MBA Thesis

The impact of open business model, innovation types and firm's capital structure on product's time-to-market and firm performance

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The author(s) declare(s) that they have completed the thesis work independently. All external sources are cited and listed under the References section. The thesis work has not been submitted in the same or similar form to any other institution(s) as part of another examination or degree.

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Abstract

For decades, globalization has introduced both opportunities and pressures for companies around the world by introducing freer trade, increasing foreign direct investment and the international use of intellectual property that boosted the diffusion of knowledge and technology. As a result, the international competition has become more intense for many firms. Hence, putting a good or service into the market has never been as demanding as now and the demand to be early mover and have a low time-to-market is increasingly important for first be successful. This research will focus on determining whether a low time-to-market will contribute to a higher firm performance and what relation the time to market has with a firm's business model framework and business model openness, preference for external funding and type of innovation. A theoretical framework was created based on relevant literature to be able to reach the objective of this thesis. The conceptual model was created from the literature which consisted of the hypotheses and variables that the study aimed to investigate. From the theoretical framework using a confirmatory approach, a survey was designed that was shared online to available network that the authors had. In summary, 43% of respondents had some sort of managing positions (upper management, manager and project management), 83% were mainly based in Sweden but also in Denmark, Germany, USA etc. and the work experience of the respondents was fairly distributed. Overall, 50% of the firms were between 0 to 30 years (1% did not respond) and more than 50% were considered to be a large firm depending if the classification was based on turnover with 51% as large firms (17% did not respond) or based on the number of employees with 58% as large firms. Data with 200 applicable responses (eight were removed i.e., 3.8%) was collected over four weeks of time. With the use of structural equation modeling and exploratory factor analysis, the collected data could be analyzed, and the hypotheses relevance could be answered.

The final model was concluded to be adequate, as GOF indices and standardized factor loadings were on a sufficient level. As a result, the research showed that a fast time-to-market had a positive impact on firm performance measured in monetary measures (sales, profit, and market share) and that marketing innovation had a positive mediating effect on time to market and thus financial performance. The hypotheses regarding business model framework and capital structure correlating positive time to market were removed since the model was reworked. However, the study showed that technological innovation (product and process innovation) had a positive correlation to preference for external funding such as debt or issuance of equity. Since the construct validity of open business model and technological innovation was proved to be non-convergent, any deeper conclusion of this must be carefully reviewed. The results reinforced what other studies had shown, which is that open innovation or a more open business model contributes to both technological and marketing innovation. In summary, this demonstrated that a positive mediating effect existed for an open business model and marketing innovation which will speed up the time-to-market and hence increase the financial performance. Suggestion of future work could be to conduct similar studies in specific industry sectors to observe whether there is a difference in time-to-market depending on industry and what effect innovation and business model framework has.

Keywords: Business model framework, innovation, capital structure, time-to-market, firm performance, structural equation modeling, exploratory factor analysis

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Helsingborg & Malmö, June 2022, Christoffer Nilsson and Belinda Hsu

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List of abbreviations

AVE	Average variance extracted
CD	Coefficient of determination
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CIS	Community innovation survey
CR	Construct/composite reliability
EFA	Exploratory factor analysis
GOF	Goodness-of-fit
IP	Intellectual property
PCA	Principal component analysis
KMO	Kaiser-Meyer-Olkin
MANOVA	Multivariate analysis of variance
MLE	Maximum likelihood estimation
MVP	Minimum viable product
MSA	Measure of sampling adequacy
PLS-SEM	Partial least squared-structural equation modelling
R&D	Research and development
RD&E	Research development and engineering
RMSEA	Root mean square error of approximation
SC	Standardized correlation
SEM	Structural equation modelling
SRMR	Standardized root mean squared residual
TLI	Tucker Lewis index
TTM	Time to market

1. Introduction

For decades, globalization has introduced both opportunities and pressures for companies around the world by introducing freer trade, increasing foreign direct investment and the international use of intellectual property that boosted the diffusion of knowledge and technology. As a result, the international competition has become more intense for many firms where the low-cost countries, South Korea and China, have become large recipients of adopting knowledge and technology and have even started to engage in innovation itself to gain market shares from its competitors (Canuto, 2018). Hence, putting a good or service into the market has never been as demanding as now. Moreover, the time it takes to reduce time-to-market (TTM) is increasingly important to stay competitive.

A solution to compete as a firm is to strategically work with innovation. Historically, innovation has primarily been associated with technological innovation. According to the 2005 edition of the Oslo Manual, technological innovation refers to product and process innovation and non-technological innovation refers to organizational (or management) and marketing innovation (OECD and Statistical Office of the European Commun, 2005). Until recently, little attention has been paid to the non-technological innovation, but it has been proven to be key factor to sustain competitive advantage (Camisón & Villar-López, 2011; Tang, Zhang, & Peng, 2021).

The landscape of innovation is altering in conjunction with globalization and changes in supply chain, increased customer demands, and increased competition, which has made it increasingly more important to innovate and release new products to the market. Since emerging countries are catching up to the technological advancements, companies will need to widen their horizon to new approaches of their innovation strategies as well as externally search for complementary partners to acquire quick access to technologies i.e., open innovation (De Backer, López-Bassols, & Martinez, 2008). During and after covid-19, open innovation has never been as urgent and trendy as during this period, which have produced many success stories on how to turn the tables around for the survival or growth of their company (Dahlander & Wallin, 2020). Having a business model that promotes open innovation i.e., open business model, will help to accelerate the innovation process by converting ideas and technologies into economic means (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

Moreover, innovation is often a costly process and large investment is required. In average, companies in the European Union invested approximately 2.4 % of GDP in 2020 on R&D (Eurostat, 2022). Moreover, highly successful companies such as Amazon, Alphabet and Huawei spent 11.0-15.9 % of the revenue on research and development. To fund research and innovation, firms can choose different approaches such as internal or external funding. Internal funding is often in the form of the firms retained earning while external funding can be in the form of debt or equity from investors (Heijde, 2018). A low time-to-market often requires intense investments in R&D at a short period of time, therefore retained earnings might not sufficient, and firms might need to obtain capital from banks or investors (Vesey, 1992).

Furthermore, Sweden was placed 2nd in the Global Innovation Index (GII) in 2021 have proven to be a dominant player in innovation, as Sweden that resides 10 million people was placed before the great power, USA, that inhabits 334 million people (Worldometers, 2022; World Intellectual Property Organization, 2021). Furthermore, United Kingdom, Sweden and Italy have the most companies that have adopted open innovation. Acquiring knowledge has become more expensive and riskier with globalization since it has become multidisciplinary and more broadly located, which means that funding is a prerequisite to innovate successfully (De Backer, López-Bassols, & Martinez, 2008).

As far as we, as researchers, are concerned, there seems to be a lack of research regarding time-to-market and its association to firm performance, capital structure and business model framework. Consequently, this study centers around time-to-market that will act as a mediator between firm performance and the other concepts. Time-to-market has most likely been overlooked since it is often self-explanatory that companies want their products to be quickly released and that most of them focuses on product development and innovation (Feng, Sun, Sohale, & Wang, 2014). However, there is a difference between running a firm with the objective to have a low time-to-market and simply just accepting the firm's time-to-market and hoping that it will turn out to be low. In the former, the organization is shaped for its purpose but in the latter the organization is shaped for another purpose that wishfully also involves low time-to-market. However, to stay competitive, firms should ponder on the lyrics of "Forever Young" performed by Alphaville (1984); instead of "Hoping for the best but expecting the worst" to shape their future, one should rather decide if they want to "die young" or "live forever".

Hence, this research will focus on determining whether innovation will contribute to reaching the market faster and how much it will contribute to firm performance. This will be performed in conjunction with establishing a firm's business model regarding innovation strategy and its preference to external funding (excluding governmental funding).

1.1. Problem discussion

Companies that want to sustain in the future need to assess their organizational environment and realize the fact that this digital era boosts speed and breadth of knowledge through technology (Shepherd, 2004). Knowledge can be obtained quickly by engaging in open innovation through partnerships with external parties (e.g., alliances, joint ventures, joint development) or acquisition/sale of knowledge (e.g., contract R&D, purchasing, licensing) (De Backer, López-Bassols, & Martinez, 2008). This would be the ultimate step of an open business model in innovation strategy. However, this strategy could also be highly resource intensive (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). At the end of the day, any business has the strategy of making profit and survive which is simply the core of any business model (Kopp, 2020). This means that firms can exist in different stages or levels of openness of innovation including sophistication of internal processes and organization. Consequently, companies need to find the right balance between an open business model that could be more costly and a more closed business model that could results in less competitiveness (Smith, Cavalcante, Kesting, & Ulhøi, 2010; Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

Moreover, knowing how a company manage innovation is crucial for surviving but knowing what types of innovation that the company focus on is equally important. By making the right choice and focus on certain type or types of innovation could result in more "bang for the buck", which in turn will make the firm more competitive. Innovation can be classified into different types, whereas product and process innovations are the most known ones (OECD and Statistical Office of the European Commun, 2005). However, marketing innovation and organizational innovation have gained more attention in research articles and have become more important for companies to increase their profit and competitiveness (Chen, Wang, & Huang, 2020; Tang, Zhang, & Peng, 2021). Therefore, we argue that non-technologically innovation types are just as important as technological innovation to generate economic growth and companies should therefore find the right mix of technological and non-technological innovation.

Furthermore, most innovation activities do require capital and it has been recognized that innovation is indeed expensive (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006; Kedzior, Grabinska, Grabinski, & Kedzior, 2020). Moreover, to achieve a fast time-to-market, committing resources intensely to product development is necessary (TCGen, 2022). The required resources for product development can be human resources or financial resources, which can

be used to invest in increased working hours at R&D or in new equipment. The pecking order theory states that firms primarily prefer to use their retained earnings, while issuing equity is the last resort to fund their operation due the higher cost of capital (Berk & DeMarzo, 2017). However, in order to intensify resource commitment at an early stage of the product development, retained earnings is in many cases likely not a sufficient amount and external capital is thus necessary (Fourati & Affes, 2013). Therefore, we argue that to have a fast time to market, firms have a higher preference for external funding such as debt or equity to be able to conduct the activities needed.

As mentioned before, product life cycle has decreased considerably due to the globalized race which means that the next innovation needs to be rapidly created in order to maintain profitable and competitive (De Backer, López-Bassols, & Martinez, 2008). No matter what type of business, this fast-changing world have upgraded time to a new level of key factor for success. Any choice of business model, innovation type and financial funding is in some way bound to time. Other terms related to time are timing and speed, where phrases commonly heard are: "*Launch the product at the right timing when the market is ready*" and "*Speed up the product launch to capture the market share*". Historical failures of the wrong timing are many such as between Betamax who launched before VHS but still lost (Swann, 2009). However, the importance of timing was not directly correlated to new product performance in an American empiric study, while lean launch[1] and effective marketing was strongly associated to it (Calantone & Di Benedetto, 2012). Although timing is still important when launching several products on firm value according to another study (Sharma, Saboo, & Kumar, 2018), this thesis will not further research on the matter of market timing. Moreover, one of the strategies to win standard races is to gain first mover advantages by reducing time-to-market (Swann, 2009). To optimize profit margins, time-to-market has shown to be critical for launching products or services (Vesey, 1992). This also applies to innovation since the outcome of innovation is to generate profit in the short- and long-term.

As change or innovation takes time and "time is money" according to a commonly known phrase (The Free-Thinker, 1719). This research will thus measure the time-to-market of innovation types in combination of the business model framework and capital structure by using relevant firm performance measures.

[1] Lean launch is defined as where continuous, real-time market feedback and/or quick response stock replenishment is applied to retain reseller inventories and costs at a very low level (Calantone & Di Benedetto, 2012)

1.2. Problem formulation and purpose

In this research study, the impact of different innovation types to a product's time-to-market including firm performance is investigated, by also assessing the firm's innovation process (i.e., open business model) and capital structure. Hence, the research question of this thesis is postulated as:

"How will the extent of an open business model, the choice of innovation and a firm's capital structure affect time-to-market and thus firm performance?"

1.3. Delimitations

This study is limited to the population of the survey, as the inclusion of acceptable answers from the survey was wide regarding country, industry sector, respondent's work position and firm characteristics. In addition, partially least squared-structural equation modelling (PLS-SEM) could have been employed instead of structural equation modelling (SEM) along with exploratory factory analysis (EFA) that was used in this study. The reason for this is because this study started as explanatory but ended up as exploratory, and the need for change of statistical tool was discovered too late to apply it. The advantage of PLS-SEM is because it allows the use of non-normal data and small sample sizes, which is suitable in exploratory research (Ghauri, Grønhaug, & Strange, 2020). However, the use of SEM and EFA proved to be sufficient to move further in answering the research question.

1.4. Thesis structure

In the following chapters, a theoretical framework of the different chosen concept or constructs will be introduced, i.e., business model framework, innovation types, time-to-market, firm performance, including introductory concepts of the business model, open innovation, open business model. Based on the research question and theory, hypotheses will be set up for the different concepts. Thereafter, the methodology of the statistical techniques (i.e., SEM and EFA) and data collection (i.e., survey including sample population) will be further described. Lastly, the thesis will go more into detail of this research by presenting the results, analysis and discussion, and conclusion.

2. Theoretical framework and literature review

In the following chapter, the reader will get acquainted with the different theoretical concepts used in this study. It starts with explaining the concepts of open innovation and open business model, which will then be followed by the different types of innovation and descriptions of firm's capital structure. Thereafter, the reader will be introduced to time-to-market and how it is related to firm performance. Finally, the different hypotheses will be presented and how they relate to the theoretical framework.

2.1. Business model framework

Before going into detail regarding open innovation and business model framework, it is essential to define what a business model is and its importance to the firm. There are many interpretations of what a business model is, and include definitions such as:

- "an architecture for the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; a description of the sources of revenue" (Timmers, 1998)
- "is a reflection of the firm's realized strategy" (Casadesus-Masanell & Ricart, 2010).

In the present study, business model is defined according to the following six functions:

1. Articulate the value created for customers (value proposition)
2. Define/identify the market segment
3. Define the structure of the value chain that is needed to create and deliver the product/service and what assets is needed. This should include raw material to the final customer and include suppliers and customers.
4. Specify how revenue is generated and estimate cost structure and profit potential.
5. Describe the ecosystem in which the company is present and linking suppliers, customers competitors (Value network)
6. Formulate the competitive strategy that the firm will use to stay competitive (Chesbrough H. W., Open Innovation: The New Imperative for Creating and Profiting from Technology, 2003)

Innovation is traditionally defined as the product/process from internal R&D departments in a closed innovation model, where companies only relied on themselves. Unused ideas would usually be archived and in best cases be used later when time, recourses or the market were ready. Today, innovation is viewed broader than this and may include input from external partners such as universities, research organizations, competitors, and customers (De Backer, López-Bassols, & Martinez, 2008). This phenomenon was coined as "open innovation" by Henry Chesbrough (Chesbrough H. W., Open Innovation: The New Imperative for Creating and Profiting from Technology, 2003). Open innovation model has since then increasingly been gaining recognition of its importance by the increased number of publications per year (Weiblen, 2014). Several industry projects have adopted open innovation, for example the paper bottle project conducted by Carlsberg, BillerdudKorsnäs, DTU and ecoXpac where they jointly developed a paper bottle for beer and other packed consumer goods (Chesbrough, Strand, & Bogers, 2018). Furthermore, studies have reported that the created value from open innovation can belong to the intellectual, technological, and organizational domain (Dell'Era, et al., 2020).

Chesbrough (2006) also suggested that companies need to adopt their business models to be able to capture the full value of open innovation (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). This can be done by employing an open business model that consists of two concepts: open innovation and business model including their interconnection (Weiblen, 2014). By using an open business model, firms can create a greater value by leveraging resources and assets owned by different organizations or firms (Luo & Chang, 2011; Dell'Era, et al., 2020). In

addition, the firms could obtain a joint legitimacy through cooperation and therefore be perceived as more unique and valuable and in turn increase the price for their products (Dell'Era, et al., 2020).

Furthermore, Chesbrough (2006) developed a business model framework for characterizing firms in terms of openness of the business model and the level of investment made to support the business model in regard to innovation activities, internal processes to handle innovation and management of intellectual property (IP). In this framework, six different categories are defined and categorized according to their innovation process as can be seen in Table 1. The categories ranges from simple to sophisticated business model in terms of both innovation process and IP management (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). In this report, IP management will not be further detailed to narrow the scope of this study. Table 1 share some examples of firms that have very little or no innovation process (e.g., restaurants or farms) to firms that are highly innovative and constantly innovating their products and business model (e.g., Intel or Wal-Mart).

Table 1. The matrix of the business model framework, with its associated innovation and IP management processes (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

Type	Business model	Innovation process	Examples
1	Undifferentiated	None	Mom-and-pop restaurants Family farms Independent bookstores
2	Differentiated	Ad hoc	Start-up technology companies *(one-hit wonder)*
3	Segmented	Planned	Technology push companies Young start-ups *(going beyond one-hit wonder)* Industrial age companies *(good reputation in product/technology but difficult to adapt to new business environment)*
4	Externally Aware	Externally supportive	Mature industrial R&D firms Drug companies working with start-up biotech firms and university spin-offs
5	Integrated	Connected to business model	Leading financial firms Firms that have incorporated external sources of technologies and that are building business models around it.
6	Adaptive/ Platform player shapes markets	Identifies new business models	Dell, Intel, Wal-Mart

Firms that are categorized as *undifferentiated* business model (type 1) entail competing in price and availability and is selling commodity and operates in perfect competition. These types of companies rely on copying from others or by learning from their external recruitments. These companies are often poor in managing their innovation processes (Chesbrough, Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

In the *differentiated* business model (type 2), the firm has been able to differentiate it from competitors and may enjoy above-normal profits for a period. However, their innovation process is ad-hoc and the budget may limit investments to support innovation activities (Chesbrough, Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

A company with *segmented* business model (type 3) have the possibility to plan their future partly because the company can now segment its market. However, moving from type 2 to type 3 requires a substantial input to sustain this business model. This market segment is price sensitive but creates the base for high-volume, low-cost production. This type of company is usually the winner of dominant design and will be able to reinvest their profit into innovation activities typically in their engineering or R&D department. This type of company also entails planning and organizing the company's innovation

road maps of future products and services (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

An *externally aware* company (type 4) distinguishes itself from type 3 by searching knowledge externally selectively, which opens up to new possibilities. This will support and extend the segmentation even further with external sources of technology and marks the beginning of establishing open business models. This business model type reduces the cost of supporting the business (e.g. R&D costs), reduces time-to-market and shares the risks of new products and processes with other partners. The company's road maps are now shared externally, i.e., suppliers and customers, in a higher frequency to capture innovative ideas from them and also letting plan ahead their activities accordingly (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

In a company with *integrated* business model (type 5) the business model has permeated throughout the company. In other words, the employees share an understanding of the business model's capacity, which helps them to take decisions and effectively deal with complex challenges. This exchange also includes external parties in both business model and the innovation process, where the road maps are shared between all the partners. This type of company also puts effort into getting insights throughout the supply chain including customer's customer and their distribution channels (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

A *platform player that shapes markets* or a company with *adapted* business model (type 6) is an evolved version of type 4 and 5 in terms of openness and adaption and can innovate its own business model by including key suppliers and customers. This is done by experimenting with investing in start-ups, initiate spin-offs, mergers and acquisitions (M&A) and create joint ventures to commercialize technologies not fitting to the current business model. They also started internal incubators to nurture promising ideas that are immature for commercialization but have high potential in the future. The technical and financial risks and rewards are shared in the innovation process between the involved partners (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

To summarize the business model framework, the higher the category type, the more sophisticated strategy the firm has regarding both innovation and the openness of the business model. A firm with an *undifferentiated* focus little on internal or external innovation, lacks a plan for its innovations and products and how the firm can differentiate from others. On the contrary, firms that are in type 4, 5 or 6 put large focus on open innovation, work closely with external partners and has defined and structured a roadmap for future products and in which direction the firm is moving (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). However, as Chesbrough (2006) also states, the framework is a simplification of reality and there will be exceptions form the framework.

2.2. Innovation types

According to Najafi-Tavani, et al. (2018), innovation is usually explained or associated to a product that a firm releases to the market (product/service innovation) and the methods it uses to deliver or supply these products or services (process innovation). However, innovation can take many different forms and we have chosen to adopt to the innovation types defined in the Oslo Manual (2005) which is guidelines created by the Organization for Economic Co-operation and Development (OECD). These guidelines are widely accepted among researchers and organizations. Innovation is divided into four categories: product innovation, process innovation, organizational innovation, and marketing innovation (OECD and Statistical Office of the European Commun, 2005; Opazo-Basaez, Vendrell-Herrero, & Bustinza, 2021). Moreover, these categories can be grouped into two major groups as can be seen in Figure 1. These are technological and non-technological innovation which are closely linked to each other. Product and process innovation are categorized as technological/technical innovations while organizational and marketing innovation is non-technological innovations (Schmidt & Rammer, 2007; Opazo-Basaez, Vendrell-Herrero, & Bustinza, 2021). An example of the linkage between the two groups of innovation is when a new product is created and it is preparing for product launch, new marketing strategies also need to be developed. Hence, product innovation and marketing innovation often coincide and can be comparatively vital when releasing and selling competitive products on the market (D'Attoma & Ieva, 2020).

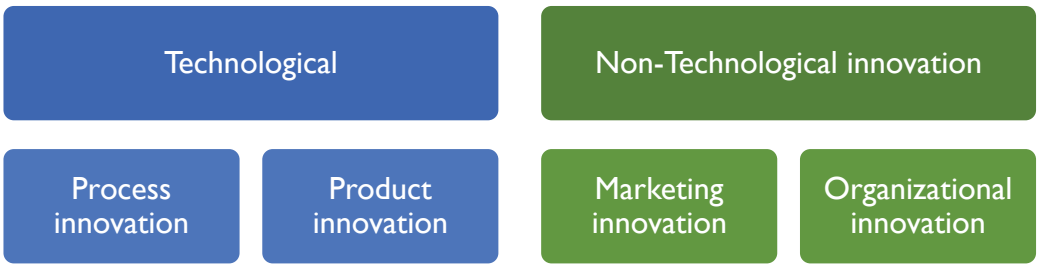


Figure 1. Technological and non-technological innovation and their subgroups.

According to Schmidt and Rammer (2007), the focus on the different types of innovation (technological versus non-technological) depends on the industry. To generalize, firms that operates in the manufacturing industries such as mining, chemicals, mechanical engineering have a large focus on technological innovation while service industries such as wholesale trade, transport and consulting put a greater focus on non-technological innovation (Schmidt & Rammer, 2007).

For a firm to exist or survive, it needs to conduct product and/or process innovation (technological innovation). Without innovation, a firm's competitors that do innovate can compete by either producing more attractive goods (benefit advantage) or by producing the existing products cheaper (cost benefit) and hence become more competitive (Besanko, Dranove, Shanley, & Schaefer, 2017). In contrast, non-technological innovation can have an equally considerable importance and be interconnected with the technological innovation (Schmidt & Rammer, 2007). For example, introduction of new manufacturing practices (organizational innovation) could be intertwined with process innovation which will increase the competitiveness of a firm (Opazo-Basaez, Vendrell-Herrero, & Bustinza, 2021). Moreover, marketing innovation can be used either alone (new product placements or pricing models but identical core product) or in combination with technological innovation (new core product with new product placement) to increase sales (OECD and Statistical Office of the European Commun, 2005; Tang, Zhang, & Peng, 2021).

2.2.1. Product innovation

Product innovation are what most people think when it comes to innovation and that is when a product, i.e., good or service, are improved in a significant way. This includes new functions or improvements in existing functions of goods or services but can also include changes in quality, technical performance, durability, affordability, or user friendliness. Moreover, a greater change in design or appearance of the product can enhance the user experience, which can therefore be consider as a product innovation (Swann, 2009; Opazo-Basaez, Vendrell-Herrero, & Bustinza, 2021). According to Oslo manual (2018), minor aesthetical modification such as change of color is not included since they argue that it is unlikely that the new product will differ significantly (OECD/Eurostat, 2018). Moreover, a product innovation does not necessarily need to generate more sales to be considered an innovation, since a change in product is not always appreciated by customers and could lead to customers abandoning the good or service (Swann, 2009).

