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RENATA DE OLIVEIRA MOTA

A FRAMEWORK FOR TIME-TO-MARKET REDUCTION IN STARTUPS

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Thesis presented to the Post Graduation Program in Production Engineering at the Federal University of São Carlos, as part of the requirements for obtaining the PhD degree in Production Engineering.

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“Educação não transforma o mundo. Educação muda as pessoas. Pessoas transformam o mundo.”

Paulo Freire

ABSTRACT

Companies need to commit to new product development (NPD) and innovation to maintain sustainable competition. An excellent indicator to measure the technological change in a market is the portfolio of start-ups, after all, these companies develop new-to-the-world products every day. They can benefit more from innovation because they have less rigid routines and, consequently, greater adaptability to change. However, the sustainability of start-ups is very fragile. It is observed a high percentage of companies that are discontinued in a short time. Therefore, it is essential to promote actions that corroborate the improvement of the performance of these companies. Start-ups should minimize the time to receive feedback from customers about the product to be successful. This implies that these companies must produce, measure and learn quickly. Currently, there is a lack of a well-structured gradual approach for establishing factors to reduce time-to-market (TTM) in startups. Being early can provide an important competitive advantage, making the TTM reduction a significant area for inquiry. To address this need, the objective of this study is to evaluate the potential for startups to reduce time-to-market. First, to point out the drivers and capabilities for reduced TTM, as well as show its main attributes and effects on performance, a systematic literature review was developed. The results indicate 5 drivers as motivators for companies to reduce this time. As well as 19 capabilities grouped into five categories, namely: team, product, process, integration and strategy. In addition, 11 performance indicators are sensitive to TTM reduction. This stage has as the main contribution the proposal of a theoretical model that synthesizes 25 years of literature. A research agenda is also presented with interesting gaps found in this topic. Then, to identify the map of the relationship between drivers and capabilities pointed out in the NPD literature and their potential effect on start-ups performance, Interpretive Structural Modelling (ISM) was used with data obtained through interviews with experts. Only from this structured model and validated by experts, it was possible to create a TTM reduction measurement scale in startups using the item classification method, which resulted in a structured questionnaire. Thus, a survey was carried out on a sample of 191 startups to empirically investigate the impact of these drivers and capabilities and test the relationship between the contours of the model. Structural Equation Modeling was used for data analysis. With the fulfillment of the research objective, the best proven and modern organizational capabilities implemented by innovative companies in the process of developing new products can serve to guide future professionals in their innovation journey.

Keywords: New Product Development. Time-to-market. Start-ups. Systematic Literature Review. Expert interviews. ISM approach. Fuzzy MICMAC. Measurement Scale. Survey. Structural Equation Modeling. Framework.

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SUMMARY

1 INTRODUCTION

This chapter introduces the subject studied and presents the problem definition. Besides, the importance and motivation of the study are defined, as well as the research method selection is described.

1.1 Contextualization and motivation

Companies seek to introduce technological innovation, at the global level, to increase the performance of their business and adapting to the demands of the market. Innovation allows organizations to adapt to economic, legislative, technological and social changes, which may favour the differentiation of the company from its competitors (UZKURT et al., 2013). To maintain a competitive advantage, companies need to commit to new product development (NPD) and innovation. After all, "to capture long-term revenues and sustainable competitive advantages, companies must commit to bringing new products to market regularly. Carefully managing the creative process can result in a product, and ultimately firm, success or failure" (BREWER; ARNETTE, 2017, p.28).

An excellent indicator to measure innovation in a region is to assess the economic activity of its start-ups since these companies develop new-to-the-world products every day (SIMON; LEKER, 2016). The startups emerge as entrepreneurial ventures that seek business opportunities based on innovation. These nascent companies need to break market barriers, gain new customers, have competitive production costs, and present a differential to companies already consolidated in the market (KÖR; MADEN, 2013). They can benefit more from innovation because they have less rigid routines, greater adaptability to change and alert entrepreneurship (OLOGBO; NOR, 2015). Moreover, “The fact that startups commercialize their innovations is crucial because this enables measuring innovation rather than monitoring inventions that do not meet a market demand or cannot be commercially exploited” (SIMON; LEKER, 2016, p.3).

The sustainability of startups is very fragile. "Most startups fail, and only a small proportion of startups show continued growth and launch initial public offerings" (XIA; GUO; FUNG, 2017, p.1). According to Ries (2012), to be successful, startups should minimize the time to receive feedback from customers about the product. This implies that these companies must produce, measure and learn quickly. Thus, to obtain the gains of opportunities identified in the market, companies must finalize their innovation project before the competition does so, in the shortest time possible. And as stated by Tripathi et al. (2019, p.77), “to find and develop the right product that can help them become established and successful in the market, startups need to validate their minimum viable product (MVP) as quickly as possible until a product-market fit is attained". Therefore, promoting actions that corroborate the commercial success of the product to be launched by these companies is fundamental. Being early can provide an important competitive advantage, making the time-to-market (TTM) reduction a significant area for inquiry. In this research, some structural aspects that, when implemented, can facilitate the reduction of TTM and are called "capabilities". There are also external conditions that motivate companies to accelerate their NPD process and are called "drivers".

Several studies have sought to assess the impact of individual capability for reducing TTM in new product development (KONG et al., 2015; SIMON; LEKER, 2016; VAYVAY; CRUZ-CUNHA, 2016). However, there is little effort to conduct this analysis holistically in the company (GRANER; MISSLER-BEHR, 2015; ZHAN et al., 2017), analyzing jointly the relationship of people, processes, strategies and other factors that may have influenced this time. Besides, there are gaps as to the possible ways of implementing these capabilities (BARCZAK; HULTINK; SULTAN, 2008; TAN; ZHAN, 2017) and how these drivers and capabilities relate to new product performance (GRANER; MISSLER-BEHR, 2015), especially with regards to innovative products (CHEN; REILLY; LYNN, 2005; GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017). Most of the studies identified in the literature use large firms as the object of study (ALLOCCA; KESSLER, 2006; JOHNSON; PICCOLOTTO; FILIPPINI, 2009; CHANG; TAYLOR, 2016), 2016), and despite the evidence that startups present different behaviours during the development of their products due to scarce resources when compared to traditional companies (MARION; FRIAR; SIMPSON, 2012), little attention was paid to identify these peculiarities in the area (SIMON; LEKER, 2016).

Startups need NPD resources and specific conditions, since, by definition, these companies have their business model based on the delivery of an innovative new product to the market. Interestingly, NPD literature has neglected the peculiarities of these companies. To minimize this literature gap, this thesis aims to evaluate the potential for startups to TTM reduction. By translating the literature insights of the TTM reduction into a testable hypothesis about the innovation in startups, this study may contribute by providing the best organizational practices adopted by innovative companies, which can serve to guide future professionals in their journey of innovation.

To consolidate the existing literature on the drivers and capabilities for reducing TTM, a systematic literature review (SLR) was conducted at first. To guide this step, two research questions were used:

RQ1. How is TTM reduction research evolving?
RQ2. How is TTM reduction implemented?

The model built from the traditional literature about TTM reduction can be impacted by the specific characteristics of start-ups (MARION; FRIAR; SIMPSON, 2012; SIMON; LEKER, 2016), to evaluate this, a multi-method approach was applied, involving expert interviews, Interpretative Structural Modelling (ISM) and Fuzzy MICMAC (Matriced' Impacts Croise's Multiplication Applique'e a' un Classement). This step sought to answer:

RQ3. What is the relationship between drivers and capabilities for reduced TTM in start-ups?

A good measuring instrument is essential to develop good empirical science (MENOR; ROTH, 2007). Given this gap in the literature of this theme, to develop a multi-item measurement to reflect the TTM reduction concept in start-ups, a set of assertions were statically validated through item-sorting rounds to investigate the degree of adoption of the capabilities for reduced TTM in start-ups, survey research is performed to answer:

RQ4. What is the degree of capabilities implementation for TTM reduction in start-ups?

In competitive and fast-changing environments, the Dynamic-capability view (DCV) is more appropriate than the Resource-based View (RBV), which analyses these internal aspects of an organization in a more static way (FERREIRA; COELHO, 2020; SCHRIBER; LÖWSTEDT, 2020). Therefore, based on this view some drivers seem to affect the adoption of capabilities for reducing TTM in the startups. To investigate this empirically, a large sample was used to answer:

RQ5. What is the impact of drivers on the capabilities implementation for TTM reduction?

Lastly, the study intends to investigate the impact that of TTM reduction on the start-ups' performance, since this implementation has benefited different sectors (TATIKONDA; MONTOYA-WEISS, 2001; JOHNSON; PICCOLOTTO; FILIPPINI, 2009; MILLSON; WILEMON, 2010; CHEN; REILLY; LYNN, 2012; GRANER; MISSLER-BEHR, 2015; BREWER; ARNETTE, 2017), so the following question emerged:

RQ6. What is the impact of TTM reduction on the start-ups' performance?

1.2 Objective

Based on the above considerations, the objective of this study is to evaluate the potential of startups to align their capabilities with external conditions (drivers) during the new product development process to obtain performance benefits by reducing time-to-market. For this, some specific objectives need to be achieved. These are pointed with their respective research methods in Table 1.1.

Table 1.1 - Specific objectives

Objectives	Research method
Specific objective 1 Consolidate the existing knowledge about TTM reduction and analyze the relevant aspects of their implementation	Systematic literature review
Specific objective 2 Assess the relationship between drivers and capabilities for reduced TTM in start-ups.	Multi-method approach
Specific objective 3 Develop new multi-item measurement scales reflecting the TTM reduction in the start-ups.	Survey
Specific objective 4 Verify the degree of adoption of capabilities for reduced TTM in the start-ups. *Specific objective 5* Evaluate the impact of drivers on the adoption of capabilities for reduced TTM in start-ups. *Specific objective 6* Analyze the impact of the TTM reduction on start-ups performance.	Survey

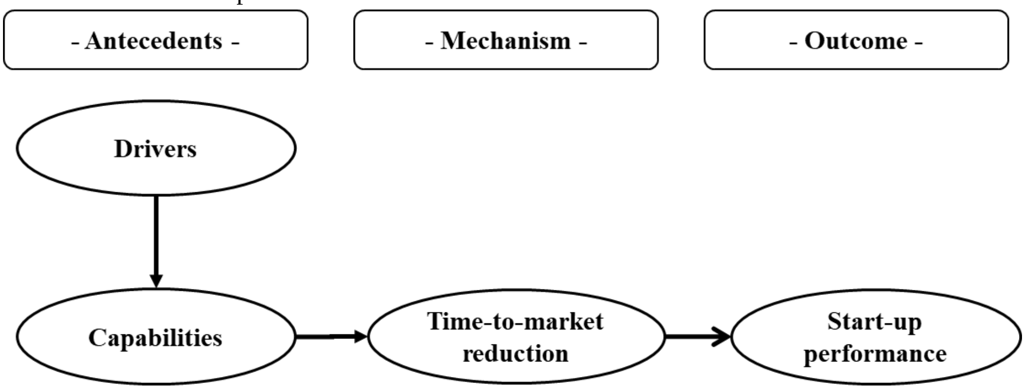
Source: Proposed by the author.

1.3 Research method release

The conception used in this research is inductivism because it is intended to derive consequences of the impact of TTM reduction to elaborate explanations and predictions in the universe of startups through the process of deductivism. This generalization to the object will be based on the observation of regularity observable from known circumstances. It complies with the rigour of inductivism by making use of organizational practices already identified in NPD theory, more specifically for time-to-market reduction. Therefore, to achieve the proposed research objective, a multi-method approach was applied.

A systematic review seeks to identify, select and critically evaluate relevant research. When included in the review, significant data are collected and analyzed in each study to generate a better understanding of the subject. For this, it makes use of explicit methods and a formulated research question (MOHER et al., 2009). Using the existing high impact scientific production to support the research proposal, the SLR allowed the construction of a coherent theoretical model with its respective constructs. Figure 1.1 shows a synthesized representation of the developed theoretical model.

Figure 1.1 - Theoretical conceptual model



Source: Proposed by the author.

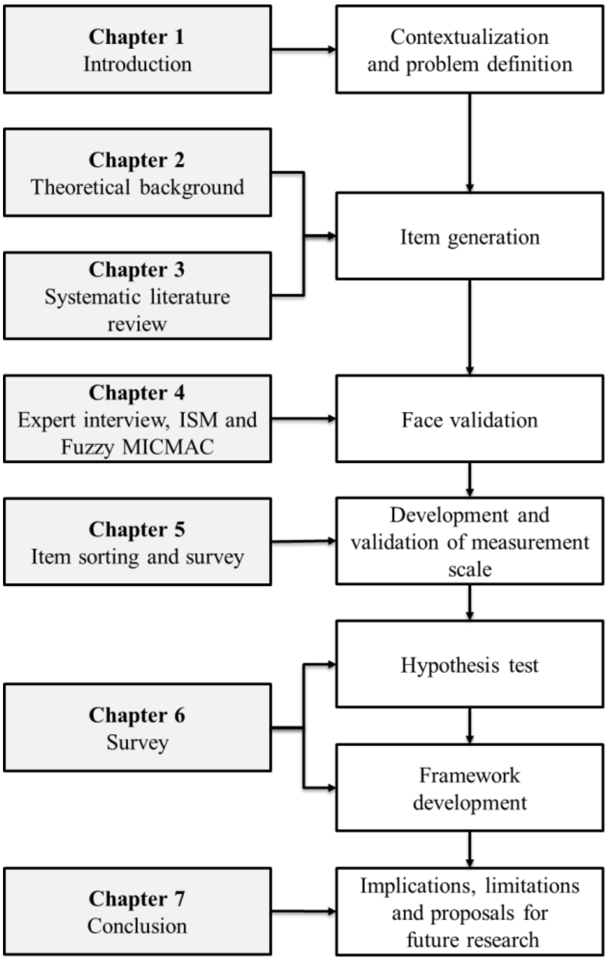
This model comes from the analysis of the traditional literature of NPD, therefore it needed to be refined and validated for the context of startups. For this, a multi-method approach was applied with rounds of semi-structured interviews as data collection, and data analysis with the Interpretive Structural Modelling (ISM) and Fuzzy MICMAC (Matriced' Impacts Croise's Multiplication Applique'e a' un Classement). To test the hypotheses of the theoretical conceptual model, the variables studied should represent well the construct to be measured. After all, only with quality in the measurement, it is possible to achieve the objective of expressing the cause and effect relationship between variables. Therefore, a measurement scale was developed.

