mutually benefit from one another and contribute to the overall economy of the European Union thereby creating a business opportunity (Hanson & Lilla, 2019; Interreg Baltic Sea Region, 2018).

To address this business opportunity, the European Union aims at creating a computation environment involving the customer groups. This practical solution involves development of business model, hardware configurations, software tools, end-user needs and requirements, technical designs and practical application recommendations (Interreg Baltic Sea Region, 2018). However, the scope of this research study aims at creating a coherent business model for the offering and usage of computation environment. Therefore, a business model needs to be developed keeping its focus on the main participants of the environment who are LSC end-users and LSC computation power providers. The business model should describe the rationale on how the computation network can create, deliver, and capture the value for stakeholders of the network.

To arrive at the desired goal, understanding the concept of business model and its relevance becomes necessary. When internet technology surfaced during the millennium turn (Magretta, 2002), "business model" became one of the buzzwords and since then firms have begun to realize the prominence of business models and considered rethinking their strategy concerning their value chain (Schmid, 2001). As a result a lot of practitioners and researchers came up with publications having their own understanding, definitions, frameworks and key elements of the business model (Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; Morris et al., 2005; Osterwalder et al., 2005). However all these frameworks and their respective elements share the common similarity of how through a business model any firm creates, delivers and captures value (Fielt, 2013). Business model informs a firm's way of doing business and it identifies the core components and their relationships that drive the business of a firm thereby reducing the complexity to an understandable level. It is a conceptual tool that describes the business logic of a specific firm and shows how a firm generate revenues and create profits (Osterwalder et al., 2005; Taran et al., 2015).

In the business model research, different business model patterns have been identified and described (Fielt, 2013). These patterns help to understand business model and analyze the logic existing behind the model. They serve as verified solutions to recurring problems during designing business models (Mettler & Eurich, 2012). According to Osterwalder and Pigneur (2010), business model patterns are described as similar characteristics, behaviors and arrangement of elements in business model that describe the dynamics of business model and are useful guiding sources for practitioners to create new business models. A multi-sided platform business pattern is chosen for the study as the developed business model needs to address two independent group of customers.

Multi-sided platforms have emerged recently as one of the important economic and business phenomena with the growth of information communication and technology in many industries. As a result, firms are seeking opportunities to build large, valuable and strong platforms (Hagiu, 2007). Multi-sided platforms act as intermediating hubs to create value exchanges by facilitating connection between two or more groups (Eisenmann et al., 2006; Hagiu, 2015; Osterwalder & Pigneur, 2010; Parker & Van Alstyne, 2005). These platforms provide components or technologies or infrastructure and comprise a set of rules that facilitate transactions between the two groups (Eisenmann et al., 2006).

Many researchers such as Eisenmann et al., 2006; Hagiu, 2015; Magretta, 2002; Osterwalder et al., 2005; Rochet & Tirole, 2006; Teece, 2010 have contributed to the literature on business models and multi-sided platforms, however the previous literature lacks research on the development of business model for the provision of large-scale computing via cloud addressing two segments of customers. As Netto et al. (2018) iterates in his work, there is a need for creation of appropriate business model for the latest paradigm of offering high-performance or large-scale computing over cloud that promotes cost/performance benefit to HPC users and efficient resource utilization of service providers. Hence, this thesis will address this knowledge gap by developing a suitable business model and contributing to the significant business opportunity.

BalticLSC is a project aimed at creating a supercomputing environment that helps small actors across the Baltic Sea region to create and develop significantly innovative data intense and computation intense products and services. This practical solution encompasses a hardware and easy-to-use software that assures affordable, scalable, and efficient distribution across the Baltic Sea region. The solution will involve development of business model, hardware configurations, software tools, end-user needs and requirements, technical designs, and practical application recommendations. The project aims at creation of an initial network of large-scale computing centers with the help of BalticLSC partner countries to build an active community of BalticLSC users and providers. To develop a solution that is transferable, replicable, and easy to disseminate, the interactions and feedbacks from researchers, innovators, and engineers and most importantly end-users are taken into consideration.

The BalticLSC environment consists of an online platform developed by professionals from the project partners which is designed to affect two major groups across the Baltic Sea region, namely:

1. Large LSC service providers who can offer their computational power to perform calculations by joining the network. Even start-ups and SMEs can take up BalticLSC specifications and emerge as LSC service providers by creating their own local computing centers. Furthermore, several of such centers can combine to form a network and increase their computing capability which can be distributed across Baltic Sea region.
2. End-users such as SMEs, start-ups, research and development centers, design centers and others can utilize the platform to develop and test their own applications and carry out complex computations and calculations thus reducing the time to market in the delivery of innovative products and services. With the help of this environment, the end-users can now make use of LSC services easily which were previously difficult to access.

The project strives to develop a solution that is replicable, transferable, sustainable, and easy to implement. In future, the BalticLSC environment will be extended beyond the Baltic regions to involve more and more European companies and institutions in the network.

6.2 Scope of the research

The scope of this document is to develop a coherent business model for offering and usage of BalticLSC computation environment across the Baltic Sea region. As a result, a business model will be developed keeping its focus on the main users of the platform who are LSC end-users and LSC computation power providers. It is developed with significant support from all the project participants. The business model will describe the rationale on how the platform along with partners and other organizations in the Baltic Sea region will create, deliver, and capture the value of the BalticLSC network. It will be conducted based on the results of market analysis, technical design decisions taken, and collected feedback from potential users of the BalticLSC platform through the consortium of project partners.

The process of business model construction will be part of the overall business strategy for BalticLSC. The key goal is to assure wide usage of the system around the region and assure durability of the results by assuring that the model consists also of maintenance, development and cooperation between the various parties participating in the BalticLSC network. The developed business model will be executed first among the initial network created by the project partners. The aim will be to organize a strong initial group that will maintain the BalticLSC

network beyond the project. This network would follow a non-profit model of operations and would be able to manage all the further development and business activities around the network, facilitating easy access to its services and easy access to new partners.

7. Literature review

The objective of this document is to develop a business model for a platform that creates a large-scale computing network for SMEs and research institutions acting both as end-users and service providers along with other large HPC service providers. To achieve this objective relevant study in terms of literature reviews and previous research is undergone and analyzed. The literature review concentrates on three main topics that can potentially solve the research question: What would be a suitable business model for the creation of large-scale computation network involving LSC end-users and service providers across the Baltic Sea region?

7.1 High-performance computing

7.1.1 Brief overview of high-performance computing

High performance computing has become a very essential field responsible for technological, societal, and economic development. Majority of the countries are participating in the race to on-board best of the supercomputers as it has now also become a measure of a country's power. Hence every year a TOP500 supercomputers list is compiled twice since June 2003 whose objective is to provide ranking of best supercomputers suitable for high end applications available in various countries across the globe. This list is updated with the help of experts in the field of high-performance computing, scientists, manufacturers, research institutions etc.

High performance computers have the capability to perform highest level computing to solve complex technical and scientific, computation and data intensive challenges (Bomatpalli et al., 2015). Although supercomputers hail back to 1960s, it is only recently the advanced computing is exploited by commerce and industries, various technological domains from designing safer cars to weather predications to medical discoveries because of their higher processing power. High performance computing is playing a crucial role when it comes to developing innovative products, spurring innovation, increasing competitiveness and reducing the time-to-market (Moran & O'Dea, 2013).

HPC has become a very important asset in global data economy to increase the competitiveness across industries including small and medium enterprises. The combination of high-performance computing, big data, artificial intelligence and cloud computing have contributed to the blooming of new HPC applications (European Commission, 2019). Some of the application areas of HPC are in various domains such as health and biosciences, computer aided design or manufacturing, weather forecasting and climate modelling, geosciences, government

labs, academic and research institutions, finance and economics, defense and energy, electronic design, and automation etc. The list just gives a few examples where HPC is employed but the application goes beyond the mentioned list as a lot of domains find HPC as a very important tool to understand their market, understand the science behind products and services and develop them in reduced time (Eadline, 2009).

7.2 Cloud computing

7.2.1 Brief overview of cloud computing

One of the latest trends in the information technology industry is cloud computing. The term 'cloud computing' was first use in 1961 when Prof. John McCarthy stated that "computation may someday be organized as a public utility" (Giordanelli & Mastroianni, 2010). According to Ramnath K. Chellappa, who happens to be the first one to provide an academic definition, called cloud computing a computing paradigm whose boundaries will be defined by economic reasons instead of technical limits. The commercial use of word 'cloud' appeared largely during the turn of 21st century but it was mostly limited to software-as-a-service (Chellappa, 1997). The commercial use of word "cloud" appeared largely during the turn of 21st century but it was mostly limited to software-as-a-service (SaaS) (Giordanelli & Mastroianni, 2010).

Cloud computing is now seen as a driver of societal development because it has contributed largely to the vision of delivering computing as utility. Utility computing refers to the provision of computing resources on demand and the customers are billed or charged based on their usage, which is what cloud computing does (Zhang et al., 2010). Cloud computing works on the concept of virtualization which is a technique that creates abstract layer of computation resources such as hardware, software, network device, platform, storage or operating system and hides their complexity for the user (Rashid & Chaturvedi, 2019).

There are a lot of definitions for what cloud computing means but in simple terms it can be described as provision of configurable computing resources such as hardware and software (e.g., networks, storage, servers, applications etc.) as service over the internet. Cloud computing can be provided at a faster rate on demand and involves reduced management effort or interactions from the end-users. It has emerged as a solution to a lot of industries and organizations including research institutions and SMEs as they provide easy access to externalized computation resources to host their applications based on their needs at cheaper costs. This reduces the fixed costs that otherwise would have been occurred in purchasing own resources (Srinivas et al., 2012).

7.2.2 Characteristics of cloud computing

Below mentioned are some of the essential salient features that cloud computing possess (Srinivas et al., 2012; Zhang et al., 2010):

- Self-service on-demand: End-users can easily get access to computing capabilities such as computational cycles or CPU hours as and when required with any interaction with the service provider
- Broad network access: Since the services are delivered over internet network, they can access through various platform such as mobile phones, laptops, PDAs etc.
- Resource pooling: Several computing resources are pooled to serve the customers based on their requirement. Depending on the level of abstraction end-users can only specify hosting country or state or data centers but has no control over specific location of the resource.
- Dynamic elasticity: Based on the requirements demand of the end-users, the computing capabilities can be obtained at any time and are eligible to be scaled in and out.
- Utility-based pricing: Resource usage by the customers can be easily controlled, monitored, and billed on a pay-per-use model. Transparency is provided to both end-user and the service provider.
- Service oriented: Cloud computing is based on a service driven model and the services are delivered adhering to Service Level Agreements (SLA) which is very crucial for management of services.

7.3 Cloud based high-performance computing

High performance computing through supercomputers, cluster computing or grid environments is used to traditionally solve data or computation intensive problems such as weather forecasting, drug testing, crash simulations, automation, automotive design etc. Financial institutions are also making use of HPC to model investments, pricing and to carry out risk analysis in real time. This makes HPC attractive to a lot of businesses coming from various scientific domains. But HPC systems are out of reach to a lot of research communities and small and medium businesses due to their huge capital costs (Egwutuoha et al., 2013). Recent developments in the field of cloud computing technology have led to its emergence as an alternative to dedicated supercomputers for some of the large-scale applications. HPC via cloud is now seen by a lot of academic users, research institutions and commercial users as a cost-effective alternative to in-house, dedicated HPC systems. Renting the computing resources

instead of owning a cluster of computers avoids the installation (up-front) and maintenance costs associated with it. Moreover, cloud computing offers elasticity which means it can be provisioned as per the demand and offers flexibility and customization. These benefits lead to reduced staff and development time of products and service, reduced time-to-market, cost saving and remain competitive and profitable. HPC service providers also benefit by offering services via cloud which maximizes their resource utilization (Gupta et al., 2013).

Cloud-based high-performance computing is highly suitable for startups and small and medium-scale enterprises who want to carry out modelling, simulation, and calculations as they cannot afford on premise supercomputers and their requirement demand is varying. With pay-per-usage benefits it also enables growing businesses to optimize their processes by taking advantage of variety of computing architectures. However, end-users lack enough knowledge when it comes to choose computing resources, architecture, pricing and contractual models etc. (Gupta et al., 2013).

Although big market players like Amazon, Microsoft, IBM are developing provision of HPC via cloud (Kumar, 2016) there is still a lot of scope for research in this area. Efforts are undertaken to deliver HPC as a service where users can easily perform their computations over a web portal, especially for non-IT users by abstracting the underlying infrastructure. Non-IT users lack knowledge on system architecture and configuration and have no expertise with use of HPC. Hence measures are taken to deploy application in such a way where users can input their computation parameters and allow software to take care of resource allocation, computation scheduling and execution. Another area of research is development of appropriate business model for this latest paradigm that promotes cost/performance benefit to HPC users and efficient resource utilization of service providers (Netto et al., 2018).

7.4 Business Model

7.4.1 Brief history of business model

The very first time the term “business model” ever appeared in an academic article was in 1957 (Bellman et al., 1957). Later it happened to appear in title and abstract of a paper in 1960 (Jones, 1960). But the term became more popular in the end of 1990s. The terms “internet” and “business model” seem to have grown parallelly (Osterwalder et al., 2005). According to Magretta (2002), with the advent of internet technology, “business model” became one of the trend words. However, despite its popularity, there has been ambiguity regarding the definition of the concept of business model (Tavlaki & Loukis, 2005). The basic principle or core of the

business model is about how to produce money and sustain profits over time (Stewart & Zhao, 2000).

During millennium turn with the boom in the dot.com industry, globalization and rapid communication had started to become the trends. The way firms do business was approaching to change and researchers and practitioners debated over globalization of market, adoption of information technology, use of internet and mobility of labor in creating value to the firms. Along with these managing and utilizing knowledge resources and intangible assets such as product R&D efforts, branding, structural assets, and monopolies became even crucial for firms (Hand, 2001)

The advent of internet technology made companies across various sectors rethink their strategy concerning their value chains (Schmid, 2001). The term "business model" has been majorly associated with e-business as emergence of internet hugely impacted the ways of doing business and led to the potential of creating potential business models and gaining value through such models (Hedman & Kalling, 2003). Amit and Zott (2001) mentioned four major interlinked value drivers in e-business namely; efficiency in the way of doing business, complementarities in terms of products, services and activities, lock-in or retention of customers and offering novelty. Figure 1 shows sources of value creation in e-business.

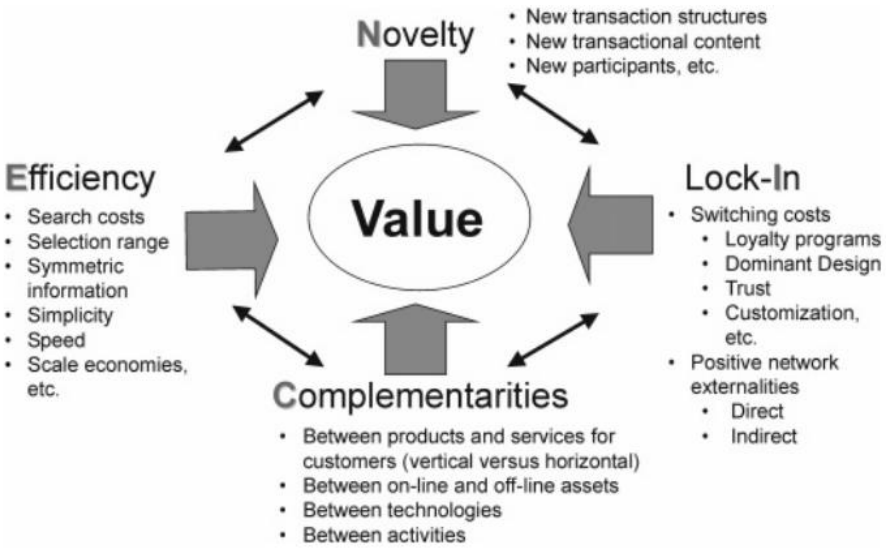


Figure 1 Value drivers in e-business Srouce: Amit & Zott, 2oo1

Although talks of moving from traditional business models to e-based business models were revolving and discussed, business models were undefined and the least understood. A lot of new ventures were failing due to their lack of or ill-defined business models. Firms were

uncertain what a business model is, what are its components or elements and characteristics (Alt & Zimmermann, 2001). Gradually business model was identified to be an independent concept and distinguished from business planning and strategy. Even though business model and strategy are used interchangeably they are different. Business model describes the relation between different components of business and how they fit together whereas strategy describes how company could do better than the competitors (Magretta, 2002). Firms started to realize the importance of business models and a lot of publications on the concept were developed but with authors having their own understanding, definitions, key components and frameworks of the business model (Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; Morris et al., 2005; Osterwalder et al., 2005).

After surviving the dot.com bubble, the term 'business model' continued to grow even in the general business such as finance, marketing, management, information & communication technologies, and other domains and has been made use of within different frameworks such as economic model, business plan/ strategy, globalization, value creation etc. Basically, the term 'business model' was essentially associated with technology-based companies and used to explain innovative and profitable ideas and concepts in business terms. Practitioners and researchers referred business model to the firm's way of doing business, however there has been a huge discrepancy between its high level of significance and low level of clarity in its interpretation (Dasilva & Trkman, 2014).

7.4.2 Business model perspectives

For any organization, be it a new venture or an established player, a good business model is very important. However, before implementation one must be familiar with the definition of a business model to clear the confusion that has been associated with the word (Magretta, 2002). There has been discrepancy in the terminology as the words "business model", "business concept", "economic model", "revenue model", "strategy" have been used interchangeably (Morris et al., 2005). A good number of earlier definitions convey that the term "business model" is associated to the company's way of doing business, showcasing how such model reduces complexity to a comprehensible level. The core of the business model is that it identifies components and their relationships that drive the business of a company (Osterwalder et al., 2005; Taran et al., 2015).

Often there is unison in considering business model as a framework via which companies implement their strategy (McGrath, 2010), thus clarifying creation and capture of value (Teece,

2010). According to Morris et al. (2005), the concept of business model is associated to interlinked decisions taken by a company with regards to strategic elements such as resources, activities and partnerships necessary to develop value proposition as well as target customers and channels and relationships to reach those customers. Thus, business model is considered to be a valuable tool for firms for enabling value creation and determining the drivers of value, organizational problems and challenges that arise when the strategy is being executed (Lambert & Montemari, 2017).

7.4.3 Business model frameworks

Different authors have developed different frameworks to get a proper understanding of business model concept and to use it productively. These frameworks encompass different elements and aspects but also have similarities. One such crucial similarity is all these frameworks and their respective elements tend to depict how a company creates, delivers and captures value (Fielt, 2013). The elements of the business models are also referred to as components (Pateli & Giaglis, 2004), functions (Chesbrough & Rosenbloom, 2002), questions (Morris et al., 2005) or building blocks (Osterwalder & Pigneur, 2010). In this section some of the prominent frameworks are reviewed to gain knowledge on categorization of the business model elements and their relationships. However, for the research work the focus is kept on representative set of popular frameworks (Fielt, 2013).

Kaplan's elements of business model

Kaplan (2012) describes business model with help of three business model story elements namely value creation, value delivery and value capture. Value creation describes how value is being created by the organization to fulfill the needs or solve problems of the customers or the end users. Understanding value through the viewpoint of customers is the key to construct appealing value proposition thereby addressing customer experience. How a promised value to the market is delivered by the organization constitutes value delivery. It describes the operating vision or model of the organization. The operating model is not limited only to own organization's capabilities, it also includes that of partner organizations in order to deliver value consistently with top notch quality and scale (Kaplan, 2012).