Going onwards in this thesis, the term "product" will be used when discussing both goods and service. Most often a good is defined as tangible and some knowledge-capturing products, while services are defined as activities that changes the conditions for the user. A knowledge-capturing product can be for example a streaming service such as Netflix or Spotify. According to Oslo manual (2018), it is not always easy to distinguish between goods or service. For example, the sale of a refrigerator includes transportation and installation, whereas the refrigerator is seen as the good and the transportation and installation is considered a service that is conducted.

2.2.2. Process innovation

Process innovation is characterized by the introduction of new improved ways to produce or to deliver the goods or services that the firm sells. This includes changes in production techniques, use of more effective equipment or introduction of new computer systems that ease up for example accounting or purchasing activities (OECD and Statistical Office of the European Commun, 2005; Radicic & Djalilov, 2019). The introduction of new equipment or production techniques can lead to decreased production cost, but it can also lead to a higher quality, lower defect rate which in turn will make the production more effective. In addition, these changes in the process can be necessary if a new type of product is being produced. Moreover, process innovation in delivery and supply chain can include new types of delivery or the introduction of computer systems or goods identification systems to allow for easier handling or tracking of goods (OECD and Statistical Office of the European Commun, 2005; Swann, 2009).

2.2.3. Organizational innovation

Organizational innovation is defined as the implementation of methods in the workplace, business practices or new ways of working with external relations. Introduction of new business practices can be for example a change of business model, introduction of knowledge management or introduction of new manufacturing practices (e.g., lean manufacturing) (Radicic & Djalilov, 2019; Opazo-Basaez, Vendrell-Herrero, & Bustinza, 2021). In addition, it can be a change in how work is organized within the firm and how decision-making and responsibilities are divided. Examples of this are introduction of teamwork, decentralization, or new training/education systems.

The reasons of conducting organizational innovation are many, but it can increase work satisfaction and in turn lead to increased productivity or reduced transaction- or administration costs. The reduction of costs or higher productivity will hence lead to increased firm performance (OECD and Statistical Office of the European Commun, 2005; Radicic & Djalilov, 2019). Further on, organizational innovation can have an effect of other types of innovation, such as technological innovation, which then is conducted in a more efficient way and thus leads to a better firm performance (Chen, Wang, & Huang, 2020).

Furthermore, a study concluded that organizational innovation had a positive impact on firm performance. It also had a mediating effect on technological innovation (Chen, Wang, & Huang, 2020).

Moreover, the company size can have an influencing factor on the benefits obtained from implementing organizational innovation. For example, non-technological innovation could be particularly beneficial for SMEs since they rely more on the external environment and in general have less organizational routines and processes in place which makes them more adaptable. In contrast, larger firms are often locked in organizational routines and making organizational changes is therefore more challenging (Radicic & Djalilov, 2019).

2.2.4. Marketing innovation

Marketing innovations involves the implementation of significant changes in which a product is marketed but the core product remains the same. These changes involve change promotion, pricing, placement or change in production design or packaging (D'Attoma & Ieva, 2020). According to Tang, Zhang, and Peng (2021), the importance of marketing innovation has increased, and their study shows that marketing innovation has a positive effect on firm value. Moreover, firms use different strategies to break through the noise and attract the customer (OECD and Statistical Office of the European Commun, 2005; Tang, Zhang, & Peng, 2021). In addition, Tang, Zhang, and Peng (2021) also concluded that increased spending on marketing innovation resulted in a positive effect on firm performance. Marketing innovation is conducted to better address the needs of the customer in existing markets or to open new markets for the company which in turn will lead to increasing sales. For a change to be defined as a market innovation, the change must be new for the firm and must be significantly different from the methods previously used by the firm. However, it does not matter if the methods are developed by the firm itself or adapted or copied from other firms (OECD and Statistical Office of the European Commun, 2005; Purchase & Volery, 2020).

The innovation of design or packaging should be significantly different and distinctive, so it appeals to another market segment. This can for instance be a completely new design of a body lotion bottle. Another example stated in the study by Tang, et al. (2021) is the Tide 3-in-1 detergent pod which changed how the detergent was sold and marketed. Moreover, another example that did not significantly change the packaging but attracted more customers and increased sales was the “Share a Coke” campaign that Coca-Cola made (Tang, Zhang, & Peng, 2021).

Moreover, the change of product placement involves the change of sales channels which can be introduction of direct selling, exclusive selling, or franchising systems to increase the number of places where the product is sold. Another example is the use of showrooms for online-retailers which allows the customers to look at the good before purchasing the product (OECD and Statistical Office of the European Commun, 2005; D'Attoma & Ieva, 2020).

Innovation within product promotion can be for instance the use of new media or technique to market that will display the product for customers. This can be executed by introducing social media marketing or endorsing products with celebrities or social media influencers. Moreover, it can also involve rebranding and introduction of a new brand symbol that will position the company on a new market (OECD and Statistical Office of the European Commun, 2005; D'Attoma & Ieva, 2020; Purchase & Volery, 2020).

Finally, the effect of marketing innovation can vary depending on firm size. Larger firms often have comprehensive service and distribution facilities while smaller firm often lack the marketing expertise and financial resources to conduct enough marketing. However, since smaller firms are often more flexible, they can react quickly to customer needs and sustain with the high pace in the market (Radicic & Djalilov, 2019).

2.2.5. Capital structure

The capital structure or funding of the firm has several critical implications for the firm and how it is operated. A company can be funding its operations in several different ways such as: (1) with debt, taking loans from banks or credit institutes (or temporarily owing money to its suppliers), (2) with equity from investors such as venture capitalist or (3) with retained earnings. In addition, implications on the capital structure are affected by other factors such as firm size and industry.

Firstly, Steward Myers who posed the pecking order hypothesis states that firms primarily prefer to use their retained earnings, then debt, and issuing of equity as a last resort (Berk & DeMarzo, 2017). The study by Heijde (2018) confirmed Myers' pecking order by concluding that the cost of capital is higher with external funding due to the riskiness of innovation and hence investors or banks want a higher return leading to higher cost of capital for the firm (Heijde, 2018). However, firms do not always follow this hypothesis strictly and instead applies the reversed pecking order hypothesis where equity is preferred over debt. Firms and entrepreneurs can consider debt as a personal liability and by finding the right investor, value can be added to the firm in form of business skills, access to relevant network and commercial contracts (Fourati & Affes, 2013). Moreover, when information asymmetry is large (which often is the case in innovation-intensive firms), equity is often a better financial option than debt (Choi, Kumar, & Zambuto, 2016). In addition, the capital structure can, to a substantial extent, influence the risk taking and management of the firm. A firm that is funded by equity must take into consideration of its shareholders who have an interest that the firm is managed in an effective and cost-effective way (Choi, Kumar, & Zambuto, 2016; Berk & DeMarzo, 2017).

Secondly, Bartolini (2010) studied what effect capital structure had on innovation and firm performance. It was concluded that increased innovations effort increased the need for externally funded capital. Moreover, the study by Hellman & Puri (1999) concluded that start-ups that obtained venture capital had a faster time-to-market. This was partly due to involvement of the venture capitalist, but also because innovation activities require financial resources (Hellmann & Puri, 2000).

Thirdly, an increasing number of profitable firms have proven to prefer to use retained earnings instead of debt or equity (Bartoloni, 2010). In addition, Heijde (2018) concluded that for in-house R&D, internal financing was preferred. In contrast, outsourcing R&D has shown to be positively correlated to obtaining loans. Since outsourced R&D had less information asymmetry and was more likely to involve generic and non-firm specific knowledge which was considered as less risky (Heijde, 2018).

In regard to firm size, it could play a significant role in the capital structure of the company. Bartolini (2010) concluded that smaller firms relied more on internal funds rather than debt, in contrast to medium or larger firms where leverage was less affected. While larger firms were more likely to undertake large innovations efforts compared to smaller firms which does not have the same amount of capital and need to rely more on retained earnings (Bartoloni, 2010).

In summary, to be able to innovate and release products, capital is essential. Since retained earnings is not always sufficient, firms might need to look for external funding in the form of equity or debt. Due to the high information asymmetry related to innovation, equity might be preferable over debt due to the higher risk which banks is often not willing to take (Fourati & Affes, 2013; Heijde, 2018).

2.3. Time to market

Time to market (TTM) is described as the time it takes for the conception of a product or service to reach the market (TCGen, 2022). TTM can vary depending on the market and the industry. For example, developing new software can take 0.75 to 2 years while the development of new power plants could take up to 23 years (KPMG, 2015). In an increasingly competitive industry, a reduced time to market can be a competitive advantage for several reasons (Feng, Sun, Sohale, & Wang, 2014). The incentive to decrease time-to-market are many but are mainly to increase profit and gain market share. The advantages of reducing TTM is to increase competitive advantage and hence reduce the R&D costs as well increasing customer satisfaction and customer loyalty. (TCGen, 2022). In addition, being unique on the market allows for premium pricing strategy due to the early mover advantage which can in turn enable a firm to keep its advantage due to mechanisms e.g., learning curves, buyer switching costs and network effects (Perols, Zimmermann, & Kortmann, 2011; Besanko, Dranove, Shanley, & Schaefer, 2017).

Several other studies have concluded that TTM has a positive effect on profit and firm performance. Vesey (1992) conducted a study and estimated that that being six months late with a product on the market could result in a 33% decrease in gross profit potential. In contrast, being six month early to the market could result in a 11.9% in gross profit potential, which can be seen in Figure 2 (Vesey, 1992). Furthermore, an empiric study of 692 new product development projects under different uncertainty conditions resulted in a generally positive relation between TTM and overall new product success. The success of a product was measured in terms of meeting expectations regarding sales, profit, and market share (Chen, Reilly, & Lynn, 2005). Moreover, another study concluded that TTM had a positive impact on both the financial performance and how well the firms were able to serve its customers (Feng, Sun, Sohale, & Wang, 2014).

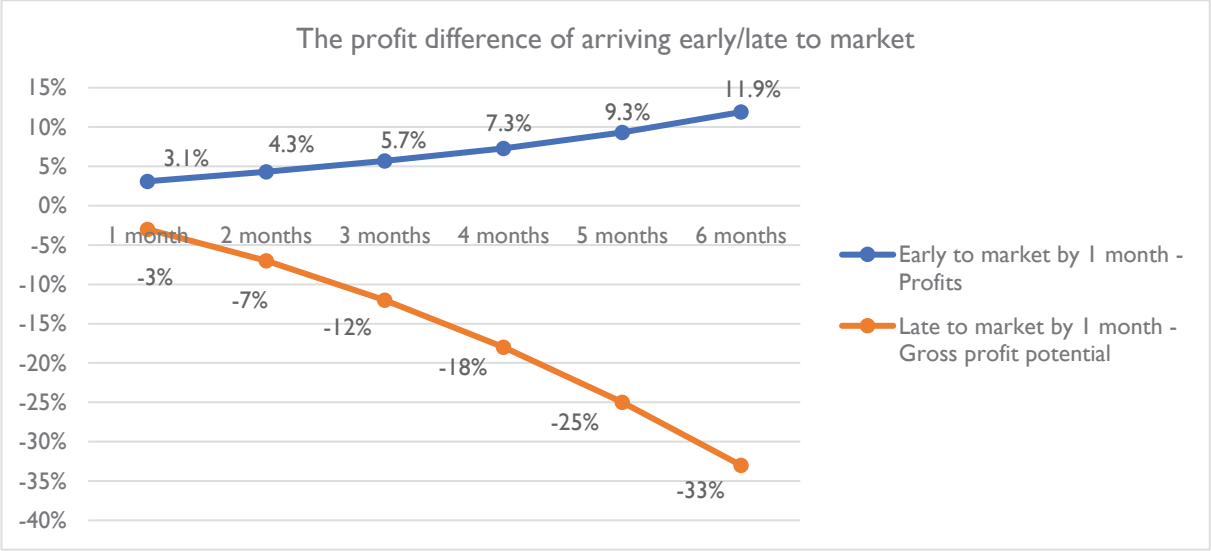


Figure 2. The profit difference of arriving early or late to market (Vesey, 1992). Original source: McKinsey & Company.

Although TTM is reported to be important to gain competitive advantage. A rapid TTM could be a tradeoff with product quality which in turn could backfire. When a product is sold to a familiar market, the product may only be accepted if it has the right price and quality. In those markets, TTM versus product quality will be a balance act. In contrast, the TTM has a greater importance on new markets over product quality because it is simply available to buy (Chen, Reilly, & Lynn, 2005).

There is no one-size-fits-all for improving TTM but it can be applied to all types of product development. However, Vesey (1992) reported two common activities that managers could focus on to

improve TTM. Firstly, this can be done by creating organizational environment where change and innovation comes naturally e.g., by managing and optimizing workflows, communicate cross-functionally and effectively. Secondly, this can be accomplished by adopting technology which gives employees the most current and proven tools to perform their job. Their speed of developing product and hence time to market could be increased e.g., by automating parts of the workflow, using virtual design software for communication, modelling, testing, or simulating (OneTimePIM, 2021). Other means to improve TTM is to intensify resource commitment (put in high efforts and capital, early in the process), and reduce the scope of the product by making tradeoffs and balancing TTM with quality and features.

In addition, working with customers and suppliers and setting up a clear product development strategy, TTM could also be reduced (Perols, Zimmermann, & Kortmann, 2011; TCGen, 2022). However, working with suppliers could in some cases increase the TTM. Perols, Zimmermann, and Kortmann (2011) found that when the product engineering was conducted solely by the supplier, the TTM was deaccelerated. When the product development was conducted jointly with the customer to make the product fit into the suppliers' process, the TTM was, however, improved (Perols, Zimmermann, & Kortmann, 2011). Furthermore, another study concluded that customer or supplier involvement had an essential role to decrease TTM in product development and that involvement of external stakeholders contributed to knowledge and reduced searching cost (Feng, Sun, Sohale, & Wang, 2014).

To conclude, TTM can be reduced in many ways. Both technological and non-technological innovation can have an immense importance to improve the time-to-market. Moreover, by working more closely with customers and suppliers and adapting to a more open business model the TTM could be increased. However, it is important to make the right choices since innovation and external involvement by default does not lead to a reduced time to market. Furthermore, to have a low or fast TTM, economical resources ought to be put in early to speed up the product development and launch of the product.

2.4. Firm performance

Most firms have a common goal, independently, whether it is a small family business or multinational corporate owned by thousands of shareholders. At the end of the day, shareholders and owners wants their firm value to increase (Berk & DeMarzo, 2017). The increase in firm value measured in monetary terms is one way of quantifying how the firm performs over time. However, the performance of the firm could also be measured in non-economic terms such as employee satisfaction, customer satisfaction and progress in sustainability work. Although, it may sound that these non-economic goals or metrics may contradict the profit maximization goal, they can be essential to maintaining customers or staying competitive in a market where customers and business partners also consider about the social and environmental responsibility that the firm undertakes (Keat, Young, & Erfle, 2014).

Firm performance can be assessed in several different levels and ways. The selection of firm performance indicator is not straightforward and can become a driver for employees' behaviors within the firm (Feng, Sun, Sohale, & Wang, 2014). For example, performance-based incentives, i.e. employees get financially rewarded depending on the effort, can be suitable in for instance sales-departments where it is easy to measure sales success. However, it can be trickier to measure the performance in R&D department where the success of product development or innovation is not seen until much later (Besanko, Dranove, Shanley, & Schaefer, 2017). Other researchers have also suggested to measure more of the operational indicators e.g., responsiveness to customers, delivery speed and customer service (Feng, Sun, Sohale, & Wang, 2014). In the study by Rosseau, et al. (2016), they argue that different metrics capture different kinds of firm performance, as well as how it is correlated to product or process innovation. According to their study, market facing measures, e.g., sales growth or market share, capture the full value added from innovation. In contrast, process innovation was often associated with increased efficiency or reduced operating costs and was therefore more often related to metrics such as net profit or return of assets. Moreover, companies that conduct both product and process innovation are more competitive and better equipped to retain or increase its market share (Rosseau, Mathias, Madden, & Crock, 2016; Radicic & Djalilov, 2019).

Feng, et al. (2014) studied the relationship of time-to-market and firm performance and categorized the performance measures into operational performance and business performance. As previously stated, operational performance was defined as how well a firm can serve its customers and its effectiveness doing so. While business performance was defined as the firm's profitability and market growth. The study concluded that both operational performance and business performance was enhanced by the lower TTM (Feng, Sun, Sohale, & Wang, 2014).

Furthermore, innovation can have a great impact on firm performance and depending on the type of innovation. An increased profitability and return of assets were correlated with process innovation. In contrast, sales growth or market share were more correlated with all types of innovation (Rosseau, Mathias, Madden, & Crock, 2016). Tang, Zhang, and Peng (2021) concluded that a 1% increase in marketing innovation resulted in a 0.2 to 1.3% increase in firm value depending on the type of marketing innovation. Moreover, a study investigated the organizational innovation and firm performance concluded that organizational had a positive impact on firm performance. However, it also had a mediating effect on technological innovation (Chen, Wang, & Huang, 2020).

In this study, we have chosen on the firm performance metrics that measure the market facing measures that measure the full value of innovation and time-to-market. These metrics include sales growth, profitability, market share, customer satisfaction and lead time (Feng, Sun, Sohale, & Wang, 2014; Rosseau, Mathias, Madden, & Crock, 2016).

2.5. Hypotheses

The following section present the hypothesis used in this research.

2.5.1. Business model framework

According to the theories discussed in earlier sections, a common denominator of a firms' business model and their type in the business model framework is the openness of their business model and how sophisticated their innovation process is. Type 1 firms in the business model framework had no innovation in place while type 6 even changes its business model to be able to capitalize on new opportunities in the market. Moreover, type 1 firms had little openness in their innovation while type 6 was highly externally focused (Chesbrough H. W., Open Innovation: The New Imperative for Creating and Profiting from Technology, 2003; Rajala, Westerlund, & Möller, 2012). As described in section 2.3 regarding reducing time-to-market, a planned innovation process and using input from suppliers and customers are essential. Moreover, the use of innovation processes leads to less spending on non-value adding activities which speeds up the time-to-market (Saebi & Foss, 2015; TCGen, 2022).

Hypothesis 1 (H1): Business model with a high openness have a positive impact on time-to-market.

2.5.2. Innovation

In a broad sense, innovation is almost a necessity for a firm to exist on the market. It is inevitably important for a firm to innovate to be competitive and as previously stated there are various kinds of innovation. Technological innovation (product and process innovation) is crucial since it is the core of innovating new products and hence time-to-market is comparably important. As previously stated, both the product and process innovation can reduce the time-to-market (Swann, 2009). For example, developing a new product that build on the same parts as its precursor results in reduced time and effort used on designing and sourcing, time-to-market can thus be reduced. Moreover, as described earlier process innovation in the form of simplifying the design and development process could lead to reduced design time, changes in drawing and reduction in lead time (Rajala, Westerlund, & Möller, 2012). In addition, Schmidt and Rammer (2007) concluded that organizational innovation (non-technological innovation) had a strong impact on several factors such as reduced time to respond to customer need (i.e., time-to-market) and improved quality of goods. While for marketing innovation, a good example on this was Coca-Cola's "Share a Coke"-campaign, where a "new" product was created and lead to a unmistakable fast time-to-market (Tang, Zhang, & Peng, 2021).

Hypothesis 2 (H2): Innovation has a positive impact on time-to-market.

2.5.3. Capital structure

As concluded in previous sections, there are several aspects within the firm that determines the capital structure and the preference of funding. Firm size and company strategy can affect the preference for funding and according to Myers' pecking order retained earnings will be preferred over debt and equity due to the lower cost of capital (Berk & DeMarzo, 2017). However, innovation is costly and to reduce time-to-market, an intensified resource commitment is crucial (Choi, Kumar, & Zambuto, 2016). Therefore, it is likely that more capital is required during a shorter period to obtain a fast time-to-market. The high demand for capital forces companies to look externally for capital, hence, applying the reversed pecking order where external funding such as equity is preferred.

Hypothesis 3 (H3): Preference for external capital (debt and/or equity) has a positive impact on time-to-market.

2.5.4. Time-to-market

As previously stated in the literature review, a low time-to-market can have several advantages on the overall firm performance such as competitive advantage, improved customer satisfaction, increased revenue and market share (Chen, Reilly, & Lynn, 2005; TCGen, 2022). By reducing the time-to-market, the firm performance can be increased, and the firm can thus become more competitive (Feng, Sun, Sohale, & Wang, 2014).

Hypothesis 4 (H4): A fast time-to-market has a positive impact on firm performance.

2.5.5. Hypotheses delimitation

The chosen theoretical concepts investigated in this study are highly intertwined with each other and it is inevitable to avoid the others when one concept is discussed. For example, an increased firm performance could be correlated directly with innovation without even consider the time-to-market as a variable (Swann, 2009; Feng, Sun, Sohale, & Wang, 2014). Moreover, one could argue that capital structure should be more correlated with innovation than time-to-market since innovation activities is in reality draining the funds. Furthermore, business model framework is highly correlated with innovation and the openness of a firm's innovation process including business model. However, we have chosen to put time-to-market as the mediating effect between the different theoretical concepts and place it at the core of the study, since many companies might be interested in how to succeed with their innovation efforts as fast as possible in this fast-paced world as well as to limit the study. Moreover, when building the theoretical framework, it was found that literature connected to time-to-market and for example firm performance occurred less frequently than for example innovation connected to firm performance. Hence, this study can contribute to a less investigated area.

3. Methodology

This research started off as explanatory research since it was convinced that the literature review was a solid foundation for shaping the conceptual model. However, the research ended up of becoming somewhat explorative which will be later explained in the consecutive chapters.

To answer the research question, necessary data from people working in any type of company in terms of business model and firm size is required. The only types of enterprises that was not included in this study had a social mission to uphold such as health care, law enforcement, fire department or educational institutions. Their social mission impedes them from putting financial performances as a top priority.

Moreover, the data collection method consisted of a literature review and a survey based on the conceptual model. Literature review is used to validate and challenge the conceptual model. The choice of using a survey is to gain data on topics that may be difficult to find in secondary sources, e.g., open or closed business model, innovation activities, firm's capital structure. Since the research question "*How will the extent of an open business model, the choice of innovation and a firm's capital structure affect time-to-market and thus firm performance?*" is related to "How much?", survey as a data collection method was favored (Ghauri, Grønhaug, & Strange, 2020).

The sample selection for the survey is done according to purposeful sampling, i.e., selecting participants to partake in the study. This technique is considered to be the most cost-effective and time-effective sampling method, since it is the only available method when the data source is limited to primary data. This sampling method is also effective when studying human behavior. In contrast, researcher's judgement is vulnerable to errors, this method has low reliability and high levels of bias as well as the risk of not being able to generalize research findings (Dudoviskiy, 2022). The two previous mentioned disadvantages will be addressed by assembling a sufficient sample size as well as checking the model for reliability and bias. An already known issue is that the sample size will be limited by the researcher's network, relationship status and ability to motivate these population members. In order to gain answers to the stated research question, this survey aims to gather responses from managers, stakeholders, project managers, project participants.

The concepts or constructs is operationalized by using a survey that will use a number of statements in the survey to represent the concept. The collected data is thereafter analyzed using structural equation modelling (SEM). However, the outcome of the collected data directed the study to return to exploratory factor analysis (EFA), which is explained more in the consecutive chapter. Lastly, the output is analyzed, discussed, and concluded.

3.1. Structural equation modelling

When choosing data analysis method, the ability to examine several relationships simultaneously were the basis for selecting SEM compared to other techniques. Another reason was due to research approach where the aim was to confirm a hypothesized conceptual model i.e., the measured variables (or observed, independent indicator variables) are prespecified in how they are related to the latent variables (or dependent constructs) (Hair, Black, Babin, & Anderson, 2014). SEM is a quantitative statistical tool that is utilized to analyze qualitative data, by combining factor analysis and regression analysis that enables simultaneous analysis of all the paths between observed indicator and latent variables (Ghauri, Grønhaug, & Strange, 2020). After collecting and assessing the data in chapter 4.2.2 and estimating the correlation matrix in 4.2.3.1, realization that the data in the correlation matrix were too low. A decision was taken to reconstruct the model using EFA and thereafter finalize the model using the methodology of SEM again. In short, EFA is used to explore all the relations between the observed variables and the latent variables, where the objective is to maintain significant variables that explains the data. The procedure of EFA is more thoroughly explained in chapter 3.3. Both SEM and EFA uses the methodology of factor analysis and are similar in assessing the data and results (Hair, Black, Babin, & Anderson, 2014).