With a large number and a variety of startups studied, it is intended to generalize the results obtained and allow for future replications, using a quantitative approach. The constructs to be studied need a retrospective analysis of organizational events. The performance of companies can only be evaluated after the facts have occurred, so that observational is more appropriate than experimental research in this case. Thus, the method used in the research was the survey, where the researcher collects the data of interest without adding any type of intervention. By presenting established hypotheses and associated with the theoretical level, the type of survey developed was the explanatory, after all this allows for greater robustness of the data and the conclusions of the investigation.

1.4 Thesis structure

This thesis is structured in seven chapters, being the third, fourth, fifth and sixth chapters in paper format. This choice was due to the intention to publish the main chapters of this study in journals and could imply repetitive sections during this document. Figure 1.2 shows the complete structure of this document.

Figure 1.2 - Thesis structure and status



Source: Proposed by the author.

The context and the research problem were described in this introductory chapter. In chapter 2, the organizational theory and the main concepts that support this study are presented. The development of the systematic literature review is described in chapter 3 (Drivers and capabilities for reducing time-to-market: a systematic literature review and research agenda). A theoretical validation of these capabilities is developed through interviews with experts analyzed by the ISM and Fuzzy MICMAC approach in chapter 4 (Unveiling the relationship between drivers and capabilities for reducing time-to-market in start-ups: a multimethod approach). The measurement scale to be used in the research is carried out in chapter 5 (Reduced time-to-market in startups: construct development and measurement validation). The survey application and data analysis are described in chapter 6 (The effect of reduced time-to-market on startups performance). In the final of research, chapter 7 summarizes the main results of this thesis, with their respective implications, limitations and proposals for future research.

2 CONCEPTUAL BACKGROUND

To achieve a more efficient contextualization of the topics covered in this research, this section will present a brief conceptual background about New product development, Time-to-market, Startups and the Dynamic capabilities theory.

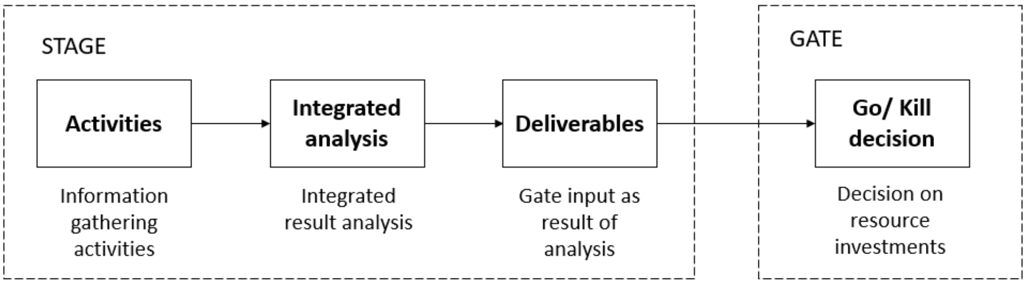
2.1 The new product development process

Based on the Resource-based View (RBV), resources are the tangible and intangible capabilities that enable the company to deliver a product of value to the market, and one of these higher-order intangible assets that enables the company to perform critical activities better than competitors is the new product development (NPD) (TATIKONDA; MONTOYA-WEISS, 2001). The NPD process can be defined as chains of decisions involving different stages that must be completed for a product to enter the market, commonly they are a selection of ideas, approval of the prototype, production and final distribution of the product (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017). As Kessler and Bierly (2002, p. 2) argue, "new product development is a critical component of competitive strategy because it can be a used to leapfrog the competition, create entry barriers, establish a leadership position, open up new distribution channels, and garner new customers to improve market position".

A company faces harsh challenges at the NPD when it is under conditions of extreme uncertainty because generally the technology is not well understood and product specifications and designs need to be continually modified (ZHAO; CAVUSGIL; CAVUSGIL, 2014). In such a trial-and-error process, the NPD is extremely complex and there are risks associated with each step. Avoiding failures and delays in this process can turn into a matter of survival. Therefore, when the NPD team develops a new product, they need to explore, absorb and learn to use several new tools and methods (CHEN; REILLY; LYNN, 2012a). "Having a systematic NPD process can provide this framework to help new product teams achieve their goals" (LYNN; SKOV; ABEL, 1999, p. 442). Adopting product development methods is crucial to project performance, after all, structured use of methods can be a very effective way of generating new ideas and improving companies 'ability to innovate, and thus cushion the negative impact of complexity on development projects (GRANER; MISSLER-BEHR, 2015). Therefore, "understanding the product development processes and methods used to increase the likelihood of successful outcomes is paramount to the new venture" (MARION; SIMPSON, 2012, p. 640).

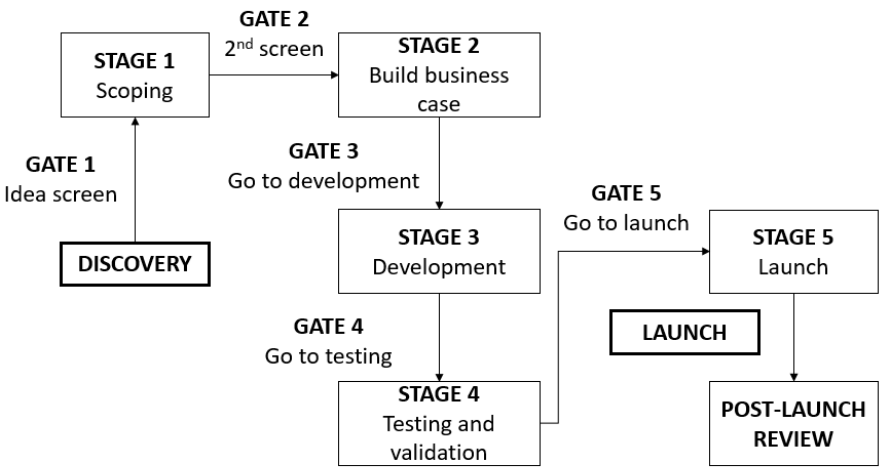
Given its importance in the organization, over the years, several authors have tried to develop NPD process models. And for a long time, the most common way to organize and guide NPD processes has been to implement stages and gates (SMOLNIK; BERGMANN, 2020). The Stage-Gate® process concept was introduced by Cooper (1990) and has become the basis of most current NPD processes used in industry. The model developed by the author was based on comparative studies in companies that were successful with passing new products from the idea stage to the market and companies that failed in this process. Two decades later, Cooper (2008) presents the most rudimentary form of a Stage-Gate® process (Figure 2.1). Within this simpler concept, a series of stages containing information gathering, data integration and analysis is followed by gates, where important project resource allocation decisions are made. However, currently, the most commonly used representation of the Stage-Gate® process is shown in Figure 2.2.

Figure 2.1 - Most rudimentary form of a Stage-Gate® process in allusion to Cooper (2008)



Source: Adapted from Smolnik and Bergmann (2020).

Figure 2.2 - Standard Stage-Gate® model in NPD in allusion to Cooper (2014)



Source: Adapted from Smolnik and Bergmann (2020).

The standard Stage-Gate® process starts with the discovery, ideation stage, and ends with the post-release review (COOPER, 2014). During each stage, a Go/Kill (Gate) decision is made, which decides the progress of the project. Therefore, these ports contain criteria by which the project is evaluated, which are subdivided into: “should meet” and “must meet criteria”. And it is based on these criteria categories that projects are prioritized and their progress is decided. In addition, the Stage-Gate® process consists of a series of steps that contain a set of best practices that lead to better process performance, such as focus groups and Voice of the Customer (VoC) survey to determine needs missed customer services (SMOLNIK; BERGMANN, 2020). The main activities at each stage of this model are summarized in Table 2.1.

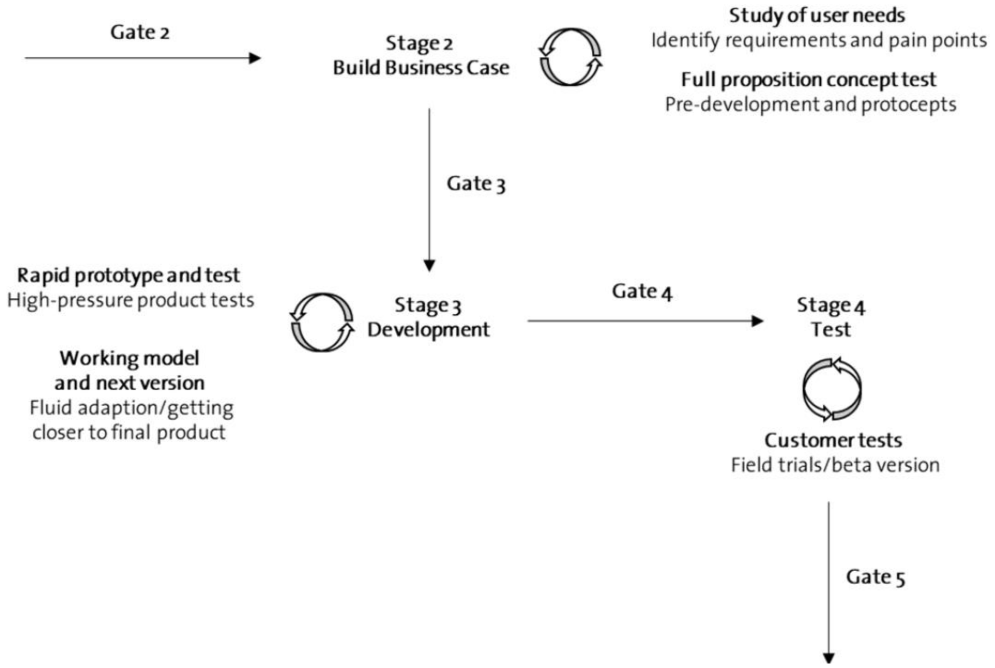
Table 2.1 - Activity and underlying actions of each stage and gate within the original Stage-Gate® process

Stage/Gate	Activity	Actions
Start	Discovery	Generation and collection of promising new product ideas.
Gate 1	Idea screen	Selection and prioritization of product ideas for NPD projects within a dynamic process with high uncertainty.
Stage 1	Scoping	Rough market and technology analysis such as assessment of basic financial values.
Gate 2	2nd screen	Decision on project´s progress based on profound conditioned information collection and analysis.
Stage 2	Build business case	Conceptualization of business case including detailed development and market launch plan.
Gate 3	Go to development	Decision on project´s profitability and release of exalted re-sources.
Stage 3	Development	Technological development and evaluation of marketing and fabrication activities.
Gate 4	Go to testing	Assessment of project’s technical feasibility and control of R&D spending.
Stage 4	Testing and validation	Evaluation of customer acceptance, validation of financial planning and technological achievements.
Gate 5	Go to launch	Approval of market launch.
Stage 5	Launch	Market launch and product commercialization.
Post-launch review	Monitoring	Evaluation of launch process.

Source: Smolnik and Bergmann (2020).

It is important to emphasize that these steps may follow a sequential or concurrent approach depending on several factors, for example, the type of industry or the type of innovation (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017). In general, in the pre-development phases, companies should avoid using rigid and linear NPD processes for market assessment, as the market may not yet exist. In such cases, the ideal is for potential customers to be very involved (COOPER, 1988). This integration can be achieved by incorporating spiral development cycles designed to directly integrate customer feedback (COOPER, 2017). These iterative steps include demonstrating product drafts to the customer and validating. Based on this, a new approach was created allowing and encouraging you to fail often, quickly and cheaply (SMOLNIK; BERGMANN, 2020). Figure 2.3 illustrates the stages of spiral development, which did not alter stages 1 and 5 of the stage-gate process, so these stages do not appear in the structure shown.

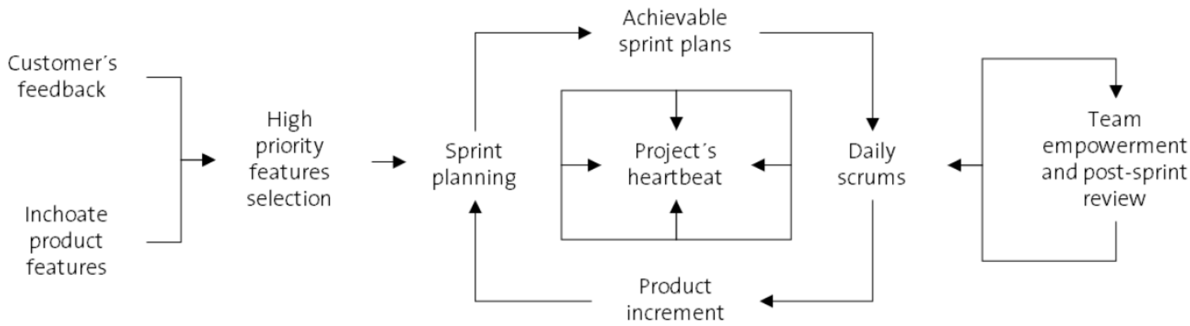
Figure 2.3 - Spiral development phases in allusion to Cooper (2014)



Source: Smolnik and Bergmann (2020).