Value capture describes the financial model of an organization explaining how the economic value is captured. It helps to determine revenue sources and answers questions such as who pays for the value delivered and how, along with required operating cost structure. For any business model, pricing is also very crucial while capturing value and needs thorough decisions.

Most of the elements in further discussed meta model frameworks fall into the category of parts associated with value creation, delivery and capture presented in the Kaplan's model. In order to discuss similarities and have a better understanding, different frameworks will be compared from the perspective of value creation, capture and delivery (Kaplan, 2012).

Chesbrough and Rosenbloom's framework

The focus of Chesbrough and Rosenbloom (2002) is on technological innovation and describe business model as the linking bridge between development of technology and creation of economic value as depicted in the Figure 2. It provides a framework that translates the technological potential of an organization into economic output through the market and customers. According to Chesbrough (2007), innovation plays an essential role in the business model. It is necessary to have a business model to take the technological innovation to the market and generate revenue out of it. Having a good technological innovation without a sound business model will reduce value yield of the firm. Chesbrough and Rosenbloom (2002) identify six functions of the business model as follows:

1. articulate the *value proposition* i.e., informing what value is created for the end-users through technology-based offering.
2. identify a *market segment* – informs what is the purpose of the technology and to whom it is offered and specifies mechanisms of revenue generation for the firm.
3. define structure of the *value chain* that is necessary to create and distribute the offering and identify the required complementary assets to support the position of the firm in the value chain.
4. given the selected value chain structure and value proposition, to determine the *cost structure* and *profit potential* of producing the offering.
5. describe the position of the firm in the *value network* linking customers and suppliers and to also identify potential complementors and competitors.
6. formulate a *competitive strategy* by which the innovating firm will gain and hold advantage over rivals.

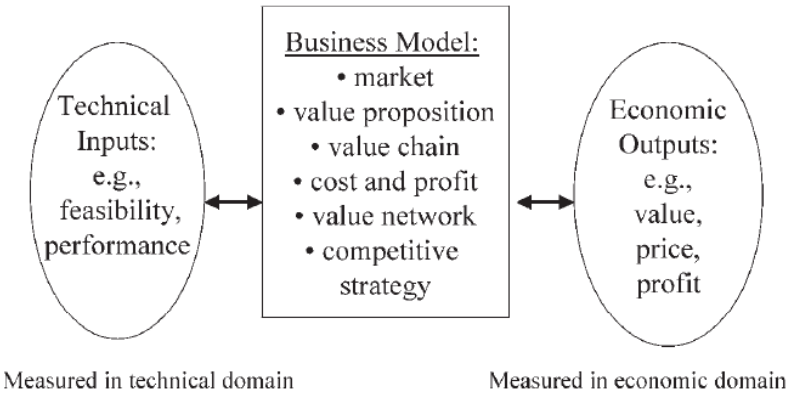


Figure 2 Business model as mediating construct between technical and economic domains Source: Chesbrough & Rosenbloom, 2002:533

The functions mentioned here are like the elements or components in some of the other business model frameworks. With the help of these 6 functions, a business model can be developed. They also additionally justify the financial capital required for the realization of model and path required to define a scalable business.

The Four-Box business model

Every firm or organization is having a business model to meet some customer need whether they have an explicit understanding of it or not. According to Johnson et al. (2008), there might be situations that require a business model change such as:

- when a large group of customers find an existing solution very complicated or expensive
- taking capital out of a new technology or take the existing technology into a new market
- bringing a 'job-to-be-done' focus i.e., fulfilling unmet need or job of the target customers
- to defend the firm against low end disruptors
- to respond to shifts in the competition

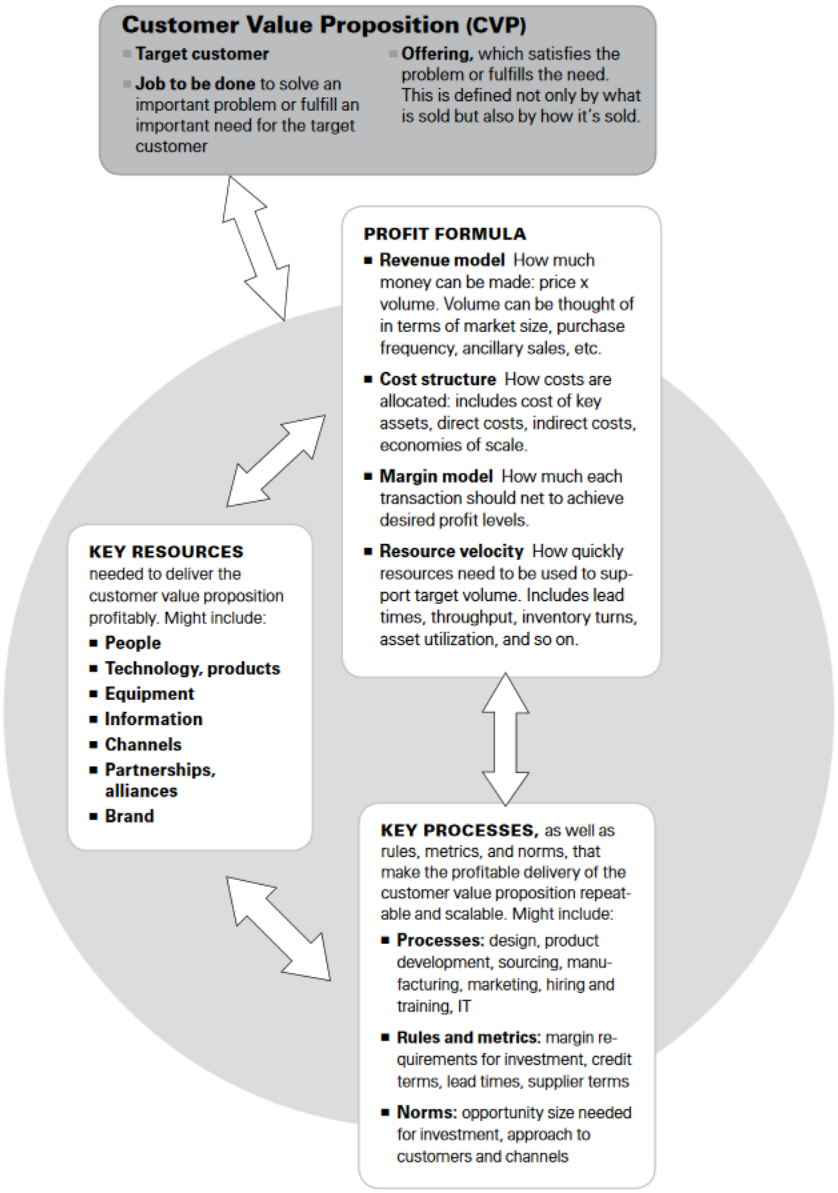


Figure 3 Elements of Four Box business model (Source: Johnson et al., 2008)

Therefore, understanding the existing business model as the initial step becomes crucial to the new business model development. According to the author, a business model is defined by 4 interlocking elements which together can create and deliver value:

1. Customer value proposition (CVP): It defines value created for the target customer by getting their important job done. By 'job', the author means any problem that needs a solution. Any firm can deliver greater CVP, when it offers compelling value to the customer that yields higher satisfaction compared to the competition's offering and possibly at a lower price.
2. Profit formula: It is the blueprint that describes how a firm can create value for its own, while contributing to value creation for the customers. It involves the financial aspects

of the model namely, revenue model, cost structures, margin model required to gain profits from each transaction and resource velocity i.e., estimating the turnover and utilization of resources to achieve the desired volume and gain expected profits.

3. Key resources: To deliver the value proposition to the target customers, firms need key resources such as products, channels, people, technology, brand, equipment, and facilities. The focus here is how these elements create value to firm and customers and how they interact with each other.
4. Key processes: To successfully deliver value to customers on repetitive basis and on an increased scale requires companies to incorporate certain managerial and operational processes. These key processes include recurring tasks such as planning, training, development, sales, and service etc. They also include rules, norms, and metrics of the firm.

While customer value proposition and profit formula define value for customer and firm respectively, key resources along with key processes define value delivery to both firm and customers. The strength of such business model developed with the help of these 4 elements lies in the consistency and complementarity of interdependencies between the elements (Johnson et al., 2008). All the elements put together can be seen in the figure above.

Osterwalder and Pigneur's Business Model Canvas:

According to (Osterwalder et al., 2005, pp. 4–5), the term 'business model' is a combination of two words which have specific meaning but when put together throw light on possible application of the concept of business model. The term 'model' is interpreted as "a simplified description and representation of a complex entity or process" and the word 'business' is interpreted as "the activity of providing goods and services involving financial, commercial and industrial aspects". Hence business model is defined as a tool that portrays business logic of a firm and describes value offered to the customers:

"A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore, we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences."(Osterwalder et al., 2005, pp. 4–5)

In the famous book "Business Model Generation", there are nine building blocks to describe a business model that can show the logic of how a firm can make money. A simplified business

model canvas for the creation of business model is also proposed in the book. This canvas is identified as a "shared language for describing, visualizing, assessing and changing business models" (Osterwalder & Pigneur, 2010, p. 12). Each of the element or building block in the canvas is presented if it has been stated by a minimum of two authors in the prior literature. The nine building blocks of the canvas tool are categorized into four main pillars of business namely product or offer, customer interface, infrastructure management and financial aspects (Osterwalder, 2004; Osterwalder et al., 2005). The table below shows the four pillars and nine corresponding building blocks of the framework.

Pillar			Building block	Description
I	Product	1.	Value Proposition	Value in terms of bundle of products and service offered to the customers
II	Customer Interface	2.	Customer Segment	Represents the segments of customers the firm wants to offer value to
		3.	Channel	Different means of getting in touch with the target customers
		4.	Customer Relationship	Describes the relationship or link a firm wants to have between itself and customer segments
III	Infrastructure Management	5.	Key Partners	Defines firms who cooperatively agree on partnership to create value to customer.
		6.	Key Resources	Important assets and their arrangement required to create and deliver value to customers
		7.	Key Activities	Actions undertaken by a firm to achieve desired goals
IV	Financial Aspects	8.	Revenue Streams	Describes how a firm makes money by offering value proposition to customers
		9.	Cost Structure	Representation of monetary consequences of the means involved in the business model

Table 1 Building blocks of business model canvas and their descriptions (source Isterwakder et al, 2005; Osterwalder & Pigneur, 2010)

Frameworks comparison

In this section, the frameworks previously discussed are compared. The comparison showcases that all the frameworks depict same idea despite of the fact that they are represented in different forms. In order to have an overarching framework, Kaplan's (2012) business model elements are used as reference. The table below shows the comparison of frameworks.

Kaplan (2012)	Chesbrough and Rosenbloom (2002)	Osterwalder and Pigneur (2010)	Johnson, Christensen and Kagermann (2008)
Value creation	Value proposition	Value proposition	
	Market segment *Revenue generation*	Customer segments	Customer value proposition
		Customer relationships	
	Value network	Key partners	
Value delivery		Customer relationships	
	Value network	Key partners	Key resources
		Key resources	
	Value chain	Channels	Key processes
		Key activities	
Value capture	Revenue generation *Market segment*	Revenue streams	Profit formula
	Cost structure and profit potential	Cost structure	
	Competitive strategy		

Table 2 Comparison of business model frameworks source: 0wn illustration based on (Chesbrough & Rosenbloom, 2002; Johnson et al., 2008; Kaplan, 2012; Osterwalder & Pigneur, 2010)

The functions in the Chesbrough and Rosenbloom's business model can easily be categorized into the value creation, delivery, and capture elements of the Kaplan's business model. Articulating the value proposition and identification of market segment or users describe the customer experience, hence they fall into the category of value creation. Identification of market segment is also associated with specifying the revenue generation. But revenue generation is a part of value capture along with estimation of cost structure and profit potential as they represent the financial aspects of the business model. Position of the firm in the value network and structure of the value chain represent the operating model of the firm and hence they are

categorized under value delivery. Value network involves customers, suppliers, complementors and competitors, who altogether contribute to the value creation. However, to some extent, value captured is influenced by the value network through commercialization of innovation (Chesbrough & Rosenbloom, 2002)..

One major difference that has been identified compared to the Osterwalder's framework and four-box business model is the mention of competitive strategy as a function in the business model and categorize it under the value capture. However, it does not fully cover the strategy. Chesbrough and Rosenbloom convey the difference between business model and strategy. According to them, business model majorly emphasizes value creation and delivery while value capture and sustainability are emphasized by strategy (Chesbrough & Rosenbloom, 2002; Fielt, 2013).

The nine building blocks of the Osterwalder's business model can also be categorized into Kaplan's elements for value creation, capture and delivery. Both value proposition and customer segment blocks contribute to value creation as they respectively describe what value is offered to the customers and who are the targeted customers, thereby addressing the customer experience. The relationship firm wants to have with the customer also hugely influences the customer experience. One example of such relationship is the value co-creation where customers are engaged in the process of value creation (Grönroos, 2008).

The operating model of the company is described by key resources, key activities, and channels of the firm. Hence, they are categorized under value delivery. Customer relationships also play a very important role in delivering value to the desired market. Key partners also impact both value creation and delivery. As discussed previously, operating model is not only limited to organization's own capabilities and whenever the operating vision demands activities and resources, they can be outsourced from the partner organizations. Value captured by the organization is represented by the financial aspects of the business model namely cost structure and the revenue streams.

What makes Osterwalder's business model more simplified compared to Chesbrough and Rosenbloom's framework are the financial aspects. In Chesbrough and Rosenbloom's business model, revenue generation is linked to market segment whereas in the Osterwalder's business model, revenue streams are put as a separate element. Revenue streams and cost structure together result in profit statements which makes describing financial aspects and hence value capture more simplified.

The four-box business model developed by Johnson et al. (2008) is similar to the Kaplan's business model in terms of value creation, delivery and capture. Customer value proposition focuses on getting the job done for the customers satisfactorily and hence is a part of value creation. Key resources and key activities are categorized into value delivery. Profit formula describes how the firm generates economic value for its own through the financial model, hence it can be categorized under value capture element of the Kaplan's business model although Johnson et al. (2008) does not explicitly mention 'value capture' in their model.

The four-box business model and the Osterwalder's business model are like each other. One identified difference is that the four-box model does not possess a customer box but sheds light on some of the customer aspects in the customer value proposition. In the Osterwalder business model, the key partners are mentioned as a separate block but in the four-box model they are defined under key resources. In the four-box model there is more emphasis on operation aspects such as norms, rules and metrics and financial aspects such as margin model and resource velocity. However, the four-box model lacks extent discussion on interdependencies or interrelationships between the boxes or elements that can make the framework quite complex (Fielt, 2013).

Conclusion on business model frameworks

It can be inferred from the previous comparison that all the business models depict the same idea of value creation, value delivery and value capture. However, the primary difference lies in the categorization of different elements. In the Osterwalder's business model framework, it is observed that most of the recurring elements are covered and are logically categorized. It is one of the most comprehensive business models developed through prior study of business model research literature and its theoretical underpinnings developed in Osterwalder (2004). Even in the later research work, as observed in Johnson et al. (2008) and Kaplan (2012), although there is variation in the categorization, the concept or the idea of business model remains the same. Hence Osterwalder's business model framework will be used as the theoretical framework for the development of business model in this research. A detailed explanation on the building blocks of this framework is developed in the next section.

Theoretical framework – Osterwalder's building blocks

Business model canvas is one of the most popular and extensively used framework (Fielt, 2013). According to Chesbrough (2010), it has the potential to visualize the process underlying a business model and such a tool enables firms to simulate possible business models prior to committing to real investments. Moreover, Onetti et al. (2012) based on their literature review

between 1996 and 2009, identified some of the recurring business model components such as "value proposition", "processes/activities/value chain", "value network (partners/alliances)". All these components have been used in the canvas making it one of the most comprehensive tools for business model development. Below described in detail are the four pillars and the respective building blocks of the business model canvas.

I Product pillar

This pillar informs what business the firm is in, defines the products and services and thereby the value proposition that is offered to the target market or the customer segment (Osterwalder, 2004).

1. **Value proposition:** Value proposition is the value offered to target customer segments to solve their problems or meet their needs through a bundle or mix of products and services. It is one of the main criteria based on which customers choose one firm over the other. The value propositions can be radical offering a whole new product or service or incremental in a way by adding more value-added features or attributes compared to the competition thereby enabling firm to differentiate itself from the competitors.

- The value proposed can be measured based on; the degree of newness it brings in the offered products or services, performance improvements, tailoring products or services to fit the custom needs of the customer segments, superior design it offers, lower price offered compared to the competitors, enabling other value creators reduce their costs, minimizing the risks customers incur when buying products and services, access given to customers to previously lacked products and services, ease of use or convenience (Osterwalder, 2004; Osterwalder & Pigneur, 2002).

II Customer interface pillar

This pillar describes who the target customer segments of the firm are, how the products and services are delivered to the customers and the relationship between the customers and the firm. It defines to whom and how the value proposition is delivered (Osterwalder, 2004).

2. **Customer segments:** Customers segments represent the target market to whom the firm creates value to meet their specific needs. They can be group of people or organizations; the firm wants to reach out to and provide products and services for. It is very important to have profitable customers for the survival of the firm on a long term. As customers form the core of the business model, it becomes crucial to carefully select the segments and then build the business model around it. Based on different attributes such as

common needs, characteristics or behavior, to better serve the customers, the firm divides them into distinct groups (Osterwalder & Pigneur, 2010). While segmenting it becomes very important to evaluate whether company's objectives and resources are consistent with the chosen customers and the marketing efforts (Cooil et al., 2008).

- Customer segments can be of various types such as mass markets addressing huge group of customers with similar needs or issues, niche markets addressing customers with specific needs requiring custom solutions, segmented markets addressing customer with slight variations in needs and problems, diversified markets addressing two or more previously unrelated segments and multi-sided markets having two or more mutually independent groups (Osterwalder & Pigneur, 2010).

3. **Channels:** The channel building block describes the means of the firm to reach the desired customer segment to deliver the value proposition. It enables the firm to communicate with the target customers to enhance their experience. Channels being customer touch points are very important for distribution to make the right product or service available for right customer at the right time and place. Channels can be distinguished as marketing, sales and distribution channels and are comprised of five phases namely awareness, evaluation, purchase, delivery and after (Osterwalder, 2004; Osterwalder & Pigneur, 2010).

1. Awareness	2. Evaluation	3. Purchase	4. Delivery	5. After sales
How can a firm raise awareness about its product and services?	How can a firm help customers to evaluate its value proposition?	How can a firm allow customers to purchase its value offering?	How can firm deliver its products and services to customer?	How can a firm extend post-purchase customer support?

Table 3 Channel phases. Source: Osterwalder & Pignuer, 2010

Channels can be either owned direct such as in-house sales and web sales or owned indirect such as through retail stores. There can also be indirect partner channels such as partner stores, websites etc. It is very crucial to have a right mix of channels in order efficiently deliver value to the target market and to generate revenues (Osterwalder & Pigneur, 2010).