Another statistical tool that can comparatively be used in this type of study is MANOVA, which stands for multivariate analysis of variance (Cole, Maxwell, Arvey, & Salas, 1993). It can be used in nonexperimental design (e.g., survey) where group of interest are defined, and then other metric variables are analyzed for statistical significance. MANOVA observes two or more dependent variables on a set of categorical (nonmetric) variables acting as independent variables. However, the advantages with SEM compared to MANOVA are for example the devoid of measurement errors on the outcome, the determination of model fit, the ability of modelling categorical and multilevel data etc. (Huang, 2020).

Another version of SEM, which is called partial least squared structural equation modelling (PLS-SEM) could have been employed instead of SEM in this study. The benefits of PLS-SEM are that it can be applied on nonnormal data and small sample size as well as allowing the use of formative indicators[2]. Since most data from empirical business and social sciences are characterized as non-normal, PLS-SEM could have been directly used from the start. Moreover, new research has even developed the toolbox even further by accommodating more complex structures or treating data shortfalls such as heterogeneity. However, the limitations of PLS-SEM are for example assessment of model fit (which is similar to SEM) and consistency of the parameter estimates. In general, neither method is regarded as more superior to the other (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). In fact, it depends on the research approach; SEM is preferable for confirmatory modelling while PLS-SEM for exploratory modelling.

[2] Formative measures/indicators are the opposite to reflective measures. Reflective measures are used in SEM, where the constructs define the indicators (i.e., arrow direction is pointed from constructs to indicators). While formative indicators form the latent construct (i.e., the arrow direction is pointed from indicators to constructs).

3.1.1. Stages of SEM

According to Hair, et al. (2014), there are six stages of SEM which is summarized in Table 2. Stage 1–3 will be described in the following chapter, while stage 4–6 will be described in chapter 4.2.2 for the initial model and chapter 4.2.3 for the final model. Confirmatory factor analysis (CFA) is performed at stage 2, where the measurement and structural model is together drawn. Measurement model represents the part where the relationship between latent variables and indicators whereas structural model specifies the relationship between latent variables (Hair, Black, Babin, & Anderson, 2014). When there is a predefined relationship between indicators and latent variables, CFA model is employed and is a part of SEM stage 2 and 5 (see chapter 4.2.2). Note that the chapters in Table 2 are not organized accordingly, which means that sometimes it was a necessity to deviate from the regular process of SEM. In this case, we wanted to obtain valuable information on the data such as assessing correlation matrix and to optimize the model before estimating construct validity that depends on the final constructs. More detailed explanation is elaborated in chapter 4.2 regarding how each step was proceeded.

Table 2. SEM stages according to Hair, et al. (2014).

Stage	Process step	Activity	In this study
1	Define the individual constructs	What variables shall be measured?	See chapter 3.1.1.1.
2	Develop the overall measurement model	Make measured variables with constructs Draw a path diagram for the measurement model	Conceptual and initial model is found in chapter 3.1.1.2. Measurement and structural model is found in Figure 11 in chapter 4.2.2.1.
3	Design a study to produce empirical results	Assess the adequacy of the sample size Select the estimation method and missing data approach	See chapter 3.1.1.3.
4	Assess the measurement model validity	Assess line goodness-of-fit (GOF) and construct validity of measurement model	For the initial model, see chapter 4.2.2.2 (GOF). Construct validity was not tested until at stage 6.
5	Specify the structural model	Convert measurement model to structural model	After EFA was performed (see), the final model using CFA was performed (which includes both measurement and structural model) and is presented in chapter 4.2.3.11.
6	Assess structural model validity	Assess the GOF and significance, direction, and size of structural parameter estimates	The final model including direction and size of structural parameter estimates is found in chapter 4.2.3.11. For the reconstructed model, see chapter 4.2.3.12 (GOF) and 4.2.3.13 (construct validity).

3.1.1.1. Stage 1 – Define the individual constructs

A measurements theory with high quality is needed to obtain useful results and therefore defining suitable constructs for the model is essential in this first stage (Hair, Black, Babin, & Anderson, 2014). After selecting the constructs, scale items (or scales/items) and scale type should be carefully chosen. According to the same authors, it is recommended to either use scales from previous constructs or develop new scales. The most common way is to use scales from previous studies which have also been to the majority been conducted in this study. For newly developed scales, it is recommended to do a pre-test (Hair, Black, Babin, & Anderson, 2014). In this study, scales related to business model framework and capital structure have been created for this study, see more explanations in chapter 3.2.1, but were not pretested due to time constraints. A summary of the chosen constructs including the different categories and number of indicators used for each construct/category is found in Table 3.

Table 3. Number of indicators per construct and their category.

Construct	Group	No. of indicators	Total indicators
Business model framework	Differentiated	1	5
	Segmented	1	
	Externally aware	1	
	Integrated	1	
	Adapted	1	
Innovation types	Product innovation	1	10
	Process innovation	3	
	Marketing innovation	4	
	Organizational innovation	2	
Capital structure	Debt	1	5
	Equity	1	
	Retained earnings	1	
	Preference of funding type	2	
Time-to-market	Definition of time-to-market	4	4
Firm performance	Financial performance	3	5
	Operational performance	2	

3.1.1.2. Stage 2 – Develop the overall measurement model

The second step in SEM consist of defining a measurement model which shall contain (1) measurement relationships for the items and constructs, (2) relationship between the constructs, (3) error terms for the items. Moreover, the relations between the constructs and the hypotheses are specified at this stage, see the hypothesis in chapter 2.5 (Hair, Black, Babin, & Anderson, 2014). As mentioned previously, an initial model and a final model will be presented in this research due to data collection issues.

As a start, the conceptual model can be found in Figure 3, where business model framework, innovation types, capital structure are exogenous, whereas time-to-market and firm performance are endogenous constructs. The final measurement model and structural model for the initial model is found in Figure 11 in chapter 4.2.2.1.

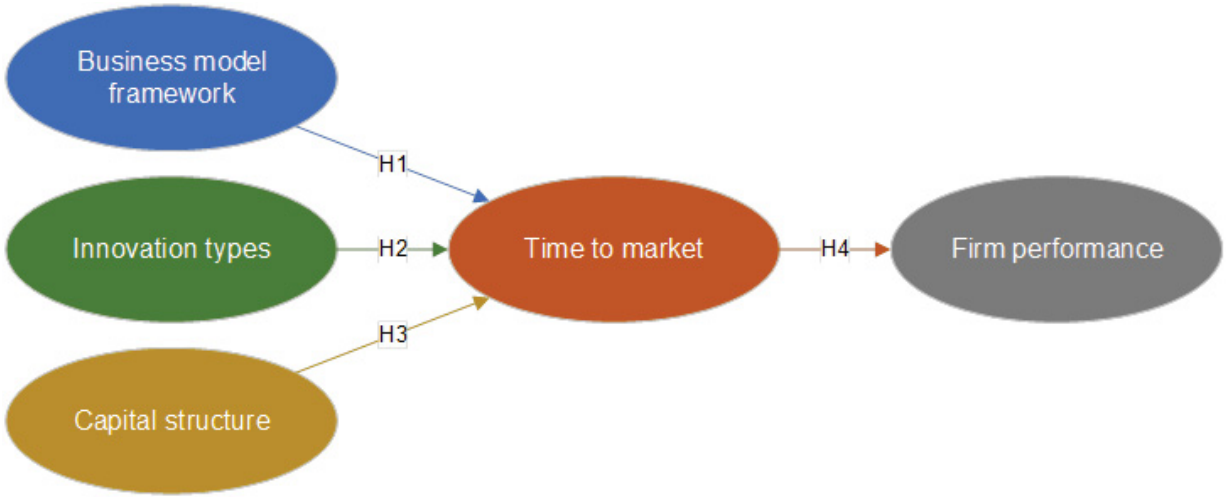


Figure 3. The conceptual model.

3.1.1.3. Stage 3 – Design a study to produce empirical results

In the third stage, empirical results are obtained from collecting data from a survey. The design of the survey is found in the following chapters regarding Data collection and Survey. Furthermore, the data type that will be mainly used for analysis is standardized correlations (SC), as these have reference limits to determine whether an item is significant or not. For SEM, the sample size is more important than other multivariate approaches. It offers a basis for estimating sampling error similar to any other statistical tool. The sample size is determined by

1. Multivariate normality of the data
2. Estimation technique
3. Model complexity
4. Amount of missing data
5. Communalities for each indicator (average variance extracted, AVE) (Hair, Black, Babin, & Anderson, 2014).

To ascertain that issues concerning when the data is not multivariate normal, it is generally accepted that the number of respondents must be 15 per each observed variable for nonnormal data (Hair, Black, Babin, & Anderson, 2014). As the survey will use a Likert scale (1, 2, 3, 4 and 5), multivariate normality cannot be checked. As for the estimation technique, maximum likelihood estimation (MLE) is the most commonly used method since it can produce valid and stable results with as small sample size as 50. In another study, a sample size of 200 was recommended in less favorable conditions but the authors suggested that sample sizes larger than 400 was not recommended due to the reason that goodness-of-fit (GOF) will indicate on poor model fit. Moreover, a model becomes more complex when there is an increased number of indicator variables, an increased number of constructs, one or two indicators per constructs or multigroup analyses in the model (Hair, Black, Babin, & Anderson, 2014).

In this case, missing data is not an issue since a web-based survey was used to ensure that all answers regarding the observed variables were compulsory. In this study, the challenge is to gather enough responses from the defined sample population. The objective of the survey is to receive as many respondents as possible who have job positions or responsibilities as managers, stakeholders, project managers, project participants. It is believed that these working backgrounds will enable them to answer the survey as thoroughly as possible, since they generally have an overview regarding the innovation activities as well as understands the different concept that have brought up in this thesis.

Regarding the communalities for each observed variable, AVE or communalities have to be higher than 0.5 to be suggesting for a smaller sample size, this is to achieve convergence and model stability. Hence, AVE is later calculated to assure that the sample size is satisfactory.

At the beginning of this study, the aim was to gather a minimum sample size of 150 respondents, which is also suggested by Hair, et al. (2014) for measurement models with seven constructs or less, modest communalities (AVE that is higher than 0.5), less than three indicators per constructs, and no underidentified constructs. However, this was changed to 200 which will be more thoroughly explained in chapter 4.2.3.1. The sample size of 200 has the advantage of not imposing any issue on normality (Hair, Black, Babin, & Anderson, 2014) and is also the typical sample size in studies that uses SEM. In this study, the following choices were made: (1) multivariate normality of the data is not considered and are instead assumed, (2) MLE is used as an estimation technique, (3) model complexity is rather simple with five constructs where each has more than two indicators (few multigroup analysis), (4) missing data is not an issue with web-based survey, which means that 200 can be considered as sufficient in this study and (5) communalities (by calculating AVE) will be later confirmed. Additionally, there are also constraining factors for researchers which limits the number of responses such as network and time.

Furthermore, the sample size also determines the significance of a path by analyzing the factor loading. For a sample size of 150, the factor loading has to be more than 0.45 while for a sample size of 200 the factor loading has to be more than 0.40 to be significant (Hair, Black, Babin, & Anderson, 2014). This will also help to determine the significance of each construct when the cut-off limit is lowered from 0.45 to 0.40 when analyzing with a higher sample size.

3.2. Data collection

The selected method for data collection in this study is to perform a survey, which will be further described in the following section.

3.2.1. Survey

A survey was formed to investigate how a (1) firm's business model framework, (2) its applied innovation types and (3) its capital structure will affect (4) the product/service's time-to-market and thus (5) the firm performance. The survey consists of two sections, where the first section is composed of questions that are used as control variables and the second section is the actual survey. The first section involves asking the participants regarding their work title, country and city of employment, work experience as well as firm-related questions regarding firm age, firm size, and firm turnover. In addition, a statement regarding the pandemic covid-19 was added in this section and was answered using a 5-step Likert scale. The reason for this is because covid-19 may have impacted organizational changes and innovation activities in the firm during 2020–2021 which overlaps the time period that the survey investigates on (2019–2021).

The second section comprises of different statements, where a five-step Likert scale have been used to scale the response. The scores in the scale ranges from 1 which corresponds to "strongly disagree" to 5 which correspond to "strongly disagree". The full survey can be found in Appendix A in both English and Swedish. The survey contains 29 statements whereof five is for business model framework, ten for innovation types, five for capital structure, four for time-to-market and five for firm performance, see Table 3. In Table 4, the statements are presented with its concept category as well as item number and variable denotation. For a construct with more than six indicators (or less than three in some cases) and several low communalities on constructs, the sample size may have to be set to more than 500 (Hair, Black, Babin, & Anderson, 2014). The aim was to initially assign 4–5 indicators per construct, but it did not end like that for the initial model. However, in order to capture the essence of every innovation type, an agreement reached to use the ten scales to see whether the sample size of 150 and later 200 will be enough to produce any significant result.

Business model framework

The first construct, business model framework, posed five statements (BMF1 to BMF5) to help define the openness and sophistication of the firms' innovation process and their business model which is correlated to their business model framework categories: undifferentiated, differentiated, segmented, externally aware, integrated, and adaptive. (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). The statements were rewritten from the definitions of the business model types, see Table 4. Higher answer values would indicate that the firms had a more developed and sophisticated innovation process and a more open business model where collaboration with external partners are common. Since business model framework is a simplified picture of reality, similar firms (within the same business model framework type) would likely, to some degree, have different answers to the selected statements. As most things, openness is a relative to the respondent's reference. For example, a respondent that daily work with external partners would probability rate high on BMF3. However, another respondent that only work occasionally with external partners might still, in their perception, rate BMF3 high.

Innovation types

The second construct has four innovation types that comprises of product innovation (PRI), process innovation (PI), marketing innovation (MI) and organizational innovation (OI), where the statements (PRI1, PI1 to P3,OI to O2, M1 to MI4) are used to determine which innovation types the firm has applied and is based on the community innovation survey (CIS) (Eurostat, 2016) and another study by Zehir and Zsahin (2008). The choice of CIS developed for 2016 is due to the fact that it contains questions regarding all the four innovation types. In which the questions were converted into statements for this study, see Table 4. Hence, no further explanation regarding the statements is elaborated here as CIS is a reference survey on innovation in enterprises used by the European Union (Eurostat, 2022).

Capital structure

The third construct concerns the capital structure at the respondent's firm and how the innovation activities are mainly funded (excluding governmental funding) and what preference the firms had for external funding (CS1 to CS5). The statements are based on corporate finance theories described by Berk, et al. (2017) and the preference according to Myers' pecking order, see Table 4. The statements regarding debt, equity, and company earnings are fairly simple but the knowledge to be able to answer it correctly might be tricky depending on the respondent's work position but may be communicated e.g., through company meetings.

Time-to-market

The fourth construct, time-to-market, (TTM1 to TTM4) adopts all the four statements that were used in the survey of Feng, et al. (2014) to determine how fast product or service were launched to the market, see Table 4. Since these statements have been previously tested, there are certainty that these formulations are established.

Firm performance

While the statements of the fifth construct, firm performance, adopted them (FP1 to FP5) from the same published article as for the statements in time-to-market (Feng, Sun, Sohale, & Wang, 2014). In this study, firm performance refers to operational performance and business/financial performance, in which the researchers cover some of the typical performance measurements at a company. Regarding financial performance, three out of five statements were chosen (sales, profit, and market share). While two out of four statements were selected for operational performance (lead time and customer satisfaction) in the survey. Some of the statements were somewhat rewritten but kept the same meaning and concept. see Table 4. Therefore, these statements are considered to be tested and valid for using in a survey.

Table 4. The structure of the survey with observed variables, items, categories, and statements.

Var.	Item	Category	Statement
BMF1	X_1	Differentiated	We conduct product development internally
BMF2	X_2	Segmented	We have a road map of product/services to be released in the near future (1-3 years)
BMF3	X_3	Externally aware	We look externally for new innovations to serve our customers
BMF4	X_4	Integrated	We work in close collaboration with customers and suppliers when innovating
BMF5	X_5	Adapted	We reinvent our business model to generate new business (e.g. merger & acquisition, creation of spin-offs or joint ventures)
PRI1	X_6	Product innovation	We introduced new or significantly improved goods or services Excluding: Simple resale of new goods and changes of a solely aesthetic nature
PI1	X_7	Process innovation	We introduced new methods of manufacturing for producing goods or services
PI2	X_8	Process innovation	We introduced significantly improved logistics or distribution methods

Var.	Item	Category	Statement
PI3	X_9	Process innovation	We introduced improved supporting activities such as maintenance systems, operations for purchasing, accounting, or computer systems
OI1	X_{10}	Organizational innovation	We introduced new business practices for organizing procedures (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)
OI2	X_{11}	Organizational innovation	We introduced new methods of organizing work responsibilities and decision making (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)
MI1	X_{12}	Marketing innovation	We introduced significant changes to the aesthetic design or packaging of a good
MI2	X_{13}	Marketing innovation	We introduced the use of new media or techniques for product promotion (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)
MI3	X_{14}	Marketing innovation	We introduced new methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems etc.)
MI4	X_{15}	Marketing innovation	We introduced new methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation etc.)
CS1	X_{16}	Equity	We funded mainly innovation activities by issuing more equity to investors (i.e. sold more shares to investors)
CS2	X_{17}	Debt	We funded mainly innovation activities by increasing its long-term debt (i.e. taking loans)
CS3	X_{18}	Retained earnings	We funded mainly innovation activities with company earnings
CS4	X_{19}	Preference of funding type	We preferred using internally generated funds over external funds when investing.
CS5	X_{20}	Preference of funding type	We preferred external debt as a funding method over capital from investors (given equal access)
TTM1	X_{21}	Definition of TTM	We delivered products to the market quickly
TTM2	X_{22}	Definition of TTM	We were first in the market introducing new products
TTM3	X_{23}	Definition of TTM	We had a time-to-market lower than industry average
TTM4	X_{24}	Definition of TTM	We had a fast product development
FP1	X_{25}	Financial performance	The growth in our sales increased
FP2	X_{26}	Financial performance	Our company's profit increased
FP3	X_{27}	Financial performance	Our company's market share increased
FP4	X_{28}	Operational performance	The lead time for fulfilling our customers' order was reduced (i.e. time from order to delivered product)
FP5	X_{29}	Operational performance	Our company's customer satisfaction increased

3.3. Exploratory factor analysis

As mentioned before, the data analysis went from CFA (a part of SEM methodology) to EFA. Hence, the model was reconstructed using EFA and finalized with SEM. EFA is applicable for the use of examining complex patterns and multidimensional relationships between variables or concepts. It is used when exploring the underlying patterns or relationships for a large number of variables and hence determine if they can be grouped or summarized into smaller set of factors or components (Hair, Black, Babin, & Anderson, 2014). In other words, the aim of EFA is to narrow down the number of variables and categorize them into different constructs by using factor analysis. Factor analysis are used to reduce data by extracting a small set of variables (preferably uncorrelated) from a large set of variables (that are mostly intercorrelated) and to create indices with variables that measures comparable components (Torres-Reyna, 2022). An EFA model is typically recognized by observing that all the relationships between all the variables are tested (double-arrowed directions between all the constructs) (Hair, Black, Babin, & Anderson, 2014).

3.3.1. Stages of EFA

There are seven stages of EFA according to Hair, et al. (2014) which can be viewed in Table 5. Stage 1 (research problem) and 2 (choice of factor analysis and research design) in EFA were not performed, because the research was initially interpreted as confirmatory. Since the first four stages of SEM were already conducted, there would be no time to redo a research problem and develop a new research design. Hence, the EFA started at stage 3 in this study. To follow stage 3–6 in EFA, a summary can be found in Table 5 and the procedure of reconstructing a new model in chapter 4.2.3. Stage 7 in EFA is optional and will not be applied. Note that the referred chapters in Table 5 are not performed accordingly to the stages and the reason for this was to attain valuable information early on (for example by performing correlation matrix to analyze the adequacy of the sample size and the conceptual coherency of the constructs). Furthermore, the main application of EFA is to delete the indicator variables that does not explain to a large extent of the data and finally a new CFA model is created to determine if the model can answer the research question.

Table 5. EFA stages according to Hair, et al. (2014).

Stage	Process step	Activity	In this study
1	Research problem	Is the analysis exploratory factor analysis or confirmatory factor analysis? If EFA, move on further to the next stage. If CFA, move on to SEM.	Starting off with CFA but returned to EFA.
2	Select the type of factor analysis	What is being grouped – variables or cases?	Variables is grouped by using R-type factor analysis and requires a correlation matrix.
	Research design	What variables are included? How are the variables measured? What is the desired sample size?	Research design is described in chapter 3.1.1.1, 3.1.1.2 and 3.1.1.3 Data collection using survey was performed according to chapter 3.2.1.
3	Assumptions	Statistical considerations of normality, linearity, and homoscedasticity Homogeneity of sample Conceptual linkages	The statistical considerations are assumed to be valid due to the chosen sample size. Sample size was previously discussed in chapter 3.2.1. Correlation matrix is performed in chapter 4.2.3.1. Appropriateness test for using factor analysis is done in chapter 4.2.3.4.
4	Selecting a factor method	Is the total variance or only commence variance analyzed?	Total variance is analyzed by extracting factors with component analysis, see chapter 4.2.3.3.
	Specifying the factor matrix	Determine the number of factors to be retained	See chapter 4.2.3.2 and the new model in 4.2.3.9.
5	Selecting a rotational method	Should the factors be correlated (oblique) or uncorrelated (orthogonal)?	Factors are assumed to be uncorrelated and thus orthogonal method was applied using VARIMAX, see chapter 4.2.3.5. It is computed for the new model in 4.2.3.8.
	Interpreting the rotated factor matrix	Can significant loadings be found? Can factors be named? Are communalities sufficient?	See chapter 4.2.3.9. Communalities are estimated in 4.2.3.13.
	Factor model respecification	Were any variables deleted? Do you want to change the number of factors? Do you want another type of rotation?	Variables were deleted, which is why stage 4 and 5 were iterated for the new model.
6	Validation of the factor matrix	Split/multiple samples Separate analysis for subgroups Identify influential cases	CFA is performed in chapter 4.2.3.11. Goodness-of-fit tests is estimated in chapter 4.2.3.12. Construct validity is tested in chapter 4.2.3.13
7	Additional uses	Selection of surrogate variables Computation of factor scores Creation of summated scales	Not performed in this study.

4. Results

Just like the survey was divided into two sections, the results are similarly structured into two parts, whereas the first section is called descriptive statistics and the second section is called empirical results. The variables used in descriptive statistics functions as control variables to obtain an overview of the sample population. While the empirical results apply more advanced statistical tool, such as SEM and EFA, to develop and validate a model that can facilitate in answering this study's research question.

4.1. Descriptive statistics

Member of the sample population were contacted in several different communication methods such as posts on social media (LinkedIn and Facebook), through direct contact on social media and e-mail to colleagues, working partners and other relevant working professionals. The aim was to attract as many respondents as possible from people that had job positions such as managers, stakeholders, project managers, project participants (e.g., engineers, product manager).

Moreover, English and Swedish versions of the survey were created (see Appendix A), and the web-based survey software Microsoft Forms was used to collect responses. The link to the survey along with information regarding privacy and introduction of the study was distributed with the media mentioned above. A total of 169 answers were obtained during a two-week period, whereof 162 were relevant to our study according to the sampling criteria mentioned in Methodology. Afterwards, another attempt of gathering totally 200 responses were made which took additional two weeks to achieve. The result was 208 answers whereof eight of them (3.8%) were removed. In total, 70% of the respondents answered in the Swedish version while the rest used the English version of the survey.

4.1.1. Work title

The respondents were asked for their work title which was categorized according to Table 6. The table also contains example of the different categories stated by the respondents. The job was categorized according to the following order of upper management, manager, project management, operations, research development & engineering (RD&E), sales & marketing, administration, and consultant e.g., a R&D manager would be categorized as a manager as supposed to RD&E. As can be seen in Figure 4, the largest category of respondents was RD&E where 19% of the respondents belonged to this category. The second largest group of respondents was operations followed by managers. The smallest category of respondents were consultants (3%).

Table 6. Category of work titles and example of stated job titles.