Based on the Agile manifesto created by IT industry leaders in 2001, a set of rules to efficiently develop new software codes was developed, providing for the development of several Agile methodologies (FEKRI; ALIAHMADI; FATHIAN, 2009; GHEZZI; CAVALLO, 2020). The integration of agile methods into existing Stage-Gate® systems resulted in the development of another new approach, Agile-Stage-Gate® (CONFORTO; AMARAL, 2016; COOPER; SOMMER, 2016). This hybrid process incorporates Scrum method sprints, which are several small packages of work executed in very short time intervals, typically one to four weeks. The structure of this approach is illustrated in Figure 2.4. Agile development starts with sprint planning to set realistic goals that can be achieved in a given period of time. In addition, daily Scrums are performed, in which the team analyzes what was accomplished and what new problems and challenges occurred. At this point, there is a discussion on how these problems or new challenges can be solved (EDISON et al., 2018). The primary objective of each sprint section is to deliver a prototype that can be tested by customers and other relevant stakeholders. It is based on this feedback that the project team decides on the improvements to be completed in the next iteration step. Due to these characteristics, the Agile-Stage-Gate® processes prove their most promising results in higher risk projects (COOPER, 2017). However, customer integration carries the danger of loss of know-how and can limit the development of disruptive innovations. Besides, the risk of integrating myopic customer feedback that can result in the development of only incremental innovations.

Figure 2.4 - Agile–Stage-Gate® hybrid processes in allusion to Wells (2009)



Source: Smolnik and Bergmann (2020).

Since then, some methodologies have been developed in order to prepare companies to deal with the increasingly dynamic and uncertain environment in which they operate (SMOLNIK; BERGMANN, 2020), such as the risk-based contingency model for Stage-Gate ® processes (KIRK, 2013), which customizes the process for each project exclusively; the Flexible Stage-Gate® (COOPER; EDGETT, 2012), which aims to adapt and accelerate NPD processes; and even The Triple A system (COOPER, 2014), which unites the three previous approaches in order to generate an adaptive, agility and acceleration system. However, what is common in the evolution of these methodologies is the need to deliver the product to the market faster, in order to more quickly assess the value attributed to customers, and consequently, ensure greater gains and success in the process (SMOLNIK; BERGMANN, 2020).

After all, in making use of the traditional approach, product development is considered as a succession of activities to be performed in a chronological sequence and assigned to independent functions. However, breaking with this logic generates the main opportunities for a time-to-market reduction (TONI; MENEGHETTI, 2000). “These efforts are justified by the need to deal with continuous changes in customer needs and the requirement to rapidly incorporate new technologies into products” (JOHNSON; PICCOLOTTO; FILIPPINI, 2009, p. 219). By competing on time, and introducing products to the market on time, the development of new products becomes an essential source for competing in the global market (SERHAN et al., 2015).

2.2 Time-to-market reduction

Along with adopted strategies and practices, time is one of the most important factors in the NPD process given the shortening of product lifecycles and increased competition. For that reason, the topic of time-to-market (TTM) reduction has been important to academics and companies in the last years (MILLSON; WILEMON, 2010; SERHAN et al., 2015; VAYVAY; CRUZ-CUNHA, 2016). Johnson, Piccolotto and Filippini (2009) argue,

> A prime motive of the research on NPD over the last 30 years has been the identification and verification of various drivers purported to contribute to the success of product development. One major use of these drivers has been to decrease development time for new products. In fact, temporal pressures on NPD have only risen over time, and as global competition increases, many companies have invested great resources into shortening their product development cycle time (JOHNSON; PICCOLOTTO; FILIPPINI, 2009, p. 219).

The strategy of differentiation that creates a competitive advantage through time compression has become known worldwide as the “Time-based competition” (SERHAN et al., 2015). This term was first used by Stalk in the article “*Time – the next source of competitive advantage*”, which won the award for the best article published in the Harvard Business Review in 1989 (HUM; SIM, 1996). This paradigm shift can be evidenced in the statement of an author contemporary to this publication. Willis (1998) reflects that,

> It used to be that business was like a game of chess. Moves were often slow and calculated, and there was a great deal of time to think before making a move. Today, business is more like a video game. A company does not know where their competition will be coming from or how they will attack, and there is little time to make decisions about the best defense or what strategy to take (WILLIS, 1998, p. 83).

According to Al Serhan, Julian and Ahmed (2015), the time-based competitiveness must be determined considering the ability to make rapid design changes; the ability to introduce new products quickly; the ability to make rapid volume changes; the ability to make product mix changes; the ability to offer a broad product line; the ability to provide fast deliveries; the ability to provide dependable deliveries; the ability to customize products to individual customers’ needs relative to their business strategy. Therefore, the elimination of wasted time will be reflected in performance (AL SERHAN; JULIAN; AHMED, 2015). That would provide such early entrants many opportunities including early entry into product categories learning curves with the potential to reduce production costs as market share increased, the prospect of gaining sustainable market share positions, the chance to align with desirable organizations including distributors, and the opportunity to set early reference prices for new product categories (MILLSON; WILEMON, 2010).

Time-based measures include the entire value delivery system, starting with the new product development and ending with delivery (JIAN'AS; BEI, 2007). Based on that, Carter, Melnyk and Handfield (1995) suggest a model for competing in TBC divided into two distinct forms: fast-to-market and fast-to-product. Fast-to-product companies emphasize the speed of response to customer demands for existing products. Fast-to-market, on the other hand, has an emphasis on reducing product design lead time, allowing companies to gain a competitive advantage in new markets, launching products before a competition, and increasing entry barriers for new competitors. This last one will base the proposals of this research.

According to Menon and Lucas (2004), there are three ways of measuring time performance, they are: (1) by comparing elapsed time with budgeted or planned project time; (2) by comparing the elapsed time of one project with the elapsed time of another project; (3) and simply by measuring the elapsed time between the conception of a product and its introduction into the commercial market. Besides, De Toni and Menegueti (2000) defined two classes of time performance, they are external, visible to consumers; and internal, measurable by the company, but not manifest to customers. These authors express the relation of each time performance in its respective phases and classes. This study assesses the product development phase of companies, and as it starts from the definition of the product, it assesses more specifically the time-to-market.

Table 2.2 - Internal and external time performances

Phase / Time performance	Internal	External
Product development	**TTM** (Time-to-market)	**FI** (Frequency of introduction) - New products, existing products and improvements.
Procurement production distribution	**LT** (Lead time) - Procurement, production and distribution	**DT** (Delivery time) - Speed and punctuality

Source: Adapted from De Toni and Meneghetti (2000, p. 257)

The TTM reduction refers, more broadly, to the reduction of the time that elapses from the definition of a new product until its adoption by the market – acceptance (SIM; CURATOLA, 1999; FENG et al., 2014). Product development time, innovation speed, innovation time, project completion time, NPD lead time and total time also denote the same concept (CANKURTARAN; LANGERAK; GRIFFIN, 2013). Several attempts to evaluate ways to shorten time-to-market can be found in the literature, Millson and Wilemom (2010) claim that the main perspectives evaluated are usually about: how to reduce development time through integration with suppliers; how marketing and technical capabilities impact speed to market and commercial success; the impact of speed on profitability or success; the methods for reducing new product development time; and about what is more important: entering markets with superior quality products or time to market.

Several authors have discussed the TTM reduction in the most diverse business activities, as well as their respective forms of measurement and the possible advantages and disadvantages of its implementation (JIAN'AS; BEI, 2007; LIN, 2009; AL SERHAN; JULIAN; AHMED, 2015). The main studies that point out possible disadvantages emphasize the trade-off between speed, cost and quality (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017). Some researchers argue that because of the greater use of resources required for faster innovation speed there may be an increase in project cost; just as there are those who claim that quality can be reduced due to the lack of specifics needed in accelerated projects (LIN; HUANG; CHIANG, 2012). However, by operating with the correct procedures one can reduce these harmful effects. As Fekri, Aliahmadi and Fathian (2009) affirm,

> To reduce the cycle time and cost of the manufacturing process with considering the quality of new product, some techniques such as lean production, alliance strategies, outsourcing, business process reengineering, total quality management, concurrent engineering, and risk and change management have been suggested and used by NPD researchers (FEKRI; ALIAHMADI; FATHIAN, 2009, p. 1240).

When talking about the performance of product development, there is a direct reference to the success of development efforts, that is, it is necessary to evaluate three aspects of success: operational, financial and marketing performance (CHANG; TAYLOR; META-ANALYSIS, 2016). In line with recent studies on NPD practices, the definition adopted in this study for the new product success (NPS) will be the degree to which the firm can develop a new product that consistently meets or exceeds financial and market goals (JOHNSON; PICCOLOTO; FILLIPINI, 2009, p. 220). The success of new product development is directly related to the monitoring of changes in customer demand and technological advances

(BREWER; ARNETTE, 2017). Even if you are slightly late, your product might neither meet user's requirement nor keep up with the cutting edge of technology (CHEN; REILLY; LYNN, 2012).

As Kong et al. (2015, p. 2269) affirms "new product development (NPD) success is particularly complex and associated with a variety of uncertainties". This subject attracts the attention of researchers and managers since the literature of the area points to failure rates of over 60% in newly launched products (GRANER; MIBLER-BEHR, 2015). Valle; Vázquez-Bustelo (2009, p 136) point to three challenges to be overcome to reduce these failures, they are: Achieve shorter new product development times; have more efficient developments; and develop superior products. When using external measures to assess the achievement of market goals, one has a good parameter for the market success of a new product development effort (TATIKONDA; MONTOYA-WEISS, 2001). "It is generally accepted that the three primary NPD outcomes defining a project's success are speed, cost and quality" (LIN et al., 2013, p. 316). Nevertheless, the ways to execute these strategic goals has generated heated discussions. "The adoption of product development methods is crucial to the performance of development projects" (GRANER; MIBLER-BEHR, 2015, p. 4). Moreover, in addition to the choice of method, "the execution quality of NPD activities is significantly associated with the success of new product" (MILLSON; MILEMON, 2010, p. 845).

The relationship between TTM reduction and the NPS has been advocated in the last decades. "Shorter development lead times are therefore a critical capability for a firm to be successful in commercial product development" (KRISHNAN; EPPINGER; WHITNEY, 1995, p. 491). However, "the existing literature has produced inconsistent or conflicting predictions regarding the relationship between speed and success for NPD projects" (JOHNSON; PICCOLOTO; FILIPPINI, 2009; CHEN; REILLY; LYNN, 2012). While there is a current in the literature that accelerating NPD increases the chances of achieving NPS (KODAMA, 2005; MILLSON; WILEMON, 2010; CIARAPICA; BEVILACQUA; MAZZUTO, 2016). Some authors claim that speed can have negative effects such as increased resource requirements and excess product and process failures (JIAN'AS; BEI, 2007; LIN; HUANG; CHIANG, 2012; CHEN; REILLY; LYNN, 2012). There are still authors who moderate this relationship, like Kessler and Bierly (2002) when questioning in their study *"is faster really better?"* They conclude that external factors, such as market uncertainties and change rates, are associated with how time will interfere with success.

A primary concern in time-to-market reduction research has been to identify the determinants that help make NPD projects successful, given any time constraints imposed"

(KACH; AZADEGAN; DOOLEY, 2012, p. 377). However, "what makes product development successful in a predictable market is a different story compared to the determinants of success in unpredictable environments" (BSTIELER; GROSS, 2003, p. 158). After all, in addition to greater risks, highly innovative products require a greater degree of exploration of development alternatives. The assessment of NPD determinants based on product novelty and conditions of more dynamic environments is absent in the literature (KACH; AZADEGAN; DOOLEY, 2012). Thus, our research assumes that there are several challenges to implement rapid product development and TTM is an essential indicator for evaluating a company's innovation performance, as well as for achieving success in environments of high turbulence and uncertainty. And, therefore, it will evaluate these determinants of TTM reduction within a perspective of innovation and environmental dynamism.

2.3 Innovation and agility in light of dynamic capabilities theory

As discussed throughout this chapter, the ability to innovate and develop new products plays a fundamental role in the long-term survival and competitiveness of companies in terms of maintaining and growing market share. Furthermore, innovation, as a source of competitive advantage, is closely associated with the ability to sense and seize new business opportunities, as well as to reconfigure the assets and resources of companies in order to deliver faster value to customers, reducing the process time and increasing the rate of introduction of new products in the market. Consequently, a time-based strategy works better for product innovations introduced in rapidly changing markets than for NPDs in stable markets (CHEN; REILLY; LYNN, 2005), so speed to market has become the mantra for NPD professionals and researchers in recent years (MITRĘGA, 2020)

Time-based competition and agility are closely related (TEECE; PETERATD; LEIH, 2016). After all, one of the parameter which determines the business agility is faster time-to-market. organizations using agility can increase the speed of decisions and product development, as well as shorten the time between the conception and release of a product (known as time to market) (MITRĘGA, 2020). Therefore, agility across a whole enterprise combines speed and stability; helps role clarity, innovation and operational discipline. As an organizational feature, agility means that the company is able to adjust its operations to market changes in a reasonably short time, including increasing short-term manufacturing capacity and quick product modifications. The challenge, then, is to define how quickly the company iterates through this process and how effectively it will shape its business for agility. This operations adjustment is closely linked to the enhancement of features to reduce time to market to a minimum. In addition, it is important to consider that the time to market is both quantitative and qualitative. That is, there is a best time to launch a product and that time is not always the fastest time possible, although with more innovative offerings it usually is. And releasing at the right time requires adaptability, the ability to learn quickly, and resilience. Therefore, time-to-market is intrinsically related to the mechanics of the feedback loop, this is what is called scrum in agile sprint methodology. This makes the dynamic capabilities at the forefront of time-based competition today. After all, as stated by Teece et al. (2016),

> "If firms have strong dynamic capabilities, they will be better at sensing emerging developments; moreover, they will achieve agility with less sacrifice of efficiency, along with making better use of whatever agility they possess. This is because they will, by definition, be better at sensing, seizing, and transforming" (TEECE; PETERATD; LEIH, 2016, p. 31).