4. Customer relationships: This describes the type of relationship a firm wants to establish and maintain between itself and the target customer segment. They play an essential role in influencing the experience customers have with the firm and can vary from personal to automated. The three motivators that drive customer relationships are acquisition of new customers, retention of existing customers and boosting sales. As interacting with the customers involve costs, it is necessary to choose what kind of relationship a firm wants to have with the customer. When successful relationships are established between firm and customers, they yield maximized revenues, profits and shareholder values on a long run (Bolton & Tarasi, 2007). Customer relationship can be distinguished into several categories such as personal assistance, dedicated personal assistance, self-service, automated services, communities and co-creation (Osterwalder, 2004; Osterwalder & Pigneur, 2010).

Of interest are communities and co-creation. Companies are using communities in their business model to understand the arising needs and problems of the users. The communities enable firms to be more involved with the customers and have better connections. Communities are also source for knowledge exchange between users where they mutually contribute to solve each other's problems (Osterwalder & Pigneur, 2010). Co-creation promotes engagement of customers during the creation of value itself. Compared to traditional market research techniques, value co-creation through involving customers during various stages of value chain has proved to be successful in the development and offering of novel product and services (Gustafsson et al., 2012).

III Infrastructure management pillar

This pillar describes how value is created by a firm for the customers. It necessarily specifies the value network configuration that comprises of strategic partners, important resources and activities that are required to create and deliver the value proposition and maintain the customer interface thus facilitating economic value (Osterwalder, 2004).

5. **Key partnerships:** This building block describes the alliances of the firm with partners and suppliers to facilitate a business model to function efficiently. Such a network helps to reduce risks by reducing uncertainty, to acquire resources and outsource activities enabling extension of capabilities, to drive optimization of business models by sharing resources and reducing costs thereby improving economies of scale. Having strategic alliances help firms to gain knowledge, licenses, skills, and extended customer access and promote mutual economic growth.

- The partnerships can be between non-competitors or competitors or both, two or more parties to undertake joint ventures to set up new businesses, buyers and suppliers to assure steady supplies (Osterwalder & Pigneur, 2010)..

6. **Key resources:** This building block describes the most crucial assets or resources that are needed to make a business model function. Key resources are responsible for creating and delivering the value proposition, to reach the target customers, maintain customer relationships and generate revenues. Key resources can vary depending what type of business a firm is doing. Firms enjoy the flexibility to own the resources or lease or acquire them from the key partners. According to (Osterwalder & Pigneur, 2010), key resources can be categorized into physical, financial, intellectual (brands, patents, copyrights, knowledge, customer database etc.) and human.
7. **Key activities:** This block describes the most important actions a firm undertakes to make a business model function profitably. Like key resources, these are also necessary to create and deliver value, reach market, maintain links with customers and earn economic value. Depending on the type of business, key activities differ. Key activities can be distinguished as production related, problem-solving and platform/network.

- For this research project, problem-solving and platform/network are of more importance. Addressing customer problems with new and innovative solutions describes the problem-solving key activity. Some of the activities that promote problem-solving are maintaining knowledge, offering consultation, providing training etc. This key activity can be observed mainly in the service organizations.
- Businesses that are platform-based employ platform or network based key activities. Key activities in such a platform-based business model include platform development, maintenance, provision of services, community building, promotion of platform, matchmaking etc. One of the famous examples is eBay that operates a platform website. The key activities of eBay include continuous development and management of the platform (Osterwalder & Pigneur, 2010).

IV Financial aspects pillar

It describes the cost structure and revenue model of a business model which is crucial for sustainability of any business. The revenue streams and cost structures together define the profit or loss logic of any firm. All other building blocks of the framework have influence on financial aspects. In order to survive in the market amongst the competition, it is necessary to have an efficient financial model (Osterwalder, 2004).

8. **Revenue streams:** This block describes the money-making aspect of a firm from each customer segment. Whenever a company offers value proposition to customers, it generates revenue flow through appropriate pricing mechanisms. A firm should analyze revenue stream for each customer segment based on their desire or will to pay for the value offering. Revenue streams are distinguished into two types, first is transaction revenues obtained from one-time customer payments and second is recurring revenues which result from on-going payment for delivery of proposed value to the customers and provision of customer support post-purchase (Osterwalder, 2004; Osterwalder & Pigneur, 2010). Revenue streams can be generated in different ways as mentioned below:
    - Asset sale: Firm makes revenue through selling of a physical product thereby making customer the owner of the product.
    - Usage fee: Revenue is generated based on the usage of a particular service by a customer. More usage of service corresponds to more revenues.
    - Subscription fees: Revenue is generated by providing customers continuous provision to a service.
    - Renting/ leasing: Customers are given the right to access to a particular asset for a defined span of time and in turn the customer pays a fee for this, thus enabling recurring revenues for the firm. Renting facilitates the customers to avoid full cost of ownership.
    - Brokerage fees: Revenues are generated by acting as an intermediary to perform services for the benefit of two or more parties.
    - Advertising: Revenues are generated by charging fees to advertise a brand, product or a service (Osterwalder, 2004; Osterwalder & Pigneur, 2010).

- There are different pricing mechanisms and choosing right mechanism can largely influence the revenue flows. Mainly pricing mechanism can be divided into three categories namely fixed pricing, differential pricing, and dynamic pricing. The prices set for the proposed value by fixed pricing mechanisms are predefined and remain static irrespective of customer characteristics, volume or real-time market conditions (Osterwalder, 2004; Osterwalder & Pigneur, 2010). In this category there are three types of mechanisms:
    - Pay-per-use: Pricing based on time or quantity of consumption of a specific service by the customer.

- Subscription: A flat fee is charged to the customer for consuming a product or accessing a service.
- Menu or list price: Fixed price often found in a list or catalogue.

- Differential pricing mechanism set prices based on customer or product characteristics. They are volume dependent however they are not based on real time market conditions. Following are the types of differential pricing mechanisms:
  - Product feature dependent: Products and services have become more configurable meaning pricing can be based on features of the value offering.
  - Customer segment dependent: Depending on characteristics or types of customers, price is defined.
  - Volume dependent: Pricing based on the purchased volume.
- Dynamic pricing mechanism enables pricing based on the market conditions. Following are the types of dynamic pricing mechanisms:
  - Negotiation: Pricing is based on negotiation between two or more parties and influenced by skills of bargaining.
  - Yield management: Pricing is dependent on time of purchase and inventory and determined by the real time forecasting of demand behavior.
  - Real-time market: Dynamic pricing based on supply and demand.
  - Auctions: Pricing based on results of competitive bidding (Osterwalder, 2004; Osterwalder & Pigneur, 2010).

9. **Cost structure:** This block describes the costs that are involved in the operation of business model. Starting from value creation to establishing relationships with the target customers and gaining revenue, everything demands a cost. These costs can be estimated after determining most essential resources, activities, and partners. A business model should strive to find ways to reduce incurred costs. It is very essential to realize whether a business model is cost driven or value driven (Osterwalder & Pigneur, 2010).

- Cost driven business aims to reduce costs in ways possible such as opting reduced price value propositions, increasing degree of automation or outsourcing resources and activities. Value driven business model has less concern about the cost and focusses on value creation for the customers. Top notch value and customized services characterize such a business model. Cost structures can have characteristics such as fixed costs where costs do not change irrespective of produced volume of products and services, variable

costs that are dependent on volume of products or services, economies of scale and scope (Osterwalder & Pigneur, 2010).

7.5 Business model pattern

Different business model patterns have been identified and described in the business model research (Fielt, 2013). With the help of business model pattern, it becomes easier to understand business model and analyze the rationale underlying the model. While designing a business model, for recurring problems, business model patterns describe verified solutions (Mettler & Eurich, 2012). What makes these patterns important is the finding that 90% of the business model innovations are a recombination of the patterns that already exist (Gassmann et al., 2014).

In their famous book, Osterwalder and Pigneur (2010) describe patterns as similar characteristics, behaviors and arrangement of elements of business model and are responsible for understanding the dynamics of business model and aid as guiding source to develop new business models. There are five identified patterns namely Unbundling, the Long Tail, Multi-sided Platforms, FREE and Open business models. Since this research project requires developing a platform assisting interactions between 2 independent groups, the study of multi-sided platform business model pattern seems more relevant.

7.5.1 Platform business model

Today we get to see so many platform marketplaces around us. To mention, Facebook, Google, Airbnb, eBay are just a few examples. The platforms are growing rapidly and disrupting the way business is done today. Marketplaces, as rapidly emerging category of platforms, work on idea of putting two groups such as producers-consumers, sellers-buyers, developers-users, supply-demand in touch who need each other by enabling and supporting transactions. With the advent of information and communication technologies and internet, digital platforms have come into picture making it easier for the participating parties to interact. With such platforms, reaching global markets is now achievable better than before. The strength of such platforms increases with large number of users making it more relevant (Hagiu, 2007; Täuscher & Laudien, 2018).

According to Gawer (2009), the research on concept of platform has been developed in three waves by the management scholars namely product development, technology strategy and industrial economics. The product development researchers described ‘platforms’ as projects

that led to the creation of new products or families of product for a certain company. The author mentions the term 'platform product' to describe products that could be easily modified through adding or removing or substituting features to meet the requirements of core customers. In technology strategy, platforms were identified as valuable points of control in an industry. Platforms were an important force in an industrial level responsible for evolution of product designs and to determine success or failure of a company. In industrial economics, the term 'platform' refers to products, services, firms or institutions that facilitate transactions between two or more groups of agents (Rochet & Tirole, 2003).

7.5.2 Types of platforms

Based on context, number of participants, objectives of platform and design rules, Gawer (2009) divides platforms into 4 different types namely internal platforms, supply chain platforms, industry platforms and multi-sided markets or platforms. Internal platform is observed within the company, and it is widely associated with the context of new product development. The objectives of internal platform are to enhance the productive capability of firm, to achieve product variety at lower costs, mass customization and flexibly design new products. The concept of supply chain platform is like internal platform but extended to supply chain allowing partners to efficiently create and produce derivative products.

Industry platforms enable one or more firms to develop products, services, or technologies which in turn act as foundations that enable other firms to build complementary products, services, or technologies. Industry platforms are external meaning they are open to outside firms which are not a part of the supply chain thus making industry platforms different from supply chain platform. Multi-sided or double-sided platforms enable transactions between different sides of the platform or market. The platform acts as intermediary to several firms or group of firms. Multi-level platform and industry platforms share some similarities such as existence of indirect network effects. More on multi-sided platforms and network effects will be studied in the later part of the report.

7.5.3 Multi-sided platforms (two-sided market)

Multi-sided platforms, which are also known as multi-sided businesses have emerged recently as one of the important economic and business phenomena with the growth of information communication and technology and internet in many industries. As a result, firms are seeking opportunities to build large, valuable, and strong platforms (Hagiu, 2007). Two-sided platforms or two-sided networks are specific types of multi-sided platforms that play the role of bringing

together two unmet distinct groups of independent customers. Multi-sided platforms act as intermediating hubs to create value exchanges by facilitating connection between two or more groups (Hagiu, 2015; Muzellec et al., 2015; Osterwalder & Pigneur, 2010; Parker & Van Alstyne, 2005). Multi-sided platforms facilitate rapidly new transaction methods and at much lesser cost. Unlike "pipeline businesses" which control linear series of activities in the value chain, the ownership of goods and services is not taken by the multi-sided platforms instead they depend on resources such as skills, technologies or ideas and activities that are controlled and offered by the various sides of the market (Thomas et al., 2014; Van Alstyne et al., 2016).

Some of the main examples of multi-sided platforms include that of videogaming platforms like Sony Play Station, Nintendo, Microsoft X-Box etc., whose two sides include gamers and game developers. They need to fetch gamers to persuade game developers to pay license fees to design and produce games for the platform. On the other hand, the platform needs new and variety of games to attract gamers to purchase their gaming console. Similarly, newspaper or media portals need advertisers and viewers, operating systems (OS) need developers and users and so on. These platforms instigate a virtuous cycle where more demand from one user group stimulates the other user group. As the number of users increase, the margins tend to grow (Eisenmann et al., 2006; Rochet & Tirole, 2004). These firms have structured their organizational design and moved their industrial boundaries from conventional selling of products towards facilitating economic transactions between two or more participant or user groups (Zhao et al., 2019).

According to Rochet and Tirole (2003), a good number of markets who possess network externalities are two-sided in nature. Such markets are distinguished by the presence of two distinct sides that benefit by interacting on a common platform. Platform's owners in this scenario must be concerned about "chicken-and-egg problem" while doing the task of getting the two sides "on board". As a result, the choice of business model matters for the success of a platform. With the help of some illustrations, it is shown that, among two sides of the platform, one side is treated as "profit-making segment", or "subsidizing segment" and other side is treated as "loss leader" or "break-even segment" or "subsidized segment". Depending on the business model, either sides can be treated as profit center or loss leader. This is referred to as price structure. The platform providers should appropriately charge each side of the platform in the context of making money or at least not face any loss of money (Rochet & Tirole, 2003, 2004).

According to Eisenmann et al. (2006), products and services that bring two groups of users together in two-sided networks are platforms. Such platforms provide components or technologies or infrastructure and incorporate set of rules that persuade transactions between the two groups. Some platforms rely on physical products such as gaming consoles or customer debit cards while some rely on services such as shopping malls or websites such as eBay and LinkedIn. Compared to traditional value chain, in a two-sided market, the platform incurs cost to serve both groups and generates revenues from each of the groups. However, one of the two groups are often subsidized (Eisenmann et al., 2006; Hagiu, 2015).

A phenomenon called "network effect" describes how two groups are pulled towards each other. Network effect describes how the value of platform matters more to user group on one side when there are large number of users on the other side. Such network effect improves value when the demand from both sides is matched by the platform (Hagiu, 2015). One of the classic examples to demonstrate network effects is the gaming industry platform bringing together gamers and game developers which is described above. Network effects enhance returns to scale for any successful platform. Users always tend to pay more to acquire reach to a bigger network and as the user base expands it in turn yields bigger margins. This is one of the major characteristics found in multi-sided platform business when compared to traditional businesses (Eisenmann et al., 2006).

For the strategic design of any multi-sided platform, lot of technical and economic factors are crucial. Deciding on which group of customers are relevant for the platform and what fundamental services the platform should offer for the target customer groups is very essential for the success of the firm before it is even launched, and pricing decisions are taken. Irrespective of industry, any multi-sided platform should serve one or more of three fundamental functions namely identifying the relevant platform sides or constituents, activities that platform should perform or let go for the constituents and trading off the depth vs. scope in its functions (Hagiu, 2007).

According to (Hagiu, 2007), at the most basic level multi-sided platforms can perform two types of basic functions:

1. Reducing search costs that are incurred for the multiple users of the platform before the transactions
2. Reducing shared costs that occur during the transactions

The potential sides of multi-sided platforms look for best "trading partner" before interacting and the costs involved are called as search costs which can be of two types depending on whether either (or multiple) sides are looking for each other or just one side is searching. In a one-sided setting, the platform reduces the search costs for searching side by providing audiences while standalone services are provided to the non-searching side i.e., audiences. An example to one-sided case is advertising platform like TV, where audience in the form of viewers are sold to advertisers. Audience making platforms help the searching sides to exhibit information about new products and experiences to the audiences present on the other side (Hagiu, 2007).

Reducing the search costs involve reducing the asymmetric information between the two sides that makes "sampling" of constituents easier for the transactions. In this case, network efforts work in both directions. Multi-sided platforms strive to reduce asymmetric information by employing "quality certification" of at least one side of the platform. Certification can take place in different forms and can range from tight to soft depending on the market. On the other hand, shared costs are the costs that are incurred during the transaction i.e., when the search is over, and the transacting sides have found each other, and it is one of the fundamental functions of multi-sided platforms to reduce shared costs and ease the transactions. Shared cost observation can be observed in payment systems such as eBay's PayPal facilitating easy and quick transactions between merchants and buyers (Hagiu, 2007).

Another key strategic trade-off for a platform is between depth vs. breadth in its functions i.e., deepening the functionalities associated with the existing customers and expanding the platform that might add new radical functions and thereby bring new customer groups on board. Depth creates more value to the customers by enhancing network effects and making the transactions between the sided more efficient, frequent, and easier. Another critical dimension related to platform depth is quality certification which helps reduce asymmetric information between the transacting sides. It becomes necessary for the platform to decide on the strictness of certification policy. Decision should also be taken regarding, if certification must be performed by platform itself or enabled by platform and performed by the transacting sides. The authors refer it to as centralized and decentralized respectively. Decentralized approach is more suitable in situations where platform does not have informational advantage over the constituents of the platform. Platform should take care as to not overdo deepening the functionalities as it might have negative impact such as overdoing cost reductions when there appears no scope or putting unwanted pressure on the users. On the other hand, breadth of multi-sided platforms refers to

how platforms strive to capture value from adding new sides to the existing platform and creating indirect network efforts with the new sides. It can a move of survival in the growing competition where other competitors can take over existing users of the platform. However, knocking new industries or customer groups is a difficult task due to factors such as resource constraints (financial or human) and potential conflicts of interest that may arise within the existing eco-system (Hagiu, 2007).

Multi-sidedness is treated as characteristic of relevant firms and industries by the pioneers (Parker & Van Alstyne, 2005; Rochet & Tirole, 2003). Many firms make choices to determine how far or close they are to the economic model of multi-sided platforms and based on these choices they make economic trade-offs. Lately lot of service firms are moving from vertically integrated models who provide client service through their own employees to MSP model by facilitating direct interaction between professionals and clients however, the firms have good control on transactions between the sides by establishing contractual relationships (Hagiu & Wright, 2015).

According to Hagiu and Wright (2015), multi-sided platforms possess two features at the most fundamental level:

1. Between the two or more distinct sides of the platform, they enable direct interactions (Hagiu, 2015).
2. Affiliation of each side with the platform.

Direct interaction means that associated distinct sides of the platform retain control over the interactions in contrast to the platform provider taking charge of the prime terms of such interactions. These terms of transaction could be pricing, bundling of services, marketing, delivery of services and other terms and conditions. Direct interaction as a feature sets apart multi-sided platforms from vertically integrated firms and reseller firms (Hagiu & Wright, 2015).

Affiliation refers to the platform specific investment that user sides deliberately make to have direct interaction with each other. These can be fixed access costs, resource usage expenditure or opportunity costs (Hagiu, 2015). Affiliation of the constituents makes multi-sided platform different from the input suppliers which are not affiliated to all the sides. To generate cross-group or indirect network effect, affiliation of multiple sides with the platform is important. Thus, it is understood that platforms do not manufacture, resell, or develop goods and services but help connect the different user sides of the market (Hagiu & Yoffie, 2009). The Figure 5

helps us to understand the difference between multi-sided platforms and other alternative business models (Hagiu & Wright, 2015).