Work department	**Example of job title**
Upper management	CEO, Founder, Managing Director, Board member, Vice president
Manager	Team manager, R&D manager, manager, QA lead
Project management	Project manager, Commercial project leader
Operations	Purchaser, IT support, Global controller
RD&E	Development engineer, Material specialist, Process engineer
Sales & marketing	Product manager, Business developer, Senior global key account manager, Sales specialist
Consultant	Energy consultant, Senior consultant, IT analyst consultant
Administration	Business analyst, Strategic finance, Digitalization strategist

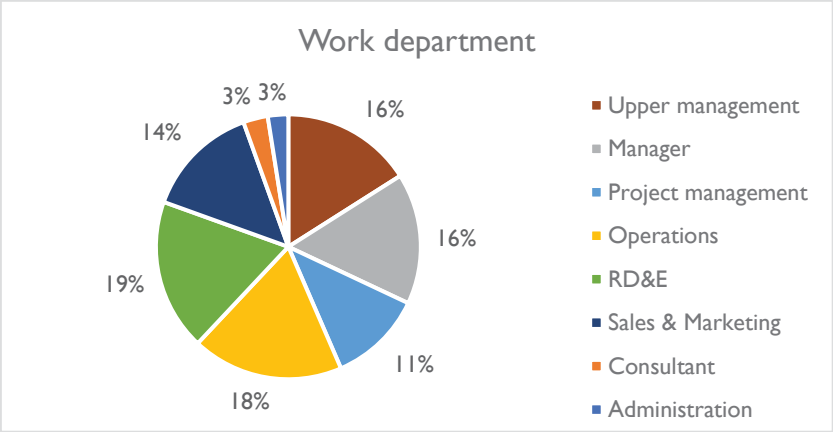


Figure 4. Respondents' work title.

4.1.2. Country

In this study, the survey did not aim to investigate in a certain country because innovation can occur at any company regardless of a specific country. A multinational company based in Sweden does not necessarily represent Swedish innovation thinking, since innovation strategies are usually set by the executive management who could be based in another country where the headquarters is located. Since both authors are based in Sweden and talk Swedish (but work at international companies), it is natural that most of the respondents would be based in Sweden which can be seen in Figure 5. The other category consists of respondents from Canada, China, Greece, Hong Kong, Netherlands, Norway, Philippines, Romania, Spain and United Kingdom.

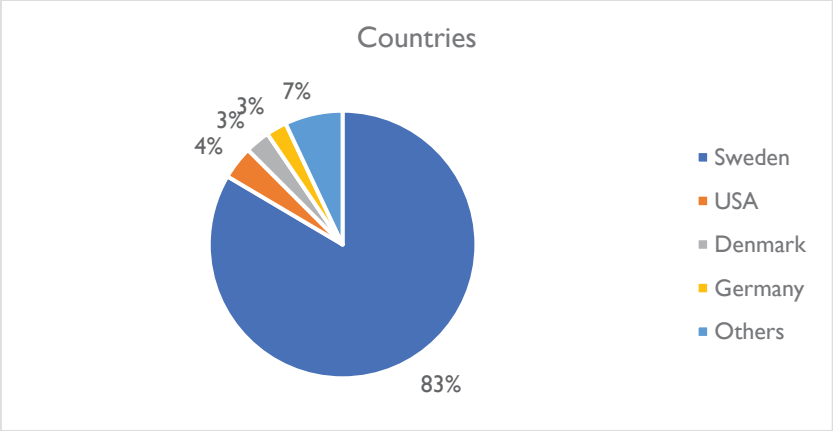


Figure 5. Respondents' country of employment.

4.1.3. Work experience

To get a deeper understanding of the respondents, the survey also asked the participants of how long they have worked for the company. The answers categorized in four different groups: 0–2 years, 3–5 years, 5–10 years, and more than 10 years. As can be seen in Figure 6, the largest category was 0–2 years of employment in the same company which was followed by the group that only worked for the same firm 5–10 years. This could lead to answers that less representative for the firm the respondent is working on. Since the questions were related to changes that happened within the last three years (2019 –2021), changes could have already been implemented before the employee joined the company but took place within that time period. However, most of the respondents (73%) have worked for more than three years at their firm. Due to the covid-19 pandemic, many companies have also experienced immense of changes that might have been directly or indirectly accelerated by the pandemic.

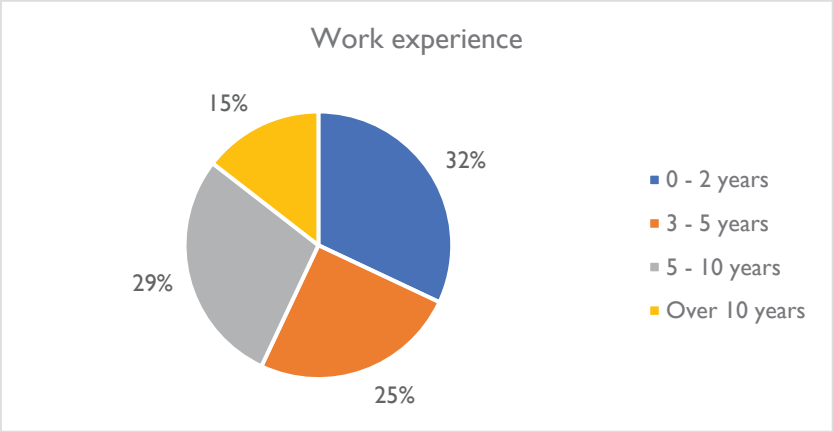


Figure 6. Work experience within the same organization/firm.

4.1.4. Firm age

To obtain a better understanding of the firm that the respondent worked for, the survey posed a question regarding the age of their firm. The age of the firm can be related to the maturity and the business model framework of the firm. This could not be later confirmed, since the model was reconstructed and removed some of the statements used to represent business model framework. The average firm age was 46 years, and the median firm age was 32 years. The oldest firm was more than 200 years while the youngest firm was less than one year old. Out of the 200 responses, 29 were micro enterprises or startups based on their turnover. The firms were divided into different age group, 0–5 years, 6–10 years, 11–30 years, 31–50 years, 51–100 years, 101–200 years and unknown, see Figure 7. A total of 50% of the firms had the age between 0 to 30 years.

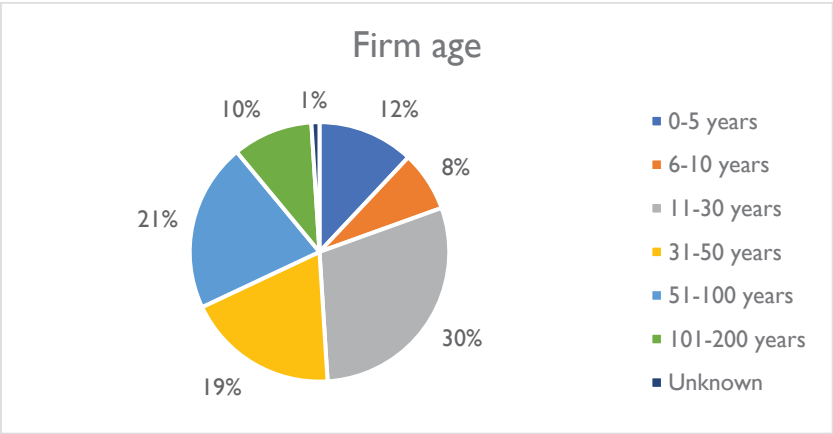


Figure 7. Firm age of respondents' companies.

4.1.5. Number of employees and turnover

To understand the size of the firms that respondents were working for, the survey asked for the number of employees and turnover. Categorization of the firm was done according to the number of employees and turnover, respectively, and were divided into either micro, small, medium, or large enterprises, see Table 7. The definitions in Table 7 follows the guidelines of European Commission (European Commission, 2022).

Table 7. Firm size classification and the number of employees and turnover ceilings.

Firm size/type	Number of employees	Turnover ceiling
Micro	≤ 9	< 2 million €
Small	10–49	< 10 million €
Medium	49–249	< 50 million €
Large	>250	≥ 50 million €

Following the classification mentioned in the table above, Figure 8 shows the results of the respondent's firm regarding the number of employees in their company. The largest firm category was the large firms (58%) while the micro and small enterprise (10%) were the smallest category.

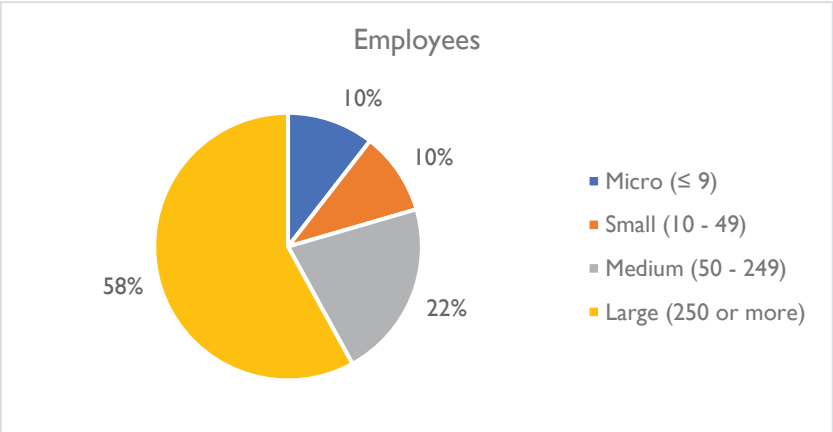


Figure 8. Firm size and total number of employees at the firm.

As for the turnover, most of the firms (51%) were large enterprises while the smallest category was the small enterprises (8%), which can be seen in Figure 9. A total of 10% of the respondents' firm were medium enterprises while 14% were micro enterprise. The largest firm had a turnover of 87 billion € while the smallest reported turnover of 10,000 €. The average turnover was 4.3 billion € while the median was 120 million €. It should be noted that 34 answers of the 200 survey responses were either missing (not filled in or incorrect number), since the question was open-ended and not multiple-choice like for question regarding number of employees.

In summary, the size of each firm size category in the number of employees are not corresponding to the turnover, which can be explained by the lack of answers in the question related to firm turnover. Many respondents regarded turnover as a company secret or simply did not know the turnover of their company.

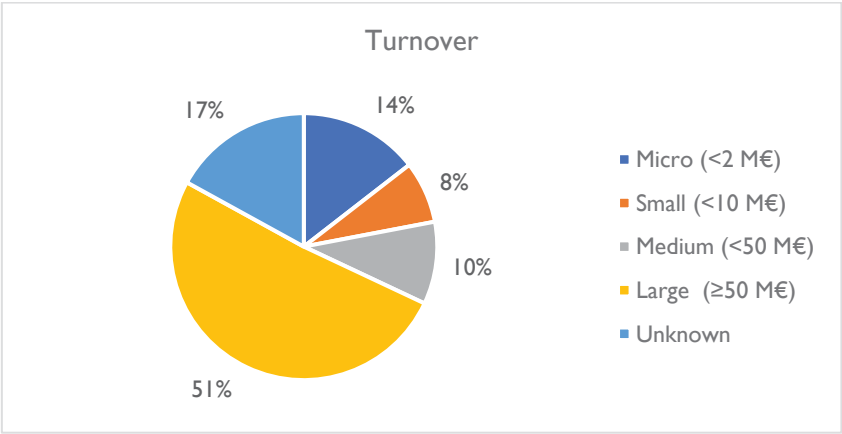


Figure 9. Firm size and firm turnover.

4.1.6. Covid-19

The aim of this study was to not examine the effect from the pandemic that had on companies' innovation or organizational changes. However, due to the pandemic it was inevitable to not make changes in how business was made. For example, the share of digital customer interactions increased more than 20% depending on region (LaBerge, O'Toole, Schneider, & Smaje, 2020). Moreover, many new innovations have been seen during the crisis. For example, the market size of food delivery services market has more than doubled in the USA due to the pandemic (Ahuja, Chandra, Lord, & Peens, 2022). It is therefore relevant to control to what extent the changes made are due to the pandemic or not. This was done by survey the following statement: "During the period of 2019–2021, the organizational changes or innovation activities conducted in your company was mainly accelerated by the covid-19 pandemic". The answer was categorized in a Likert scale form strongly disagree (1) to strongly agree (5). The result is shown in Figure 10, where the average score was 3.2.

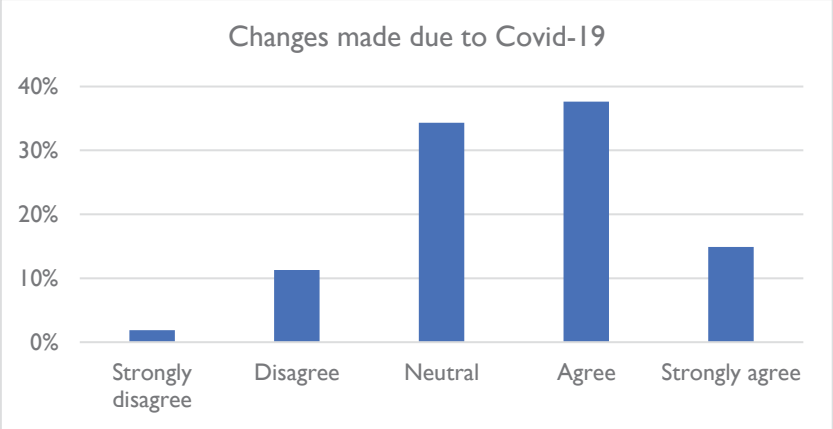


Figure 10. Changes made due to covid-19.

4.2. Empirical results

The empirical results of the results are presented in the subsequent chapters, where a quick overview of the analytical and statistical procedure is explained and then followed by how the initial model was analyzed and how the new model was reconstructed.

4.2.1. Overview

In the final stages of analyzing the results, the validity of the model will be assessed. STATA 17.0 is used as a statistical software tool for all the following statistical analysis. As a part of the methodology of SEM, CFA will be used in this study. CFA is applied when there is a defined hypothesis with different constructs and an underlying set of variables. While EFA explores the path of different constructs with a set of variables by testing all paths (Torres-Reyna, 2022). In this research, EFA will be used to reduce the number of variables that are contributing less to the results. After performing EFA, a CFA model from the SEM methodology will be conducted. The following chapters are structured firstly in how the initial model was assessed and continuing how the model was reconstructed, see the following overview of the procedure and the use of statistical tools for the initial and reconstructed models in the text below.

Initial model

- **SEM** is applied to test the initial model according to stage 4 in SEM (see stage 1–3 in chapter 3.1.1.1, 3.1.1.2 and 3.1.1.3), where the following tools are used:
    - **CFA –** To construct the measurement and structural model (based on the conceptual model)
    - **Goodness-of-fit** of the initial model – To test the model fit by computing
        - $\chi 2$ goodness-of-fit index
        - Root mean square error of approximation (RMSEA)
        - Comparative fit index (CFI)
        - Tucker Lewis index (TLI)
        - Standardized root mean squared residual (SRMR)
        - Coefficient of determination R^2 (CD).

Reconstructed model

- **EFA** is applied to reduce insignificant variables according to stage 3–6 in EFA, where the following tools are used:
    - **Correlation matrix –** To assess the correlation in the observed data set
    - **Principal component analysis** (PCA) – To condense the information into smaller set of factors (uses the same approach as factor analysis)
    - **Appropriateness test** – To test whether factor analysis can be employed by computing
        - Bartlett test of sphericity
        - Kaiser-Meyer-Olkin (KMO)
    - **Rotated component matrix –** To simplify the factor structures
    - **Regrouping new constructs –** To restructure the constructs by using rotated component matrix and assessing the statements' implication
    - **Correlation matrix** of the new constructs **–** To mainly verify if the regroup of new constructs have improved when assessing the correlation in the observed data set
    - **Rotated component matrix** of the new model **–** To mainly verify if the new model is better than by comparing to the initial rotated component matrix
    - **Factor analysis** of the new model – To determine eigenvalue and cumulative and hence determine the number of factors that are relevant to calculate factor loading
    - **EFA** – To determine the relationships between the constructs of the reconstructed model.

- **SEM** is applied to test the reconstructed model according to stage 5–6 in SEM, where the following tools are used:
    - **CFA** – To build the reconstructed model based on EFA and theory
    - **Goodness-of-fit** of the reconstructed model – To test the model fit
    - **Construct validity –** To verify convergent validity and discriminant validity by estimating
        - Standardized factor loading
        - AVE or communalities
        - Comparison of squared AVE and standardized correlation/factor loading (SC)
        - Construct/composite factor reliability (CR).

4.2.2. Initial model

4.2.2.1. Measurement and structural model

A visual presentation of the conceptual model including the variables that are connected to the constructs is presented in Figure 11. A total of 29 statements were used in the survey which means that there are 29 observed indicators and five latent constructs. The constructs Business model framework (BMF), innovation types (INT) and capital structure (CS) are exogenous while time-to-market (TTM) and firm performance (FP) are endogenous.

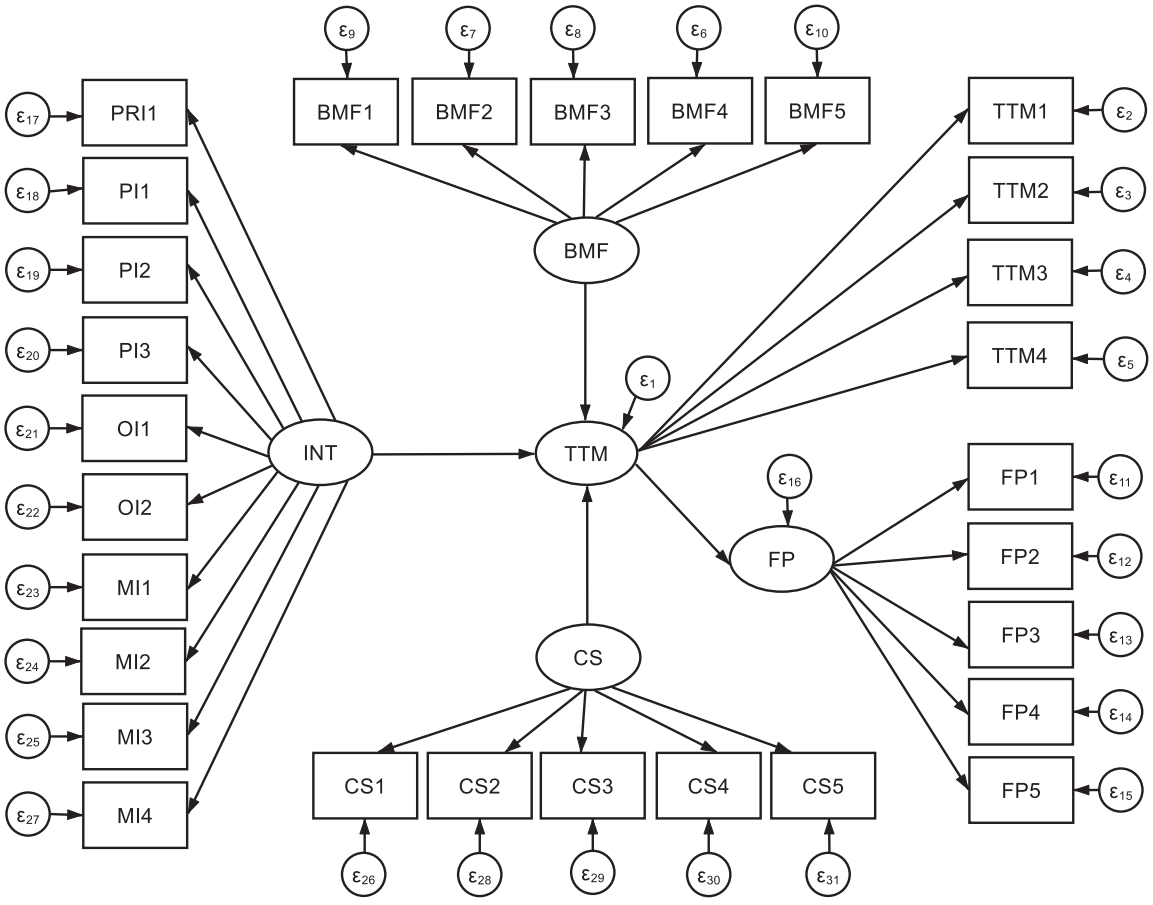


Figure 11. The initial model.

4.2.2.2. Goodness-of-fit

Since the model is now built, the model will now be evaluated of how well the data fit to the CFA model in Figure 11. Table 8 shows the different established indexes that are used in this study: χ^2 goodness-of-fit (GOF), root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI), standardized root mean squared residual (SRMR) and coefficient of determination R^2 (CD). The measures χ^2 GOF, RMSEA and SRMR are a type of absolute fit index, while CFI, TLI and CD are incremental fit indices (Hair, Black, Babin, & Anderson, 2014).

Chi-square (χ^2) GOF calculates the difference between observed and estimated covariances matrices and is considered to be the key GOF index in assessing the model fit to any SEM model. Since the estimated covariances matrices is affected by degrees of freedom (df) but is not calculated as in regression. In fact, it relays on the number of indicators in the model. The null hypothesis of SEM is that the model fit is perfect i.e., the observed sample and estimated covariance matrices are equal. Another difference for using this index in SEM compared to other multivariate techniques is to achieve a p-value more than 0.05, which is usually vice versa. A p-value less than 0.05 means that there is a significant difference between the two covariance matrix and hence implies that there are issues with the model fit. Moreover, a good model fit means that the value should be more than 0 but the value should rather be closer to 0. However, it cannot be used as the sole GOF measure since larger sample size will make it more difficult to depict if the GOF is statistically insignificant. Also, adding indicators will increase χ^2 which makes it difficult to achieve a good model fit (χ^2 closer to 0). Since the assessment of GOF with a χ^2 is rather complex, other alternatives of GOF measures have been developed (Hair, Black, Babin, & Anderson, 2014).

RMSEA is the next measures that is most broadly estimated to address the issues of χ^2. It takes into accounts on how well the model fits to a sample population and not just simply a sample used for estimation. In other words, RMSEA computes for both model complexity and sample size. The lower the value of RMSEA is, the better the model is. Previous researchers have argued that a reference limit for RMSEA should be less than either 0.05 or 0.08. Other argue that evaluation of RMSEA is best suited for confirmatory or similar models and sampling sizes of 500 or more (Hair, Black, Babin, & Anderson, 2014). Although the sample size in this study is 200, RSMEA will be estimated to compare between different models. As for the cut-off point for RMSEA, 0.8 is applied in this research.

CD (R^2) is a commonly used measure for model fit and is calculated as the squared correlation between actual and predicted values of the dependent variable. A good model is when CD converges to 1 (Hair, Black, Babin, & Anderson, 2014).

SRMR is related to standardized residuals that is deviation of individual covariance terms and thus not consider overall model fit. A rule of thumb for SRMR is that a value over 0.1 means that the model fit may be poor. However, another compilation of simulation research sets a limit of 0.08 or less, which will also be used as a reference in this study. The value is determined by sample size, model complexity and degrees of error in model specification (Hair, Black, Babin, & Anderson, 2014).

CFI and TLI are incremental fit indices that compares the estimated model fit to an alternative baseline model or termed as null model, in which it assumes that all observed variables are uncorrelated. TLI is not normed and can have values that exceed below 0 or above 1. The closer TLI converges to 1, the better the model fit is. CFI and TLI are similar in the way that they stem from another index, but CFI is the improved version. A CFI-value higher than 0.9 typically indicates usually that the model has a good fit (Hair, Black, Babin, & Anderson, 2014). Since the model will be reconstructed using both exploratory and confirmatory approach, the reference limit for CFI and TLI is set that it should approach to 1.

A compilation of the discussed reference limits can be found in Table 8 and could differ from research case to case (Hair, Black, Babin, & Anderson, 2014). Hair, et al. (2014) emphasizes that it is therefore highly advisable to compare models using GOF indices as this will at least give determine which of the model is better. Moreover, computation of the GOF indices for the initial model is presented in Table 8. All the estimated GOF values failed except for R^2 for the initial model, which already here implies that the conceptual model needs to be revised.

Table 8. Goodness-of-fit check for the initial model.