Besides, the deep uncertainty is ubiquitous in the innovation economy. However, uncertainty is very different from risk, which can be managed using traditional tools and approaches. Given this context, the dynamic capabilities (DC) theory emerges as the most appropriate organizational approach to assess the reduction of time-to-market in innovative companies. DCs are regarded as a transformer for converting resources into improved performance in situations involving dynamic and fast-changing environments (FERREIRA; COELHO, 2020). This perspective arises in response to the shortcomings of the static approach of the classical theory of the Resource-Based View (WERNERFELT, 1984) which proved to be ineffective in explaining the strategic adaptation of companies when the business environment changes and also in valuing the creation potential of organizations (MITRĘGA, 2020).

The popularization of the DC view not only resulted in a way to define dynamic capabilities and measure them empirically, but also motivated academic interest in areas such as manufacturing networks, supply chain, marketing and new product development related to dynamic capabilities (TEECE; PETERATD; LEIH, 2016; MITRĘGA, 2020). Besides, this approach encourages a greater analysis of the external environment, which is marked by dynamism and is called the VUCA environment by DC theory researchers. This acronym alludes to the four main characteristics of the current environment in which companies are inserted, where depending on the nature of their operations and market objectives, companies can be more or less impacted by these external conditions. According to Bennett and Lemoine (2014), the four characteristics of the VUCA environment are: volatility, uncertainty, complexity, and ambiguity. Table 2.3 describes the definitions, examples and ways of dealing with each of these characteristics presented by these authors.

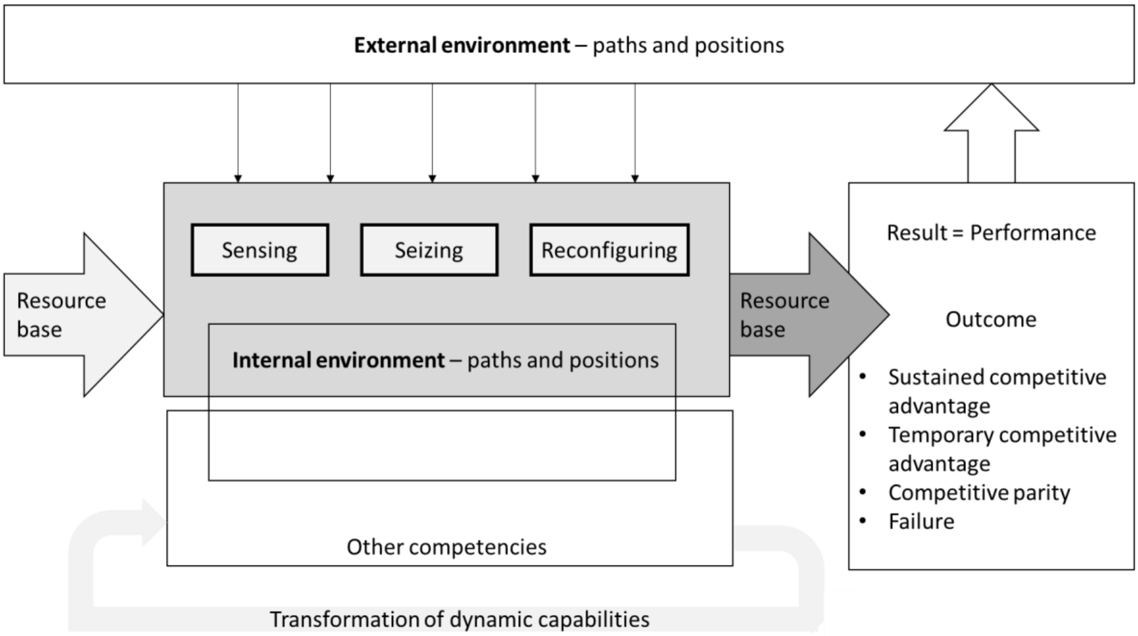
Table 2.3 - VUCA environment framework

	What it is	An example	How to effectively address it
Volatility	Relatively unstable change; information is available and the situation is understandable, but change is frequent and sometimes unpredictable.	Commodity pricing is often quite volatile; jet fuel costs, for instance, have been quite volatile in the 21st century.	***Agility*** is key to coping with volatility. Resources should be aggressively directed toward building slack and creating the potential for future flexibility.
Uncertainty	A lack of knowledge as to whether an event will have meaningful ramifications; cause and effect are understood, but it is unknown if an event will create significant change.	Anti-terrorism initiatives are generally plagued with uncertainty; we understand many causes of terrorism, but not exactly when and how they could spur attacks.	***Information*** is critical to reducing uncertainty. Firms should move beyond existing information sources to both gather new data and consider it from new perspectives.
Complexity	Many interconnected parts forming an elaborate network of information and procedures; often multiform and convoluted, but not necessarily involving change.	Moving into foreign markets is frequently complex; doing business in new countries often involves navigating a complex web of tariffs, laws, regulations, and logistics issues.	***Restructuring*** internal company operations to match the external complexity is the most effective and efficient way to address it. Firms should attempt to 'match' their own operations and processes to mirror environmental complexities.
Ambiguity	A lack of knowledge as to 'the basic rules of the game'; cause and effect are not understood and there is no precedent for making predictions as to what to expect.	The transition from print to digital media has been very ambiguous; companies are still learning how customers will access and experience data and entertainment given new technologies.	***Experimentation*** is necessary for reducing ambiguity. Only through intelligent experimentation can firm leaders determine what strategies are and are not beneficial in situations where the former rules of business no longer apply.

Source: Bennett and Lemoine (2014, p. 313)

Dynamic capabilities thus defines the firm's capacity to innovate, adapt to change, and create change that is favorable to customers and unfavorable to competitors (TEECE; PETERATD; LEIH, 2016). For that reason, the model used in this research to structure this organizational theory is the proposed by Teece (2007) and adapted from Nagel (2016), who combined in his study dynamic capabilities with environmental aspects and results in organizational performance (See Figure 2.5). These authors argue that the internal resources of organizations through (i.e., ability to explore the firm's environment to identify opportunities), seizing (i.e., as soon as opportunities are sensed, they must be addressed) and reconfiguration (i.e., to address new opportunities, firms need to reconfigure their resources) capabilities are transformed to adapt to different external conditions, and this has a direct impact on performance. of the organization that can result, depending on the efficiency of the implementation of all the capabilities, in a sustainable competitive advantage, of the failure of the organization.

Figure 2.5 - Fundamental elements of dynamic capabilities



Source: Adapted from Nagel (2016, p. 2)

Given these relationships between internal resources, external conditions and organizational performance, Teece, Peteratd and Leih (2016) advise that,

> managers must recognize that the pursuit of agility requires sensing, seizing, and transforming and often puts ordinary and dynamic capabilities in conflict. Achieving organizational agility often involves sacrificing technical efficiencies. If not for this tradeoff, organizational agility would not be so hard to achieve, and ordinary and dynamic capabilities would always be additive. […] The net benefits (i.e., benefits minus costs) of organizational agility increase with the degree of uncertainty in the organization's competitive environment. At the other extreme, if the environment is quite stable, with little or no dynamism, then the costs of maintaining organizational agility are likely to outweigh the benefits (TEECE; PETERATD; LEIH, 2016, p. 26-28).

Developing these capabilities and using this approach is more appropriate for types of companies that are more intrinsically involved in dynamic environments, such as startups, and this is recognized in the literature (ZAHRA; SAPIENZA; DAVIDSSON, 2006). DCs enable innovative companies to perceive and respond to changing market conditions and operational or strategic crises, and thus improve the likelihood of sustaining their growth and maximizing their objectives. These capabilities cannot be bought, they are necessarily created and developed over time by organizational processes adopted by start-ups and, consequently, can be learned (POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020). Therefore, in the context of startups, the ability to generate these capabilities at an early stage will increase the likelihood of sustained growth for the new company as it will help it meet its responsibilities and challenges. Macpherson, Jones and Zhang (2004) conclude in their study that the availability of resources and their integration and reconfiguration could play a critical role in improving the performance of high-tech startups, and dynamic capabilities are characterized as a key antecedent to innovation and growth. In agreement, Zahra et al. (2006) state that, a company's resource capacity is expanded by building an effective business network and also how that network allows it to flexibly respond to customer needs and exploit opportunities quickly. The underlying assumption is that startups that use dynamic capabilities will maximize their goals and improve their performance outcomes.

2.4 Start-ups

The new product development is a subprocess of the innovation process. Thus, if firms want to force and visible power, they need to develop core competencies for NPD and innovation (DERELI; BAYKASOĞLU; BÜYÜKÖZKAN, 2008; TAN; ZHAN, 2017). Definitions of innovation are abundant in the literature, each emphasizing a different aspect of the term. One of its first definitions says that innovation reflects a new way out; a new product or a new quality of a product; a new organizational structure; a new mode of production; a new market; a new source of supply (SCHUMPETER, 1934). These innovations must present some degree of novelty and impact on the life of the agents in contact with it, and reduce operating costs, improve work activity and productivity (OECD, 2005). Innovation increases the market power of firms (SCHUMPETER, 1934), improves the ability to escape competition and reduces production costs (PORTER, 1980). And the prevailing view in the empirical literature also infers this positive association (COLOMBELLI; KRAFFT; QUATRARO, 2013).

Innovation is a critical component of business success, and new products and services resulting from the interaction of knowledge and technology bring significant changes in the way companies to operate and compete in this new era. The application of technologies results in better use of productive resources and the transformation of new ideas into economic solutions that will form the basis for sustainable competitive advantages for companies (ZUNIGA; CRESPI, 2013). The classifications for the innovations are diverse, among the main ones we have: product or process; radical or incremental; technical or administrative. Innovations involving management processes and work structures are defined as administrative, while those linked to products, services and technologies are technical innovations. Product innovations are related to new products or services aimed at satisfying users, while process innovations are new elements in operation (UZKURT et al., 2013). Besides, “new product development can be categorized by their radicalness or degree of attempted advancement" (KESSLER; BIERLY, 2002, p. 4). Radical innovations are defined as practices that are discontinuous of ideas and behaviours adopted by the organization previously, and incremental innovations represent the innovations that emerge from gradual changes (UZKURT et al., 2013). "Nevertheless, our understanding of success in NPD projects based on varying levels of novelty is quite limited" (KACH; AZADEGAN; DOOLEY, 2012, p. 377).

Different aspects of the innovations have already been researched, such as the degree of novelty, costs, adaptability, complexity, area of impact and others. These studies mainly refer to the results that can be obtained with the development of an innovation. However, little is said about the factors that contribute to companies being able to generate these innovations more quickly. And this is an important question, after all, "product innovation cycles become shorter and more frequent" (VAYVAY; CUNHA, 2016). Therefore, as Kach, Azadegan and Dooley (2012, p. 377) claim, "new product development (NPD) speed has become a critical consideration in innovation management". "Speed is critical to the situation of uncertainty, arguing that uncertainty may provide benefits that enable a faster response. Further, accelerating the NPD development speed can reduce uncertainty" (LIN et al., 2013, p. 318).

High-tech companies, submerged in an environment of uncertainty, need to deliver innovative products to the market on time if they are to achieve a competitive advantage. But this is not an easy path and can compromise the survival of companies, as is common in the case of startups. Ries (2012) defines a start-up as "a new company that develops an innovative service or product in conditions of extreme uncertainty". Salim et al. (2003) go further in their definition by adding information that they are companies in the process of construction, coming from the union of entrepreneurs who came together to achieve it. The first uses of this term to describe a specific type of company were in the area of software engineering (SE), with Carmel (1994) being known as the first study to cite the term in SE literature (TRIPATHI et al., 2019). And since then, there are several attempts to conceptualize this theme, but the most current are those that contemplate a group of people looking for a repeatable and scalable business model, working in extreme uncertainty. Table 2.4 makes this definition explicit.

Table 2.4 - Startups characteristics

Characteristics	Description
Product	-Based on innovation
Business Model	- Repeatable: it is possible to market the same product or service on a potentially unlimited scale without the need for major adaptations to each customer or market. - Scalable: the business can grow more and more without changing the business model; this growth occurs essentially on the revenue side, without costs growing proportionally which corresponds to increasing margin growth.
Environment	-Conditions of extreme uncertainty

Ghezzi and Cavallo (2020) state that innovation in startups follows two different paths, although intertwined: (i) innovation necessary to modify and adapt their products, services and value proposition to changes in internal and/or market conditions, that is, related to the New Product Development process and (ii) innovation in its business model, where the general value architecture and related mechanisms are defined to place this value in the market and retain part of it to ensure the economic and financial viability of the company. This research is related to that first path. However, in agreement with these authors, several elements of our analyzes go through the process of developing the business model of the companies, since these structures cannot be totally disassociated. Therefore, given that one of the main activities of startups is to develop technological and innovative products or services, these companies are an excellent source of data to understand the trends of new developments. After all, they go beyond the frontiers of technological and business innovation by investing their creative work, time and money to implement new opportunities (SIMON; LEKER, 2016).