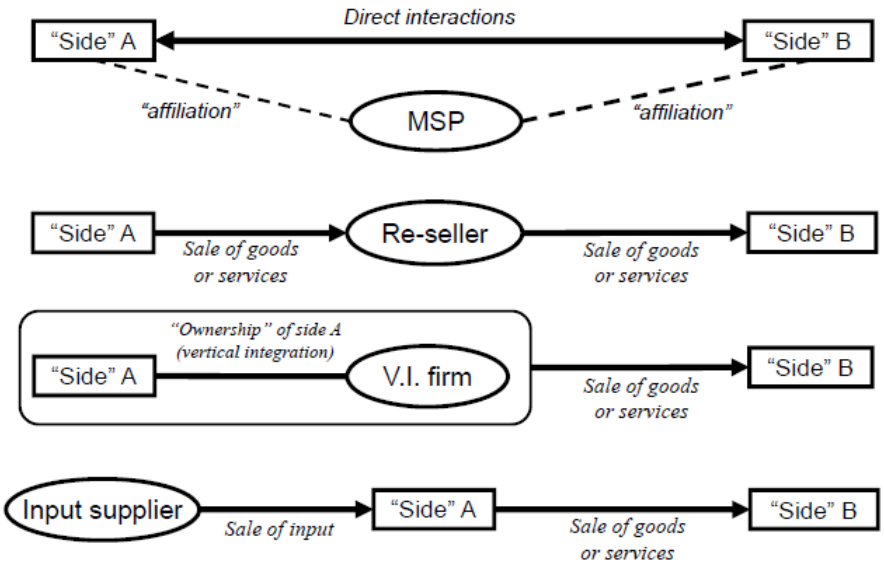


Figure 4 Multi-sided platform vs. alternative business models, Source Hagiu & Wright, 2015

It has been observed that in the recent decade, some of the largest and fastest growing firms have adopted multi-sided platforms and proved to be successful by creating and capturing value by reducing search costs and transaction costs for the participant sides (Hagiu, 2015; Zhao et al., 2019). Prior literature emphasizes on a some of the parameters that attract the users and enable their lock-in to the platform. Those parameters include attractive deals and dedicated contracts for producers, governance of transaction partners through policies, offering new features and add-ons to draw users, easy access to platforms, efficient match making of users with corresponding terms and effective ways to close the transactions. These choice of design parameters have great impact on the growth of associated user base of the platform. How design of multi-sided platforms evolve can be understood with the help of business models. Another important observation in the literature is how multilateral set of partners contribute to the platform through interdependent value creation. Some of the examples are platforms like Apple iOS or Mozilla Firefox on which community of developers build through technological core standards provided by the platform. Along with provision of platform, having relations and interactions with stakeholders play a very important role in the creation of value (Zhao et al., 2019).

Creation of any platform requires a holistic approach as the decisions taken are interdependent and compared to single design elements, entire architectural recipe becomes more crucial (Zott

& Amit, 2010). Business model on one hand, help identify transaction sides, establish customer engagement also referred to as value proposition and show how a platform connects with chosen sides (Baden-Fuller & Mangematin, 2013). On the other hand, define how value is delivered, monetized, and shared among the interacting sides (Johnson et al., 2008). As a whole business model refers to interrelated boundary spanning interactions and interlinked activities that are required for creation and capture of value (Zott & Amit, 2008).

The number of design elements in a business model and the interlink between them highly affects the platform performance. Successful platforms are characterized by the presence of efficient and complex business models wherein the design elements are highly interdependent and clearly defined. Firms that have failed to employ such business models by creating loosely coupled design elements have failed to survive in the competition. For any multi-sided platform to survive in the long run amongst the fierce competition both business model innovation and imitation become very necessary which help create complex and scalable business models (Zhao et al., 2019).

However, Zhao et al. (2019), in their work, identify platform as an activity system which describes how a business model creates firm's connection with an ecosystem of producers and users and enables the firm, along with the distinct transacting sides for value creation and value capture and monetization of a share of that value. In a business model (consisting of focal firm, end-users, partners etc.), an activity represents how human, physical and/or capital resources are engaged to serve a specific purpose thereby fulfilling an overall objective. The activity system is characterized with the help of three design elements namely activity content, structure, and governance (Zott & Amit, 2010). Activity content involves those activities that are responsible for value creation and value appropriation, activity systems represent the sequence or order in which the interactions take place and activity governance define actors of certain activities, set rules and standards for the transactions, activities to attract participants and consummate matchmaking between sides (Zhao et al., 2019).

7.5.3.1 Network effect

Multi-sided platforms are characterized by the presence of one of the important features called network effects. Van Alstyne et al. (2016) in their work identify network effects as driving force that lies behind every successful platform. With network effects the value that platform brings in for any given users depends on the number of users or participants on the same or other side of the platform. When the demand from both sides is met, the value and margins continue to grow. It yields growth in returns to scale for the platform. Unlike traditional businesses, the

users tend to pay more to gain access to a bigger network of users. Managers who have relied upon assumptions and paradigms while developing a multi-sided business without taking into account network effects have considered it to be one of the reasons for failure (Eisenmann et al., 2006).

Network effects generate demand side economies of scale. Platforms that attract a greater number of participants compared to the competition will be able to offer higher average value per transaction. This is because of the reason that when a network grows, efficient match making between supply and demand and rich data to find matches is achievable. Network effects demonstrate a virtuous feedback cycle that generates monopolies: increased participants generate more value which in turn attracts more participants which in turn creates more value. Some of the great examples succeeded by network effects are Alibaba, Google and Facebook who have dominated the market in e-commerce, mobile OS, and social networking (Eisenmann et al., 2006; Van Alstyne et al., 2016).

Prior literature identifies two kinds of network effects namely direct (also called as same-side) and indirect (also called as cross-side) network effects (Gawer & Cusumano, 2014). Users tend to value a product or service more when similar users as well use that product or service. This is referred to as positive direct network effect. Such effect arises because it becomes easier to connect to people who are using the product or service and because there is spillover of knowledge or exchange of ideas among the users. One famous example is of social networking site Facebook where users join Facebook if more of their friends or families are using it (Hagiu, 2015). Economists refer same-side network effect as snowballing pattern as more and more users are attracted. However sometimes, in some cases, users want to be different or face congestion due to unconstrained growth of network which leads to negative direct network effects where a greater number of users on same side of the platform makes it less valuable for them. In such cases, it becomes necessary to exclude some users from the network (Eisenmann et al., 2006; Evans, 2009).

On the other hand, the value to users on one side of the multi-sided platform increases when the number of participating users on the other side increases. This is referred to as indirect network effects or cross-side network effects. For example, eBay is a multi-sided platform wherein many buyers will fetch more value to the sellers and vice versa (Hagiu, 2015). Although cross-side network effects are usually positive, they can be negative too. An example of negative cross side effect can be observed in TV viewers who prefer less advertisements (Eisenmann et al., 2006). Indirect network effects arise when one type of economic user want

to look for and transact with another type of economic user. They can also arise when one side of users (e.g., PlayStation users) look for complementary products (e.g., video games) by using the platform and the other side strives to deliver those products based on the increased demand (Evans, 2009).

Indirect network externalities of platforms are referred as double-edged sword because on one hand they make it difficult for the competitors to take up their privileged position by creating high barriers to entry in their respective industries. While on other hand, building that barrier becomes difficult due to the chicken-and-egg problem. Without the presence of one-side, other side will not join. Hence overcoming the chicken-and-egg problem becomes one of the crucial tasks for the multi-sided platforms (Hagiu, 2015).

Along with cross-side network effects, to keep the competition and new entrants away from taking their position, multi-sided platforms should develop high switching costs to either one or all associated sides of the platform to be able to join more than one competing platform. This is shown with the examples of two of the early leaders for daily deals in the market namely Groupon and LivingSocial. Both the platforms connected consumers with merchants. When more consumers in the Boston area sign up to receive daily deals, a greater number of merchants would associate themselves to the platform to offer daily deals and vice versa thereby exhibiting clear cross-side effects. Both the platforms enjoyed market dominance and captured good value in less time. However, over a span of two years from 2011 to 2013 their valuations gradually decreased. Analysts and investors pointed the reason for such slash to be low switching costs on both sides of the platform and ease of the consumers to participate in more than one platform which led other daily deals enter the competition (Hagiu, 2015).

Strong demand side economies of scale and scope are generated by network effects which in combination with technology help platform break through the industry barriers and extend their presence. To intensify network effects, platforms should work on depth i.e., to provide all the potential value to their existing sides efficiently which make the sides “stickier” and reduce their chance of moving to other platforms (Hagiu, 2007). Having more sides also contribute to large indirect network effects but while doing so, platforms should consider the risk of complications and clash of interests arising between the participants and the multi-sided platform (Hagiu, 2015).

7.5.3.2 Chicken-and-egg problem

As mentioned earlier multi-sided platforms face a chicken-and-egg problem which arise due to indirect network externalities (Caillaud & Jullien, 2003; Hagiu, 2007). It is a coordination issue on the platform pricing structure (Hagiu, 2009). Multi-sided platforms must attract two or more distinct groups at the same time. One user group cannot exist without demand from the other side. The platform must find ways to get both the groups on board. Let us consider example of payment card, if customers cannot use payment cards anywhere, there would be no demand for the cards. Similarly, there would be no demand from the retailers for the payment cards if no customers use them. The chicken-and-egg problem here is who to get on board first: retailers or cardholders. Investment and pricing strategies are considered as potential solutions in this situation (Evans, 2003).

According to Evans (2003), this problem can be solved in two ways:

1. To gather a good number of users on one side of the platform by offering the services for free (or inexpensive) or at times even paying the users to take them. For example, Microsoft offers their Xbox console at a subsidized rate to attract more gamers on board, Facebook allowing people to browse the social networking for free.
2. Investing on one-side or user group of the market to lower their costs of participation in the market. For example, Microsoft offers application development kits and necessary assistance for developers to develop applications using the Microsoft operating systems.

Providing subsidy or low-price proposition to one user group of the market helps the platform to solve the chicken-and-egg dilemma by encouraging the participation of the group that is benefitted which in turn because of cross-side externalities encourages the participation of non-benefitted group (Evans, 2003; Osterwalder & Pigneur, 2010). This is referred to as "divide-and-conquer" strategy i.e., to subsidize a side is to divide and recovering the loss from the other side is to conquer. Choosing which side to subsidize is also crucial, however, according to Parker and Van Alstyne (2005) the side that contributes largely to the demand for its offering is the side to be subsidized. Hagiu (2015) in his work suggest that it is advantageous to begin with a multi-sided platform with fewer sides to solve the initial chicken-and-egg problem.

7.5.3.3 Openness in a multi-sided platform

There are four distinct players in a platform mediated network namely end-users, complementors, platform providers and platform sponsors. The fore-mentioned roles can be opened to encourage participation of players or closed. To create and maintain the platform,

selecting optimal level of openness becomes very important. Opening a platform can stimulate adoption of the platform by exploiting the network effects, lessens the concerns of users about lock-in, enables the development of differentiated products and services to meet the needs of the user groups. However, on opening a platform, the switching costs for the users are reduced and competition among the platform providers increases which makes it tough for the platform for the appropriation of rents (Eisenmann et al., 2009).

A platform is open if it allowed players to participate in its development, commercialization or use or if there are any restrictions, they should be placed reasonably without any discrimination i.e., applied uniformly to potential players of the platform. To characterize a platform as open or closed, it becomes relevant to understand the distinct roles of different players in a platform mediated network as shown in the figure below:

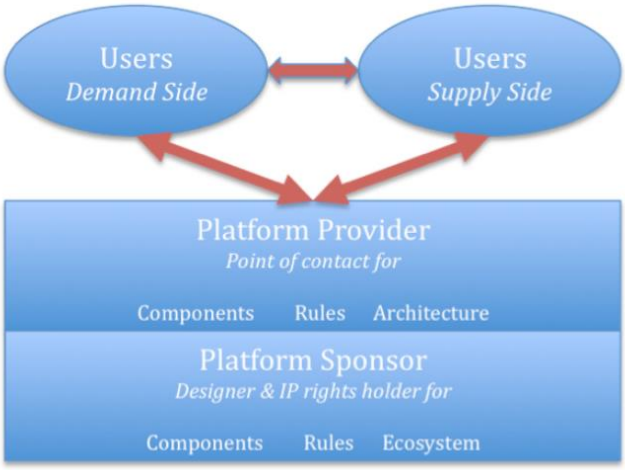


Figure 5 Participants in a platform-mediated network - source Eisenmann et al. 2009

1. End-users: They are the demand side users of the platform.
2. Complementors: They are the supply side users of the platform who offer complements to the end-users associated with the platform.
3. Platform providers: They are the primary point of contact on platform for the users and are responsible for mediating the user transactions. Providers supply the components and stick to the rules set by platform sponsors.
4. Platform sponsors: They are responsible for developing and modifying the platform technology. They design the platform components like hardware, software, service modules and rules to coordinate and control the participation of providers and users in the network

The roles of platform provider and platform sponsor can be fulfilled by one firm or shared by multiple firms. Depending on the situation, either closed or open model can be beneficial. For example, Linux platform is open to all four roles whereas Apple's iPhone is closed with respect to three out of four roles, the only open side being demand side users i.e., end users (Eisenmann et al., 2009).

Van Alstyne et al. (2016) in their work describe open architecture and open governance. An open architecture provides platform participants to access platform resources and help create new value sources. An open governance allows the platform participants other than the owners to shape the rules of transaction and sharing of reward. Normally new entrants start with closed architecture and governance and gradually open on identification of additional sources of value and new ways to carry out transactions.

7.5.3.4 Governance in a multi-sided platform

A governance model entails rules for participation, transactions of the various players and resolution of issues or conflicts. Participation rules define who can associate with the platform thereby governing the openness of a platform. Behavior of the interacting participants on the platform is controlled by the interaction rules. They also govern division of surplus, privileges, and responsibilities (Parker & Van Alstyne, 2016).

The owners of the platform are responsible for controlling their intellectual property and governance. Access and Governance become very crucial to persuade the participation of various parties in the platform ecosystem. Access control whom to involve in the platform and governance controls what platform providers, supply-side users, and demand-side users and even competitors are allowed to do on the platform. Platforms encompass rules and architecture. The openness of these is decided by the owners. Platforms should encourage participants to interact and enable sharing of their ideas and resources. When governance is efficient, it encourages outsiders to bring in their intellectual property to the platform (Van Alstyne et al., 2016).

Hagiu (2015) mentions governance rules as one of the challenges that a multisided platform owner should consider. According to him, there are two non-price governance rules that platform should employ to regulate their various transacting participants namely:

1. Rules to regulate access of the transacting participants to the multi-sided platform i.e., to control who has permission to join the platform.

2. Rules to regulate interactions on the platform i.e., what the participants are allowed to do.

Governing rules can be tight or loose for a multi-sided platform, sometimes even in the same industries. The authors explain this with the help of example of Apple and Google in the smartphone market. When it comes to third-party application developers, Apple has tighter restrictions while accepting applications for the iOS platform. On the other hand, Google is liberal in terms of accepting applications from third-party developers for its android platform. Apple periodically checks and rejects application that do not meet satisfactory quality (Hagiu, 2015).

At a higher level, when a multi-sided platform prefers tighter governance rules, it is favoring quality over quantity. This is because it is not only how many participants are present on each side and what is the number of transactions but also the quality of participant and transactions that matter. When firms to choose to implement tighter governance rules to enhance quality, it should also consider the costs involved in it. These costs can be technological or operational. Due to network effects, if quantity is growing and platform still wants to ensure quality, then it can still utilize costly governance rules or 'out-source' its pursuance to users. For example, e-commerce sites such as eBay and Airbnb have rating systems for buyers and sellers, which help both sides to perform with utmost quality (Hagiu, 2015).

Governance is necessary for the platform ecosystem to function properly that can help overcome market failures. Active governance should be enforced to beat the three sources of market failure as mentioned below:

1. Lack of information and transparency in transactions lead to 'lemon market failure' in which low quality participants drive out superior quality ones which ultimately leads to break down of the market.
2. If one side of the platform faces excess competition, it hinders them to invest on developing and offering high quality products or services.
3. Weak governance by multi-sided platform makes each participant not to invest or take actions that would otherwise facilitate positive spillover effects for the platform and other participants (Hagiu, 2015).

Another dimension of platform governance are the pricing policies incorporated by the platform which include choices between symmetric or asymmetric pricing i.e., whether to charge both

sides or one side. Pricing also governs entry of undesirable participants as by rising the entry prices it can act as a gatekeeper and limit access if wanted (Staykova & Damsgaard, 2015).

7.5.3.5 Pricing in a multi-sided platform

To ensure platform's success pricing is very important. Getting the price right is one of the key strategic decisions and solving it is a challenging affair. In a two-sided network, each of the two sides are to be the charged considering the scope of growth and willingness-to-pay of the other side. Of the two sides, there is often a subsidy side or loss side, which is a side where participants are attracted in volumes. The subsidy side stands a high value, and it is attractive to the other side of the platform, which is the money side or the profit side, thereby creating cross-side network effects. Both subsidy and money sides, pay less (sometimes free; freemium model) and more respectively, if it were to be viewed as an independent market (Eisenmann et al., 2006; Hagiu, 2015; Rochet & Tirole, 2003; Staykova & Damsgaard, 2015).

Based on whether to charge one side or both the sides in a platform, the pricing is said to be asymmetric and symmetric (Staykova & Damsgaard, 2015). However, the choice of side to charge and choice of side to subsidize is not always obvious. Below mentioned are some of the factors suggested by Eisenmann et al. (2006) to make right pricing decisions:

- Ability to capture indirect network effects: Subsidy should be provided in a way that users stick to platform and do not transact with the money side of other rival platforms.
- User sensitivity to price: The side of the platform that is more price sensitive is to be subsidized whereas the other side is to be charged whose demand increases because of other side's growth. The price sensitivity is estimated based on availability of substitute services or by bargaining power that platform has over particular participant side (Hagiu, 2015).
- User sensitivity to quality: Users that are sensitive to high quality should be subsidized i.e., participants that demand quality is subsidized and participants that supply quality are to be charged.
- Output costs: Pricing decisions are simple when addition of each subsidy side user does not cost anything for the platform. This can be observed in cases of provision of digital goods such as software program, idle computer time etc. However, in case of tangible goods with appreciable goods, pricing decisions should be carefully taken.
- Users' brand value: It is appreciated to involve marquee users in the network as their participation will attract more participants on the other side of the network. Big buyers

and high-profile suppliers are some of the marquee users. Addition of marquee users help platform to grow if their participation is exclusive and they are not committed to any other rival platforms (Eisenmann et al., 2006).

In addition to principle of user sensitivity to price, Hagiu (2015) suggests pricing principle in terms of prices transactions:

- If there is no priced transaction between the two sides, then the side that has more advantages from the presence of other side must be charged more.
- Given a minimum acceptable quality, if there is priced transaction between the two sides, then the side that can derive more value from the other side must be charged more.

There are two different prices set by multi-sided platforms namely membership fee or registration fee and transaction fee. Membership fee is the price paid by any of the participants to enter the network whereas the latter is the price paid on occurrence of transaction between matched parties (Armstrong, 2006; Rochet & Tirole, 2006). To gain high market shares transaction fees is one of the strong weapons for intermediation service providers (Caillaud & Jullien, 2003). However, based on behavior of the platform either or both pricing mechanisms can be chosen. Pricing structures should be opted in a way to balance out value extraction and value creation on different sides of the platform. Generally, participant groups that reap higher benefits should be charged more (Hagiu, 2015). It is important to realize that pricing in two-sided networks is different from traditional businesses, otherwise potential business would end up sinking (Eisenmann et al., 2006; Parker & Van Alstyne, 2005).