Goodness-of-fit indices	**Abbreviation**	**Reference limit**	**Initial model**	**Pass/Fail Initial model**
χ^2 Goodness of Fit Index	GOF	$0 < \chi^2$ GOF $p \geq 0.05$	909 df=373 p=0.000	Fail
Root Mean Square Error of Approximation	RMSEA	RMSEA < 0.08	0.085	Fail
Standardized Root Mean Squared Residual	SRMR	SRMR ≤ 0.08	0.119	Fail
Coefficient of Determination R^2	CD	→ 1	0.989	Pass
Comparative Fit Index	CFI	→ 1	0.646	Fail
Tucker Lewis Index	TLI	→ 1	0.615	Fail

4.2.3. Reconstructed model

4.2.3.1. Correlation matrix

As the model fit was inadequate, the data set is now assessed. Since the survey was performed digitally with required responses, missing data was not a concern. Therefore, the evaluation of the data will be focused on determining whether the number of responses was enough to validate the model. This is done by performing a correlation matrix with the command `correlate` or `corr`. The values in the correlation matrix shows the Pearson correlation coefficient, denoted by r, which is a measure of the strength of the linear relationship between two variables. The absolute value of 0–0.3 indicate a weak linear relationship, the absolute value of 0.3–0.7 indicate a moderate linear relationship and the absolute value of 0.7–1.0 indicate a strong linear relationship. The squared of r, r^2, is also called coefficient of determination and usually denoted as R^2, which is used as a GOF measure (Ratner, 2009).

As a first try, 169 responses were collected, whereof 162 were relevant according to the sampling criteria clarified in Methodology. But the correlations were too low and an additional attempt to increase the number of relevant responses to 200 was made. A total of 208 responses were thereafter gathered whereof eight of them were not included (3.8%), see the results of the correlation matrix for the 200 responses in Table 9. The values in the correlation matrix are color coded depending on the value.

Table 9. Correlation matrix of the initial model.

	BMF1	BMF2	BMF3	BMF4	BMF5	PRI1	PI1	PI2	PI3	OI1	OI2	M1	M2	MI3	MI4
BMF1	1.000														
BMF2	0.384	1.000													
BMF3	-0.030	0.160	1.000												
BMF4	-0.054	0.199	0.203	1.000											
BMF5	0.155	0.300	0.212	0.216	1.000										
PRI1	0.413	0.388	0.050	0.176	0.316	1.000									
PI1	0.138	0.139	0.036	0.153	0.160	0.388	1.000								
PI2	0.039	0.222	-0.073	0.129	0.177	0.204	0.371	1.000							
PI3	0.120	0.223	0.061	0.115	0.264	0.175	0.238	0.450	1.000						
OI1	0.080	0.254	0.170	0.117	0.201	0.204	0.252	0.353	0.325	1.000					
OI2	0.196	0.286	0.133	0.141	0.329	0.278	0.217	0.246	0.359	0.411	1.000				
MI1	0.156	0.188	0.092	0.022	0.171	0.326	0.328	0.291	0.285	0.234	0.138	1.000			
MI2	0.146	0.310	0.146	0.097	0.278	0.315	0.053	0.135	0.340	0.215	0.395	0.324	1.000		
MI3	0.089	0.079	-0.025	0.013	0.185	0.197	0.131	0.169	0.083	0.159	0.257	0.212	0.283	1.000	
MI4	0.144	0.164	0.040	0.037	0.264	0.303	0.192	0.252	0.209	0.100	0.252	0.374	0.593	0.305	1.000
CS1	-0.036	0.063	0.083	0.107	0.274	0.110	0.173	0.142	0.174	0.021	0.189	0.113	0.027	0.018	0.130
CS2	-0.061	0.020	0.074	0.075	0.229	0.061	0.112	0.275	0.217	0.224	0.349	0.094	0.139	0.190	0.141
CS3	0.100	0.022	-0.067	-0.041	0.032	0.160	-0.021	0.036	-0.032	-0.002	-0.112	0.022	0.155	-0.008	0.053
CS4	0.171	0.051	-0.071	-0.137	0.015	0.119	0.077	0.139	0.105	0.050	-0.063	0.055	0.164	0.058	0.142
CS5	-0.033	0.069	-0.055	0.176	0.186	0.019	0.079	0.283	0.229	0.194	0.196	0.021	0.066	0.152	0.058
TTM1	-0.027	0.060	0.016	0.052	0.172	0.230	0.200	0.234	0.157	0.176	0.142	0.324	0.217	0.215	0.141
TTM2	0.220	0.216	0.001	0.054	0.246	0.354	0.272	0.207	0.167	0.093	0.202	0.318	0.268	0.146	0.180
TTM3	0.043	0.039	0.002	-0.095	0.022	0.145	0.025	0.136	0.089	0.058	0.093	0.173	0.099	0.105	0.025
TTM4	0.081	0.018	0.119	0.040	0.146	0.249	0.223	0.103	0.111	0.130	0.145	0.291	0.209	0.172	0.170
FP1	0.146	0.107	0.010	0.007	0.088	0.257	0.112	0.047	0.094	0.185	0.042	0.243	0.204	0.119	0.164
FP2	0.106	0.089	-0.035	0.041	0.101	0.208	-0.006	-0.013	0.032	0.035	0.047	0.159	0.162	0.013	0.107
FP3	0.055	0.207	0.082	0.135	0.287	0.227	0.041	0.047	0.122	0.104	0.077	0.269	0.270	0.088	0.296
FP4	-0.145	-0.078	-0.045	-0.113	0.055	-0.109	0.119	0.104	0.094	0.073	0.096	0.075	0.103	0.125	0.014
FP5	-0.046	0.063	0.026	0.111	0.132	-0.020	0.172	0.134	0.065	0.137	0.222	0.125	0.127	0.024	0.069

	CS1	CS2	CS3	CS4	CS5	TTM1	TTM2	TTM3	TTM4	FP1	FP2	FP3	FP4	FP5
CS1	1.000													
CS2	0.490	1.000												
CS3	-0.429	-0.325	1.000											
CS4	-0.279	-0.182	0.552	1.000										
CS5	0.192	0.455	-0.011	0.019	1.000									
TTM1	0.023	0.084	0.054	0.018	0.019	1.000								
TTM2	0.068	0.007	0.139	0.196	-0.048	0.290	1.000							
TTM3	-0.004	0.145	0.032	-0.012	0.001	0.324	0.374	1.000						
TTM4	0.017	0.039	0.038	0.062	0.006	0.598	0.372	0.400	1.000					
FP1	-0.108	-0.080	0.351	0.204	-0.081	0.301	0.276	0.137	0.248	1.000				
FP2	-0.143	-0.166	0.350	0.198	-0.131	0.210	0.192	0.110	0.155	0.774	1.000			
FP3	-0.064	-0.037	0.217	0.078	-0.025	0.322	0.356	0.142	0.281	0.505	0.474	1.000		
FP4	0.132	0.067	-0.078	-0.065	0.119	0.212	0.046	-0.016	0.131	0.026	-0.010	0.052	1.000	
FP5	0.093	-0.006	0.021	-0.026	0.088	0.275	0.124	0.114	0.244	0.174	0.186	0.302	0.415	1.000

The chosen sample size of 200 depends on the model complexity and is also the typical sample size of SEM research (Kline, 2015). However, practical issues in regard to network and time constraint was experienced when gathering this many responses. According to Hair, et al. (2014), the next step of sample after 150 is 300 which would not be feasible in this short amount of time.

The correlation matrix is assessed by checking that all the correlation coefficients within the construct are more than |0.7| (i.e., strong correlation) (Hair, Black, Babin, & Anderson, 2014), however, this is not the case here. Since almost all the correlation coefficients were less than |0.7| except for FP1-FP2 (0.774), the results were not improved as anticipated even though 200 data points were acquired.

At this stage, gathering more data is not possible and continuing the confirmatory approach is not feasible without understanding the underlying structure of the variables. As a result, the authors chose to move on from an explanatory to an exploratory approach which will now be applied to assess the data in order to define new constructs to explain the relationships of the gathered variables and then finally return to an explanatory approach to develop a new model using the last stages of SEM.

4.2.3.2. Exploratory factor analysis

As previously stated, EFA is used to reduce the number of indicators by exploring the relations between all the different latent variables and their factor loadings (or standardized regression weights or coefficients) to its connected indicators (Torres-Reyna, 2022), which is done by estimating the factor loadings. A rule of thumb is that a standardized factor loading should be 0.5 or higher and ideally 0.7 or higher, which shows that the construct extracts sufficient variance from the construct. However, another guideline specifies when a factor loading is significant (α=0.05, P=80% and measurement error ε is twice as large as correlation coefficients) and for a sample size of 200, a factor loading of more than the absolute value of 0.40 is sufficient. Using standardized factor loadings means that they are constrained between -1.0 and 1.0 and these shall be therefore used when using these reference limits (Hair, Black, Babin, & Anderson, 2014).

Depending on which of the reference limit to use, the interpretation of the result here may differ. The EFA of the initial model is visualized in Figure 12, where the standardized factor loading is found next to the two-headed curved arrows. For this model, the values are particularly low, and all are below 0.7 except for INT and BMF, which means that the current constructs are questionable. Since many of the factor loadings are rather low, absolute value of 0.4 is used as a threshold for the choice of removing variables which are BMF3, BMF4, MI3, CS3, CS4, CS5, FP4 and FP5. This will be done in the later stage when reconstructing a new model with redefined constructs.

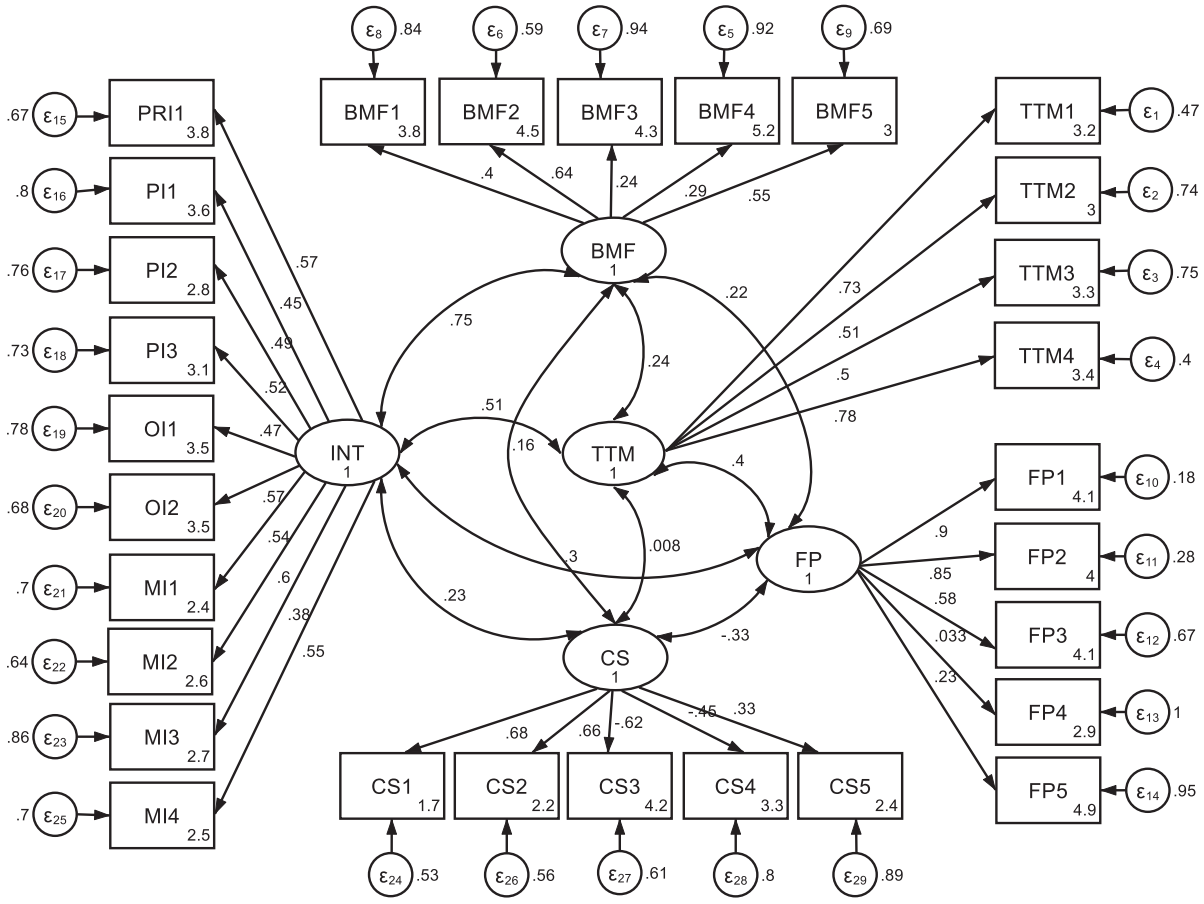


Figure 12. Exploratory factor analysis of the initial model (standardized coefficients and values) of initial model.

As mentioned in earlier text, a new model will be redefined based on the correlations between the indicators. To avoid confusion by previous named indicators, the items will also be assigned to an item denotation (X_1 to X_{29}), see Table 10, where the red marked are those statements that will be removed when reforming new constructs in the later stages.

Table 10. New denotations of the statements.

Old var.	Item	Statement
BMF1	X_1	We conduct product development internally
BMF2	X_2	We have a road map of product/services to be released in the near future (1-3 years)
BMF3	X_3	We look externally for new innovations to serve our customers
BMF4	X_4	We work in close collaboration with customers and suppliers when innovating
BMF5	X_5	We reinvent our business model to generate new business (e.g. merger & acquisition, creation of spin-offs or joint ventures)
PRI1	X_6	We introduced new or significantly improved goods or services Excluding: Simple resale of new goods and changes of a solely aesthetic nature
PI1	X_7	We introduced new methods of manufacturing for producing goods or services
PI2	X_8	We introduced significantly improved logistics or distribution methods
PI3	X_9	We introduced improved supporting activities such as maintenance systems, operations for purchasing, accounting or computer systems
OI1	X_{10}	We introduced new business practices for organizing procedures (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)
OI2	X_{11}	We introduced new methods of organizing work responsibilities and decision making (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)
MI1	X_{12}	We introduced significant changes to the aesthetic design or packaging of a good
MI2	X_{13}	We introduced the use of new media or techniques for product promotion (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)
MI3	X_{14}	We introduced new methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems etc.)
MI4	X_{15}	We introduced new methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation etc.)
CS1	X_{16}	We funded mainly innovation activities by issuing more equity to investors (i.e. sold more shares to investors)
CS2	X_{17}	We funded mainly innovation activities by increasing its long-term debt (i.e. taking loans)
CS3	X_{18}	We funded mainly innovation activities with company earnings
CS4	X_{19}	We preferred using internally generated funds over external funds when investing.
CS5	X_{20}	We preferred external debt as a funding method over capital from investors (given equal access)
TTM1	X_{21}	We delivered products to the market quickly
TTM2	X_{22}	We were first in the market introducing new products
TTM3	X_{23}	We had a time-to-market lower than industry average
TTM4	X_{24}	We had a fast product development
FP1	X_{25}	The growth in our sales increased
FP2	X_{26}	Our company's profit increased
FP3	X_{27}	Our company's market share increased
FP4	X_{28}	The lead time for fulfilling our customers' order was reduced (i.e. time from order to delivered product)
FP5	X_{29}	Our company's customer satisfaction increased

4.2.3.3. Principal component analysis

Due to the low correlations attained in the correlation matrix from the initial model, principal component analysis (PCA) is performed to find the underlying structure among the variables in the analysis i.e., to select the components that will become a part of the final model. The first criterium of selecting the number of components is by choosing the components that has an eigenvalue above 1.0 or close enough (Hair, Black, Babin, & Anderson, 2014). The second criterium is to achieve a cumulative of at least 70% i.e., these components explain 70% of the total variance (Jolliffe & Cadima, 2015). According to the first criteria only the 10 components would be selected but 11 components are chosen to fulfill the second criteria. The number of components will later be used when deriving the rotated component matrix.

Table 11. Principal component analysis.

Component	**Eigenvalue** (>1.0)	**Difference**	**Proportion**	**Cumulative**
Comp 1	5.327	2.238	0.184	0.184
Comp 2	3.089	1.055	0.107	0.290
Comp 3	2.035	0.430	0.070	0.360
Comp 4	1.605	0.080	0.055	0.416
Comp 5	1.525	0.183	0.053	0.468
Comp 6	1.342	0.154	0.046	0.515
Comp 7	1.188	0.034	0.041	0.556
Comp 8	1.154	0.072	0.040	0.595
Comp 9	1.082	0.064	0.037	0.633
Comp 10	1.018	0.061	0.035	0.668
Comp 11	0.957	0.095	0.033	0.701
Comp 12	0.862	0.129	0.030	0.731
Comp 13	0.733	0.036	0.025	0.756
Comp 14	0.698	0.012	0.024	0.780
Comp 15	0.685	0.072	0.024	0.804
Comp 16	0.613	0.029	0.021	0.825
Comp 17	0.584	0.020	0.020	0.845
Comp 18	0.563	0.032	0.019	0.864
Comp 19	0.532	0.047	0.018	0.883
Comp 20	0.485	0.049	0.017	0.899
Comp 21	0.436	0.013	0.015	0.914
Comp 22	0.423	0.029	0.015	0.929
Comp 23	0.394	0.030	0.014	0.943
Comp 24	0.365	0.027	0.013	0.955
Comp 25	0.337	0.031	0.012	0.967
Comp 26	0.306	0.018	0.011	0.977
Comp 27	0.287	0.081	0.010	0.987
Comp 28	0.206	0.041	0.007	0.994
Comp 29	0.166	.	0.006	1.000

4.2.3.4. Appropriateness test for using factor analysis

The two essential assumptions are that multicollinearity is detected in the data set and that the sampling is homogeneous i.e., similar characteristics between the samples. Some extent of multicollinearity is wanted, because the objective is to determine interrelated set of variables, which is done by measuring Kaiser-Meyer-Olkin (KMO) and/or Bartlett test of sphericity.

The function `factortest` (module package in STATA) is used prior to factor analysis to test the appropriateness of the factor analysis, which is done by estimating Bartlett test of sphericity and KMO. Bartlett test of sphericity is used to test the overall significance of all correlations within a correlation matrix. This measure becomes more sensitive in detecting correlations when increasing the sample size. The p-value from this test should be lower than 0.05. Moreover, KMO can also be called as a measure of sampling adequacy (MSA). KMO ranges between 0 and 1 and should be higher than 0.50 (Hair, Black, Babin, & Anderson, 2014).

The result of the two measures can be found in Table 12. Since p-value for Bartlett test of sphericity is 0.00 which is less than 0.05 (significance level), the hypothesis can thus be nulled. Moreover, the function `estat kmo` was used to calculate the individual values of each item. The average of KMO is calculated to 0.729, which is higher than 0.5 and therefore passes the test of appropriateness.

Table 12. Bartlett test of sphericity and KMO.

Measure	**Value**	**Pass/Fail**
Bartlett test of sphericity H_0=Variables are not intercorrelated ($p<0.05$)	1811 df=406 p=0.000	Pass
Kaiser-Meyer-Olkin (>0.50)	0.729	Pass

Table 13. Calculation of KMO.

Old var.	**Item**	**KMO** (<0.5)	**Old var.**	**Item**	**KMO** (<0.5)
BMF1	X_1	0.6922	CS1	X_{16}	0.6831
BMF2	X_2	0.7590	CS2	X_{17}	0.6711
BMF3	X_3	0.5577	CS3	X_{18}	0.6842
BMF4	X_4	0.5939	CS4	X_{19}	0.6581
BMF5	X_5	0.8329	CS5	X_{20}	0.6767
PRI1	X_6	0.8318	TTM1	X_{21}	0.7992
PI1	X_7	0.7474	TTM2	X_{22}	0.7638
PI2	X_8	0.7219	TTM3	X_{23}	0.6446
PI3	X_9	0.7466	TTM4	X_{24}	0.7751
OI1	X_{10}	0.7716	FP1	X_{25}	0.6893
OI2	X_{11}	0.7732	FP2	X_{26}	0.6671
MI1	X_{12}	0.8813	FP3	X_{27}	0.7749
MI2	X_{13}	0.7102	FP4	X_{28}	0.5885
MI3	X_{14}	0.7922	FP5	X_{29}	0.6212
MI4	X_{15}	0.6757		Overall	0.7288

4.2.3.5. Rotated component matrix

As the factors are assumed to be uncorrelated, orthogonal rotation method is applied. The STATA function `rotate, varimax` is used to compute the orthogonal (VARIMAX) rotation, which is the most widely used orthogonal method because of its superiority in simplifying factor structure. The result of the rotated component matrix is found in Table 14. In a sample size of 200, the loading should be either less than -0.4 or higher than 0.4 in order to be considered as significant (Hair, Black, Babin, & Anderson, 2014).

Table 14. Rotated factor loadings (pattern matrix) and unique variances.

Item	Factor1 (>|0.4|)	Factor2 (>|0.4|)	Factor3 (>|0.4|)	Factor4 (>|0.4|)	Factor5 (>|0.4|)	Factor6 (>|0.4|)	Factor7 (>|0.4|)	Factor8 (>|0.4|)	Factor9 (>|0.4|)	Factor10 (>|0.4|)	Factor11 (>|0.4|)	Unique-ness
X_1					0.800							0.294
X_2					0.650							0.400
X_3								0.345		0.559		0.352
X_4										0.800		0.287
X_5		0.344			0.351	0.329				0.416		0.432
X_6					0.574		0.386					0.312
X_7							0.803					0.266
X_8						0.426	0.569	0.318				0.326
X_9		0.339				0.319		0.452			-0.360	0.357
X_{10}								0.794				0.268
X_{11}					0.394			0.506				0.348
X_{12}		0.461					0.506					0.382
X_{13}		0.782										0.244
X_{14}		0.320									0.751	0.265
X_{15}		0.823										0.238
X_{16}				-0.643		0.398						0.273
X_{17}				-0.430		0.691						0.252
X_{18}				0.808								0.250
X_{19}				0.779								0.309
X_{20}						0.791						0.299
X_{21}			0.627									0.356
X_{22}			0.559		0.365							0.384
X_{23}			0.808									0.266
X_{24}			0.750									0.302
X_{25}	0.889											0.149
X_{26}	0.898											0.163
X_{27}	0.627											0.350
X_{28}									0.810			0.271
X_{29}									0.796			0.282

4.2.3.6. Regrouping new constructs

Based on the rotated component matrix, suggested constructs that are newly formed constructs are presented in Table 15. To form new constructs, those variables that have a high factor loading (more than 0.40) for a certain factor will be lumped and the result can be found in Table 15, for example indicators that have factor loading less than -0.4 or higher than 0.4 in "Factor 1" will join "Construct 1" and etc. The number of constructs will now be further reduced with BMF3, BMF4, MI3, CS3, CS4, CS5, FP4 and FP5 (selected from EFA), see the red marked variables in Table 16.

Furthermore, the statements will now be lumped together and then form new constructs by firstly, considering the suggested proposed new constructs in Table 15 and ,secondly, assessing the meaning of each statement to make each construct conceptually coherent, where the results can be found in Table 16. This procedure had to be reiterated along with setting up EFA models and in turn constructing CFA models to confirm the factor loadings and the different relations before the final model and results could be determined, which can be seen in the following chapters. In the end, the calculation of GOF indices was the determining factor when selecting models as the factor loadings between the optimal models were similar.

Table 15. Proposed new constructs based on the rotated component matrix.

Construct	Old var.	Item	Statement
Construct 1	FP1	X_{25}	The growth in our sales increased
	FP2	X_{26}	Our company's profit increased
	FP3	X_{27}	Our company's market share increased
Construct 2	MI2	X_{13}	We introduced the use of new media or techniques for product promotion (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)
	MI4	X_{15}	We introduced new methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation etc.)
Construct 3	TTM1	X_{21}	We delivered products to the market quickly
	TTM2	X_{22}	We were first in the market introducing new products
	TTM3	X_{23}	We had a time-to-market lower than industry average
	TTM4	X_{24}	We had a fast product development
Construct 4	CS1	X_{16}	We funded mainly innovation activities by issuing more equity to investors (i.e. sold more shares to investors)
	CS3	X_{18}	We funded mainly innovation activities with company earnings
	CS4	X_{19}	We preferred using internally generated funds over external funds when investing.
Construct 5	BMF1	X_{1}	We conduct product development internally
	BMF2	X_{2}	We have a road map of product/services to be released in the near future (1-3 years)
	PRI1	X_{6}	We introduced new or significantly improved goods or services Excluding: Simple resale of new goods and changes of a solely aesthetic nature
Construct 6	CS2	X_{17}	We funded mainly innovation activities by increasing its long-term debt (i.e. taking loans)
	CS5	X_{20}	We preferred external debt as a funding method over capital from investors (given equal access)
Construct 7	PI1	X_{7}	We introduced new methods of manufacturing for producing goods or services

Construct	Old var.	Item	Statement
	PI2	X_8	We introduced significantly improved logistics or distribution methods
	MI1	X_{12}	We introduced significant changes to the aesthetic design or packaging of a good
Construct 8	PI3	X_9	We introduced improved supporting activities such as maintenance systems, operations for purchasing, accounting or computer systems
	OI1	X_{10}	We introduced new business practices for organizing procedures (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)
	OI2	X_{11}	We introduced new methods of organizing work responsibilities and decision making (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)
Construct 9	FP4	X_{28}	The lead time for fulfilling our customers' order was reduced (i.e. time from order to delivered product)
	FP5	X_{29}	Our company's customer satisfaction increased
Construct 10	BMF3	X_3	We look externally for new innovations to serve our customers
	BMF4	X_4	We work in close collaboration with customers and suppliers when innovating
	BMF5	X_5	We reinvent our business model to generate new business (e.g. merger & acquisition, creation of spin-offs or joint ventures)
Construct 11	MI3	X_{14}	We introduced new methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems etc.)