Start-ups are usually founded to create new technologies, are visionary, have a flexible structure, have low operating costs and should be faster to adopt new products, technologies and processes (PATERNOSTER et al., 2014). “It is often startups (an individual or small of like-minded individuals) that develop cutting edge technology” (SIMON; LEKER, 2016, p. 16). So these new entrants need to strategically use their knowledge base to explore new technologies and gain significant market share quickly (BLANK, 2013). The effective search for innovation may be possible by drawing up a plan that directs efforts and allows deciding what actions should be taken. Thus, startup innovation success may be coupled with a routine plan that applies specific tools and techniques to deliver positive results at these companies. Nonetheless, due to their bases in innovation, this process of development is linked to uncertainties and risks (BLANK, 2013). And despite advances in research that seek to understand the peculiarities of these companies (HEIRMAN; CLARYSSE, 2007), “the failure rate for startups is very high even in the product development phase” (SIMON; LEKER, 2016, p. 17). After all, as stated by Tripathi et al. (2019, p. 77), "most startups fail within two years of their launch because of a poor problem-solution fit and negligence of the learning process during minimum viable product (MVP) development". Therefore, support for these companies is important both for their social outcomes and for the country's industrial policies (FUKUGAWA, 2006). After all, as Heirman and Clarysse (2007, p. 303) affirm, these companies “contribute to an economy in terms of exports, employment, taxes paid, research and development, and innovation”.

It is important to emphasize that when it comes to startups, there is little separation between organizational level analysis (entrepreneurship) and product(s) level analysis, as the development of these companies as businesses is closely associated with their products (CARMEL, 1994). This separation difficulty is evident in the model proposed by Tripathi (2019) on the stages of development of a startup. In the model, the author suggests three main steps: formation, validation and growth (see Figure 2.6). During the formation phase, the vision and formation of the team are established to identify the problem-solution fit. That is, the company seeks that the modeled solution solves a relevant problem or meets an identified need in a certain segment of people (target audience). At this point, several tools (such as interviews and A/B tests) to validate the problem hypothesis can be employed, and preferably they should be applied with real customers.

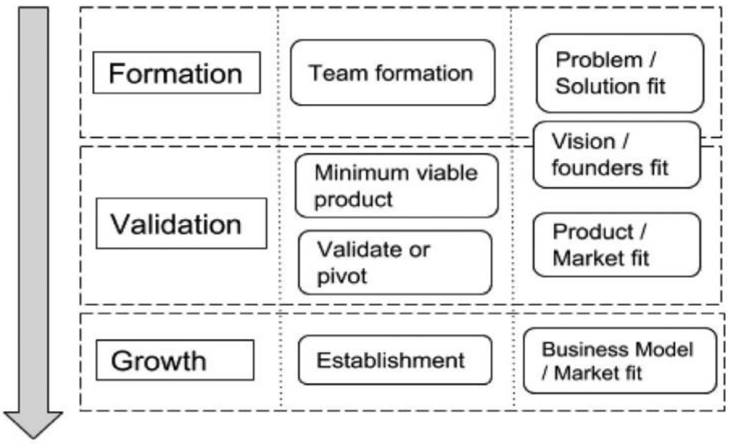


Figure 2.6 - Startup development stages
Source: Tripathi et al. (2019)

The validation phase includes the development of the MVP, which needs to be validated until the product-market fit is established. Therefore, the company creates a real product and adjusts it until its first adopters adhere to its solution, bringing a high level of engagement, adherence and validation of the idea. After that, the company needs to expand its market in order to reach the market fit. This fit is achieved when the product remains effective satisfying strong market demand. If this does not happen, the company can change in course or strategy in a practice that became known among startups as pivoting (EDISON et al., 2018). According to Ries (2011), there are several types of pivot, such as: zoom-in (an isolated resource in the product becomes the whole); zoom-out (the completed product becomes a resource isolated from a larger product); customer segment (when the product serves a different customer than originally foreseen); customer need (when the target customer has a problem deserving of a solution, just not the one that was originally envisaged); platform (refers to a move from an application to a platform, and vice versa); business architecture (some companies change from high margin to low volume, going to the mass market or companies originally designed for the mass market, end up requiring long and costly sales cycles); value capture (are changes in monetization or revenue models); growth engine (a company changes the growth strategy to seek faster or more profitable growth); channel (are changes in the company’s sales or distribution channel); and technology (when a new technology can provide superior price and/or performance compared to existing technology).

Lastly, during the growth phase, more resources are needed to support full the product development. Therefore, this last phase requires more investments to support business expansion. It is emphasized, however, that a suitable ecosystem needs to be developed to nurture a startup from the product design stage until the product is mature enough to be brought to market (TRIPATHI et al., 2019). Furthermore, an important question arises when discussing the maturity stages of these types of innovative companies: *when is a startup no longer a startup?* Returning to one of the first definitions of what a startup is, Blank (2013) says that "startup is a temporary organization looking for a repeatable and scalable business model." Therefore, the temporary nature of these companies can be evidenced. Still following the logic of this definition, since these companies are looking for a repeatable and scalable business model, we could say that by finding such stability, these companies would no longer have the startup attribute. However, currently, there is no consensus on this issue. Other metrics could also be used in an attempt to characterize them, such as revenue, number of employees, company age, profitability, among others. Also, rather than, as Kim, Kim and Jeon (2018, p. 5) states "how to creatively combine technology and the market, and how well such a combination meets the requirements and expectations of users or consumers, are the keys to a startup business". Therefore, startups have an idiosyncratic disruptive mindset that makes them a peculiar type of organization, and therefore, would prevent them from changing categories, or else, they would change categories the moment they put that mindset aside. It was in this last perspective that the present research was based for its analyses, since the evaluated companies carried out their registration in a national database where they called themselves startups, and therefore, they consider themselves as such.

3 DRIVERS AND CAPABILITIES FOR REDUCING TIME-TO-MARKET: A SYSTEMATIC LITERATURE REVIEW AND RESEARCH AGENDA

This chapter systematizes the existing knowledge about reducing time-to-market (TTM) in papers published in the last 25 years to point out the factors that motivate (drivers) and allow (capabilities) reducing TTM, as well as show the capabilities attributes, their relationship and effects on operational and business performance. For this, a systematic literature review was developed, and its details are discussed below.

3.1 Introduction

Digital platforms, network connectivity, and big data analysis have conditioned people to instant gratification (TAN; ZHAN, 2017). Inserted at a high level of uncertainty, modern companies must be ready to quickly innovate with new products and services to meet customer expectations (LI, 2020). Therefore, managers assume that a time-to-market (TTM) reduction will allow companies to be more flexible and have greater commercial value (EDISON et al., 2018). One consequence of this way of thinking is that companies must commit themselves to new product development (NPD) and innovation to face environmental dynamism in the global market (MORGAN; ANOKHIN; WINCENT, 2019; BUCCIERI; JAVALGI; CAVUSGIL, 2020). However, while accelerating NPD is important for achieving internal goals and market gains, it can be difficult for managers to identify which practices should be prioritized in this process and how their implementation should occur (MILAN et al., 2020).

Previous attempts to synthesize the knowledge about TTM reduction could be found. Rosas-Vega and Vokurka (2000) sought to identify the reasons for product development delays in the computer industry, and they did not indicate any ways to improve this process. A decade later, Chen et al. (2010) made important contributions for understanding the NPD speed through a meta-analysis. These authors only used empirical studies in the analysis, and although they identified some capabilities, they do not evaluate external aspects, possible forms of implementation of TTM reduction or their potential results. Evanschitzky et al. (2012) emphasized possible performance results but neglected to indicate which drivers and capabilities affect the speed of this process. The most recent study attempting to synthesize NPD performance knowledge is a meta-analysis by Chang et al. (2016). However, these authors evaluate this performance under the exclusive perspective of integration with customers.

Therefore, the present study intends to mitigate the described gaps and also develop a list of potential opportunities for future research.

This study aims to consolidate the existing knowledge in this research topic, analyze the TTM reduction evolution and identify relevant aspects of implementation such as drivers, capabilities, attributes and benefits obtained. For this, a systematic literature review (SLR) was developed and a theoretical model will be proposed. Time-to-market is defined in this study as the time elapsed from business opportunity analysis and concept generation to the introduction of the product to the market (ZHAO; CAVUSGIL; CAVUSGIL, 2014). Some structural aspects that, when implemented, can facilitate the reduction of TTM and are called "capabilities". There are also external conditions that motivate companies to accelerate their NPD process and are called "drivers".

The TTM reduction further demonstrates its relevance in periods of instability. Facing the first global pandemic of the century, the COVID-19, companies and policy-makers are urgently looking for a contingency plan that protects enterprises and the innovation ecosystem as a whole in the face of such economic and social uncertainties. After all, as Chesbrough (2020, p. 2) says "COVID-19 has severely tested our public health systems. Recovering from COVID-19 will soon test our economic systems". Given the current international scenario, entrepreneurs can be expected to demonstrate flexibility in adapting their business models, quickly delivering solutions to the market (KUCKERTZ et al., 2020). Therefore, our contribution is to provide an updated and extensive investigation into TTM reduction. This may assist managers in implementing TTM reduction and researchers will be able to use the insights from this study in future empirical research on this topic.

3.2 Research method

To increase the rigour of the research and minimize biases when analyzing the literature, an SLR was utilized. The systematic method used in this study was proposed by Denyer and Tranfield (2009) and consists of three main stages, they are: planning, conducting, and reporting/dissemination. A set of steps must be performed at each stage as a standard way to scan and analyze the studies published in the research area analyzed, and thus provide consistent results that can serve as a relevant and reliable basis for formulating decisions for future management.

In the planning stage, the research protocol is defined with the research questions and the inclusion or exclusion criteria for studies (Table 3.1). This review was guided by two research questions: (1) How is TTM reduction research evolving? (2) How is TTM reduction implemented? Web of Science and Scopus databases were used to identify the studies because they more widely cover the selected research areas and have effective search refinement tools (CHADEGANI et al., 2013). The search strings applied to these databases were: *"time-based competition"*; *"time"* AND *"new product development"*; *"time"* AND *"innovation"; "time"* AND *"new product development"* AND *"innovation"; "agil*"* AND *"new product development"* AND *"innovation"; "speed"* AND *"new product development"* AND *"innovation"*. Some additional filters were applied to this search, such as peer-reviewed articles, written in English, in the areas of engineering, social science, business research and decision science. No year of publication filter was applied.

Table 3.1 - Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Description of main concepts, applications and evaluations of TTM; • Identifying drivers and/or capabilities for reducing TTM.	• Inconsistency with the scope; • Evaluation of time reduction in other areas such as manufacturing, office activities and supply chain.

Source: Proposed by the authors.

In the conducting stage, the search is carried out in the database, a total of 757 papers were identified. Duplicate documents in the two databases were excluded and 638 were analyzed. The PRISMA method proposed by Moher et al. (2009) was developed as a filtering procedure. In the screening step, a systematic reading of titles and abstracts based on the inclusion and exclusion criteria was performed and 223 articles left. In the eligibility step, the systematic reading was of the full text, and when excluding studies that were not included in the pre-established criteria, 88 papers remained to be included in the next step.

In reporting/dissemination stage, the content analysis was developed. To answer the first research question on the evolution of TTM reduction research, four elements were assessed (year of publication, country, industry sector and research method). An information crossover was performed to detect potential research gaps. To accomplish this, all objectives and future research proposals presented in the selected papers were listed. By organizing the documents based on time, it was possible to verify which proposed research questions were answered in subsequent years and those that were not. The latter was characterized as research gaps. The second research question was answered by identifying six other elements in the studies (drivers, capabilities, capabilities attributes, capabilities relationship, operational performance and business performance). Figure 3.1 summarizes the ten elements evaluated to fulfil the objective of this research.

During the content analysis, the NVivo software was used for adding nodes that were later used to locate the main passages and quantify characteristics present in the documents. For example, the following excerpt was taken from Carbonell and Rodriguez (2006, p. 226) "…diverse teams decrease development time by increasing goal congruence among the functional groups, bringing more creative potential to problem-solving, and ensuring the availability of crucial input". The excerpt was associated with a capability (in this case, "cross-functional team").

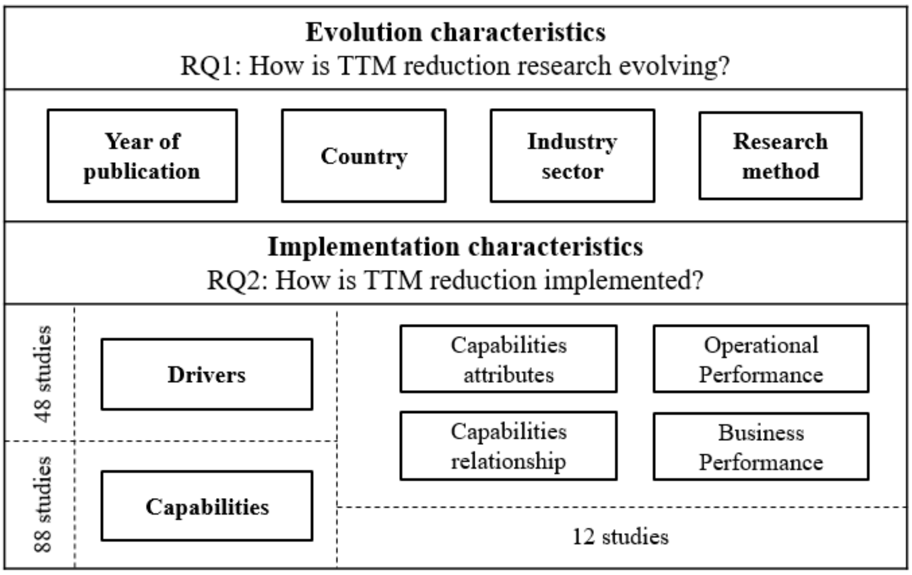


Figure 3.1 - Evolution and implementation characteristics

3.3 Classification and analysis results

The set of 88 papers analyzed in this review were evaluated according to 10 predefined elements to answer the research questions. Therefore, this section will describe the analysis of the results in two groups: the evolution characteristics of the sampled roles and the implementation characteristics found in the studies.