7.5.3.6 eBay as an example of multi-sided platform

With the advent of information technology, a lot of global online platforms came into existence such as Amazon, Google, eBay, Facebook etc. The main function of these multi-sided platforms is to get two or more sides on board and facilitate interactions between them (Evans, 2016; Hagiu & Wright, 2015). eBay among them, is one of the privileged e-commerce marketplaces that facilitates business-to-consumer and consumer-to-consumer sales. The role of eBay is to attract participants to join the marketplace, consummate matchmaking between buyers and sellers and thereby enabling value creating exchanges. To achieve this eBay provides transactional architecture and sets governance rules. Moreover, it is a proprietary platform that functions both as platform sponsor and platform provider (Eisenmann et al., 2009; Zhao et al., 2019).

Founded in 1995, eBay has established itself as "The world's Online Marketplace" which also is its positioning statement. It provides an online platform on which millions of transactions take place. eBay has facilitated trade on local, national, and international basis which includes community of various businesses and consumers who can buy and sell almost anything across thousands of categories. Unlike traditional retail business, eBay has a unique business model that generates money by enabling matchmaking between buyer and sellers. Items are shipped by the sellers themselves to the buyers which brings us to the fact that eBay enjoys the benefit of not having any distribution and fulfillment costs (Amin & Amin, n.d.).

For eBay, identifying buyers and sellers as its relevant sides was an obvious choice. Like any other multi-sided platform, eBay also exhibits indirect network effects. Sellers can derive high value from eBay when they can gain access to large base of buyers and vice versa. In this case, buyers are on the loss-leader side and sellers are on the profit-making side (Hagiu, 2015). There are two ways in eBay, through which buyers and sellers come together. First one is "Buy It Now" where sellers offer commodities at a fixed price which is like how retailer sell in a conventional shopping mall. Second is through auction where seller accept bids from buyers and offers the merchandise to winner but at the price of second highest bid (Evans et al., 2006).

According to Evans et al. (2006), sellers could be charged for accessing the platform, using the resources offered to set up stores, to advertise, to list and to sell items. Buyers who are price sensitive are not charged by eBay for browsing, bidding, and buying on the platform (Evans, 2016). eBay charges sellers an insertion fee for each commodity which is fixed. On the other hand, eBay takes variable fee in terms of commission from the seller based on the value of item that is sold. It increases its revenue by promoting more sales instead of relying on to get highest price for every transaction. eBay incorporates PayPal (acquired by eBay in 1999) as its payment system to conveniently settle transactions between buyers and sellers (Hagiu, 2015). The acquisition of PayPal has increased the depth of the platform by promoting easy, reliable, and efficient transactions between the participating parties thereby reducing the two-sided shared costs (Hagiu, 2007).

One example of eBay shows us how excessive deepening of platform had a negative impact on the platform. In 2005, eBay acquired Skype VOIP to reduce transaction costs between buyers and sellers by facilitating voice communication however, many users were turned off by this feature as it imposed pressure by affecting the comfortable anonymity of online transactions (Hagiu, 2015).

Coming to governance, eBay has a Feedback forum to reduce the asymmetric information between buyers and sellers. Buyers are encouraged to provide ratings to sellers which are then made public. Sellers mainly value the rating system as having a negative rating will decrease their chances of offering commodities to a broad base of buyers. eBay here adopts softer quality certification by allowing the buyers to rate the sellers instead of certifying by its own. This is due to the reason that eBay doesn't have a clear informational advantage over the sellers thus chooses a decentralized approach of certification (Evans et al., 2006; Hagiu, 2007)

Overall eBay strives to enhance trading experience of both buyers and sellers. eBay helps sellers by providing them number of tools to run their business through the platform. It involves offering free tips and advice, local seminars, software programs, free applications etc. It has transformed the way of doing traditional retail business. It made the process of transactions convenient and efficient through its online marketplace. eBay community today boasts of having millions of registered members from around the globe and stands out to be one of the most successful multi-sided platforms (Amin & Amin, n.d.; Evans et al., 2006)

8. Research methodology

This chapter shows the methodological choices that were opted to solve the research problem. It guides through the defined research philosophy, research approach, choice of research method, research strategy, time horizon and techniques and procedures that were adopted to collect and analyze the data. All these demonstrate the underpinnings for the results that are obtained and their justification in the research process. To carry out the research process, the research onion developed by Saunders et al. (2016) is used as reference. It describes the various stages involved in the process of research that a researcher undergoes to develop the methodology to solve the desired research question. The research onion is depicted in the figure below.

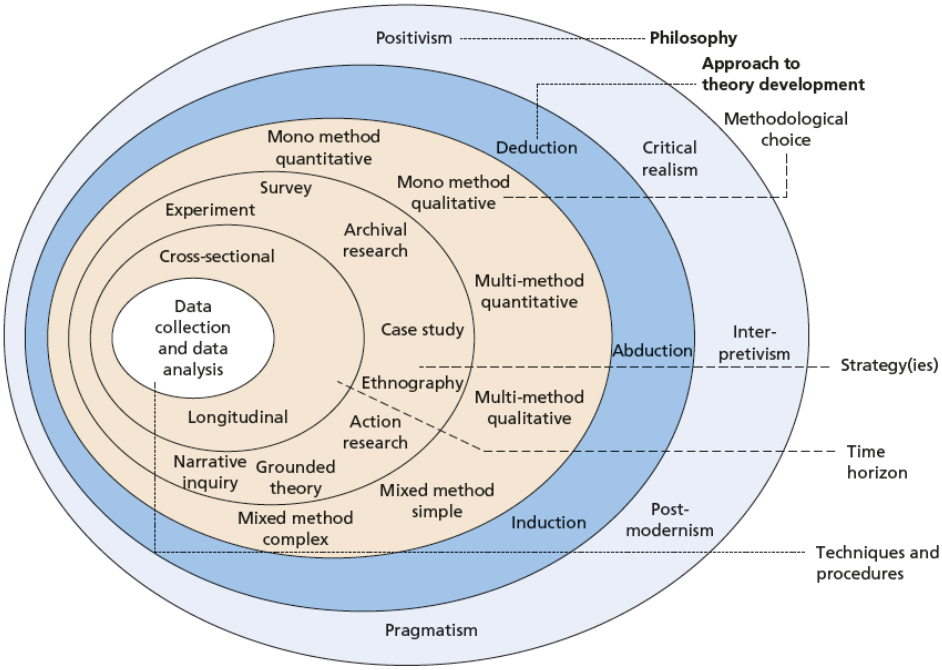


Figure 6 The research onion - Source: Saunders et al. 2016

8.1 Research philosophy

Research philosophy refers to the beliefs and assumptions that a researcher, consciously or not, makes through the process of research to develop the knowledge and nature of that knowledge in a particular field of study. These assumptions can be ontological, epistemological, and axiological which shape our understanding towards the research problem and selection of our research approaches, methodological choices, strategies and data collection and analysis techniques necessary for a credible and coherent research process (Saunders et al., 2016).

Ontology concerns assumptions about nature of reality, it defines how we see and study the objects in our research. The objects can be organizations, management, organizational events, and artefacts in the world of business and management. It represents the belief that researcher perceives about what constitutes a fact (Saunders et al., 2016; Žukauskas et al., 2018). Epistemology refers to what constitutes acceptable knowledge in each discipline. It concerns assumptions about the legitimacy, adequacy, and validity of knowledge and how such knowledge can be conveyed to others. The knowledge can be data in the form of text or number or pictures, facts, interpretations, stories, narratives etc., and can prove to be valid depending on the context in the field of business and management studies. It answers the question how we can know what we know (Saunders et al., 2016). For any researcher having an epistemological perspective helps solve issues related to research design and helps choose appropriate design for a given set of objectives (Easterby-Smith et al., 2015). Axiology concerns about what impact researcher's and research participants' value and ethics have on the research process and how we deal with them which in turn are responsible for the credibility of the research (Saunders et al., 2016).

There are five major research philosophies according to Saunders et al. (2016) namely: positivism, critical realism, interpretivism, postmodernism and pragmatism. Out of these five, this research follows as pragmatism school of philosophy because the significance of meaning of the research findings are its practical outcomes and successful actions. In pragmatism, the researcher begins with a problem and aims to obtain practical solutions that can help the future practice. This philosophy deals with facts. In the view of pragmatist, different methods, techniques, procedures, and types of knowledge can be adopted within one study that help enable successful actions (Saunders et al., 2016; Žukauskas et al., 2018). The purpose of development of this business model is to fulfill practical task of serving the SMEs across the Baltic Sea region to utilize or provide high performance computing and enhance their position in the growing market.

8.2 Research approach

Research approach helps make informed decisions about the design of research. It justifies the kind of evidence, which is gathered, from where it is gathered and how it is interpreted to solve the research question (Saunders et al., 2016). The research follows a practical study, the goal of which is to create a business model for a two-sided platform. The research approach chosen is abductive because it follows a pragmatist perspective (Mitchell, 2018). Abduction refers to:

"the logic used to construct descriptions and explanations that are grounded in the everyday activities of, as well as in the language and meanings used by, social actors" (Lewis-Beck et al., 2004, p. 1).

Abduction is a combination of both deduction and induction research approaches as the research swings between theory and empirical data (Dubois & Gadde, 2002). First, a deductive approach was taken to study previous theories on business model and multi-sided platform as the beginning point. The research proceeds towards collection of empirical data. It then follows an inductive approach in the research as collected data is used to extend theory based on the findings obtained. A topic that has extensive literature in one context but less in the context of interest of researcher promotes adopting abductive approach that enables research to develop or modify an existing theory to suit the practical needs. The advantage with abductive reasoning is that known premises are utilized to develop verifiable conclusions (Saunders et al., 2016).

8.3 Research design

The research design is comprised of three layers of the research onion namely methodological choice, research strategy and selection of time horizon for the research. Appropriate selections in these layers will help yield coherence in the research design. Among the methodological choice of quantitative, qualitative, or mixed method research designs, this research follows a mono-method qualitative research design. One reason to use qualitative study is because it falls in line with pragmatist research philosophy and abductive approach. Qualitative research design aims at studying participants' meanings and their relationships with the help of different data collection and analysis procedures, either to contribute theoretically or in developing conceptual framework which in this research work is the development of Osterwalder and Pigneur's (2010) business model framework for a two-sided network connecting HPC service providers and SMEs. Also, the research follows an exploratory study as it leans towards gaining understanding of business model concept and multi-sided business pattern as a phenomenon and to develop framework (Saunders et al., 2016).

The research strategy chosen for this research work is case study. A case study is an intensive, in-depth, and detailed inquiry into a topic or phenomenon within its real-life context. It is an empirical method of research that answers 'how' and 'why' form of research (Yin, 2003). Case study refers to "a research strategy which focuses on understanding the dynamics present within single settings" (Eisenhardt, 1989, p. 534). It can be used to accomplish different objectives: to provide description, to test theory or to generate theory (Eisenhardt, 1989). In a case study,

"case" can refer to a company, an organization, a person, a group, an association, an event, a project, a decision, and many other forms of case subjects that can be studied by one or more methods (Astalin, 2013; Saunders et al., 2016). Case study as a strategy tends to produce insights from in-depth research into a phenomenon in its real-life settings which yields rich, empirical descriptions and helps building theory. An in-depth inquiry is often designed to determine what is happening and how. Furthermore, it helps to understand the impact of situation and inference of the situation for action (Saunders et al., 2016). It is argued that the objective of the case study should be to consider cases for their uniqueness instead of just using them to focus on obtaining broad empirical and theoretical conclusions. Reaching general conclusions should be influenced by the inferences found cases rather than through cases being chosen to verify a hypothesis (Lewis-Beck et al., 2004).

Case study can be used for all three exploratory, descriptive, and explanatory studies (Yin, 2003). It can rely on mono-method or multi-method research design and uses different data collections methods such as archives, observations, interviews and focus groups, ethnography, questionnaires etc., to gain rich, detailed, and in-depth data. The resulting evidence may be qualitative, quantitative or both (Eisenhardt, 1989; Saunders et al., 2016). According to Yin (2003), case studies can be distinguished between single case and multiple case. A single case usually represents a critical case, a typical/representative case, a revelatory case or otherwise an extreme/unique case. Single case enables to observe and analyze a phenomenon that has little prior consideration. A case study can also incorporate more than one case wherein the rationale for considering multiple cases lies in whether findings can be replicated across cases. The choice of single or multiple case depends on the nature of the research question and its goal (Saunders et al., 2016; Yin, 2003).

Case study as a qualitative research method best suits the objective of this research i.e., to develop business model framework to be used for the case project. A single case-based study approach is chosen as the focus is based on contemporary phenomenon in a practical context that calls for an in-depth understanding. Another reason to choose case study is because the phenomenon that this case is addressing is unique as the search for articles concerned with discussing business model for a two-sided market for provision and utilization of high-performance computing is lacking. The research object selected shows practical interest from participants in the case project towards developing a business model for the network connecting two groups of participants.

Another layer in research design is the time horizon. The studies can be cross-sectional which is also referred as 'snapshot' time horizon, involves study of a particular phenomenon at a particular time. Such a study accounts for time constraint. They can adopt quantitative methods such as surveys or qualitative methods such as case studies or mixed methods as research strategy. On the other hand, longitudinal studies cover a longer span of time than cross-sectional studies. They are used to study change and development over a given period (Saunders et al., 2016). However, for the scope of this research work a cross-sectional study over a short period was adopted.

8.4 BalticLSC project case

One of the most challenging tasks in various engineering innovation and research activities involve processing of large amounts of data using sophisticated computation algorithms. Computations like this take up huge resources (processing time and power) and necessitate highly efficient supercomputing systems - Large Scale Computing (LSC) environments. However, such environments are mostly available to big global companies and large research institutions that can afford building them. Moreover, use of supercomputing equipment is restricted to personnel proficient in configuring computing hardware and developing software. Such a situation poses a considerable problem in the Baltic Sea Region (BSR), where more and more SMEs (including start-ups) and other institutions work on innovative services and products that require computations on large scale. Specifically, this includes such domains as ship design, marine engineering, biotechnology, spatial planning, weather forecasting and other. Unfortunately, smaller companies and institutions generally suffer from lack of proper access to supercomputing resources and lack necessary expertise to use them (Interreg Baltic Sea Region, 2018).

This project aims at development of universal and practical solution namely BalticLSC (supercomputing) environment that strives to significantly increase capacities to create new innovative data and computation intense products and services to be utilized by a vast array of small actors across the Baltic Sea region. The solution will involve development of business models, hardware configurations, software tools, end-user requirements, technical designs, and practical application recommendations. To meet the project goals the consortium is composed of partners with competencies in one of the three areas namely, technology, business development and SME outreach but also spanning the other two, thus giving good synergy within the consortium. The summary of the partnership is described below:

1. The BalticLSC system will be developed jointly by 3 partners with the coordination of the Warsaw University of Technology. WUT is the largest technical university in Poland. It will provide high expertise in designing LSC systems and in creating software tools and software languages. Development of the hardware and operating software platform will be led by RISE SICS North AB (SICS). It is a Swedish research institute focusing on datacenter research and cooperating with SMEs using a large datacenter of their own. Development of the computation software will be led by IMCS University of Latvia (IMCS). It has significant experience and expertise in research associated with software modelling and development of domain-specific software languages and tools.
2. Development of business models for the BalticLSC system, communication, exploitation, and various other business development activities planned in the project will be handled by 3 business development partners. This part will be coordinated by EurA AG who is well experienced in managing technology driven innovations, developing sustainable business models for its customers and in providing cross sectoral technology transfer to SMEs and research institutions. EurA will gain significant support from the Lithuanian Innovation Center (LIC) and the Corporate Business Department of the Municipality of Vejle (Vejle). LIC is a public consultancy organization with a mission of advising establishments interested in innovation-related issues. Annually, it has over 1300 clients, mostly SMEs, R&D labs, and clusters. CBD is a unit within the Municipality of Vejle that works with numerous innovative SMEs in developing their business models and supporting them in activities that involve Big Data and LSC.
3. Gathering of requirements and reaching out to innovative SMEs will be the main role of science parks. These activities will be coordinated by the Machine Technology Center Turku (MTC) which is a non-profit company whose goal is to support local companies in accessing labor and technology development. They will be significantly supported by Tartu Science Park (TSP) which is also a non-profit, non-commercial technology development and business support center. Both science parks host and cooperate with many innovative SMEs (start-ups) which assures high relevance and impact (Interreg Baltic Sea Region, 2018).

The scope of this work package is limited to the development of business model for a multi-sided platform that engages users on two sides of the BalticLSC environment. One side of the environment comprises of large-scale computing service providers which can be large LSC

centers or even small startups and SMEs who want to take up the BalticLSC specifications and create their own local LSC centers. The other side comprises of small innovation and design centers, SMEs and research institutions who wants to utilize the BalticLSC environment to develop and test their own applications or carry out complex calculations with ease thereby creating innovative engineering products and reducing time-to-market.

8.5 Data collection

Data collection constitutes the central part of the research onion. Data can be distinguished between primary and secondary data. Secondary data refers to the data that the research analyses which was collected earlier by other research form some purpose and thereafter processed and subsequently stored (Saunders et al., 2016). For this research work, secondary data was collected from a wide range of literature addressing the key concepts. The literature review contained peer-reviewed journal articles from ResearchGate, Springer, Google Scholar, Elsevier and ScienceDirect online research databases. Furthermore, articles from renowned publications such as Harvard Business Review, John Wiley & Sons, Inc., SAGE etc., and reports from European Commission were included in the study. Articles were chosen to study the core concepts and the recent advancements in the respective fields.

Primary data refers to data collected by the researcher for the purpose of the study. The primary data collection technique used for this empirical case-study to obtain a comprehensive view of the research subject is a mono-qualitative method namely focus group. A focus group is a research interviewing process that is designed to gain insights from a small group of subjects or participants. It is distinctive which means questions are sequenced in a way as to bring the focus of the participant discussion towards the topic of interest to the researcher. Focus groups essentially involve participants who discuss a predetermined topic within a permissive and non-threatening ambience. The interview is guided by an interviewer or moderator who holds the responsibility of guiding the discussion and asking the questions (Lewis-Beck et al., 2004). As focus group follows a qualitative research design and exploratory nature, data collection is non-standardized which means during a research process, questions and procedures may undergo alteration either naturally or depending on the interactions (Saunders et al., 2016).

Focus groups interviews are associated with many advantages over individual interviews for extracting deeper insights into the ideas of the participating group members. The roots of focus group interviews lie in group therapy whose concept is based on the therapeutic assumption that people who share a common problem will more willingly discuss it amongst the presence

of others with the same problem thereby generating more ideas than if they were to be interviewed on an individual basis (Lederman, 1990). Focus group interactions enable participants to question, respond, criticize, or construct on each other's views and to re-evaluate and reconsider their own ideas (Gibbs, 1997).

According to (Gibbs, 1997), the role of moderator or group facilitator becomes very important. The author lists the key functions of the moderator:

- to describe and clearly explain the purpose of the focus group and help them feel at ease
- to enable interaction between the participants and not influence participants towards personal opinions
- to make the participants stay in the scope of the research problem
- to ask open questions and promote debate, challenge participants to obtain diverse range of ideas on the topic and probe for details
- to make sure every participant gets a chance to contribute.