The number of constructs has now been reduced from 11 to 6 constructs and from 29 to 21 statements, see Table 16. The newly formed constructs are named:

- Open business model (OBM)
- Technological innovation (TI)
- Marketing innovation (MAI)
- External funding (EF)
- Time to market (TTM)
- Financial performance (FIP)

where time-to-market remains the same as the previously old model setup. Since some of the original constructs were revised, the construct and the indicators had to be renamed to separate the modifications between the initial and reconstructed model. The most drastically change to the constructs is the choice of lumping BMF2, BMF5 with OI, OI2 (see Table 16), where these statements are grouped due to the fact that the organizational innovation is conceptually related to Chesbrough's business model framework (2014). Business model is said to describe how an organization creates, delivers and captures (Osterwalder & Pigneur, 2010), which strengthen the reasoning for lumping them together since business model and organization are connected. These are thereafter named as open business model to present how open a firm's business model is, since not all the statements from business model framework are used to any further extent.

Table 16. Renamed and lumped constructs forming new constructs.

Construct	Old	New	Item	Statement
Open business model (OBM)				
Construct 5	BMF2	OBM1	X_2	We have a **road map of product/services** to be released in the near future (1–3 years)
Construct 10	BMF5	OBM2	X_5	We **reinvent our business model to generate new business** (e.g. merger & acquisition, creation of spin-offs or joint ventures)
Construct 8	OI1	OBM3	X_{10}	We introduced **new business practices for organizing procedures** (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)
	OI2	OBM4	X_{11}	We introduced **new methods of organizing work responsibilities and decision making** (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)
Technological innovation (TI)				
Construct 5	BMF1	TI1	X_1	We conduct **product development internally**
	PRI1	TI2	X_6	We introduced **new or significantly improved goods or services** Excluding: Simple resale of new goods and changes of a solely aesthetic nature
Construct 7	PI1	TI3	X_7	We introduced **new methods of manufacturing** for producing goods or services
	PI2	TI4	X_8	We introduced significantly **improved logistics or distribution methods**
Construct 8	PI3	TI5	X_9	We introduced **improved supporting activities** such as maintenance systems, operations for purchasing, accounting or computer systems
Marketing innovation (MAI)				
Construct 7	MI1	MAI1	X_{12}	We introduced significant **changes to the aesthetic design or packaging of a good**
Construct 2	MI2	MAI2	X_{13}	We introduced the use of **new media or techniques for product promotion** (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)
	MI4	MAI3	X_{15}	We introduced **new methods for product placement or sales channels** (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation etc.)
External funding (EF)				
Construct 4	CS1	EF1	X_{16}	We funded mainly innovation activities by issuing more **equity** to investors (i.e. sold more shares to investors)
Construct 6	CS2	EF2	X_{17}	We funded mainly innovation activities by increasing its long-term **debt** (i.e. taking loans)
Time to market (TTM)				
Construct 3	TTM1	TTM1	X_{21}	We **delivered products to the market quickly**
	TTM2	TTM2	X_{22}	We were **first in the market introducing new products**
	TTM3	TTM3	X_{23}	We had a **time-to-market lower than industry average**
	TTM4	TTM4	X_{24}	We had a **fast product development**
Financial performance (FIP)				
Construct 1	FP1	FIP1	X_{25}	The growth in our **sales increased**
	FP2	FIP2	X_{26}	Our company's **profit increased**
	FP3	FIP3	X_{27}	Our company's **market share increased**

4.2.3.7. Correlation matrix of the new constructs

A new correlation matrix was computed after reducing and grouping indicators using factor analysis, see Table 17. The values are color coded depending on the value of the correlation coefficient. The expected results is to find the higher correlation coefficient together within a group, for example the values OBM1-OBM4 should be for the most part be higher than OBM1 is correlated to other variables (see bolded values in the same table). This matrix can also be compared to the previous correlation matrix (see Table 9) to see if there is an improvement and it is concluded that it is somewhat better than the initial one.

Table 17. Correlation matrix after reduction of indicators and grouping using factor analysis.

	OBM1	OBM2	OBM3	OBM4	TI1	TI2	TI3	TI4	TI5	MAI1	MAI2	MAI3	EF1	EF2
OBM1	1.000													
OBM2	**0.292**	1.000												
OBM3	**0.252**	**0.211**	1.000											
OBM4	**0.276**	**0.332**	**0.427**	1.000										
TI1	**0.380**	**0.142**	**0.071**	**0.176**	1.000									
TI2	0.391	0.313	0.217	**0.268**	**0.416**	1.000								
TI3	0.136	0.148	0.249	**0.202**	**0.138**	**0.386**	1.000							
TI4	0.227	0.183	0.354	**0.249**	**0.044**	**0.208**	**0.374**	1.000						
TI5	0.232	0.283	0.359	**0.379**	**0.121**	**0.159**	**0.234**	**0.451**	1.000					
MAI1	0.193	0.180	0.254	**0.148**	**0.157**	**0.317**	**0.326**	**0.291**	**0.274**	1.000				
MAI2	0.313	0.288	0.240	0.403	0.143	0.302	0.045	0.136	0.333	**0.317**	1.000			
MAI3	0.163	0.261	0.108	0.235	0.148	0.293	0.189	0.256	0.192	**0.362**	**0.581**	1.000		
EF1	0.053	0.266	0.028	0.183	-0.048	0.101	0.165	0.152	0.186	**0.118**	**0.026**	**0.120**	1.000	
EF2	0.011	0.220	0.239	0.346	-0.075	0.047	0.102	0.285	0.225	0.096	0.136	0.125	**0.481**	1.000
TTM1	0.073	0.189	0.188	0.162	-0.018	0.234	0.208	0.227	0.145	0.320	0.216	0.139	**0.045**	**0.106**
TTM2	0.212	0.247	0.088	0.200	0.216	0.365	0.270	0.211	0.186	0.330	0.281	0.191	0.066	0.005
TTM3	0.045	0.030	0.061	0.100	0.049	0.148	0.028	0.132	0.084	0.171	0.100	0.026	0.007	0.156
TTM4	0.013	0.132	0.122	0.126	0.081	0.249	0.223	0.107	0.110	0.292	0.204	0.172	0.004	0.025
FIP1	0.118	0.107	0.176	0.047	0.162	0.278	0.121	0.040	0.093	0.246	0.215	0.189	-0.090	-0.066
FIP2	0.101	0.117	0.035	0.073	0.112	0.224	0.002	-0.023	0.037	0.167	0.176	0.111	-0.119	-0.138
FIP3	0.221	0.313	0.104	0.105	0.061	0.248	0.047	0.039	0.137	0.282	0.293	0.313	-0.038	-0.008

	TTM1	TTM2	TTM3	TTM4	FIP1	FIP2	FIP3
TTM1	1.000						
TTM2	**0.304**	1.000					
TTM3	**0.316**	**0.380**	1.000				
TTM4	**0.614**	**0.368**	**0.406**	1.000			
FIP1	**0.282**	**0.285**	**0.127**	**0.264**	1.000		
FIP2	0.197	0.194	0.101	0.163	**0.749**	1.000	
FIP3	0.312	0.365	0.133	0.291	**0.485**	**0.458**	1.000

4.2.3.8. Rotated component matrix of the new model

Once again, a rotated component matrix (VARIMAX) is performed and this time with three factors from the previous factor analysis, see the result in Table 18. As displayed in the table, every factor has a loading that is significant in one of the three factors. This is only used to confirm that all the 21 variables are significant when only retaining three factors.

Table 18. Rotated factor loadings (pattern matrix) and unique variances.

Old var.	New var.	Factor 1 (>|0.4|)	Factor 2 (>|0.4|)	Factor 3 (>|0.4|)	Uniqueness
BMF2	OBM1	0.567	0.332		0.535
BMF5	OBM2	0.557			0.665
OI1	OBM3	0.548			0.680
OI2	OBM4	0.667			0.548
BMF1	TI1	0.362	0.412		0.657
PRI1	TI2	0.518	0.406		0.546
PI1	TI3	0.426			0.739
PI2	TI4	0.554			0.578
PI3	TI5	0.621			0.589
MI1	MAI1	0.410		0.397	0.628
MI2	MAI2	0.551	0.328		0.578
MI4	MAI3	0.497			0.675
CS1	EF1	0.381	-0.402		0.674
CS2	EF2	0.441	-0.478		0.522
TTM1	TTM1			0.756	0.394
TTM2	TTM2		0.330	0.482	0.580
TTM3	TTM3			0.636	0.595
TTM4	TTM4			0.767	0.373
FP1	FIP1		0.705	0.309	0.403
FP2	FIP2		0.723		0.438
FP3	FIP3		0.593	0.326	0.512

4.2.3.9. Factor analysis of the new model

A factor analysis using `factor` (module package in STATA) could thereafter be performed and the results is found in Table 19. The eigenvalue is supposed to be greater than 1.0 but can also include those factors that are close to 1 (Hair, Black, Babin, & Anderson, 2014). By examining the eigenvalue (<1.0) and cumulative (more than 0.7) in Table 19, it could be determined that there are three factors that shall be retained in the next step.

Table 19. Factor analysis/correlation.

Factor	**Eigenvalue** (<1.0)	**Difference**	**Proportion**	**Cumulative**
Factor 1	4.429	2.558	0.504	0.504
Factor 2	1.871	0.766	0.213	0.717
Factor 3	1.105	0.316	0.126	0.843
Factor 4	0.789	0.132	0.090	0.933
Factor 5	0.657	0.143	0.075	1.008
Factor 6	0.513	0.041	0.059	1.066
Factor 7	0.472	0.237	0.054	1.120
Factor 8	0.235	0.012	0.027	1.147
Factor 9	0.222	0.150	0.025	1.172
Factor 10	0.072	0.037	0.008	1.180
Factor 11	0.035	0.024	0.004	1.184
Factor 12	0.011	0.063	0.001	1.186
Factor 13	-0.052	0.038	-0.006	1.180
Factor 14	-0.090	0.026	-0.010	1.169
Factor 15	-0.116	0.028	-0.013	1.156
Factor 16	-0.144	0.021	-0.016	1.140
Factor 17	-0.166	0.055	-0.019	1.121
Factor 18	-0.221	0.008	-0.025	1.096
Factor 19	-0.229	0.044	-0.026	1.070
Factor 20	-0.273	0.065	-0.031	1.038
Factor 21	-0.338	.	-0.038	1.000

4.2.3.10. Exploratory factor analysis of the new model

An EFA model with the new constructs is built and displayed in Figure 13. This is used to explore which relationship are strong or not, where the most apparent weakest relationships (i.e., standardized factor loading between constructs that are below 0.2) are removed. Those relations that are close to 0.4 or -0.4 are now removed incrementally to avoid making the model non-convergent. The final results are found in the next chapter.

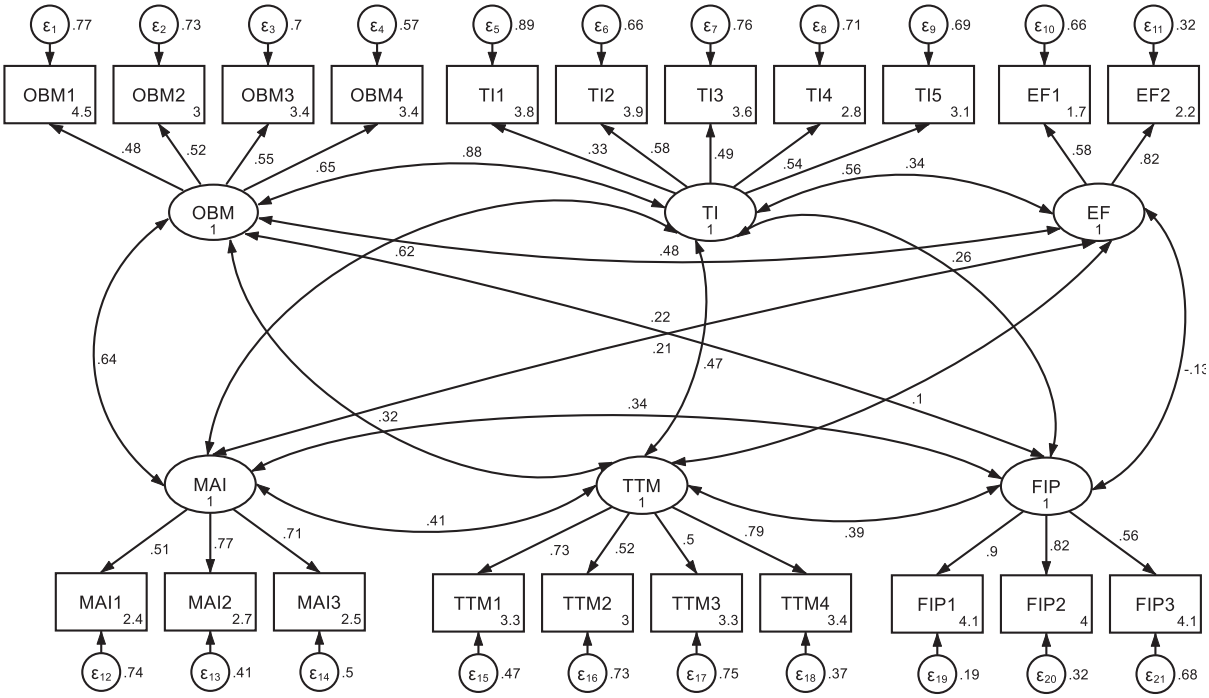


Figure 13. Exploratory factor analysis of the reconstructed model (standardized coefficients and values).

4.2.3.11. Confirmatory factor analysis of the new model

By using the extracted information from EFA model with its factor loading and theoretical background, each of the arrow (relation) was reduced in the CFA model by first removing apparent insignificant relations (lowest factor loadings first), then the factor loadings were reestimated. Afterwards, the arrows are carefully removed one at a time while checking the factor loadings to assure that the model is still convergent valid. As a final step, the most significant direction of the arrows is verified by comparing factor loadings as well as assessing previous theory, which resulted in a final CFA model, see Figure 14.

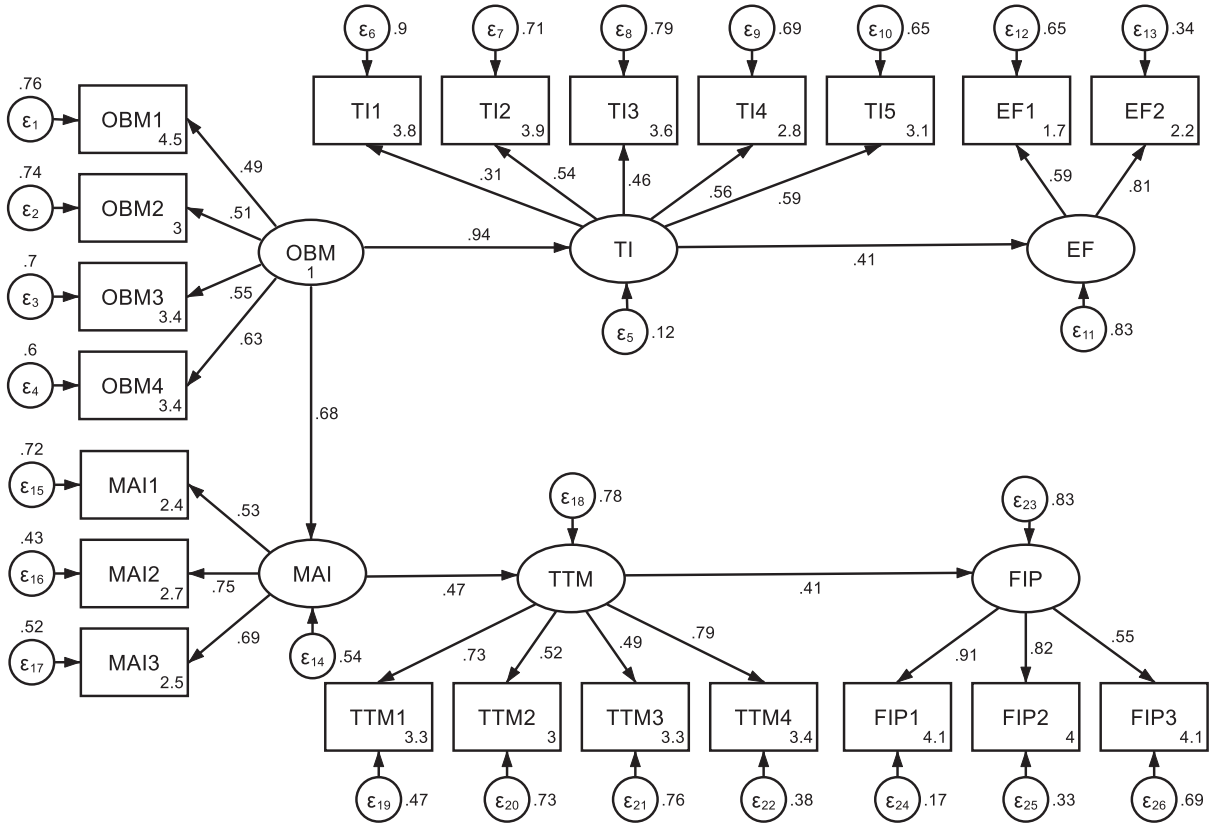


Figure 14. Confirmatory factor analysis of the reconstructed model (standardized coefficients and values).

4.2.3.12. Goodness-of-fit of the new model

Thereafter, the goodness-of-fit measures were computed, see Table 20. Overall, all the indices were improved but for χ^2 GOF and SRMR, they did not meet the criteria of being an adequate model. Only CD did worsen after the removal of indicators as well as modified model, which can be explained by the fact that eight indicators (including the data) were removed. Hair, et al. (2014) also specifies that there is a rule thumb that a SRMR-value above 0.1 indicates inadequate model fit. If this rule thumb rule is applied, the fit of the final model would have further been strengthened with a fifth index, since SRMR is 0.091. Although the key measure χ^2 GOF did not pass, five out of six of the other indices would demonstrate that the model is a good fit.

Table 20. Goodness-of-fit for initial and reconstructed model.

Goodness-of-fit indices	**Abbreviation**	**Reference limit**	**Initial model**	**Final model**	**Pass/Fail Final model**
χ^2 Goodness of Fit Index	GOF	$0 < \chi^2$ GOF $p \geq 0.05$	909 df=373 p=0.000	427 df=184 p=0.000	Fail, improved
Root Mean Square Error of Approximation	RMSEA	RMSEA < 0.08	0.085	0.081	Pass, improved
Standardized Root Mean Squared Residual	SRMR	SRMR ≤ 0.08	0.119	0.091	Fail, improved (Pass, if the reference limit changes to ≤ 0.1)
Coefficient of Determination R^2	CD	→ 1	0.989	0.907	Pass, worsen
Comparative Fit Index	CFI	→ 1	0.646	0.791	Pass, improved
Tucker Lewis Index	TLI	→ 1	0.615	0.761	Pass, improved

4.2.3.13. Construct validity of the new model

According to SEM methodology, construct validity should already be checked at stage 4 but was in fact performed at stage 6, which is after the EFA was performed and the model was optimized. Construct validity is used to assess if a set of measured items really reflects the theoretical latent constructs i.e., the accuracy of measurement. In order to determine the construct validity, measuring convergent validity and discriminant validity is essential. Convergent validity means that the indicators of a specific construct should converge or share a high proportion of variance. It can be measured by calculating factor loading and average variance extracted (AVE). In addition, the reliability of an EFA model is measured with Cronbach's alpha while construct/composite reliability (CR) is calculated in conjunction with CFA or SEM models. Determining discriminant validity means that a construct is truly distinct from other constructs (Hair, Black, Babin, & Anderson, 2014).

As previously described, communality or AVE should be 0.5 or greater to indicate on adequate convergent validity. The square root of AVE value should also be larger than standardized correlation (SC) between two constructs (or latent variables) to prove discriminant validity. To determine the factor loadings for the indicators and constructs, the commando `estat eqgof` was used, see Table 21. The square root of AVE is compared to SC and meets the criteria to determine discriminant validity. The relationship between OBM and TI failed in terms of convergent validity, but the rest passed.

Table 21. Results of standardized (std.) loadings and calculation of AVE.

Construct	New var.	Std. loadings	Squared std. loadings (A)	Sum of squared loadings (B)	No. of indicators (N)	AVE = B/N (≥0.5)	Square root of AVE	Std. corr. for construct (SC)	Square root of AVE > SC
OBM	OBM1	0.493	0.702	2.949	4	0.737	0.859	-	-
	OBM2	0.506	0.711						
	OBM3	0.550	0.741						
	OBM4	0.631	0.794						
TI	TI1	0.315	0.561	3.488	5	0.698	0.835	0.936	Fail
	TI2	0.537	0.732						
	TI3	0.463	0.681						
	TI4	0.557	0.746						
	TI5	0.589	0.768						
MAI	MAI1	0.593	0.770	2.397	3	0.799	0.894	0.678	Pass
	MAI2	0.811	0.901						
	MAI3	0.527	0.726						
EF	EF1	0.754	0.868	1.700	2	0.850	0.922	0.415	Pass
	EF2	0.692	0.832						
TTM	TTM1	0.730	0.854	3.162	4	0.790	0.889	0.465	Pass
	TTM2	0.516	0.719						
	TTM3	0.491	0.701						
	TTM4	0.789	0.888						
FIP	FIP1	0.910	0.954	2.601	3	0.867	0.931	0.414	Pass
	FIP2	0.817	0.904						
	FIP3	0.553	0.743						

In order to verify the model's reliability, CR was calculated in Table 22. Construct reliability should be 0.7 or higher to imply on acceptable convergence or internal consistency. As can be seen in Table 22, all the constructs comply to this. All of the constructs proved to be discriminant validity according to CR.

Table 22. Results of standardized (std.) loadings and calculation of CR.

Construct	**Old var.**	**New var.**	**Std. loadings**	**Squared std. loadings (A)**	**Sum of squared loadings (B)**	**Measure-ment error ε = 1-A**	**Sum of ε (E)**	**Squared B (C)**	**CR = C/(C+E)** (≤0.7)
OBM	BMF2	OBM1	0.493	0.702	2.949	0.298	1.051	8.699	0.892
	BMF5	OBM2	0.506	0.711		0.289			
	OI1	OBM3	0.550	0.741		0.259			
	OI2	OBM4	0.631	0.794		0.206			
TI	BMF1	TI1	0.315	0.561	3.488	0.439	1.512	12.164	1.124
	PRI1	TI2	0.537	0.732		0.268			
	PI1	TI3	0.463	0.681		0.319			
	PI2	TI4	0.557	0.746		0.254			
	PI3	TI5	0.589	0.768		0.232			
MAI	MI1	MAI1	0.593	0.770	2.397	0.230	0.603	5.747	0.905
	MI2	MAI2	0.811	0.901		0.099			
	MI4	MAI3	0.527	0.726		0.274			
EF	CS1	EF1	0.754	0.868	1.700	0.132	0.300	2.891	0.906
	CS2	EF2	0.692	0.832		0.168			
TTM	TTM1	TTM1	0.730	0.854	3.162	0.146	0.838	9.997	1.084
	TTM2	TTM2	0.516	0.719		0.281			
	TTM3	TTM3	0.491	0.701		0.299			
	TTM4	TTM4	0.789	0.888		0.112			
FIP	FP1	FIP1	0.910	0.954	2.601	0.046	0.399	6.767	1.059
	FP2	FIP2	0.817	0.904		0.096			
	FP3	FIP3	0.553	0.743		0.257			

5. Analysis and discussion

This chapter incorporate both the analysis and discussion of the final model in regards to its construction and fit, connection to hypothesis, relationships between constructs and finally the overall correlations.