3.3.1 Evolution characteristics

The discussion regarding TTM reduction in the academic community has intensified since 1992, with a case study by Mabert et al. (1992) about elements that affect TTM and how customers and technical factors influence this time. This research theme progressed over the years with the application of different methods, with surveys being the most commonly used research method (66%). Case studies are the second most common at 15%, followed by conceptual studies (8%), experiments (6%), literature reviews (4%), and action research (1%). There are few studies (e.g., Ramachandran and Krishnan, 2008; Tennant and Roberts, 2001) where the researcher follows and/or tests the TTM reduction implementation in the NPD process, such as in experiments and action research. Of the four literature reviews found (e.g., Chang et al., 2016; Chen et al., 2010; Evanschitzky et al., 2012; Rosas-Vega and Vokurka, 2000) only one embodied a purpose similar to that of this study. The review consisted of a meta-analysis performed by Chen et al. (2010), whose objective was to understand the antecedents of NPD speed. However, the study only evaluated survey-based research, excluding all other research methods that could provide insights into the implementation of capabilities and their results in organizations.

Our sample of papers indicated that TTM reduction has attracted the interest of researchers from all over the world, as we identified research development in five continents. However, more than half of the selected publications (51%) were developed in the USA, followed by China, Spain, and the United Kingdom with 8% each, together making up 75% of the sample. This determination was based on the country from which the data were collected, not the origin of the authors.

The most cited industry sector was Computer equipment, electronics and optics with 13.8% of citations, followed by Chemical products (10.8%) and Machinery and equipment (10%). Concerning company size, 35.5% of companies were characterized as large, 23.3% of the papers did not identify the size of the company, 22.8% were medium-sized companies, 17.9% were small companies, and only 0.5% were considered micro-enterprises. The emphasis on large companies neglects the small and medium-sized enterprises (SMEs). Although SMEs have fewer resources and less market power than large companies, these firms have a more flexible and informal configuration that can offer advantages in innovation (PESCH; BOUNCKEN; KRAUS, 2015). Therefore, the results obtained for large companies may differ compared to results for small and/or early-stage companies (MARION; FRIAR; SIMPSON, 2012), and these differences can be explored in future research. Figure 3.2 summarizes this bibliometric analysis of the papers.

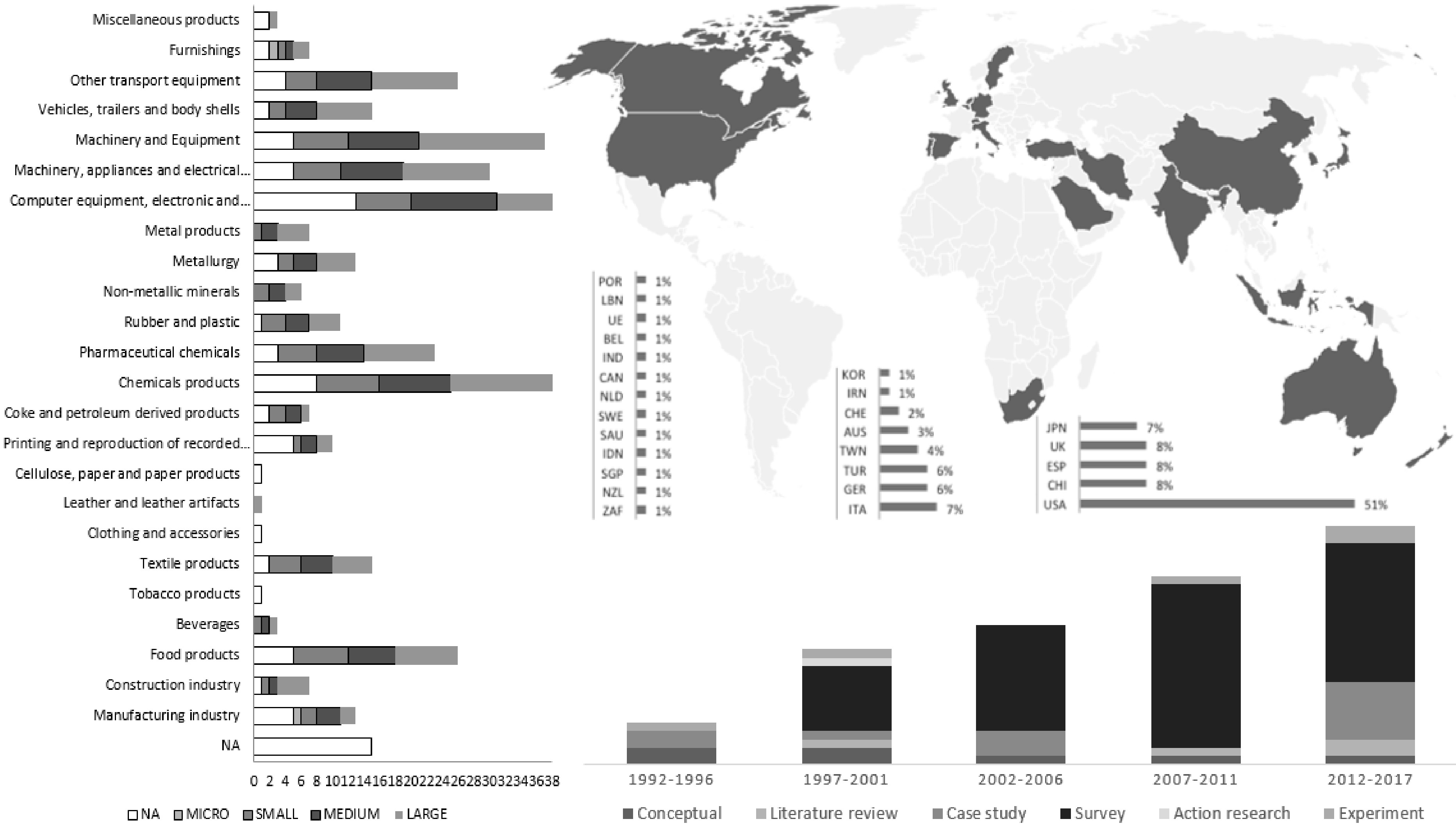


Figure 3.2 - Bibliometric analysis of the papers
Source: Developed by the authors.

3.3.2 Implementation characteristics

All the papers studied indicated at least one driver and/or capabilities to reduce TTM, after all this was one of the criteria for inclusion of the studies in the sample. However, only 12 effectively implemented the TTM reduction, describe the capabilities attributes, their relationship and assessed the impacts on the operational performance and business performance. The following subsections present these six elements related to TTM reduction implementation.

3.3.2.1 Drivers

From the papers selected for this review, 48 studies indicated at least one driver that motivates the reduction of TTM in companies. They consist of the external aspects that influence organizational decision making and trigger innovative efforts (CIARAPICA; BEVILACQUA; MAZZUTO, 2016a). After all, as Li (2020, p. 52) states "the ways that firms benefit from innovation are contingent on a variety of factors, such as ownership structure, the nature of innovation, the institutional environment and industrial competition". The analyzed literature suggests that there are five essential drivers: competitive intensity, uncertainty, technological turbulence, time-sensitive and innovation ecosystems. Table 3.2 presents the definitions and references related to these drivers.

Some authors have discussed the effect of competitive intensity on TTM reduction decisions. Mabert et al. (1992, p. 211) state, "there is nothing like the urgency brought by competitive challenges to existing products to accelerate product development." Industry sectors vary significantly in TTM as they experience different levels of regulation, demand and competition. For example, the introduction of new products in the computer, film, and footwear industries tends to occur faster and more frequently than in the aeronautical, petrochemical, and steel industries (TSINOPOULOS; AL-ZU'BI, 2012). Therefore, the dynamics of specific industries and competitive situations alter the relationship between TTM and management focus on project deadlines (BSTIELER; GROSS, 2003).

Another driver that appears frequently in the literature is uncertainty. Uncertainty can be defined as the unpredictability of the environment, the inability to predict the impact of environmental changes, and the inability to predict the consequences of a response (Chen et al., 2012). Therefore, different types of uncertainty may have different impacts on team absorptive capacity. Teams faced with high uncertainty need to process additional technical and conceptual information and develop new ways of performing tasks, resulting in a prolonged TTM (CARBONELL; RODRIGUEZ, 2006).

Table 3.2 - Main drivers identified

Drivers	#	Description	References
Competitive intensity	T20	A large number of competitors, competitive product inputs and the threat of substitutes has a wide impact on project decisions.	1, 7, 11, 15, 25, 35, 36, 48, 52, 57, 58, 59, 60, 61, 62, 71, 77, 79, 83, 88.
Uncertainty	T21	A multidimensional construct associated with the inability to predict the impact of environmental change and the consequences of a choice of response.	2, 11, 20, 23, 24, 25, 27, 29, 35, 36, 38, 45, 48, 49, 52, 53, 55, 58, 62, 63, 64, 65, 71, 77, 78, 79, 80, 83.
Technological turbulence	T22	Markets with high technology changes rates tend to encourage companies to accelerate NPD to keep up with the competition.	2, 6, 11, 22, 23, 25, 37, 42, 45, 47, 49, 52, 57, 58, 59, 61, 63, 64, 68, 69, 71, 81, 84, 86.
Time-sensitive	T23	In trying to attract increasingly sensitive customers, companies are looking to increase the number of products launched at a rapid pace.	14, 27, 48, 49, 69.
Innovation ecosystems	T24	Innovative market testing environment, where organizations combine their individual offering into a coherent customer-focused solution.	84, 86

Notes: 1. (MABERT; MUTH; SCHMENNER, 1992); 2. (KARAGOZOGLU; BROWN, 1993); 6. (PRAGMAN, 1996); 7. (WILLIS, 1998); 11. (JAYARAM; VICKERY; DROGE, 1999); 14. (DE TONI; MENEGHETTI, 2000); 15. (ROSAS-VEGA; VOKURKA, 2000); 20. (TATIKONDA; MONTOYA-WEISS, 2001); 22. (PRIMO; AMUNDSON, 2002); 23. (KESSLER; BIERLY; GOPALAKRISHNAN, 2000); 24. (SWINK, 2003); 25. (RONDEAU; RAGU-NATHAN; VONDEREMBSE, 2003); 27. (BSTIELER; GROSS, 2003); 29. (SÁNCHEZ; PÉREZ, 2003); 35. (Chen et al., 2005); 36. (CARBONELL; RODRIGUEZ, 2006); 37. (ALLOCCA; KESSLER, 2006); 38. (JIAN'AS; BEI, 2007); 42. (DERELI; BAYKASOĞLU; BÜYÜKÖZKAN, 2008); 45. (VALLE; VÁZQUEZ-BUSTELO, 2009); 47. (PARRY et al., 2009); 48. (JOHNSON; PICCOLOTTO; FILIPPINI, 2009b); 49. (FEKRI; ALIAHMADI; FATHIAN, 2009); 52. (LIN, 2009); 53. (Chen et al., 2010); 55. (AKGUN et al., 2010); 57. (CARBONELL; ESCUDERO, 2010); 58. (DAYAN; BASARIR, 2009); 59. (MILLSON; WILEMON, 2010); 60. (KACH; AZADEGAN; DOOLEY, 2012b); 61. (Lin et al., 2012); 62. (TSINOPOULOS; AL-ZU'BI, 2012); 63. (Chen et al., 2012); 64. (EVANSCHITZKY et al., 2012); 65. (AKGÜN et al., 2012a); 68. (DANESE; FILIPPINI, 2013); 69. (LIN et al., 2013); 71. (ZHAO; CAVUSGIL; CAVUSGIL, 2014); 77. (CHIANG; WU, 2016); 78. (CIARAPICA; BEVILACQUA; MAZZUTO, 2016a); 79. (VAYVAY; CRUZ-CUNHA, 2016); 80. (ELVERS; SONG, 2016); 81. (CHANG; TAYLOR; META-ANALYSIS, 2016); 83. (BREWER; ARNETTE, 2017a); 84. (ZHAN et al., 2017); 86. (TAN; ZHAN, 2017); 88. (ZHANG; WANG; GAO, 2017).

Markets with high rates of technological change also seem to have a major influence on the company decisions on accelerating NPD. This technological turbulence of the context in which organizations operate can be measured by the product life cycle (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017b). This is an important contingency factor that can not only drive companies to develop superior competitive capabilities but also modularity and supplier engagement strategies, which in dynamic contexts are particularly useful for rapidly launching new products into the marketplace (DANESE; FILIPPINI, 2013). This rapid introduction and withdrawal of new products may affect their pricing and attributes (DERELI; BAYKASOĞLU; BÜYÜKÖZKAN, 2008).

There are assumptions in the literature that some markets and/or types of consumers are more time-sensitive than others. Therefore, companies attempt to attract customers that are increasingly sensitive to novelty by increasing the pace of products launches (DE TONI; MENEGHETTI, 2000). Because of this time-sensitive, it is vital for organizations to capture competitive market opportunities and competencies, taking into account customer requirements and desires and increasing customer convenience to space, time and customization (FEKRI; ALIAHMADI; FATHIAN, 2009).

Finally, the structure of the environment (i.e., the set of individuals, organizations, material resources, norms, and policies) in which the company operates also appears to affect this relationship; therefore, the last driver considered is an innovative ecosystem (VAYVAY; CRUZ-CUNHA, 2016). This represents an environment of innovation and market testing for developing new products faster and at a lower cost. The literature indicates that these ecosystems have become a central element in the growth strategies of organizations in a wide range of industries (TAN; ZHAN, 2017). It is noteworthy that these last two drivers are not discussed as prevalently in the selected studies.