Focus group interview can be semi-structured or unstructured (in-depth) which are both non-standardized qualitative research interviews. However, for this research work semi-structured interview was chosen to collect the data. Such an interview entails a list of themes and some key questions to be covered. In an exploratory study, semi-structured interviews help obtain crucial background or contextual material for the study. These interviews are likely to be advantageous where a greater number of questions need to be answered, where questions are either complex or open-ended and where variation is needed in the order and logic of asking questions to the participants (Saunders et al., 2016). In order to collect the data needed for the development of the business model, Osterwalder and Pigneur (2010)'s business model canvas framework was used as reference in the focus group interview. This was done to ensure that data remained in the context of business model development for the case project thus eliciting valid results. Focus group interview was carried out with the help of steps given in Gray (2017) as shown in the figure below.

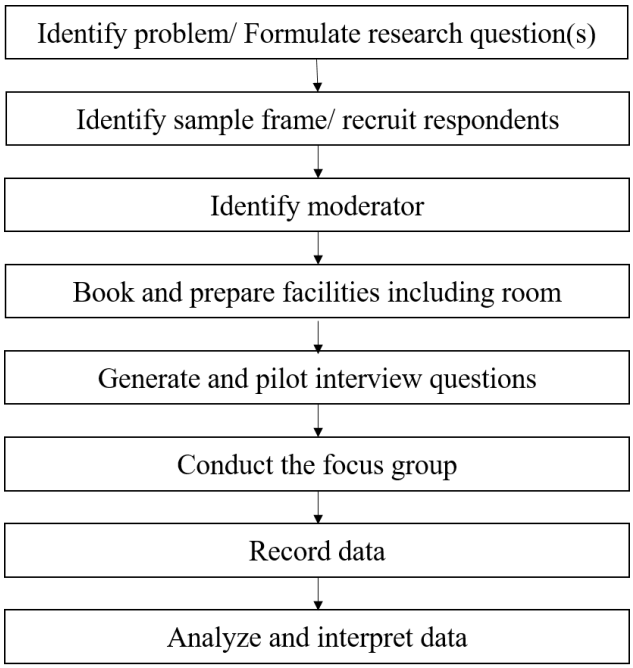


Figure 7 - Steps to design and conduct a focus group. Source: Gray, 2017

Focus group interview for the BalticLSC case project took place during fall 2019 at the Electrical engineering building on the central campus of Warsaw University of Technology (Politechnika Warszawska), Warsaw, Poland. The research question was how to develop an efficient business model for the BalticLSC platform connecting large-scale computing providers and users across the Baltic Sea region. The list of participants who took part in the focus group can be seen in the table below. The list includes participants from the partner organizations across the Baltic Sea region who are a part of the BalticLSC project. A non-probability purposive sampling was done which uses the judgement of the researcher to select participants that will best answer the research questions and meet the objectives. In that it followed a heterogenous sampling where participants from diverse backgrounds were chosen to obtain maximum variation in the data collected (Saunders et al., 2016). The participants were selected from partner organizations with different competencies. It included participants from technology partners, business development partners and SME outreach partners.

Participant position	Partner organization	Country	Competence
Project Coordinator	Warsaw University of Technology, WUT	Poland	Technology development

Development Manager	Warsaw University of Technology, WUT	Poland	Technology development
Coordinator Assistant	Warsaw University of Technology, WUT	Poland	Technology development
Project Steering Committee Member	RISE Research Institutes of Sweden AG, RISE	Sweden	Technology development
Team member	Institute of Mathematics and Computer Science, University of Latvia, IMCS	Latvia	Technology development
Project Steering Committee Member	EurA AG	Germany	Business development
Team leader	Municipality of Vejle	Denmark	Business development
Team Leader	Lithuanian Innovation Center, LIC	Lithuania	Business development
Project Steering Committee Member	Machine Technology Center, Turku Ltd., MTC	Finland	SME outreach
Team Leader	Tartu Science Park Foundation, TSP	Estonia	SME outreach

Table 4 Participant's list for the focus group

At first, the participants were informed about the purpose of the focus group. They were given a brief introduction on business model and the importance of business model for any organization. They were also informed about what a business model is not. The idea was to develop a common understanding of the business model following which the participants were familiarized with Osterwalder and Pigneur's (2010) business model canvas framework as a conceptual tool to describe, analyze and design business model. Each element in the business model canvas was explained to the participants. A few of them already had prior experience of working with the business model canvas. As the BalticLSC project addresses two major group of actors, the participants were given insights on multi-sided platform pattern of business model. They were familiarized different concepts associated with multi-sided platforms such as chicken-and-egg problem, network effects, pricing, openness, and governance of platforms.

Each of the nine business model elements were considered as key themes for the focus group. With the help of findings from the literature review and adhering to the context of the research, a focus group guide (appendix 1) was created. The guide consists of initial set of questions and probes which might be used to obtain further details after the initial responses (Saunders et al., 2016). It is the protocol for the interview that consists of a series of questions which are chosen to extract all the required information to address the research issue (Lederman, 1990).

Osterwalder and Pigneur (2010)'s business model elements were used as background to develop the interview guide for the focus group. The guide questions were followed with certain ad-hoc questions whenever necessary. The discussion followed the theme of the focus group guide. The participants were given the space and opportunity to raise and discuss their suggestions. It was ensured that all the topics were covered during the focus group. Being part of the case project helped me to achieve preliminary understanding of the project and develop relevant interview guide for the focus group.

The objective of the focus group was to collaboratively trigger ideas to develop a comprehensive business model. The data from the group discussions and interactions between the participants were carefully observed and recorded with the help of taking field notes. Every idea from a participant went through a thorough discussion based on each key theme and the impact each decision had on the other elements of the business model was also considered. In order to record the notes from the focus group, a large business model canvas poster was used. On the canvas all the notes were made using sticky papers. Sticky papers worked like idea containers which could be easily added, removed, and shifted between different blocks of the canvas. It is crucial because during discussions of business model participants do not quickly agree on which ideas should appear on canvas and where they should be placed on the canvas. Detailed transcriptions for everything that was discussed was not done because that approach is impractical for the purpose of focus groups involving many participants. After each theme was covered and the results were noted down, the entire business model was discussed with participants and necessary corrections were made.

8.6 Data analysis and validation

In a focus group, data collection and data analysis are concurrent (Rabiee, 2004). The analytic process was based on the data derived from the field notes. The advantage associated with note-based analysis is the speed. The analysis followed a preplanned systematic coding as the research was grounded in existing theory as a base. It is predeveloped thematic coding scheme

to be used to collect and analyze the empirical data (Eriksson & Kovalainen, 2008). As the research followed an abductive approach, the theoretical concept of business model and its elements from the prior research were used as sensitizing concepts to describe and analyze the empirical data. During the data collection and analysis, all the recurring ideas were put into their specific themes. This made the data analysis procedure easy. After careful analysis the empirical data from the focus group was categorized according to the Osterwalder and Pigneur's (2010) business model framework in an excel spreadsheet and grouped into the 9 elements of the business model canvas.

In order to achieve participant or member validation, the data gathered was sent back to participants to allow them to confirm its accuracy and participants were permitted to provide feedback or comment on the validity of the data (Saunders et al., 2016). To do this, all the data collected on the business model canvas poster was analyzed and digitally recorded with the help of Strategyzer. Strategyzer is a software that helps to sketch business ideas on business model canvas. It allowed the canvas to be shared virtually with other participants. After the validation from the participants, the research went on to present the empirical findings, discuss the results and develop the business model framework for the BalticLSC project.

9. Empirical findings

This chapter presents the results derived from the data collected in the empirical study the purpose of which was to find information that is needed to develop a business model using the theoretical framework of business model canvas. The data was collected and analyzed based on building blocks of the business model canvas as themes. Hence the results are presented accordingly under the respective themes i.e., the elements of the business model canvas namely value proposition, customer segments, channels, customer relationships, key resources, key activities, key partnerships, revenue streams and cost structure.

9.1 Value Proposition

Baltic Large-Scale Computing (BalticLSC) is an Interreg Baltic Sea region project dedicated to solving the issue of smaller companies and institutions suffering from the lack of proper access to super computing resources and necessary expertise to use them. The primary value proposition of BalticLSC platform is to offer services which can be used by small and medium scale enterprises and research institutions to build applications or conduct large scale computations via cloud which distinguishes it from other physical HPC centers. This is enabled by creation of marketplace involving service providers and SMEs and by providing efficient match making between them based on the requirements while acting as intermediary for protection of sensitive data. The BalticLSC marketplace will have a dedicated knowledge or competence center, LSC application and algorithm store customized for particular users and quick and easy solution development tools. On the platform the users can request for apps and algorithms based on their requirements hence, platform provides an organized space for users to co-create large scale computing applications. In order to make it simpler for the SMEs and for the ease of use, the platform strives towards eliminating programmers and instead have the process more automated. There will be manuals for both technical and non-technical partners and users involved in the network and also for potential future members. Some SMEs might lack necessary knowledge on the use of high-performance computing; hence the consortium will provide consulting services on using the platform and necessary training required for the full use of LSC services.

Another key value proposition is that any SME or research institution can take up BalticLSC specifications and create their own local LSC center. By this the SMEs and research institutions can put their unused computation resources to function. The service provider is given the

flexibility to turn on and off the hardware as they wish or choose the capacity to be offered at any given time. Thus, by helping create local LSC centers as service providers and by offering LSC services in a simple and affordable way even to the remote SMEs or research institutions across the Baltic Sea region, the BalticLSC platform aims to create a large-scale computing network. This way, the platform will help reduce time-to-market of innovative engineering products through easy access to LSC resources that were previously not accessible and were too difficult to use. Renumeration will be dependent on a variety of factors, such as computing power available, time available, time in use, etc.

9.2 Customer Segments

There are two main customer segments that the BalticLSC project wants to address namely LSC end users and LSC providers. Firstly, the customer segment that the BalticLSC network is aiming to reach are mainly SMEs across the Baltic Sea region who are potential LSC users. The actors can be engineering firms, manufacturing enterprises, medical companies, software companies etc. These small design and innovation centers including start-ups will be able to develop their own computing applications and carry out complex calculations with the help of emerging BalticLSC platform.

Another segment of customer includes the centers that are already providing large-scale computing services could be private or public computation centers, research institutions, cloud providers, HPC consortiums etc. They will play an efficient role in the network as they already have state of the art computing resources, related technical know-how and training programs associated with the use of large-scale computing. These centers will provide the computational power needed to carry out computations.

Even small actors like SMEs also come under this segment by emerging as service providers. Not only will they benefit from the use of high-performance computing resulting in designing of highly innovative products through LSC resources which were previously not accessible or were difficult to use, the small actors can themselves emerge as LSC service providers. They will be able to take up the BalticLSC specifications and create their own local LSC centers with their unused computation resources. Moreover, several such local centers will be able to network and combine their computing capacities, distributed trans-nationally.

9.3 Channels

Channels play a very important role in raising awareness among the SMEs and service providers across Baltic Sea region about the BalticLSC platform. They help customers to evaluate the value proposition offered by the platform. Channels also indicate the means for the customers to purchase the BalticLSC services and for the platform to deliver them. They also help to provide support to members as long as they are part of the BalticLSC network.

For the promotional activities various channels such as social media including Facebook, twitter, LinkedIn will be used. Dedicated pages have been set up and regular updates with regards to development of project are posted. Many workshops, summits and conferences will be regularly conducted not only to raise awareness about the network but also to obtain feedback during the development of network concerning the BalticLSC environment. During these meetings, a regular evaluation of the value proposition is conducted to constantly improve the value delivered. The BalticLSC network has dedicated website that has every information related to the project including news, work packages, surveys, partnerships, contact details, upcoming programs, privacy policy etc.

Majority of the SMEs will be reached through partner channels and CRM tools, innovation consulting agencies, cluster organizations etc., as they have own database of large number of SMEs and research institutions. The BalticLSC network will have a dedicated public marketplace i.e., the platform for the service providers to offer services and for the small actors to avail the services offered. It will be the point of contact for both these customer segments (end-users & service providers). Through marketplace website, the members can offer and avail services securely without any hassle. The post-purchase customer support will be provided through the BalticLSC marketplace via automated services, emails, and call center assistance. The network could also offer a forum or community for all the members to have interactions with other members, post issues or questions and get appropriate solutions for the same. This would also help the new members joining the network to learn about previous developments and find solutions to their issues.

9.4 Customer Relationships

Customer relationships are crucial for customer acquisition, customer retention and for boosting the growth of the network. Through the BalticLSC marketplace, services will be automated for both LSC users and providers for convenient availing and offering of services respectively with

reduced time and complications. The platform providers in their role as facilitators could be further assigned to take care of the community/forum developed for the network.

Customers will be constantly informed about the latest updates through newsletters and media. All the offering of the networks may be regularly evaluated through reviews/ ratings and feedback. Feedbacks will be extended to the service providers and small and medium scale enterprises and research institutions helping them to adhere to the standards of the community.

In addition to above mentioned points, the members will be provided with personal and professional assistance when required throughout the duration of their association. This can be ranging from the procedure to avail LSC services to use of LSC services to fix any issues encountered during the use of LSC services. The network has training programs tailored specifically for SMEs related to high-performance computing technologies. Even the LSC service providers will be provided with necessary assistance.

For SMEs or research institutions, who wish to run calculations or application on the BalticLSC marketplace but have confidential data, in order to enable the exchange and safety of data or information, Non-Disclosure Agreements are decided upon. Service Level Agreements/ contracts might be made to fulfill the objectives such as co-operation between two parties, documentation of roles of both parties, ensure good quality service and to define details about the level of services offered and expected. It is necessary to include in the SLA contents such as representatives' details, end user responsibilities, service provider responsibilities, scope of service, quality of service, downtime and credits and review procedures.

9.5 Key Activities

These are activities necessary for efficient operation of the BalticLSC project. They are very essential to create and offer the BalticLSC services, reach service providers and SMEs, maintain relationship among the members of the network and to earn revenues. The major key activities involved in the project are as follows:

- Development and maintenance of a platform/ marketplace for LSC providers to offer services and for small actors across Baltic Sea region to avail large-scale computing services through developed applications on the platform to carry out complex computations necessary for the development of their products and solutions. Another key activity is to enable efficient match making between the two sides of the customers segments, namely the end user and the resource providers.

- Development of community or forum that can make a space for members of the network to interact, write and address issues associated with the use of LSC.
- Competence center facilitation that will provide the knowledge transfer as and when required throughout the project duration and beyond. Through benchmarking and always scouting for new services a key activity will consist in suggesting / developing new solutions for the end-users and bringing them into contact to those service providers offering those services.
- Accounting to manage all the computation capacities, availability and handling of financial data including billing.
- Development of applications on the platform to handle the data and computations and to improve the computation performance.
- Management of the developers for their efficient operation in creation of applications tailored to the needs of SMEs and research institutions.
- Marketing and local promotional activities to involve more SMEs and service providers in the network and informing them about the perks of BalticLSC network.
- Computation power supplier validation and membership management of both providers and users.
- Verifying applications that are developed by users of the platform and to monitor and perform quality assurance.
- To obtain feedback regarding services, applications, service providers and customers availing LSC services.
- Customer support throughout the duration of availing services by offering automated services and providing personal assistance when necessary.

9.6 Key Resources

Key resources are important to create and offer the value proposition, to reach and maintain relationship with the customers and to earn revenues. Key resources can be physical, financial, intellectual, or human. In the BalticLSC project, the essential key resources identified during the focus groups are as follows:

- Platform: Platform is the key resource where service providers of the network can offer their computation power capabilities and SMEs and research institutions can make use

of that power to run their computations and perform complex calculations. The platform will be an online marketplace that has a dedicated application store where customer can select any application to perform computation that caters their needs.

- Application and Community developers and managers: Developers to cater the needs of the SMEs and research institutions by means of developing applications and solutions are one of the key resources. Developers are also needed in order to develop an easy to access, simple to use community for the BalticLSC network. Managers are needed to timely assess both the applications and community.
- Accountant: Since offering and availing services in BalticLSC network will involve cash flow, an accountant will be very important to keep track of all the financials.
- Marketing and digital communication / salesperson for every country: Marketing plays a very important role as not many small actors are aware of the large-scale computing and do not realize benefits associated with it. Since the BalticLSC network will involve customers from across the Baltic Sea region, it becomes very crucial to have dedicated marketing and digital salesperson for every country having their own language, culture, and way to reach out to customers.
- Legal issue agreement/ Legal services: As network involve members across Baltic Sea region there might be cross border policies, cross border payments etc. Hence personnel handling legal services in each country will be an essential key resource.
- Intellectual property rights for system applications.
- Hardware and Software architecture: This includes all the computing and networking hardware, operating system software, computing languages that are used to develop the platform. This is limited only to the consortium involving the partner organization as they are responsible for creating the initial network for BalticLSC environment.
- The financial resources for the development and running of BalticLSC will be funded by the European Regional Development Fund.
- Manuals for both technical and non-technical partners and users involved in the network
- Business Developers for further expanding the outreach, even beyond the geographical limits of BSR with a responsibility also to scout for new services relevant to the customers that could / should be incorporated.

9.7 Key Partnerships

Partnerships are important to optimize the business model, acquire resources and activities and reduce risks and uncertainties. To meet the project goals, competences in 3 areas are combined: technology, business development and SME outreach. The consortium is composed of carefully selected partners with competences dominating in one of the areas but also spanning the other two, thus giving good synergy within the consortium. The consortium will be supported by several associated partners such as Government bodies, local authorities, and municipality. These bodies will use the project results in their statutory activities to enhance positive impact of the project on SME innovation around the BSR. Also, some of them (research institutions) will support certain technology-related activities.

The network is also looking forward to having partnerships with cloud providers, consulting centers, cluster organizations and alliances, private companies, science, and technological parks to promote and provide the large-scale computing services to small and medium enterprises and research institutions. For use cases and feedback, the consortium will collaborate with SMEs, universities, and research institutions to constantly create, develop, deliver, and evaluate new applications. The BalticLSC network also has partnerships with universities for incorporating developers and trained personnel into the network.

Some of the other key partnerships will be to look forward to including investors, banks, and venture capital firms. This is for the functioning of the network through the duration of project and beyond. Payment partners also play an important role to make transactions on the platform. In order to have effective public relations, it is necessary to reach out to them and inform them about the objective of the BalticLSC project, here the business media partners will come into play.

9.8 Revenue Streams

For the network to keep running after the project duration, it becomes very essential to have revenue mechanisms that can take care of the expenses involved in delivering the services be it promotional activities, LSC architecture management of the consortium, development, and maintenance costs of the platform etc. Some of the important revenue streams identified during focus groups are mentioned below:

- The major source of revenue comes from users of computational power. Usage fees are charged for making use of BalticLSC platform. LSC users will be charged on a pay-per-usage basis.
- By charging for the provision of consulting services to SMEs and research institutions. However, the pilot SMEs who join the BalticLSC network during its development phase shall not be charged.
- Match making brokerage fee for matching SMEs to service providers who offered solution to their computational needs. This will be charged to the service providers. A percentage of their charges for computation power will be taken as commission after the computation is successfully completed. As far as the app developers' group is concerned, the commission will be applicable on the app or module sale.
- LSC service providers will have to pay a membership fee to join the network to cater to a large base of LSC users. However, the pilot service providers who join the BalticLSC network during its development phase shall not be charged.