5.1. Model construction and model fit

The final model consisted of 2–5 measured indicators per latent constructs and a total of six constructs. For a minimum sample size of 150, the recommended number of indicators is 3–5 and of constructs maximum seven if the communalities is 0.5 or lower, and no underidentified constructs exists (Hair, Black, Babin, & Anderson, 2014). However, the number of constructs for external funding was only two indicators which makes the model more complex. When testing to remove this construct, it did not improve in the overall GOF indices when removed and marginally increased or decreased the factor loadings. As a result, this indicated that the chosen sample size of 200 was sufficient for this final model as the model can still be considered as rather simple.

The final model failed when estimating the key index χ^2 GOF but passed for five out of the six GOF indices (RMSEA, SRMR, CD, CFI and TLI). In fact, Hair, et al. (2014) states that three to four GOF indices proves that the model fit is acceptable. A good reminder is that the determination of the model fit is interpretable, and researchers should put equally effort into assessing the theory of the concepts. As a conclusion of the model fit, five out of six testified that the model fit is adequate. In addition, the model is considered to be conceptually coherent which will be further analyzed and discussed in the following sections of how the theoretical concepts fit together with the results from the final model.

5.2. Hypothesis

Since the SEM model was rebuilt (see Figure 14), some of the original hypothesis was scrapped e.g., the first and third hypothesis, see Table 23. While hypothesis H2 could only be confirmed for marketing innovation and H4 only for financial performance. The following analysis will be based on the final model in Figure 14 and will mostly be referred to their old variable name (see Table 10 for the removed indicators and Table 16 for the renamed indicators).

Table 23. Evaluation of hypothesis.

No.	Hypothesis	Relationship (old var.)	Validity of new model	Relationship (using new var.)
H1	Business model with a high openness have a positive impact on time-to-market.	BMF → TTM	Removed	Removed
H2	Innovation has a positive impact on time-to-market.	INT → TTM	Valid for marketing innovation	MAI → TTM
H3	Preference for external capital (debt and/or equity) has a positive impact on time-to-market.	CS → TTM	Removed	Removed
H4	A fast time-to-market has a positive impact on firm performance.	TTM → FP	Valid for financial performance	TTM → FIP

5.3. Open business model and technological and marketing innovation

As could be confirmed by the final model, open business model (OBM) had a positive effect on increasing product, process, and marketing innovations. This construct was renamed to OBM since BMF2 (road map) and BMF5 (reinventing business model) was lumped together with OI1 (new business practices for organizing procedures) and OI2 (new methods of organizing work responsibilities and decision making), while BMF3 (external search for new innovations) and BMF4 (close

collaboration with customers and suppliers when innovating) were deleted as well as BMF1 (internal product development) was moved to another construct. As previously discussed, the choice of grouping BMF2 and BMF5 with OI1 and OI2 was because business model and organization innovation are conceptually related. The four observed variables form together open business model, as a high value of these statements would indicate that the respondent's firm has a more open business model and that it's likely that their business model is more sophisticated where organizational change and work with external partners is occurring naturally to generate new business (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

The reason for the removal of BMF3 (look externally for new innovations) and BMF4 (close collaboration with customers and suppliers when innovating) could be because of how the statements were phrased and how respondents interpreted the statement. It is safe to assume that most companies and employees look externally when innovating but rather in a sense of seeing what competitors are doing or what customers are requesting. Moreover, most companies can say that they work closely with suppliers and customers. However, according to business model framework theory, the externally aware companies and firms with an integrated business model have an even deeper cooperation with external parties where knowledge and R&D risks are shared openly between companies and where stakeholders (employees, customers, and suppliers) have deeper insights in the business model and how innovation work is conducted (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006). It is therefore likely that respondents interpreted the statement in a way that not corresponded to the business model framework and that the statement should have been rephrased. With all the facts in our hands, these statements should have been pre-tested according to EFA to gain a better understanding of the underlying meaning of the statements as well as to validate if they were formulated adequately. Nevertheless, the four dependent variables in OBM had an overall sufficient relation to OBM ranging from 0.49 to 0.63.

Furthermore, BMF5 consists of firms that have created start-ups, initiated spin-offs, created joint ventures or took part in M&A. The BMF5 statement is very specific and is probably easy to answer independently of what part of the organization the respondent is working in. Moreover, BMF5 corresponds to type 6 in the business model framework which is highly oriented into working with other companies. It can be executed either by innovating as partners or by merging/acquiring another firm to create synergies (Chesbrough H. W., Open Business Models: How To Thrive In The New Innovation Landscape, 2006).

As for the technological innovation (TI), product and process innovation formed a new construct where BMF1 (internal product innovation) somewhat resembles to PRI1 (new or improved products) as well as PI1 (new manufacturing methods), PI2 (improved logistics/distribution methods) and PI3 (improved supporting activities) was previously grouped. The standardized loading on BMF1 (or TI1) was rather low (0.31) but was shown to have a high factor correlation (0.80) from Table 14, therefore it could not be excluded. In addition, this statement was tested to group together with OBM and marketing innovation (MAI), but the results were rather indifferent and, in the end, GOF was the determining factor for letting it remain with TI. Moreover, the correlation between the PRI1, PI1, PI2 and PI3 with TI ranged from 0.46-0.59 which was sufficient.

As for the relationship between the constructs OBM and TI was very strong (0.94) but not convergent when compared to the square root of AVE (0.859) in Table 21 but fulfill the first criteria of having an AVE (0.737) higher than 0.5. Convergent validity basically means that they are measuring the same construct. Since organizational innovation statements were added to OBM and were not originally thought to be in this construct, the result here was not surprising and it can be concluded that they needed to be pre-tested. In addition, another model setup was tested (see Appendix B) showed that when OI1 and OI2 was not present in OBM, OBM was convergent with process innovation and technological innovation, respectively. This only confirms the importance of pre-testing new statements used in surveys.

As for marketing innovation (MAI), MI1 (significant changes to aesthetic design/packaging of a good), MI2 (new media/techniques for product promotion) and MI4 (new methods for product placement/sales channels) were grouped together while MI3 (new methods or pricing products) was removed. MI2 (0.75) and MI4 (0.69) had a stronger loading than MI1 (.53) to MAI. The correlation between MAI and TTM was indeed satisfactory (0.68), which partly verifies the hypothesis H2 "Innovation has a positive impact on time-to-market" but only for marketing innovation.

The original definitions of the different business model framework types were rewritten to fit for use in a survey and have previously not been tested. The positive effect of having an open business model can now be verified by this study that it propels activities within product, process, and marketing innovation, except for pricing products with new methods (MI3). Furthermore, the definition of open business model can be defined into two perspectives i.e., open innovation and business model (Weiblen, 2014). This essentially means that a firm that builds upon having business model revolving innovation must be related to innovations (no matter which type), thereof the strong positive correlation of OBM to technological innovation (0.94) and marketing innovation (0.68).

5.4. Technological innovation and capital structure

The relationship between TI and the newly formed construct external funding (EF) is acceptable (0.41). EF stems from the capital structure construct with only two out of five indicators remaining: CS1 (funded innovation activates with equity) and CS2 (funded innovation activates with debt). CS1 and CS2 show a strong relationship to the construct EF with a loading of 0.59 and 0.81, respectively.

As previously stated, all types of innovation need funding and product and process innovation can be very costly since it can include investment in new machinery, software and negation of logistics and distribution contracts (transaction costs) (Besanko, Dranove, Shanley, & Schaefer, 2017). In general, R&D and innovation is risky and hence has a higher cost of capital and do not correlate well with debt which requires predictable return and assets that has residual value (Choi, Kumar, & Zambuto, 2016). However, capital investments on such as machinery allows for a lower cost of capital and enables the usage of external funding such as debt. Capital investments is seen as less risky since they are tangible and have a residual value (Choi, Kumar, & Zambuto, 2016; Heijde, 2018). Moreover, investments in improved efficiency within logistics and distribution or maintenance systems or purchasing systems will likely lead to lower costs but the core product will remain the same (Keat, Young, & Erfle, 2014). Therefore, it will likely make the investment easier to predict and thus less risky, which opens for financing with equity or debt (Berk & DeMarzo, 2017).

5.5. Marketing innovation and time to market

All the indicators for TTM remained after the reduction of variables, which were TTM1 (fast delivery of product to the market), TTM2 (first with new products to the market), TTM3 (low TTM compared to industry average) and TTM4 (fast product development). Marketing innovation was the only construct that had a positive effect on TTM (0.47), where TTM1 and TTM4 had the strongest correlation to TTM (0.73 and 0.79 respectively) and TTM2 and TTM3 had the lowest (0.52 and 0.49 respectively). This result simply confirmed the arguments that Vesey (1992) posed regarding that innovation may lead to improved time-to-market, including non-technological ones (Feng, Sun, Sohale, & Wang, 2014). Moreover, a short time to market can be easier to obtained by utilizing marketing innovation. For example, a new method for product placement can attract new customers which result in the product being perceived as "new" although the core product is identical to the old product. Moreover, another example is the "share a Coke" campaign that resulted in higher sales without making any changes in the core product (Tang, Zhang, & Peng, 2021). Furthermore, the disruption of the pandemic probably made companies rethink their innovation strategies and focus on innovation that could generate "new" products or sales channels fast without putting too much effort into innovation. An example is the shift

to use digital sales channels instead of physical sales channels (Pegu, 2020) which is defined as marketing innovation (OECD and Statistical Office of the European Commun, 2005).

5.6. Time to market and firm performance

The firm performance construct was left with three out of five indicators, where the remaining indicators were FP1 (increased growth in sales), FP2 (increased profit) and FP3 (increased market share increased). As these are related to the financial performance, the construct was renamed to FIP. All indicators showed a strong relationship with the construct, where FP1 and FP2 had the strongest (0.92 and 0.82 respectively) and FP3 (0.55) had the lowest. The insignificant indicators were removed: FP4 (reduced lead time for fulfilling our customers' order) and FP5 (increased customer satisfaction).

The construct time-to-market has a contribution to firm performance which partially confirmed H4 – "A fast time-to-market has a positive impact on firm performance", but only for the financial statements. As described in the literature review, a low time-to-market can have several advantages on the overall firm performance such as competitive advantage, improved customer satisfaction, increased revenue, and market share (Chen, Reilly, & Lynn, 2005; TCGen, 2022). However, in the present study, the indicators that corresponds to reduced lead time and increased customer satisfaction were removed due to low correlation while the indicators correlating to monetary values had strong correlation. There are likely several reasons for this but both indicator FP4 and FP5 could be explained by the supply chain disruptions that many company faces today which makes it very challenging for some companies to deliver on time and to be able to increase customer satisfaction (Sweeney, 2022). Moreover, having a low time-to-market could be facilitated by reducing the scope of the product and release a minimum viable product (MVP). However, the usage of MVP comes with the risk that the customer might view the product as less valuable than the "full" product (TCGen, 2022). In new markets, the acceptance of MVP is higher where the product does not already exist and product quality is conceived as less important (Chen, Wang, & Huang, 2020). Due to the pandemic, traveling and meeting customers in person have also been demanding or even impossible in the recent years, which may have contributed to difficulties in opening up new markets where MVP would have been more suitable. In summary, the benefit of a good or service including customer satisfaction is especially challenging to predict which depends on several factors such as customer demographic and personal preference (Besanko, Dranove, Shanley, & Schaefer, 2017).

5.7. Overall correlations

For the final model, it could be concluded that there were two consecutive pathways where all had a positive mediating effect but varied between 0.41-0.94. These were OBM→TI→EF (0.94→0.41) and OBM→MAI→TTM→FP. The mediating effect between OBM→TI→EF were verified by just interpreting the factor loading. Theoretically, it means that opting for a certain type of the business model will most likely end up in technological innovation types and hence depend on debt or equity to fund this investment. However, the validity of the OBM and TI was non-convergent, any conclusion of the results must be carefully made. This correlation is not strikingly groundbreaking, as it is apparent that innovation will require resource and how this is funded is up to the company to decide and what they have in resources.

Lastly, a significant correlation could be found between OBM→MAI→TTM→FIP (0.68→0.47→0.41) which may be reflected by the current pandemic situation of this world. Pandemic has forced many companies to digitally transform their companies and in response thinking of new marketing strategies (Dash & Chakraborty, 2021), since 53% answered that they were affected by the pandemic (those who responded agree and strongly agree). Thus, this confirms the following statement by Peter Drucker: "Because the purpose of business is to create a customer, the business enterprise has two – and only two – basic functions: marketing and innovation. Marketing and innovation produce results; all the rest are costs. Marketing is the distinguishing, unique function of the business" (Forbes, 2006).

6. Conclusions

This study was conducted to provide a clarity in how capital structure, innovation and choice of business model affect the time-to-market which in turn affects firm performance. The thesis also provides insight of the importance of time-to-market to firm performance as well as the different factors affecting the time-to-market which is essential to be competitive and survive as a firm.

A theoretical framework was created based on relevant literature to be able to reach the objective of this thesis. The conceptual model was created from the literature which consisted of hypotheses and variables that the study aimed to investigate. From the theoretical framework using a confirmatory approach, a survey was designed that was shared online to available network that the authors had. In summary, 43% of respondents had some sort of managing positions (upper management, manager and project management), 83% were mainly based in Sweden but also in Denmark, Germany, USA etc. and the work experience of the respondents was fairly distributed. Overall, 50% of the firms were between 0 to 30 years (1% did not respond) and more than 50% were considered to be a large firm depending if the classification was based on turnover with 51% as large firms (17% did not respond) or based on the number of employees with 58% as large firms. Data with 200 applicable responses (eight were removed i.e., 3.8%) was collected over four weeks of time. With the use of structural equation modeling and exploratory factor analysis, the collected data could be analyzed, and the hypotheses relevance could be answered.

The final model was concluded to be adequate, as GOF indices and standardized factor loadings were on a sufficient level. As a result, the research showed that a fast time-to-market had a positive impact on firm performance measured in monetary measures (sales, profit, and market share) and that marketing innovation had a positive mediating effect on time to market and thus financial performance. The hypotheses regarding business model framework and capital structure correlating positive time to market were removed since the model was reworked. However, the study showed that technological innovation (product and process innovation) had a positive correlation to preference for external funding such as debt or issuance of equity. Since the validity between open business model and technological innovation was proved to be non-convergent, any deeper conclusion of this must be carefully reviewed. Furthermore, an open business model (road map of releasing products and reinvention of business model to generate new business) including organizational innovation contributed positively to both technological and marketing innovation. Although the model was determined as acceptable, the sample population could have been more restricted in terms of geography, work title and industry.

The results reinforced what other studies had shown, which is that open innovation or a more open business model contributes to both technological and non-technological innovation (marketing innovation) (Chesbrough H. W., Open Innovation: The New Imperative for Creating and Profiting from Technology, 2003). During 2019–2021 (whereof the pandemic took place during 2020–2021), marketing innovation was the one innovation type to accelerate time-to-market and thus increase the financial performances. This confirms the study conducted by Tang, Zhang and Peng (2021), where increased firm value is a result of marketing innovation. Marketing innovation is definitely gaining more importance in today's digital era, since prediction of market trend and speed of implementing changes are essential in gaining or retaining market shares (Ilić, Ostojić, & Damnjanović, 2014). As a summary, the research question "*How will the extent of an open business model, the choice of innovation and a firm's capital structure affect time-to-market and thus firm performance?*" could somewhat be answered with some modifications due to the reworked model, since it was demonstrated that an open business model and marketing innovation can speed up the time-to-market and hence increase financial performance.

6.1. Implications

This study was able to empirically and quantitively prove that a more open business model or open innovation had a positive impact on technological and marketing innovation. Marketing innovation has become an innovation type to be recognized in this digital era when speeding up the product release to market and thus generate financial value. These findings of MI1, MI2 and MI4 stress the importance to establish marketing strategies urgently, which is confirmed by another study that prove that new product designs and packages (MI1) along with innovative retail outlets (MI3) are the main accelerators of sustainable market advantages for SMEs (Quaye & Mensah, 2019). Although MI3 was not confirmed in this study, it is good to have this in mind that the overall marketing strategy is crucial.

Moreover, these findings support the idea that managers and firms should "dare" to do the balancing act between openness and control that has been reported in previous studies. This paradox of openness and control could be hard to balance, but an example described by Dragsdahl and Karafyllia (2019) is that when selecting ideas, the creators of the rejected ideas should be treated with openness and receive feedback. This promotes contribution even though the contributors' idea was rejected (Dragsdahl & Karafyllia, 2019).

Moreover, this study was able to prove that a shorter time-to-market leaded to a higher firm performance. Managers should therefore proactively and intentionally work to reduce the time-to-market. As previously stated in the literature, firms could for example intensify resource commitment, make use of the MVP concept, or work cross-functionally with the right competence involved at the right time (TCGen, 2022).

6.2. Limitations

In the present study, one limitation is the geographical restriction in which the accepted responses that the survey included. Although the majority was based in Sweden, there was still a significant part (17%) that was based in other countries, and some were working globally. Sweden is according to the Global Innovation Index (GII) a very innovative country, and the results from this study could lean toward more of how innovation in Sweden is managed as opposed to developing countries. Moreover, countries may have different polices regarding innovation and capital structure which most likely can affect the business model, and the way companies innovate. Additionally, allowing the whole world to participate in this survey may also require a larger sample size than 200 to statistically prove that the model can be applied to anyplace in the world.

Furthermore, the mix of respondents that answered the study could have affected the results. The present study included mainly upper management, project managers, managers, and engineers. It is likely that a different mix of respondents could potentially result in different results and with a better fit of the model. Feedback received from respondents was that many questions were difficult to answer and that some questions were considered as company secrets such as financial funding strategies. Therefore, it appears that the work experience and personal interest of the respondents affect the answers. For example, an engineer might be very familiar with the technical innovation approaches but less familiar regarding the company's capital structure or pricing strategies (marketing innovation).

Another limitation was that the research approach should have started as exploratory since the statements of business model framework had never been practiced in other studies and were not pre-tested as suggested by EFA. Then, the research design and data collection would have been developed differently. However, an EFA might have required more time to design a well-developed survey. As for the selection of statistical technique, PLS-SEM could have been utilized instead of SEM including EFA, since the approach was changed from confirmatory to exploratory approach and it can handle nonnormal data. Due to time constraints, this option was not assessed.

6.3. Future work

Suggestion of future work could be to conduct similar studies in specific industry sectors to observe whether there is a difference in time-to-market depending on industry and what effect innovation and business model framework had. Furthermore, although there were no restrictions of which country the respondents were located where most of the respondents were based in Sweden. Applying the same model and survey in a broader geographical area could get a broader view and find variations between the countries. For example, country polices does likely affect both innovation and capital structure of companies. In addition, the member of the sample population could be more restricted to a certain types of work titles e.g., managers. Finally, this study is conducted during the covid-19 pandemic which affected many aspects within companies. Conducting this study during a time when the economy in the world is stabilized would likely generate to a different outcome.

Bibliography

Ahuja, K., Chandra, V., Lord, V., & Peens, C. (2022, 06 04). *Ordering in: The rapid evolution of food delivery*. Retrieved from McKinsey & Company: https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ordering-in-the-rapid-evolution-of-food-delivery

Alphaville (1984). Forever Young. A. Budde, W. Loos, & C. Pearson.

Bartoloni, E. (2010). Capital Structure and Innovation: Casuality and Determinants. *Opening Up Innovation: Strategy, Organization and Technology* (pp. 2-34). London: Druid.

Berk, J., & DeMarzo, P. (2017). *Corporate Finance, 4th edition.* Harlow: Pearson.

Besanko, D., Dranove, D., Shanley, M., & Schaefer, S. (2017). *Economics of Strategy.* Hoboken: John Wiley & Sons, Inc.

Calantone, R. J., & Di Benedetto, C. A. (2012). The role of lean launch execution and launch timing on new product performance. *Journal of the Academy of Marketing Science, 40*, 526–538.

Camisón, C., & Villar-López, A. (2011, October 20). Non-technical innovation: Organizational memory and learning capabilities as antecedent factors with effects on sustained competitive advantage. *Industrial Marketing Management, 40*(8), 1294-1304. doi:https://doi.org/10.1016/j.indmarman.2011.10.001

Canuto, O. (2018, August 17). *World Economic Forum*. Retrieved from How globalization is changing innovation: https://www.weforum.org/agenda/2018/08/globalisation-has-the-potential-to-nurture-innovation-heres-how

Casadesus-Masanell, R., & Ricart, J. E. (2010). From strategy to business models and onto tactics. *Long Range Planning*, 195-215.

Chen, J., Reilly, R. R., & Lynn, G. S. (2005, May). The Impacts of Speed-to-Market on New ProductSuccess: The Moderating Effects of Uncertainty. *IEEE Transactions of Engineering Managment, 52*(2), 199-212.

Chen, Q., Wang, C.-H., & Huang, S.-Z. (2020). Effects of organizational innovation and technological innovation capabilities on firm performance: evidence from firms in China's Pearl River Delta. *Asia Pacific Business Review*, 72-96.

Chesbrough, H. B., Strand, R., & Bogers, M. (2018). *Sustainabillity through Open Innovation: Carlsberg and the green fiber bottle.* Berkely, California: Berkely Haas Case.

Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology.* Boston: Harvard Business School Press.

Chesbrough, H. W. (2006). *Open Business Models: How To Thrive In The New Innovation Landscape.* Boston: Harvard Business Review Press.

Choi, B., Kumar, M. S., & Zambuto, F. (2016). Capital Structure and Innovation Trajectory: The Role of Debt in Balancing Exploration and Exploitation. *Organization Science*, 1183–1201.

Chu, P.-Y. &.-C. (2011). Open business models: A case study of System-on-a-Chip (SoC) design foundry in the integrated circuit (IC) industry. *African Journal of Business Management, 5*(21), 8536-8544.

Cole, D. A., Maxwell, S. E., Arvey, R., & Salas, E. (1993). Multivariate group comparisons of variable systems: MANOVA and structural equation modeling. *Psychological Bulletin, 114*(1), 174-184. doi:https://doi.org/10.1037/0033-2909.114.1.1741

Dahlander, L., & Wallin, M. (2020, June 5). *Harvard Business Review*. Retrieved from Why Now Is the Time for "Open Innovation": https://hbr.org/2020/06/why-now-is-the-time-for-open-innovation

Dash, G., & Chakraborty, D. (2021, June 14). Digital Transformation of Marketing Strategies during a Pandemic:Evidence from an Emerging Economy during COVID-19. *Sustainability, 13*(12), 6735. doi:https://doi.org/10.3390/su13126735

D'Attoma, I., & Ieva, M. (2020). Determinants of technological innovation success and failure: Does marketing innovation matter? *Industrial Marketing Management, 91*, 64-81. doi:https://doi.org/10.1016/j.indmarman.2020.08.015

De Backer, K., López-Bassols, V., & Martinez, C. (2008). Open Innovation in a Global Perspective: What Do Existing Data Tell Us? doi:https://doi.org/10.1787/230073468188

Delaware. (2022). *Lot size one*. Retrieved March 13, 2022, from Delaware: https://www.delaware.pro/en-be/solutions/lot-size-one#:~:text=Lot%20size%20one%20refers%20to,in%20a%20single%20production%20run.

Dell'Era, C., Minin, A. D., Ferrigno, G., Frattini, F., Landonic, P., & Vergantia, R. (2020). Value capture in open innovation processes with radical circles: A qualitative analysis of firms' collaborations with Slow Food, Memphis, and Free Software Foundation. *Technological Forecasting and Social Change, 158*, 120128. doi:https://doi.org/10.1016/j.techfore.2020.120128

Dragsdahl, G., & Karafyllia, M. (2019). Perspective: Leveraging Open Innovation through Paradox. *Journal of Product Innovation Managment*, 107-121.

Dudoviskiy, J. (2022). *Purposive Sampling*. Retrieved May 26, 2022, from Business Research Methodlogy: https://research-methodology.net/sampling-in-primary-data-collection/purposive-sampling/

European Commission. (2022, 04 22). *SME definition*. Retrieved from European Commission: https://ec.europa.eu/growth/smes/sme-definition_en

Eurostat. (2016). *The Community Innovation Survey 2016 - The harmonized survey questionare.* Luxembourg: Eurostat.