3.3.2.2 Capabilities

The majority of papers selected for a review focused their efforts on one or two capabilities (65%). Therefore, there are few holistic analyzes of these capabilities in organizations (GRANER; MISSLER-BEHR, 2015; ZHAN et al., 2017). The content analysis of this review identified 19 capabilities in the literature. Table 3.3 lists each of the capabilities with their respective notation or code (#), description and references. To facilitate further discussion, they will be grouped according to their subject: team, integration, strategy, process and product.

The team category involves capabilities related to the people in the NPD process: cross-functional team, team experience, team empowerment, leadership, learning and organizational culture. Of these, the most cited was the cross-functional team, and the least cited is a team experience. The integration category of capabilities was the most cited one in the analyzed literature, which contains the functional integration, customer integration, supplier integration and other integrations, with functional integration as the most cited.

In the strategy category, the capabilities are related to resource allocation to fulfil a given objective: marketing strategies, management strategies and quality strategies. The discussion in the literature is scarce for this particular category (7% of the selected papers) despite the general recognition of the importance of evaluating the strategic aspects of the organization when developing a new product. The most cited capability in this group is quality strategies.

The process category contains capabilities related to the continuation of certain activities during development: standardization, communication, product testing, testing frequency and project content. In this category, greater emphasis was given to the "communication" capability. There is also an interesting result in the product category. The initial assumption was that the capabilities related to product characteristic effects would be widely present in the literature. However, only 2% of the selected studies indicated that product characteristics affected the NPD time and consequently its performance. There is only one capability in this group: product complexity.

3.3.2.3 Capabilities relationship

To evaluate the possible interaction between capabilities, a cross-citation capability matrix was developed for the selected articles. To accomplish this, the number of times a given capability was cited in the same paper as another capability was observed, and the generated matrix is expressed in Figure 3.3.

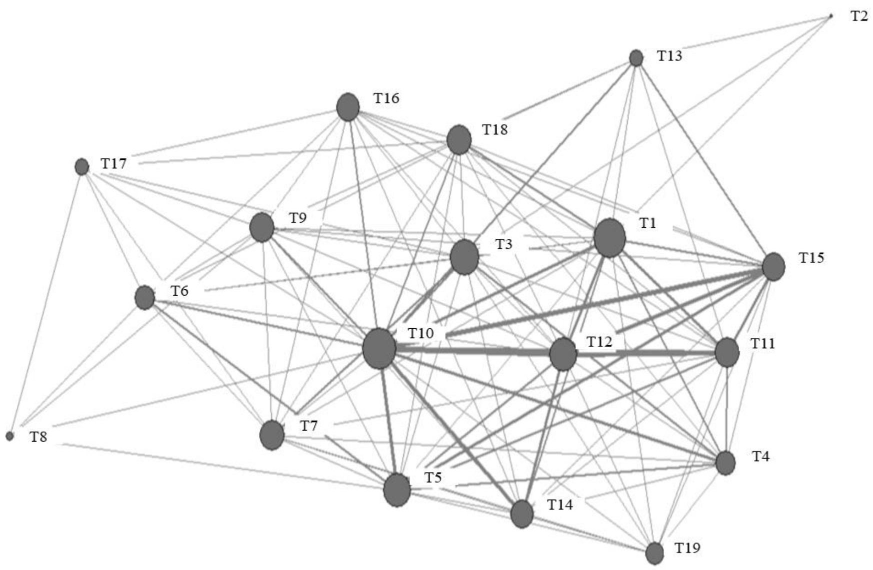


Figure 3.3 - Network of capabilities

Table 3.3 - The capabilities identified in the analysis

Capabilities	#	Description	References
Cross-functional team	T1	Level of profiles and competencies diversification on the company's NPD team.	2, 8, 11, 14, 26, 27, 29, 30, 34, 36, 45, 46, 47, 50, 51, 53, 67, 72, 78
Team experience	T2	Level of knowledge or learning obtained through the practice of professionals.	36, 40, 66
Team empowerment	T3	Level of the grant by the company of individual power to perform activities and make decisions during the process.	1, 9, 12, 37, 38, 39, 53, 58, 60, 66
Leadership	T4	Level of command and influence over the behaviours and attitudes of the development team.	1, 24, 26, 27, 37, 53, 54, 60, 84, 86
Learning	T5	Set of formal and informal knowledge, which allows the organization to create its management models.	13, 17, 14, 25, 32, 48, 53, 55, 57, 65, 61, 63, 84, 85, 86
Organizational culture	T6	Set of values, beliefs and standards adopted by the organization.	12, 19, 32, 34, 55, 65
Management strategies	T7	Set of strategies adopted by the company to coordinate the team in the execution of tasks and the capture of results	9, 12, 35, 37, 53
Marketing strategies	T8	Set of strategies adopted by the company to create, communicate, deliver and exchange offers that have value for customers, partners and society in general.	15, 32
Quality strategies	T9	Set of strategies adopted by the company to achieve the objectives set by the quality policy.	9, 15, 19, 46, 49, 73, 85
Functional integration	T10	Level of approximation of the different functional areas of the company, within a perspective of cooperation.	1, 4, 5, 6, 7, 8, 10, 11, 12, 14, 18, 19, 20, 23, 24, 25, 29, 30, 32, 38, 42, 43, 45, 49, 53, 54, 59, 61, 64, 72, 73, 75, 76, 83, 84, 85, 86, 87
Customers integration	T11	Set of cooperation actions between customers and the company to understand the needs of consumers and translate them into product requirements.	1, 2, 6, 14, 16, 25, 29, 30, 34, 43, 45, 53, 62, 69, 70, 80, 81, 82, 86
Suppliers integration	T12	Set of cooperation actions between suppliers and company to define the design of a product together.	6, 11, 14, 18, 22, 25, 28, 29, 30, 34, 43, 45, 52, 53, 68, 70, 71, 73, 77, 79, 83, 84, 88
Others integration	T13	Set of cooperation actions between the company and other institutions, to use assistance and/or information for support or research during the NPD.	29, 40, 49, 56, 76
Standardization	T14	Set of systematic actions adopted to define and use standards in the NPD process.	5, 11, 20, 21, 30, 39, 44, 53, 67, 73, 78, 83
Communication	T15	Set of actions adopted to facilitate and clarify communication between individuals involved in the NPD.	7, 14, 16, 22, 25, 29, 31, 49, 52, 56, 57, 61, 63, 68, 71, 74, 76, 78, 84, 86, 88
Product testing	T16	Set of actions adopted by the company to evaluate, proving and or validating certain product characteristics and performances.	2, 3, 11, 12, 33, 42, 73

Table 3.3 - The capabilities identified in the analysis (continuation)

Capabilities	#	Description	References
Testing frequency	T17	Periodicity of product testing.	12, 15
Project content	T18	Set of actions adopted to structure the steps that need to be taken to complete the project.	12, 14, 24, 29, 47
Technological complexity	T19	Level of difficulty for the acquisition of aspects and elements integrated into the product.	41, 53, 64, 68, 78

Notes: 3. (TRYGG, 1994); 4. (KRISHNAN; EPPINGER; WHITNEY, 1995); 5. (CARTER; MELNYK; HANDFIELD, 1995); 8. (HARDAKER, 1998); 9. (SIM; CURATOLA, 1999); 10. (NARAHARI; VISWANADHAM; KUMAR, 1999); 12. (KESSLER; CHAKRABARTI, 1999); 13. (LYNN; SKOV; ABEL, 1999); 16. (KRAEMER; DEDRICK; YAMASHIRO, 2000); 17. (KESSLER; BIERLY; GOPALAKRISHNAN, 2000); 18. (DROGE; JAYARAM; VICKERY, 2000); 19. (TENNANT; ROBERTS, 2001); 21. (LUKAS; MENON; BELL, 2002); 26. (VALLE; AVELLA, 2003); 28. (PETERSEN; HANDFIELD; RAGATZ, 2003); 30. (DROGE; JAYARAM; VICKERY, 2004); 31. (YANG, 2004); 32. (MENON; LUKAS, 2004); 33. (BECKER; SALVATORE; ZIRPOLI, 2005); 34. (KODAMA, 2005); 39. (BARCZAK; SULTAN; HULTINK, 2007); 40. (HEIRMAN; CLARYSSE, 2007); 41. (RAMACHANDRAN; KRISHNAN, 2008); 43. (CHI-JYUN CHENG; SHIU, 2008); 44. (BARCZAK; HULTINK; SULTAN, 2008); 46. (SUN; ZHAO; YAU, 2009); 50. (PARK; LIM; BIRNBAUM-MORE, 2009); 51. (MINGUELA-RATA; ARIAS-ARANDA, 2009); 54. (STRANG, 2010); 56. (OKE; IDIAGBON-OKE, 2010); 66. (PATANAKUL; CHEN; LYNN, 2012); 67. (MARION; FRIAR; SIMPSON, 2012); 70. (FENG et al., 2014); 72. (AL SERHAN; JULIAN; AHMED, 2015); 73. (GRANER; MISSLER-BEHR, 2015); 74. (PESCH; BOUNCKEN; KRAUS, 2015); 75. (KONG et al., 2015); 76. (VEZZETTI; ALEMANNI; MORELLI, 2016); 82. (SIMON; LEKER, 2016); 85. (ETTLIE; TUCCI; GIANIODIS, 2017); 87. (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017b)

Three visual characteristics are apparent in Figure 4: node size, line thickness, and centrality. As with the citation matrix, the largest node, and consequently the most cited capability was functional integration (T10). This capability also has the largest number of relationships, and it is the most centralized capability in the network because the more centralized a capability is, the greater the number of relationships it has. The most distant nodes, such as team experience (T2) and management strategies (T7) were the least cited and have the lowest number of relationships with others.

When assessing line thickness, there is a strong association between the three types of integrations: functional (T10), with customers (T11), and with suppliers (T12). The literature coherently proposes integration as something positive to NPD time performance, especially if it simultaneously occurs both internally (functional) and externally (stakeholders). These three capabilities are also strongly connected to communication (T15). It is possible to justify the strong presence of this capability being joined to the others in the papers because good communication is essential for integration in a company, both internally and externally (VEZZETTI; ALEMANNI; MORELLI, 2016). Although less frequent, the existence of a cross-functional team (T1) was also evidenced in papers that mention these three types of integration. This capability is also frequently mentioned and has a high number of relationships with the other capabilities. This result is in agreement with previous studies, as Brewer and Arnette (2017, p. 36) state, "Logically, simultaneous design activities by multifunctional teams would improve the use of resources as the activities of manufacturing, distribution, procurement, marketing, etc. are considered in advance and problems are solved before activities are initiated".

There is a strong association between team empowerment (T3) and functional integration (T10). This is a very coherent relationship since by giving greater value to individual decisions through empowerment, a greater sense of collective responsibility can be generated, which positively contributes to functional integration (AL SERHAN; JULIAN; AHMED, 2015). Learning (T5) is also strongly linked to this type of integration because a fluid relationship between team members can improve knowledge sharing (Lin et al., 2012) and, consequently, the knowledge of the team as a whole. It is important to note that communication (T15) is also closely related to these two capabilities.

Standardization is often present in the papers about functional integration and supplier integration. Standardizing product development processes makes it easier for all team members to understand these activities and interact more closely with the process. This also facilitates involvement from outside members such as suppliers. Besides, standardization capability improved portability and interactivity of company and supplier activities. As Brewer and Arnette (2017, p. 37) explain, "Inviting suppliers to participate in the development process enables firms to capture value in terms of speed to market, less engineering changes during the life of the product, improved functionality for customers and ultimately better efficiency and procurement costs". Finally, although with a lower intensity than the previously mentioned capabilities, all capabilities were related to at least three capabilities, which may show even more positive results if adopted in a more integrated way.

3.3.2.4 Capabilities attributes

Essential attributes were found in the papers for each capability for reducing TTM. Attributes are the particularities, qualities, and/or characteristics of a capability. Table 3.4 describes the 54 attributes identified in the sample, their respective capabilities and references.

For the team category, the literature suggests that to implement cross-functional teams, synergy must increase (PARK; LIM; BIRNBAUM-MORE, 2009). Other suggestions are empowering employees to build teams (PATANAKUL; CHEN; LYNN, 2012), managing authority to improve leadership (KACH; AZADEGAN; DOOLEY, 2012b), developing a lessons-learned book to improve learning (ETTLIE; TUCCI; GIANIODIS, 2017), and crafting an innovative climate to improve organizational culture (AKGUN et al., 2010). There are no direct suggestions made in the reviewed literature of possible attributes that would improve the team's experience in order to reduce TTM. In the Integration category, fifteen capabilities attributes are suggested, such as simultaneous engineering to promote greater functional integration (TAN; ZHAN, 2017) and the application of open innovation methodologies to integrate more customers into the process (SIMON; LEKER, 2016). Also, the results suggest that suppliers can become more involved through the creation of development committees (VAYVAY; CRUZ-CUNHA, 2016), benchmarking, and promoting cooperation with other companies (SÁNCHEZ; PÉREZ, 2003).

Regarding the strategy category, there are indications that the use of quality tools such as QFD, FMEA, TQM, and Six Sigma may be useful for quality strategies in reducing NPD time (GRANER; MISSLER-BEHR, 2015). NPD time also decreases when emphasizing speed in management strategies or adopting a speed reward system (Chen et al., 2010). However, no information was found on how to implement marketing strategies; there is only an indirect indication that it can be useful in reducing NPD time.