9.9 Cost Structure

This describes the most important costs that might incur during the operation of BalticLSC network. Creating and delivering value to the BalticLSC customers, maintaining relationships with them, and generating revenue all incur costs. This is divided into two types of cost. Costs concerned with the initial network of BalticLSC centers created by the members of the consortium are mentioned below:

- Costs associated with assets such as hardware, software, and servers for the provision of computing power and their maintenance
- Server costs, rack costs, cooling costs, and electrical power costs
- Human resource salaries and financial incentives

The below costs are concerned with the BalticLSC platform:

- Platform development and management costs
- Costs associated with development of applications and forum/community
- Forum moderator costs and help desk costs
- Consulting costs incurred while involving external consultants when needed
- Sales, promotion, and marketing costs

9.10 Creation of business model

The final business model is created with theoretical background as reference to complete each building block of the business model canvas. The business model consists of both quantitative and qualitative data collected during the data analysis and some additional data from the research diary. A pragmatic approach was followed throughout to translate the collective data into the business model. The final business model developed for the BalticLSC platform to create a large-scale computing network consisting of small actors such as SMEs, startups, research institutions and LSC service providers is represented through business model canvas framework in the tables below.

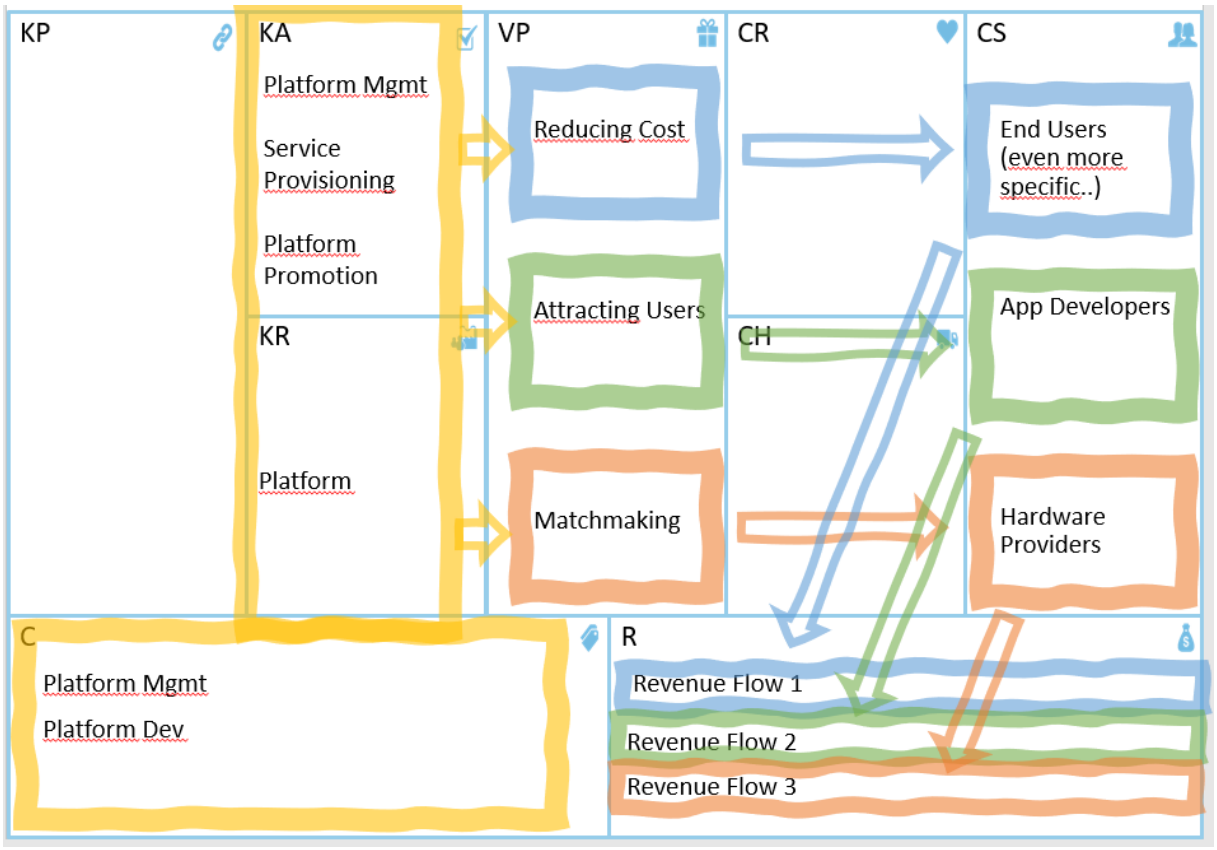


Figure 8 Business Model - Flows

<table>
<tr>
<td rowspan="2">Key Partners
Baltic LSC Partners
Banks/ Investors/ Venture capital firms
Payment partners
Business Media and PR connections
HPC Cluster Organizations and Alliances
Cloud providers and consulting centers
Govt. Bodies, Local Authorities and Municipality
Universities and Research Institutions
Science and technological parks
Regional business and public parks
Pilot SMEs for use cases and feedback</td>
<td>Key Activities
Platform development and management
Community/forum development
Competence center facilitation
Accounting
App development and management
Hosting and administering servers
Marketing and promotions
Supplier validation
Verifying apps and QA monitoring
Billing and customer support</td>
<td rowspan="2">Value Proposition
LSC marketplace to offer and use computation power
Utilization of unused computing resources
Local LSC centers
Matchmaking
Intermediary for sensitive data
Community creation, knowledge and competence center
Application store
LSC consulting (tools and full use)
Quick solution development tools
Manuals for partners and users
Organized space to co-create applications
Reduced computation time and cost
Reduced time to market
Supplier flexibility to offer resources
Training</td>
<td>Customer Relationships
Buyer-seller automated service
Community/ forum
Helpdesk
Media and Newsletters
Personal and professional assistance
Reviews, rating and feedback mechanism
SLA & NDA contracts</td>
<td rowspan="2">Customer Segments
Customer base:
Small actors such as SMEs and startups, research institutions
Company type:
Engineering firms, Manufacturing enterprises, Medical and Life science firms, software companies, app developers, innovators etc.
Customer base:
Large scale computation power providers and small actors as providers
Company type:
Private computation centers, public computation centers, cloud providers, HPC clusters and consortiums, research institution, universities etc.
Location:
Across Baltic sea region</td>
</tr>
<tr>
<td>Key Resources
BalticLSC platform
Hardware and software architecture, manuals
App and community developers and managers
Accountant
Marketing and digital salesperson
Law personnel
IP rights
Funds from ERDF</td>
<td>Channels
BalticLSC platform/ marketplace
BalticLSC website
Social media, partner channels and CRM tools
Innovation agencies, cluster organizations and universities
Summits, workshops and conferences
Automated and telephone services</td>
</tr>
<tr>
<td colspan="3">Cost Structure
Hardware, software and server costs (maintenance, rack costs, cooling costs, electricity)
Human resource salaries and financial incentives
Platform, apps and forum development and management
Operational costs (Forum, helpdesk), sales & marketing
Consulting costs for external consultants</td>
<td colspan="3">Revenues
Pay-per-use (usage-based charging)
Consulting fees
Matchmaking brokerage fee
Membership fee</td>
</tr>
</table>

Table 5 Final Business Model

10. Business Development

One of the crucial aspects ensuring the success of the BalticLSC and of its sustainable existence after the end of the project is associated with the attraction of end-users, developers, and hardware providers. The problem that was described on Chapter 2 as the "Chicken-and-egg problem" is about finding the correct balance on attracting those 3 stakeholder groups. A necessary, but not sufficient, condition for platform success is to reach a critical mass of users (Evans and Schmalensee, 2010).

In that aspect main focus should be given on attracting a minimum number of hardware providers and app developers (subsidy side – see next chapter). Once a good basis of offerings is in place, it will be more attractive for end-users to switch, and start using our services. In order to promote the services to the end-users a standard funnelling and qualification sales process is suggested.

10.1 Funnelling Process

Focus of the project is on SMEs. As thus a selection process based on the sales funneling technique is suggested in order to identify and select the best-in-class end-users, thus guarantying a successful implementation of the platform. The traditional B2B sales or acquisition process is defined by five steps. These are:

Stage in the Funnel	Actions
Prospecting	Lead generation: Finding potential customers Lead qualification: Evaluating prospects' propensity to buy
Approach	Lead Nurturing: Acquiring more information about leads and making contact Identifying Needs
Presentation	Communicating the problem-solving characteristics of the offering (e.g., prototype, use cases, simulation)
Overcoming objections & Close	Negotiating sale and overcoming objections

Follow-up	Fulfilling the current order Follow up beyond the current order Upsell, cross-sell

In our analysis the following 3 factors have been determined that influence the potential and the willingness to use a large-scale computer platform.

- Sector

- Specific sectors appear to have higher demand in Large Scale Computing Systems. Such sectors include the following: Life Science, Energy, Engineering Services and Financial Services.
- In the field of life sciences, including pharmaceutical, biotechnologies and healthcare industries, big data technologies can be used to create a molecular chemistry model to help diagnose and treat patients. Also, it can be used for clinical data mining to find new medical breakthroughs or identifying genetic patterns, knowledge of which allows preventing certain DNR disorders from developing.
- In high-stakes energy industry companies use LSC technologies to analyze data from seismic surveys, create geological models and simulate drilling. It means that today new oil and gas deposits findings require data-driven decisions where to drill, how to drill, and what to expect.
- Financial service industry is yet another example of the successful usage of big data. The industry faces new regulations, cybersecurity risks, and tons of electronic payments every day. Therefore, financial service companies use LSC technologies to model economic equations, complete financial transactions in milliseconds and react quickly to market changes.
-

- Locality

- Unexperienced end-users may not be aware of the potential a large-scale computing system might have on their business. As such getting access to information and to consulting might be a crucial factor for onboarding them.

- Furthermore, specific hardware providers offer special terms and conditions for the usage of their hardware from local end-users. Thus, locality might become a crucial factor for even lower prices and access to additional services.
-

- TRL Level

- The "Technology Readiness Level" (TRL) is originally a term coined in aerospace technology. It was used there to describe the degree of development of a technical product. For Horizon 2020, the TRL definition was adapted in the annex to the work program. It ranges on the scale from TRL 1 to TRL 9.
    - TRL 1 - Basic principles observed
    - TRL 2 - Technology concept formulated
    - TRL 3 - Experimental proof of the concept
    - TRL 4 - Technology verified in the laboratory
    - TRL 5 - Technology verified in relevant environment (for key technologies in industry-oriented environment)
    - TRL 6 - Technology tested in relevant environment (for key enabling technologies in industry-oriented environment)
    - TRL 7 - Test of a system prototype in real use
    - TRL 8 - System is complete and qualified
    - TRL 9 - System functions in operational environment (for key enabling technologies or space competitive manufacturing)
- It is expected that companies with a TRL level above 5 are a better fit for us. At TRL level 5 the companies are testing their innovation in a simulated environment. The use of a large scale computing platform is the ideal tool to simulate and test the innovation.

As such the lead generation process should prioritise the users belonging to the above groups.

In terms of lead identification, needs description etc. events (Physical & Online) as the main vehicle for Approach and Presentation. Personal contact and the word of mouth are the 2 most promising strategies in the early phase of the platform.

Negotiations and closing of a deal (end users join the platform) should be automatised as much as possible. By providing a clear pricing structure and a simple attractive user experience, it should be relatively easy for an end-user to register to the platform and start creating a first pilot run. An interesting idea is to subsidise the first pilot in terms of both hardware provision but

also app development. In that way the end-user will be in position to see the benefits and the ease of use of the platform. If needed consulting and assisting services can also be provided.

10.2 Pricing

In multi sided networks such as the BalticLSC, pricing is a complicated affair, that goes beyond the tradition willingness to pay approach. Multi sided platform providers have to choose a price for all different sides, factoring in the impact on the other side's growth and willingness to pay. Typically, multi-sided platforms have a "subsidy side," that is, a group of users who, when attracted in volume, are highly valued by the other group. The size of the subsidy side is crucial for developing strong network effects and thus for attracting the 2 other sides, namely the hardware providers and the developers.

Since each side's participation depends on the number of participants on the other side, charging both sides fees run the risk of market failure: the platform providers fail to get substantial adoption on either side, thereby making the platform unattractive to the corresponding other side. Several platform firms have chosen to kickstart network growth by providing heavy subsidies to one side, thereby drawing participation from that side and, in turn, making participation on the other side more attractive.

In the case of the BalticLSC we try to indirectly subsidize both parties:

- Hardware providers will have no entrance fees and will be in position to choose freely their pricing strategy.
- End users will pay reduced fees as the hardware providers will offer lower prices than the competition, as the resources they will put in the platform, mainly are resources not currently being used by them. E.g., a research institution with a large-scale computing system is not using that system 100% of the time. For the time it remains unused they will put it on the platform, and thus be in position to fully use, but also simultaneously offer lower prices.

From the one hand by using only the free and unused resources of the hardware providers, e.g., when their servers are not fulfilling other internal tasks. That has therefore that the pay per use rates would be lower than in the case of having resources reserved and on standby for the chance that a contract from an end user comes.

If we are to breakdown the different categories of pricing, we have the following categories:

- **Affiliation fees**. Affiliation fees are paid by the users to the platform manager, to join the platform.
- **Interaction fees**. Interaction fees are paid by the users to the platform manager whenever an interaction is carried out by the platform users.
- **Financial flows between sides**. A financial flow between sides may be present between users of two different sides and it is generally related to a transaction payment for the exchange of a product or a service.
- **Referral fees**. Referral fees represent economic flows that are given to a specific user of a side as a reward for its specific actions.

In the case of the BalticLSC Platform the pricing structure in this initial phase will be rather simplified. The end user will be paying an amount of money to the platform, anytime he is using a specific service. In that way the costs are transparent, and the end-users only pay for what they get. In the case of complicated calculations, the end users could be invited for a discounted pay-per-use option for an initial job, like for testing or experimenting with a module or a hardware provider. In that case the end-user minimizes the risk for overpaying for a job that may not bring the expected added value, whereas the developers and hardware providers do not need to block their resources for a longer period and risk the danger of not receiving a reimbursement. That amount will compromise of the following parameters:

- Modules used from the store, based on their price
- Hardware Providers based on a 'Pay per use' Service, where the end users are charged a fee according to the time and volume of a computing service that has been consumed.
- Overhead costs for the BalticLSC Platform, to cover for the operational costs.

At a later stage and then clients become familiar with the services discounts based on e.g., consumption could be integrated in the platform.

Furthermore, we strongly suggest the development of further services, such as consulting services and integrated service offerings. In that evolvement of the business model and the value proposition, will result in higher revenues generated by a multitude of sources. Acting as an intermediary offering consulting service, can act as an enabler to market growth, as particular SMEs still need the support of experts and a good understanding of the potential economic gains that can be delivered from the use of the BalticLSC services. Those services can include the following:

- Discount policies for pilots

- Discount policies for extended usage
- Discount policies based on time/day of usage
- Trial & buy mechanism
- Search for external public funding to help SMEs fund the usage of LSC services
- Contract models incl. NDA and SLA
- Incentives for industries, projects, or interests, in coordination with the hardware provides

10.3 LEGAL Aspects

The purpose of the WP2 Business Development has been on developing the general business model for the BalticLSC Platform. During our analysis we have identified several topics that need a legal consultation, that go beyond the scope.

The issues identified refer to the following topics:

- Marketaccess and other constraints for operating services
- Tax law / Form of the legal entity
- Data law (e.g., DGPR compliance)

10.4 Platform Governance

The analysis has identified two main aspects as crucial for the solid platform governance, namely managing platform control and managing platform competition.

Platform Control

Since an MSP enables the interactions between different users, control mechanisms should be set to prevent inappropriate behaviors and actions by the users that can damage the image and reputation of the platform.

The variables identified to describe the platform control are two-sided. Both the platform administration but also the platform end-users would need to be in position to provide feedback and control. In that aspect we can distinguish between:

1. Control mechanisms. The platform's methods are aimed at controlling users' behavior and actions, as well as the content given through the platform

2. Rating and review system. The availability of a rating and review system assists both users and platform managers in determining the greatest match for their needs. A Rating and Review

(R&R) system is available on various platforms and can be configured in a variety of ways. In general, the rating must be done unilaterally (from the demand side to the supply one)

Further to the above, and once the platform reaches a further stage of development, we suggest the implementation also of a 3rd pillar of control that would enhance the quality of the services and of the platform in general.

3. Exclusive agreements and contents. Exclusive agreements between the platform manager, service providers, and users enable platform owners to offer exclusive services or goods, motivating additional users to join the platform.

Platform Competition

We can distinguish among two types of competition that the platform manager needs to consider: External and Internal.

Internal competition refers to the competition among the hardware providers, and among the app developers. When resource providers have no competition, platforms have a strong motivation to attract as many resource providers and end users as feasible. When resource suppliers are in a lot of rivalry, some of them may prefer to switch to a smaller platform to avoid the competition, even if it means lower demand and revenue.

External competition refers to the competition with other platform providers. Key factors that need to be considered is the existence of some form of differentiation among platforms, the possibility for users to subscribe and use multiple platforms, and the possibility for platforms to inter-operate.

10.5 Platform Lifecycle

The value proposition may be subject to significant changes over time, particularly in the early stages of the platform lifecycle. Junic Kim and Jaewook Yoo define 4 stages in a lifecycle of a multi sided platform:

- **Entry stage**: Internal and external analysis for selecting the platform business. The entry stage describes the phase in which the platform is being created, the potential analyzed, and the main components developed. According to the literature on entrepreneurial orientation, the initial stage correlates to the inception stage in the development of an enterprise. This stage is distinguished by an emphasis on the product

technology required to achieve the core value proposition. The platform is in an Alpha or Beta stage, with websites and related technologies being tested.

The value proposition is generally known and articulated in the initial business plan from a business model standpoint, but the marketing strategy to execute this value proposition is still vague. The business plan's vocabulary outlines why business partners could be interested in the initiative, but it doesn't go into detail on how those key partners will be involved. Although the business plan outlines how the company wants to create income, it often reads more like a list of prospective revenue sources than a strategic revenue vision. The BalticLSC Platform is currently in this stage.

- **Growth stage**: Our analysis revealed that the value proposition in the early stages of development is mostly directed towards the end-consumers. Main goal of this stage is to solve the chicken-egg problem as described previously.

- **Expansion stage**: Way to reach critical mass for accelerating the network effect. Network effects occur when a two-sided market is constructed, and two groups are attracted to each other. Network effects facilitate the rapid growth of a platform company. Once a critical mass point has been reached then new services can be introduced that can enhance the overall profitability, such as promoted modules, promoted hardware providers, premium features etc.

- **Maturity stage**: Platform quality management and revenue structure construction measure for establishing the business ecosystem. A platform will fail if its participants do not continuously support it, even if it has already been established in the market. Thus, the maturity stage involves completing the business ecosystem by analyzing the quality management and revenue structure

As the BalticLSC platform matures and more end users as well as developers and hardware providers become part of it, it is expected that the value proposition and the focus shifts. As experience is gained and a specific profile of usage is gained then additional services need to offer, changing or shifting thus the lifecycle of the platform.

11. Discussion

As mentioned earlier, business models describe the design or architecture of how a firm can create value, deliver it to the customers and employ mechanisms to capture the value (Johnson et al., 2008; Kaplan, 2012; Teece, 2010). Hence this section discusses the business model developed for the BalticLSC platform in terms of value creation, delivery and capture thereby addressing the core of the business model.