Eurostat. (2022). *Description of the dataset*. Retrieved May 30, 2022, from Eurostat: https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

Eurostat. (2022, 03 23). *Eurostat*. Retrieved from R&D expenditure: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_expenditure&oldid=551418#R.26D_expenditure_by_sector_of_performance

Feng, T., Sun, L., Sohale, A. S., & Wang, D. (2014). External involvement and firm performance: is time-to-market of new products a missing link? *International Journal of Production Research*, 727–742. doi:https://doi.org/10.1080/00207543.2013.828177

Forbes. (2006, July 3). *Peter Drucker on Marketing*. Retrieved from Forbes: https://www.forbes.com/2006/06/30/jack-trout-on-marketing-cx_jt_0703drucker.html?sh=4f3ca008555c

Fourati, H., & Affes, H. (2013). The Capital Structure of Business Start-Up: Is There a Pecking Order Theory or a Reversed Pecking Order? *Technology and Investment*, 244-254.

Ghauri, P., Grønhaug, K., & Strange, R. (2020). *Research Methods in Business Studies* (5th ed.). Cambridge: Cambride University Press.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th ed.). Harlow: Pearson Education Limited.

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106-121. doi:https://doi.org/10.1108/EBR-10-2013-0128

Heijde, F. d. (2018). *Freek de Heijde.* Wagenigen: Wagenigen UR.

Hellmann, T. F., & Puri, M. (2000). The Interaction between Product Market and Financing Strategy: The Role of Venture Capital. *Review of Financial Studies*, 959-984.

Huang, F. L. (2020). MANOVA: A Procedure Whose Time Has Passed? *Methodological Brief, 64*(1), 56-60. doi:https://doi.org/10.1177/0016986219887200

Ilić, D., Ostojić, S., & Damnjanović, N. (2014). The Importance of Marketing Innovation in New Economy. *Singidunum Journal of Applied Sciences, 11*(1), 34-42. doi:10.5937/sjas11-5015

Jolliffe, I. T., & Cadima, J. (2015, February 2). Principal component analysis: a review and recent developments. *Philisophical Transactions A*, 374. doi:http://dx.doi.org/10.1098/rsta.2015.0202

Keat, P., Young, P., & Erfle, S. (2014). *Managerial Economics -Economic Tools for Today's Decision Makers.* Essex: Pearson Education Limited.

Kedzior, M., Grabinska, B., Grabinski, K., & Kedzior, D. (2020). Capital Structure Choices in Technology Firms: Empirical Results from Polish Listed Companies. *Journal of Risk Financial Management, 13*(9), 221. doi:https://doi.org/10.3390/jrfm13090221

Kline, R. B. (2015). *Principles and practice of structural equation modeling.* New York: Guilford publications.

Kondratieff, N. D. (1925). The major economic cycles. *Voprosy kon'iunktury*(1), 28-79.

Kopp, C. M. (2020, July 3). *Business Models*. Retrieved from Investopedia: https://www.investopedia.com/terms/b/businessmodel.asp#:~:text=our%20editorial%20policies-,What%20Is%20a%20Business%20Model%3F,both%20new%20and%20established%20businesses.

KPMG. (2015). *Remaining Competitive in the Technology Industry.* KPMG. Retrieved from https://assets.kpmg/content/dam/kpmg/pdf/2015/10/remaining-competitive.pdf

LaBerge, L., O'Toole, C., Schneider, J., & Smaje, K. (2020, January 5). *How COVID-19 has pushed companies over the technology tipping point—and transformed business forever*. Retrieved from McKinsey & Company: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

Li, S., Ragu-Nathan, B., Ragu-Nathan, T., & Rao, S. S. (2004). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega, 4*(2), 107-124. doi:https://doi.org/10.1016/j.omega.2004.08.002

Luo, C.-M., & Chang, H.-F. (2011). SME competitive strategy: learning from Taiwan's ODM industry. *Business Strategy Series, 12*(3), 107-114.

Najafi-Tavani, S., Najafi-Tavani, Z., Naudé, P., Oghazi, P., & Zeynaloo, E. (2018). How collaborative innovation networks affect new product performance: T Product innovation capability, process innovation capability, and absorptive capacity. *Industrial Marketing Management*, 193 - 205.

OECD and Statistical Office of the European Commun. (2005). *Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition.* Luxembourg: The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing.

OECD/Eurostat. (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition.* Paris/Eurostat, Luxembourg: The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing.

OneTimePIM. (2021, August 16). *How to reduce Time to Market (TTM)*. Retrieved from OneTimePIM: https://www.onetimepim.com/blog/how-to-reduce-time-to-market-ttm

Opazo-Basaez, M., Vendrell-Herrero, F., & Bustinza, O. F. (2021). Digital service innovation: a paradigm shift in technological innovation. *Digital service innovation*, 97-120.

Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers.* Amsterdam: Self Published.

Pegu, G. (2020). COVID-19 PANDEMIC, LOCKDOWN, AND INDIAN ECONOMY. *International Journal of Management* , 1086-1096.

Perols, J., Zimmermann, C., & Kortmann, S. (2011). On the relationship between supplier integration and time-to-market. *Journal of Operations Management*, 153-167.

Purchase, S., & Volery, T. (2020, June 9). Marketing innovation: a systematic review. *Journal of Marketing Management, 36*(9-10), 769-793. doi:https://doi.org/10.1080/0267257X.2020.1774631

Quaye, D., & Mensah, I. (2019). Marketing innovation and sustainable competitive advantage of manufacturing SMEs in Ghana. *Management Decision, 57*(7), 1535-1553. doi:https://doi.org/10.1108/MD-08-2017-0784

Radicic, D., & Djalilov, K. (2019). The impact of technological and non-technological innovations on export intensity in SMEs. *Journal of Small Business and Enterprise Development*, 612-638.

Rajala, R., Westerlund, M., & Möller, K. (2012). Strategic flexibility in open innovation – designing business models for open source software. *European Journal of Marketing*, 1368-1388.

Ratner, B. (2009). The correlation coefficient: Its values range between +1 /-1, or do they? *Journal of Targeting, Measurement and Analysis for Marketing, 17*, 139-142. doi:10.1057/jt.2009.5

Rosseau, M. B., Mathias, B. D., Madden, L. T., & Crock, T. R. (2016). INNOVATION, FIRM PERFORMANCE, AND APPROPRIATION: A Meta-Analysis. *International Journal of Innovation Management, 20*(3), 1650033.

Saebi, T., & Foss, N. J. (2015). Business models for open innovation: Matching heterogenous open innovation strategies with business model dimensions. *European Management Journal, 33*(3), 201-213. doi:https://doi.org/10.1016/j.emj.2014.11.002

Schmidt, T., & Rammer, C. (2007). *Non-Technological and Technological Innovation: Strange Bedfellows? Research Discussion Paper No. 07-052.* Mannheim: ZEW - Centre for European Economic Research.

Sharma, A., Saboo, A. R., & Kumar, V. (2018, September). Investigating the Influence of Characteristics of the New Product Introduction Process on Firm Value: The Case of the Pharmaceutical Industry. *Journal of Marketing, 82*, 66-85. doi:http://dx.doi.org/10.1509/jm.17.0276

Shepherd, J. (2004). What is the Digital Era? In G. Doukidis, N. Mylonopoulos, & N. Pouloudi, *Social and Economic Transformation in the Digital Era* (pp. 1-18). Hershey: IDEA GROUP PUBLISHING. doi:10.4018/978-1-59140-158-2.ch001

Smith, P., Cavalcante, S., Kesting, P., & Ulhøi, J. P. (2010). Opening Up the Business Model: A Multi-dimensional View of Firms' Inter-organizational Innovation Activities. *Proceedings of the 11th International CI-Net Conference*, 1-13.

Swann, G. (2009). *The Economics of Innovation.* Cheltenham, UK: Edward Elgar Publishing Ltd.

Sweeney, E. (2022, 01 19). *The big challenges for supply chains in 2022*. Retrieved from World Economic Forum: https://www.weforum.org/agenda/2022/01/challenges-supply-chains-covid19-2022

Tang, T. Y., Zhang, S., & Peng, J. (2021). The value of marketing innovation: Market-driven versus market-driving. *Journal of Business Research, 126*, 88-89. doi:https://doi.org/10.1016/j.jbusres.2020.12.067

TCGen. (2022). *Time To Market: What it is, Why it's important, and Five Ways to Reduce it*. Retrieved March 13, 2022, from TCGen: https://www.tcgen.com/time-to-market/#:~:text=Time%20to%20market%20(also%20called,the%20first%20unit%20is%20sold.

The Free-Thinker. (1719). from Lady-day to Michaelmas. *The Free-Thinker, 3*, 128.

Timmers, P. (1998). *Business Models for Electronic Markets.* Palo Alto: European Commission, Directorate-General III.

Torres-Reyna, O. (2022). *Getting Started in Factor Analysis (using Stata).* Retrieved April 24, 2022, from Data and Statistical Services: http://www.princeton.edu/~otorres/Stata/Factor

van der Zee, F., Rehfeld, D., & Hamza, C. (2015). *Open Innovation in Industry, including 3D Printing.* Brussels: European Parliament.

Vesey, J. T. (1992). Time-to-Market: Put Speed in Product Development. *Industrial Marketing Management, 21*(2), 151-158. doi:https://doi.org/10.1016/0019-8501(92)90010-Q

Weiblen, T. (2014, July 28). The Open Business Model: Understanding an Emerging Concept. *Journal of Multi Business Model Innovation and Technology, 1*, 35-66. doi:10.13052/jmbmit2245-456X.212

World Intellectual Property Organization. (2021, September 20). *World Intellectual Property Organization*. Retrieved from Global Innovation Index 2021: Innovation Investments Resilient Despite COVID-19 Pandemic; Switzerland, Sweden, U.S., U.K. and the Republic of Korea Lead Ranking; China Edges Closer to Top 10: https://www.wipo.int/pressroom/en/articles/2021/article_0008.html

Worldometers. (2022). *Worldometers*. Retrieved January 30, 2022, from Sweden Population: https://www.worldometers.info/world-population/sweden-population/

Zehir, C., & Zsahin, M. (2008). A field research on the relationship between strategic decision-making speed and innovation performance in the case of Turkish large-scale firms. *Management Decision*, 709-724.

Appendix A

Descriptive Statistics

Question	English	Swedish
DS1	Job title:	Yrkestitel:
DS2	Country of employment:	Vilket land är ditt företag verksamt i?
DS3	City of employment:	Vilken ort är ditt företag verksam i?
DS4	Work experience within the same organization/firm:	Arbetslivserfarenhet på ditt nuvarande organisation/företag:
DS5	Age of the firm (years):	Företagets ålder (år):
DS6	Total number of employees at the firm:	Antal anställda i ditt företag:
DS7	What is the annual turnover in Euros (€) of your company in 2021?	Företagets årliga omsättning i Euro (€) år 2021:
DS8	During the period of 2019-2021, the organizational changes or innovation activities conducted in your company was mainly accelerated by the covid-19 pandemic.	Under tidsperioden 2019–2021 har de organisatoriska förändringarna eller aktiviteterna i innovation som genomförts i ditt företag främst accelererats p.g.a. covid-19-pandemin.

Question	English	Swedish
-	Would you like to get the compiled survey result (If yes, we will email you the results by the end of June. Also, fill in your e-mail in the next question.)?	Önskar du de sammanställda resultaten av vår enkät (Om ja, skickas studien via email i slutet av juni. Fyll även i din e-mail i nästa fråga.)?
-	E-mail (write your e-mail if you want the compiled survey result):	E-mail (fyll i din e-mail om du önskar den sammanställda resultat av vår studie):

Business model framework

The next statements concern your company's business model (2019-2021):

Question	No.	English	Swedish
BMF1	1	We conduct product development internally	Vi utför produktutveckling internt
BMF2	2	We have a road map of product/services to be released in the near future (1-3 years)	Vi har en plan för produkter/tjänster som kommer lanseras den närmsta tiden (1–3 år)
BMF3	3	We look externally for new innovations to serve our customers	Vi söker externt efter nya innovationer för att tjäna våra kunder
BMF4	4	We work in close collaboration with customers and suppliers when innovating	I vårt innovationsarbete jobbar vi i nära samarbete med kunder och leverantörer
BMF5	5	We reinvent our business model to generate new business (e.g. merger & acquisition, creation of spin-offs or joint ventures)	Vi omformar vår affärsmodell för att skapa nya affärer (t.ex. fusioner, förvärv, skapande av spin-offs eller joint ventures)

Innovation types

The next statements concern your company's **innovation** (2019-2021):

Question	No.	English	Swedish
PRI1	6	We introduced new or significantly improved goods or services Excluding: Simple resale of new goods and changes of a solely aesthetic nature	Vi introducerade nya eller väsentligt förbättrade varor eller tjänster (Ej inkluderat: enkel återförsäljning av nya varor, förändring av enbart estetisk karaktär
PI1	7	We introduced new methods of manufacturing for producing goods or services	Vi introducerade nya metoder for att producera varor eller tjänster
PI2	8	We introduced significantly improved logistics or distribution methods	Vi introducerade signifikant förbättrade metoder inom logistik och distribution
PI3	9	We introduced improved supporting activities such as maintenance systems, operations for purchasing, accounting or computer systems	Vi införde förbättrade stödaktiviteter såsom underhållssystem, system för inköp och redovisning eller nya datorsystem
OI1	10	We introduced new business practices for organizing procedures (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)	Vi introducerade nya rutiner för att organisera procedurer (t.ex. supply chain management, knowledge management, lean produktion, kvalitetshantering etc.)
OI2	11	We introduced new methods of organizing work responsibilities and decision making (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)	Vi introducerade nya metoder för att organisera ansvarsfördelning och beslutsfattning (t.ex. omorganisering av anställdas ansvar, lagarbete, decentralisering, integrering eller segregering av avdelningar)
MI1	12	We introduced significant changes to the aesthetic design or packaging of a good	Vi gjorde signifikanta ändringar på designen eller förpackningen av en vara
MI2	13	We introduced the use of new media or techniques for product promotion (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)	Vi använde oss av nya sätt att marknadsföra produkter med hjälp av media eller teknik (t.ex. användning av ny reklammedia, ny varumärkesprofil införande av lojalitetsprogram etc).
MI3	14	We introduced new methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems etc.)	Vi introducerade nya metoder för prissättning av varor eller tjänster (t.ex. användningen av rörlig prissättning beroende på efterfrågan, rabattsystem etc.)
MI4	15	We introduced new methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation .)	Vi introducerade nya metoder för produktplacering eller användningen av nya säljkanaler (t.ex. franchising, distributionslicenser, direktförsäljning, exklusiv detaljhandel, nya koncept för produktpresentation etc.)

Capital structure

The next statements concern your company's **funding** (2019-2021):

Question	No.	English	Swedish
CS1	16	We funded mainly innovation activities by issuing more equity to investors (i.e. sold more shares to investors)	Vi finansierade huvudsakligen innovation genom att aktieemission (d.v.s. sälja fler aktier till investerare
CS2	17	We funded mainly innovation activities by increasing its long-term debt (i.e. taking loans)	Vi finansierade huvudsakligen innovation genom långsiktig upplåning (t.ex. banklån)
CS3	18	We funded mainly innovation activities with company earnings	Vi finansierade huvudsakligen innovation med företagets intäkter
CS4	19	We preferred using internally generated funds over external funds when investing.	Vid investering föredrog vi att använda internt genererade pengar framför externa pengar
CS5	20	We preferred external debt as a funding method over capital from investors (given equal access)	Vi föredrog belåning som finansiering framför kapital från investerare

Time-to-market

The next statements concern your company's **time-to-market** (2019-2021):

Question	No.	English	Swedish
TTM1	21	We delivered products to the market quickly	Vi levererade produkter till marknaden snabbt
TTM2	22	We were first in the market introducing new products	Vi var först på marknaden med att introducera nya produkter
TTM3	23	We had a time-to-market lower than industry average	Vi hade en tid till marknaden som var lägre än branschgenomsnittet
TTM4	24	We had a fast product development	Vi hade en snabb produktutveckling

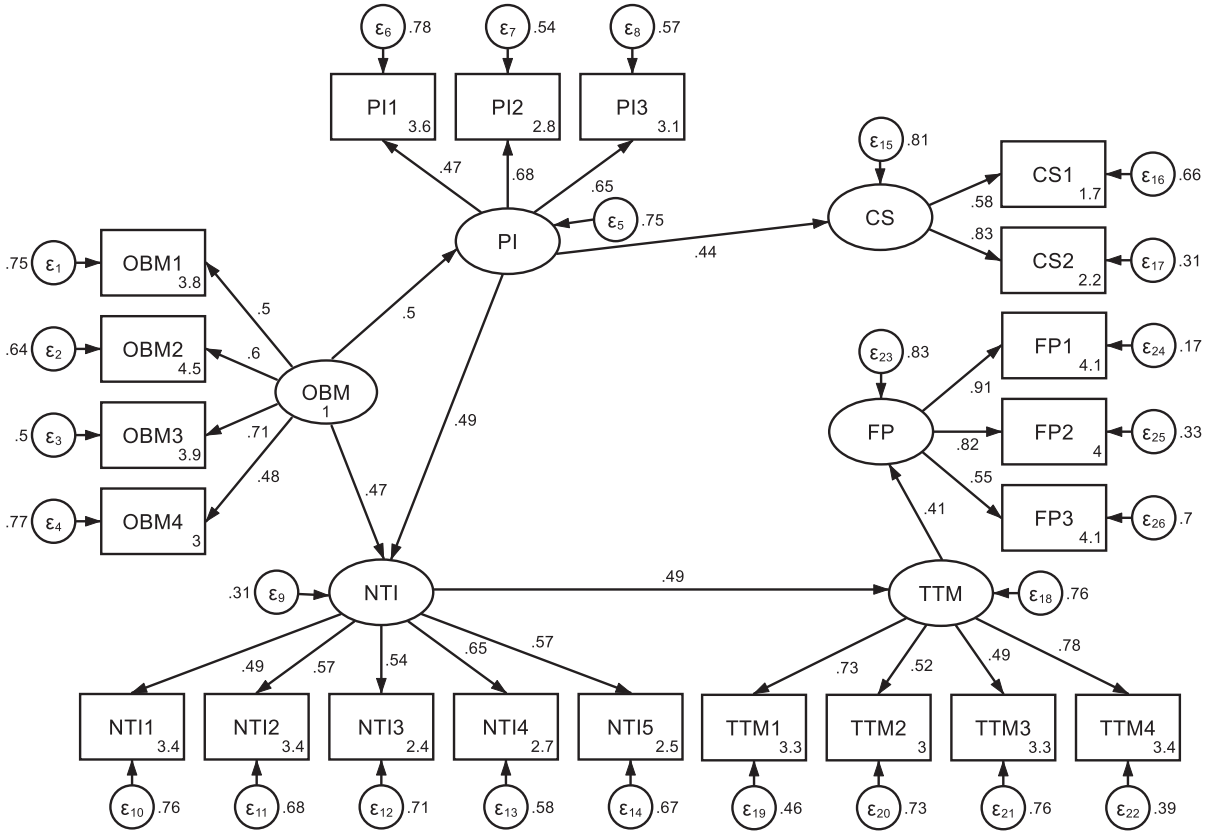
Firm performance

The next statements concern your company's **performance** (2019-2021):

Question	No.	English	Swedish
FP1	25	The growth in our sales increased	Tillväxten av vår försäljning ökade
FP2	26	Our company's profit increased	Företagets vinst ökade
FP3	27	Our company's market share increased	Vårt företags marknadsandel ökade
FP4	28	The lead time for fulfilling our customers' order was reduced (i.e. time from order to delivered product)	Ledtiden för att tillgodose våra kunders ordrar minskade (tid från beställning till levererad produkt)
FP5	29	Our company's customer satisfaction increased	Vårt företags kundnöjdhet ökade

Appendix B

Construct	Old	New	Item	Statement
Open business model (OBM)				
Construct 5	BMF1	OBM1	X_1	We conduct **product development internally**
	BMF2	OBM2	X_2	We have a **road map of product/services** to be released in the near future (1-3 years)
	PRI1	OBM3	X_6	We introduced **new or significantly improved goods or services** Excluding: Simple resale of new goods and changes of a solely aesthetic nature
Construct 10	BMF5	OBM4	X_5	We **reinvent our business model** to generate new business (e.g. merger & acquisition, creation of spin-offs or joint ventures)
Product and Process innovation (PI) (Technological innovation)				
Construct 7	PI1	PI1	X_7	We introduced **new methods of manufacturing** for producing goods or services
	PI2	PI2	X_8	We introduced significantly **improved logistics or distribution methods**
Construct 8	PI3	PI3	X_9	We introduced **improved supporting activities** such as maintenance systems, operations for purchasing, accounting or computer systems
Non-technological innovation (NTI)				
Construct 8	OI1	NTI1	X_{10}	We introduced **new business practices for organizing procedures** (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management etc.)
	OI2	NTI2	X_{11}	We introduced **new methods of organizing work responsibilities and decision making** (i.e. first time use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems etc.)
Construct 7	MI1	NTI3	X_{12}	We introduced significant **changes to the aesthetic design or packaging of a good**
Construct 2	MI2	NTI4	X_{13}	We introduced the use of **new media or techniques for product promotion** (i.e. first time use of a new advertising media, a new brand image, introduction of loyalty cards etc.)
	MI4	NTI5	X_{15}	We introduced **new methods for product placement or sales channels** (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation etc.)
Capital structure (CS)				
Construct 4	CS1	CS1	X_{16}	We funded mainly innovation activities by issuing more **equity** to investors (i.e. sold more shares to investors)
Construct 6	CS2	CS2	X_{17}	We funded mainly innovation activities by increasing its long-term **debt** (i.e. taking loans)
Time to market (TTM)				
Construct 3	TTM1	TTM1	X_{21}	We **delivered products to the market quickly**
	TTM2	TTM2	X_{22}	We were **first in the market introducing new products**
	TTM3	TTM3	X_{23}	We had a **time-to-market lower than industry average**
	TTM4	TTM4	X_{24}	We had a **fast product development**
Firm performance (FP)				
Construct 1	FP1	FP1	X_{25}	The growth in our **sales increased**
	FP2	FP2	X_{26}	Our company's **profit increased**
	FP3	FP3	X_{27}	Our company's **market share increased**



Goodness-of-fit indices	**Abbreviation**	**Reference limit**	**Model initial**	**Model reconstructed**	**Pass/Fail reconstructed**
χ^2 Goodness of Fit Index	GOF	$0 < \chi^2$ GOF	909 df=373 p=0.000	415 df=183 p=0.000	Fail, improved
Root Mean Square Error of Approximation	RMSEA	RMSEA < 0.08	0.085	0.08	Pass, improved
Coefficient of Determination R^2	CD	→ 1	0.989	0.764	Fail, worsen
Comparative Fit Index	CFI	→ 1	0.646	0.80	Fail, improved
Tucker Lewis Index	TLI	→ 1	0.615	0.77	Fail, improved
Standardized Root Mean Squared Residual	SRMR	SRMR ≤ 0.08	0.119	0.088	Fail, improved

Construct	New var.	Std. loadings	Squared std. loadings (A)	Sum of squared loadings (B)	No. of indicators	AVE ≥0.5	Square root of AVE	Std. corr. (SC)	Square root of AVE > SC
OBM	OBM1	0.497	0.705	3.02	4	0.754	0.868	-	-
	OBM2	0.597	0.773						
	OBM3	0.709	0.842						
	OBM4	0.484	0.695						
PI	PI1	0.471	0.686	2.32	3	0.773	0.879	0.498	Pass
	PI2	0.677	0.823						
	PI3	0.653	0.808						
NTI	NTI1	0.485	0.697	3.74	5	0.749	0.865	0.830	Pass
	NTI2	0.567	0.753						
	NTI3	0.539	0.734						
	NTI4	0.650	0.806						
	NTI5	0.570	0.755						
CS	CS1	0.580	0.762	1.67	2	0.836	0.914	0.441	Pass
	CS2	0.830	0.911						
TTM	TTM1	0.732	0.856	3.16	4	0.791	0.890	0.494	Pass
	TTM2	0.524	0.724						
	TTM3	0.493	0.702						
	TTM4	0.780	0.883						
FP	FP1	0.910	0.954	2.60	3	0.867	0.931	0.415	Pass
	FP2	0.817	0.904						
	FP3	0.552	0.743						