11.1 Value Creation with BalticLSC Platform

This platform aims to perform two basic functions mentioned by Hagiu (2007) i.e., firstly to reduce the search costs for small actors in the Baltic sea region in finding the LSC service providers and secondly it reduces the shared costs between service providers and users by providing efficient matchmaking and facilitating easy transactions. Like other platforms, the BalticLSC platform helps customers to meet the needs or solve a particular problem and thereby addresses their experience. It does so by offering the users of platform with an appealing value proposition (Kaplan, 2012). To create such value proposition, the BalticLSC project offers a platform that enables small innovation and design centers across the Baltic Sea region to develop their own applications and perform complex computations at relatively lesser price and time thereby reducing their time-to-market and be innovative in the design of their products and services in the growing market competition. Hence the BalticLSC platform justifies the literature that platforms should address business problems for many users or firms by offering valuable proposition (Gawer & Cusumano, 2014).

The other value creation pattern observed in the BalticLSC project is in the case of service providers. In practice, platforms create a marketplace where complementors offer their products or services and the end-users avail those products or services (Hagiu & Wright, 2014). In the case of BalticLSC platform, the complementors namely the LSC service providers offer their computation power capabilities through the platform and users can utilize that computational power to carry their computation through the app store of the platform. Even smaller actors can utilize this business opportunity by creating their own local LSC centers by taking up BalticLSC specifications.

The BalticLSC platform will allow service providers to charge end-users for using their computational power. This way the platform is creating value to the complementors through offering them business opportunities. The complementors will value a large base of end-users

that can be achieved through the platform complementing to the indirect network effects. Platform also creates value to the partners of the platform by offering them the opportunity to grow with the platform and upscale their businesses. At the same time, the platform will complement the partners' own products or technologies.

Like any other multi-sided platform, BalticLSC platform also possesses network effects. Small innovation and design centers need large-scale computation power. They want to stay relevant in the ever-growing market amongst the competition. But they lack necessary knowledge on the use of and benefits associated with large-scale computing and at the same time find it expensive too. On the other hand, many LSC service providers lack customers who can make use of their computation power and their resources remain unused. Both sides need each other. This corresponds to indirect network effects (Hagiu & Wright, 2015). Indirect network effects are associated with chicken-and-egg problem (Caillaud & Jullien, 2003) i.e., without the presence of one side, the other side will not join. As a result, platform should find ways to get both sides on board. To solve this initial chicken-and-egg problem, pricing plays a very important role. Pricing structure should ensure the ability to capture the indirect network effects. However, considering the sensitivity towards price and quality, it would be beneficial for the platform to place end-users on the subsidy side whereas LSC service providers on the money side (Eisenmann et al., 2006).

Value delivery with BalticLSC platform

After the creation of value, the business model should consider how customers can gain advantage of this value and how the platform delivers this value to the customers (Kaplan, 2012). To successfully deliver value to customers on repetitive basis and on an increased scale requires firm to incorporate certain managerial and operational processes (Johnson et al., 2008). To achieve this, in the BalticLSC project, the platform provides an interface that makes it easier for the LSC users to access and utilize the computation power. The interface is a simple website with an inbuilt app store that can run on any tablet or computer.

Value is also delivered to LSC service providers through the interface by allowing them to list their computation power capabilities and provide them access to a large base of LSC users. Even small actors will get the opportunity to utilize their unused resources which would otherwise remain idle. The platform achieves through offering BalticLSC specifications to small actors to help them emerge as local LSC centers and offer their computational power. The complementors will be assisted with manuals and technical documentations to be the potential stakeholders of the projects. The BalticLSC project will also develop a

forum/community for users to interact, raise their concerns and discuss solutions to their problems. Value is also delivered through offering training and consultation to users to proceed with the use of BalticLSC platform to meet their needs, by maintaining effective customer relationships through providing helpdesk, professional assistance and offering feedback system. This shows that key activities and resources, channels and customer relationships also significantly impact the value delivered to the customers and is very closely linked to the relevant technical expectations of the end-users that have been identified already in the technical workshops.

Value capture with BalticLSC platform

Value capture describes the financial model of an organization explaining how the economic value is captured. It helps to determine revenue sources and answers questions such as who pays for the value delivered and how, along with required operating cost structure. For any business model, pricing is also very crucial while capturing value and needs thorough decisions (Kaplan, 2012). In this regard, the platform literature suggests subsidizing at least one side of the marketplace to kickstart the adoption of platform. The other side of the platform will be charged to monetize the platform and thus enables value capturing (Parker & Van Alstyne, 2005; Rochet & Tirole, 2006).

The BalticLSC does not charge end-users to have access to the platform however, the users pay to the LSC service providers for the utilization of their computational power. The LSC service providers are on the money side. On the purchase of computational power and after a successful transaction the platform charges a brokerage or matchmaking fee to the service provider by taking a small percentage of its share value. Moreover, the LSC service providers will be charged with one-time membership or registration fee to join the network (Eurich & Boutellier, 2014). As the Baltic project follows a non-profit model, it does not aim to make profits however revenues to run the platform efficiently are necessary. This is known as the revenue sharing model.

Value capturing element of the platform is not only limited to the revenue streams, but it should also consider the operating cost structure in the business model (Teece, 2010). BalticLSC platform follows a cost driven business model that aims at offering low price value propositions to the small actors with maximized automated services (Osterwalder & Pigneur, 2010). The major cost drivers in the project are the development and management of platform and the app store. As the platforms grow, they enjoy economies of scale and scope. For the effective

functioning of the platform, it is very important that costs should be covered by the revenue streams, or the platform will tend to fail. Hence from the BalticLSC project it can be inferred that each stakeholder group is addressed with specific value proposition, delivery and capture mechanisms thus justifying the need of a business model and results from the empirical findings are in line with the previous research to a greater extent.

11.2 Partners in BalticLSC Platform

BalticLSC platform is associated with two-sides which are the major stakeholders of the platform with standardized interfaces as central governance mechanism (McIntyre & Srinivasan, 2017). However, it can be observed that along with these two stakeholders, key partners can be considered as another major stakeholder in the platform ecosystem. Partners play a very important role in the platform business model. The partners are responsible for enhancing the impact of the project in the Baltic Sea region, providing use cases, technological development of the system, addition of features or services to the platform through developing apps and offering consultation, upscaling the platform, offering investments and promotion of the platform. Partners also help to increase the spread of the platform and thereby bring in more users to the platform ecosystem. Having different partners across the Baltic sea region in the consortium will significantly impact the reach of the platform to a greater number of users enabling extension of capabilities and improving economies of scale (Osterwalder & Pigneur, 2010). Same goes with having partnerships with the marquee organizations such as HPC cluster organizations and alliances as they already have a pre-established brand value and user base in the market (Eisenmann et al., 2006). Another important advantage of having partnerships is solving the initial critical mass hurdle that the platform faces (Evans & Schmalensee, 2010). Due to the attraction of critical mass of users which in this case are complementors (service providers) and end-users (SMEs, research centers etc.), the partners contribute to the emergence of network externalities.

Having strategic partnerships play a crucial role in the value creation of the business model (Zott et al., 2011). Especially when platform is identified as an activity system it describes how the business model of the platform establishes connection with an ecosystem of partners along with the distinct transacting sides to enable value creation and capture along with monetizing a share of that value. It demonstrates the boundary spanning characteristic of business model of focal firm where partners are involved with the focal firm in value creation and appropriate a share of the value (Zhao et al., 2019; Zott & Amit, 2010). In this regard, partners are involved

to contribute to the overall business model. Hence this study sheds light on the need to go beyond platform providers and to recognize and evaluate connections and interactions with different stakeholders that play a vital role in value creation.

11.3 Openness and Governance in BalticLSC Platform

According to Eisenmann et al. (2009), platform mediated networks are usually associated with four distinct players namely end-users, complementors, platform providers and platform sponsors. In the case of BalticLSC platform, the end-users are LSC users, complementors are LSC service providers, however the role of platform provider and platform sponsor is played by the consortium of BalticLSC partners. The consortium is the primary point of contact for users and are responsible for mediating the user transactions. Moreover, consortium is responsible for developing and modifying the platform technology. They design the platform components like hardware, software, service modules and rules to coordinate and control the participation of providers and users in the network. For the creation of initial network, the platform is open to only LSC users and service providers to encourage their participation in the development, commercialization and use of platform and stimulate the network effects.

A governance model entails rules for participation, transactions of the various players and resolution of issues or conflicts (Van Alstyne et al., 2016). To achieve this, some of the measures that will be taken by the platform are supplier validation, verification of apps and quality assurance monitoring, acting as intermediary for sensitive data by putting SLA and NDA contracts in place. As the platform does not have informational advantage over the transacting parties, it follows a decentralized approach of certification to reduce the asymmetric information between them. This will be achieved by incorporating a rating system and feedback mechanism. Feedbacks will be extended to both service providers and end-users helping them to adhere to the standards of the platform. Having negative feedbacks will thereby affect the participation of the interacting parties on the platform.

11.4 Limitations

The study aimed at the development of a framework to address the business model development for the BalticLSC platform with the help of studying relevant theoretical background and collecting empirical data from the focus groups. As the research strategy followed an intensive case study approach based on the unique context of project, the usefulness of the study and the resulting framework will be limited in terms of applying it to other contexts.

The knowledge cannot be generalized as it is argued that the objective of the case study should be to consider cases for their uniqueness instead of just using them to focus on obtaining broad empirical and theoretical conclusions (Lewis-Beck et al., 2004). However, the theoretical framework that is developed could help any firm or company developing a business model for a multi-sided platform serving two or more distinct groups of customers especially in the context of creating HPC computation network. Another limitation realized during the literature review is the lack of prior research study on the development of business model for a platform for the offering and usage of large-scale computing via cloud. Some of the literature might not be available due to confidential reasons and non-disclosure agreements and hence could not be accessed. This is also one of the reasons the study followed an exploratory research.

In the research methodology, the empirical data was collected through the focus group. The focus was chosen to be appropriate because of the project's different character and competencies of the involved partners. However, the remoteness of the partners limited the possibility to have multiple focus group interviews which otherwise would have contributed to multiple business ideas and richer empirical data. Another limitation associated with the data collection method was to transcribe the entire focus group session considering it involved more participants and length of the session. Hence field notes were taken to record the data focusing on the key points or ideas during the session. Research study is often associated with researcher bias, to reduce this bias caused due to researcher's own assumptions, the results were validated with the help of focus group participants.

As noted in the developed business model, platform may add additional complementors such as application developers and administrators which can change the two-sided nature of business model into multi-sided model which might increase architectural challenges and lead to complex structural interdependencies in the business model (Zhao et al., 2019).

11.5 Practical implications and recommendations

There are a few practical implications that should be considered by the consortium while proceeding to implement the platform based on the developed business model. The consortium should have constant engagement with the users of the platform to explore then needs and engage in evaluation the value propositions. The recommendation is to achieve this by having workshops, summits, and conferences with the potential users of the BalticLSC platform. It is also important to inform the users about the benefits associated with the use of high-performance computing to stay relevant in the ever-growing market.

From the results of the study, it is evident that the value proposition is following as cost-driven approach as the aim is to enable utilization of HPC services at a lesser cost compared to the big market players. Hence understanding the customers willing to pay becomes very crucial before finalizing on the pricing model. At the same time, it is important to analyze pricing of the big market players to competitively set the pricing without compromising on the quality of the service.

To enhance the provision of service, the consortium should engage with the potential partners across universities, HPC clusters and alliances, government bodies and other relevant organizations. Such engagement will help create awareness regarding the BalticLSC network, increase the reach of the platform, make enhancements to the offerings, serve as consultants etc., thereby contributing to improve the credibility of the platform services. Consortium to look forward to accommodating potential other stakeholders of the platform likely to arrive with the growth of the platform namely application developers and administrators. Another major recommendation is to consider cross-boundary legal issues as the project involves partners and users of the platform across the Baltic Sea region.

11.6 Recommendation for future research

The scope of this research is limited to the development of a business model for the platform addressing the research question. Therefore, it is recommended to focus the future research on the implementation side and on the customer side. Further research will focus on questions such as what is the value for SMEs to use LSC? Why specific BalticLSC?

By concentrating in such questions, we will focus in preparing the BalticLSC for the phase after the project and the funding ends. Researchers will dwell within the areas of business model's financial aspects namely revenue model and the cost structure as they are key driving factors for service providers and users. The focus can be on different pricing mechanisms and cost accounting models. We can explore on how to maximize value creation by focusing the research on the aim to achieve economies of scope and scale through the LSC network.

Furthermore, the concentration on specific business cases will benefit specific industries. Furthermore, they could also act as dry runs in terms of enhancing user experience, and most importantly in testing the business model and the assumption behind it and most importantly in testing the technology and the functionality of the developed platform. Pending the outcome, certain measures and adaptions will or will not be needed to be taken.

According to Osterwalder and Pigneur (2010), it is often necessary to construct multiple prototypes in the process of designing a new and refined business model. The business model that is developed in the study based the data collected during the scope of the project. It is however possible that having multiple variations in business model may pave way for new insights and opportunities and help achieve close to best and refined possible solution. Moreover, it is always recommended to update the business models according to the changing market trends and demands, hence, research should always consider the external environment in which the business model will operate in and to evaluate the sustainability of the business model in the long run.

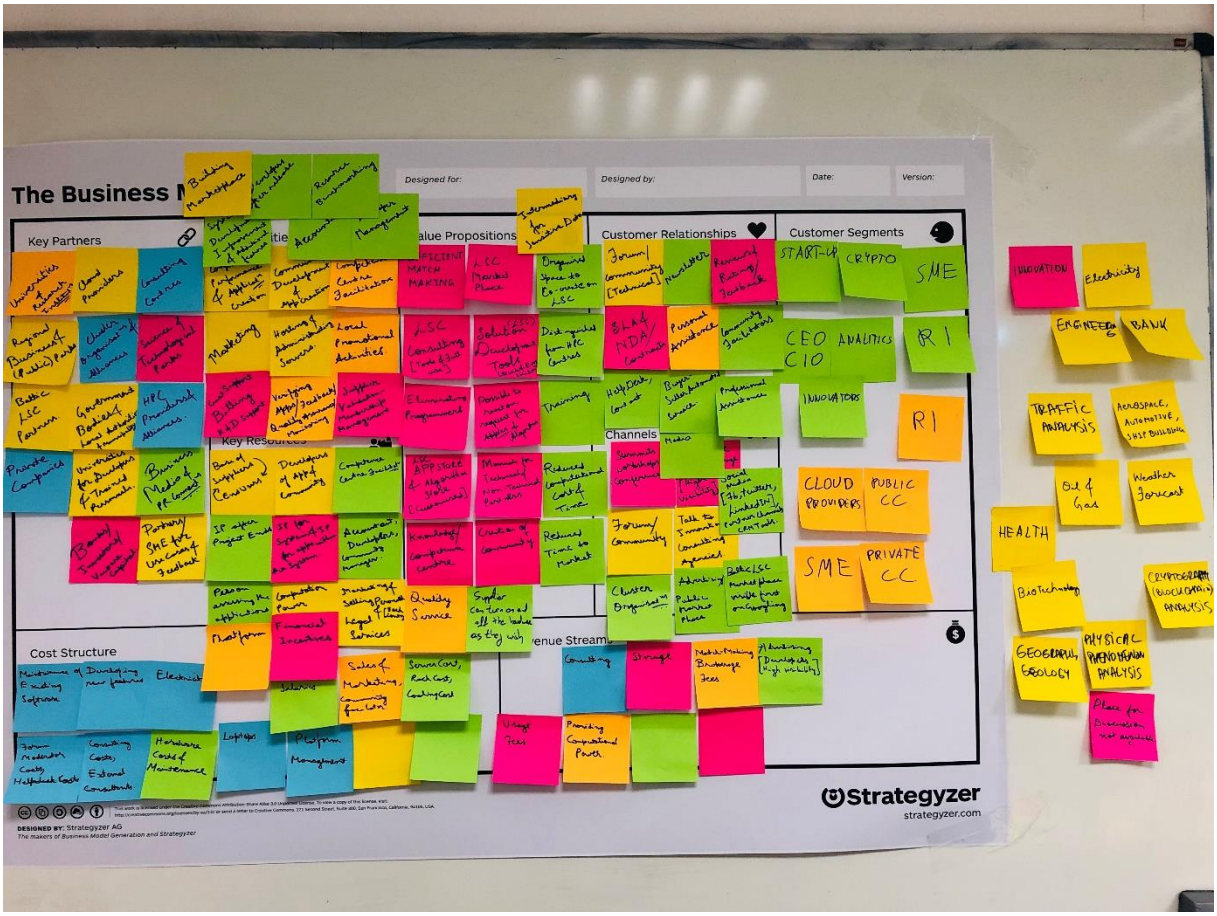
12. Appendix

Appendix 1: Interview guide

Key theme	No.	Questions
Customer Segments	1	Who are the most important customers or users that the BalticLSC platform wants to serve?
	2	Through platform, to whom is the value created?
	3	Which of the stakeholders is the platform open or closed to?
Value Proposition	4	What is the value the BalticLSC platform wants to deliver to the users of the platform?
	5	Which problems of the users is the platform looking to solve?
	6	What is the service offered to each of the user segment?
	7	Which user needs are fulfilled by the platform?
Channels	8	Awareness: How to raise awareness about the BalticLSC project to the users?
	9	Evaluation: How does the consortium help evaluate the value proposition offered through the platform?
	10	Purchase: How can users avail the services offered by the platform?
	11	Delivery: How is the value proposition delivered to the users of the platform?
	12	After transaction: How does the platform offer post purchase user support?
Customer Relationships	13	What is the relationship platform wants to establish with the users associated with the platform?
	14	What are the relationships that the platform users expect?
	15	What are measures taken for governance of platform?

Key theme	No.	Questions
Key Resources	16	What are the key resources needed to achieve the value proposition?
	17	What key resources are required for the channels?
	18	What resources are required to maintain customer relationships?
	19	What resources are needed to maintain and achieve revenue streams?
Key Activities	20	What are the critical activities needed to achieve the value proposition?
	21	What are the activities that the platform needs to outsource?
	22	Which of the activities are required to be automated?
Key Partnerships	23	Who are the key partners for the BalticLSC project?
	24	What are the key resources required to be acquired from the partners?
	25	Which key activities are to be outsourced from or performed by the partners?
Cost Structure	26	What are the important costs that the BalticLSC platform business model will incur?
	27	Which are most expensive resources and activities?
	28	Can the business model achieve a leaner cost structure?
Revenue Stream	29	For what value are the platform users willing to pay?
	30	How do the users prefer to pay?
	31	How does the platform want to set the price?

Appendix 2: Key notes taken during the focus group



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14. Glossary

Notions defined in this glossary are specific for this document only. Other notions used in this document are defined in the Project Glossary document.

Notion	Meaning
BSR	Baltic Sea Region
CVP	Customer Value Proposition
ERDF	European Regional Development Fund
HPC	High-Performance Computing
IOT	Internet of Things
IP	Intellectual Property
IT	Information Technology
LSC	Large-Scale Computing
OS	Operating System
PDA	Personal Digital Assistant
R&D	Research and Development
SAAS	Software as a Service
SLA	Service-Level Agreement
SME	Small and Medium-scale Enterprise
VOIP	Voice Over Internet Protocol