For the processes category, the literature indicates that NPD can be accelerated when the procedures are formalized and simplified (BREWER; ARNETTE, 2017a) and by improving communication efficiency by increasing the degree of transparency (CIARAPICA; BEVILACQUA; MAZZUTO, 2016a). Other suggestions include using CAD/CAM tools to create simulations (FEKRI; ALIAHMADI; FATHIAN, 2009) and establishing time goals to deepen the content of the project (PARRY et al., 2009).

Table 3.4 - Capabilities attributes for reducing TTM quoted

Capabilities attributes	Capabilities	References
- Multiple synergies between members - Diversity of age in the team - Good group confidence	T1	8, 14, 18, 26, 29, 36, 50
- Be flexible in decision making - Allow employee autonomy	T3	9, 12, 37, 38, 39, 58, 66
- Manage authority (power) - Visionary leaders	T4	26, 37, 54, 60
- Train employees - Archiving system (book of lessons learned) - Knowledge networks - Use of big data - Promote a learning environment	T5	13, 14, 17, 25, 48, 55, 57, 65, 84, 85
- Top management support - Innovative organizational climate	T6	32, 55
- Prioritize risk sharing - Emphasize speed - Speed reward system	T7	12, 35, 37, 53
- Apply the Taguchi method - Perform a value analysis - Apply the QFD - Implement quality improvement programs with suppliers - Develop the Six sigma's - Apply the FMEA - Adopt the Total Quality Management (TQM)	T9	9, 15, 46, 73, 85
- Environment layout integrator - Common database among members - Use interactive overlay - Adopt JIT I and/or JIT II - Use of concurrent engineering - Rotation between functions	T10	1, 5, 6, 7, 8, 10, 11, 14, 18, 19, 20, 25, 29, 30, 37, 41, 42, 45, 49, 53, 61, 72, 73, 75, 80, 86
- The client should serve as co-developer - Adopt the open innovation - Direct sales	T11	14, 16, 30, 45, 62, 69, 80, 81, 82, 86
- Establish contingent contracts instead of fixed ones	T12	

- Integrate IT strategies - Early involvement of suppliers - Product development committees - Supplier base reduced		14, 18, 22, 28, 30, 34, 45, 52, 68, 70, 71, 77, 79
- Benchmarking - Strategic community	T13	29
- Formalized procedures	T14	5, 11, 20, 21, 44, 53, 73, 83
- High degree of transparency - Invest in communication channels	T15	7, 14, 16, 22, 25, 29, 31, 56, 57, 74, 78
- Use of CAD/CAM - Implement 3D printer	T16	1, 2, 3, 11, 12, 33, 42, 49, 73
- Clarity in project objectives - Setting time goals - Definition of the limits of tasks between the members	T18	14, 47
- Design for manufacturing - Upgradeable module	T19	4, 24, 53, 64

Finally, for the product category, the complexity can be better implemented to promote NPD acceleration by developing designs based on manufacturability and/or modularity (KRISHNAN; EPPINGER; WHITNEY, 1995; SWINK, 2003; EVANSCHITZKY et al., 2012).

3.3.2.5 Operational performance

TTM reduction is influenced by a variety of capabilities to their implementation. From the 88 selected papers for this review, only 12 papers have effectively implemented these capabilities and report the effects obtained by the organization. Table 3.5 describes these effects in operational performance, i.e., the process measures of decreasing development costs and proficiency managing (CANKURTARAN; LANGERAK; GRIFFIN, 2013).

Table 3.5 - Operational performance achieved by TTM reduction quoted

Operational performance	Capabilities	References
- The emergence of constructive conflicts made the role and value of each work conscious. - A greater sense of individual responsibility, especially in small teams.	T1	34, 67
- Increased perception of shared risks, reducing missed deadlines. - Autonomy ensured that all team members completed their tasks, maintaining collegiality and sharing responsibility for project outcomes with others.	T2	1, 60
- Resources are used more creatively and efficiently.	T5	86
- Promote a common vision, common interests, common merits and common knowledge among actors.	T6	34

- Decreased product failures and increased "overall quality" ratings.	T9	19
- More rigour in the following planning, reducing overall project uncertainty.	T10	19
- Projects were more likely to progress sequentially, minimizing resource spending. - Inventory reduction through direct sales. - More accurate anticipation of market needs. - Easy to synthesize knowledge and deploy new product specifications.	T11	1, 16, 34, 80
- Achieving extra R&D resources and reducing investment costs.	T12	76, 79
- The collaborative creation generated a series of organic solutions	T13	76, 79
- Focus on the main tasks of the projects.	T14	67
- A greater synergy of staff and the entire value chain. - Promoted greater integration of resources and processes.	T15	76, 86
- Reduction of waiting time between R&D stages. - Greater control of the development process. - Better problem-solving.	T16	3, 33

The group of integration capabilities contains a higher number of effects quoted in operational performance. Among the several benefits cited, the literature points out interesting results such as a reduction in product failures through functional integration (VEZZETTI; ALEMANNI; MORELLI, 2016), more accurate anticipation of market needs from greater integration with customers (ELVERS; SONG, 2016), larger generation of value through integration with suppliers (TAN; ZHAN, 2017), and more organic solutions from integration with other companies (VEZZETTI; ALEMANNI; MORELLI, 2016). The capability "others integration" was mentioned the least in the analysis of the category.

There is also no definition for the "team experience" capability implementation effects. However, for the other capabilities in the Team category, it is possible to increase the perception of the shared risks with greater team empowerment (MABERT; MUTH; SCHMENNER, 1992), a more detailed project scope with a more innovative organizational culture (TENNANT; ROBERTS, 2001), constructive conflicts with the cross-functional team (KODAMA, 2005), a higher level of creativity in the project through the implementation of strong leadership (KACH; AZADEGAN; DOOLEY, 2012b), and more efficient use of resources after learning (TAN; ZHAN, 2017).

For the other three categories of capabilities, few internal effects were obtained. For the strategy category, the only result indicated was the reduction in product failures (TENNANT; ROBERTS, 2001), which refers to the "quality strategy" capability. For the Process category, studies point to improved decision making and problem-solving through running simulations (BECKER; SALVATORE; ZIRPOLI, 2005), greater integration of resources and processes with efficient communication (VEZZETTI; ALEMANNI; MORELLI, 2016), and a greater focus on process simplification project activities (MARION; FRIAR; SIMPSON, 2012). There are no effect descriptions for the other capabilities in this category. In the Product category, no internal effects were evidenced in the selected studies.

3.3.2.6 Business performance

The business performance achieved by the TTM reduction were also evaluated, i.e., the external success outcomes relative to the market, financial and quality (CANKURTARAN; LANGERAK; GRIFFIN, 2013; CHANG; TAYLOR; META-ANALYSIS, 2016). Eleven benefits in business performance were found in the implementations studies. These effects on business performance, the percentage of citations in the papers and their references are described in Figure 3.4.

Figure 3.4 - Business performance achieved by TTM reduction quoted

Business performance		References
Market	**16%**	
Increased market share	9%	9, 11, 16, 30, 63, 72, 75
Increased sales	2%	31, 88
Premium price	2%	63, 72
Increased responsiveness	2%	30, 57
Sustainable technological	1%	88
Financial	**27%**	
Reducing R&D costs	18%	9, 14, 15, 17, 22, 28, 29, 33, 51, 66, 69, 73, 75, 78, 79, 86
Increased overall financial performance	5%	30, 31, 70, 83
Increased return on investment	2%	11, 16
Reduced cost of warranty	2%	9, 19
Quality	**19%**	
Top quality products	13%	22, 23, 26, 28, 37, 45, 48, 50, 51, 57, 69, 72
High levels of customer satisfaction	6%	26, 45, 46, 72, 88

Considering these benefits, most of them are financially related (27%), followed by quality (19%) and market (16%). The review shows that the TTM reduction is mainly responsible for reducing R&D costs (18%), generating top quality products (13%) and increasing market share (9%). Additionally, TTM reduction was appointed as responsible for: increased overall financial performance and return on investment; reduced cost of warranty; increased sales and responsiveness; premium price; sustainable technological; and high levels of customer satisfaction. Despite the evidence found, the low number of studies that effectively followed the implementation of TTM reduction demonstrates a gap that could be filled in this subject in the future.

3.4 Discussion

In this study, we present the results based on a systematic literature review methodological approach to consolidate the existing knowledge about TTM reduction to identify the elements that are involved in this implementation. 88 papers were found, constituting 25 years of research on this topic. The survey research methodology was dominant, which explains the few findings of the ways of implementation and their respective outcomes. Although the number of TTM reduction papers is growing in recent years, empirical studies in some countries have not yet been carried out. As can be seen in Figure 3.2, most countries in Africa and South America did not find any studies when selecting our sample. The economic and social peculiarities of these regions can bring important insights about the interference of environmental dynamism in these results (FORBES; WIELD, 2008). Besides, the emphasis on large companies neglects the small and medium-sized enterprises (SMEs).

From the content analysis, information was collected and systematized about the drivers and capabilities to reduce TTM and their respective effects on operational and business performance. To synthesize the results obtained in this analysis, a theoretical model was developed. The purpose of the model is to provide a holistic view of the NPD process from a perspective of TTM reduction to improve organizational performance, and it can support managers and policymakers in their decision-making processes. Figure 3.5 shows the theoretical model with its respective constructs and relations.

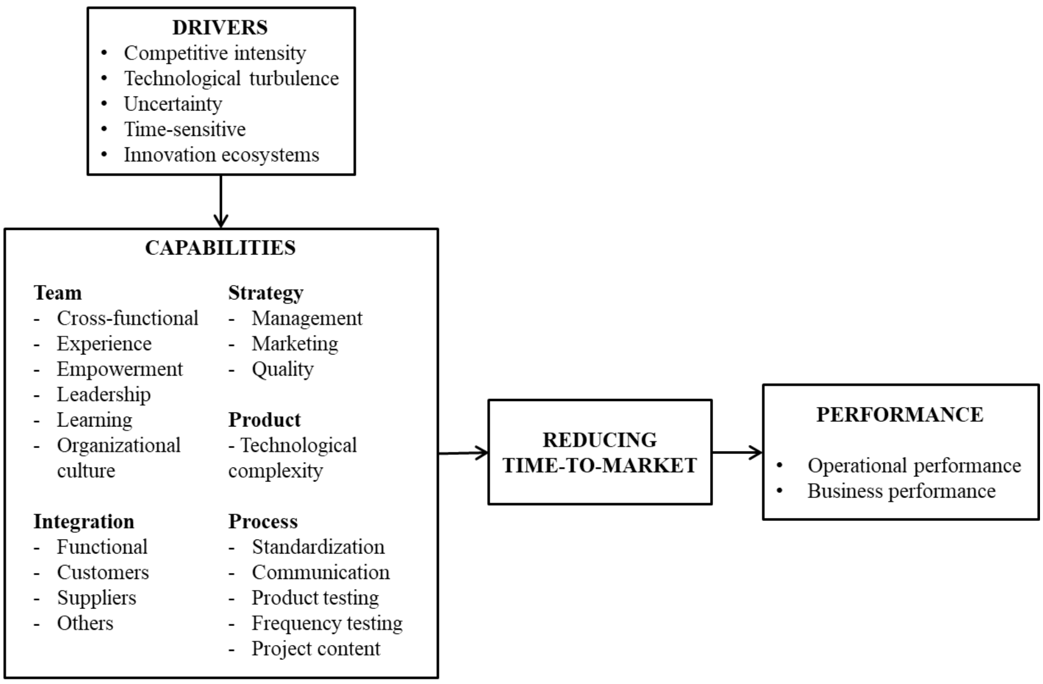


Figure 3.5 - Theoretical model

In general, understanding the interference of the external environment is vital for any system, and the case of business management is no different (FORBES; WIELD, 2008). Environmental changes can induce certain behaviours in organizations, especially with the need to introduce new products quickly (SIMON; LEKER, 2016). It is well known that for companies facing higher levels of technological change and market uncertainty, time becomes an even more critical factor (MILAN et al., 2020). A greater number of competitors and high consumer time sensitivity increase the demand that organizations be more proactive in innovating and delivering competitive advantages. One determining factor in providing innovation to new products is the innovation ecosystem which, as explained by Zhan et al. (2017, p. 523), is "an innovative and market-testing environment that can support organizations to develop new products at dramatically fast speeds and with lower expenses". After all, the existence of established legal and economic institutions and a rich network of professional intermediaries, including strong property rights and legal regimes in which capital transfer contracts are clearly defined and strongly applied, are fundamental to assist companies in the innovation process with their financial, legal and managerial knowledge (Sun et al., 2019).

In addition to the drivers, we proposed five categories of capabilities and also investigated why these elements influence the TTM reduction. In the discussions of the papers about the NPD team, the authors agree that by developing an innovative mindset in team members, a sense of individual responsibility for the project is generated (KACH; AZADEGAN; DOOLEY, 2012b). Besides, enhanced by team empowerment encourages compliance and even the advancement of established deadlines (Chen et al., 2012). We must go beyond creativity by applying collective learning practices that allow not only sharing (extremely advantageous in cross-functional teams) but also efficient absorption of knowledge (enhanced by team experience) (ETTLIE; TUCCI; GIANIODIS, 2017). The leader plays a key role in managing the execution and results of these practices (STRANG, 2010), and the organizational culture guides the entire process. As Evanschitzky et al. (2012, p. 30) conclude, "To improve success rates of NPDs requires (…) working in varied cultures (i.e., R&D teams) will result in differing antecedents of successful new product ventures."

The formulation of strategies focused on timing coordination can provide top management support and clarity for the objectives needed to give guidelines for reducing development time (KONG et al., 2015; MORGAN; ANOKHIN; WINCENT, 2019). Since sales and marketing personnel are interfaces that coordinate the communication links between customers and manufacturing, product groups, quality, and other company functions, special attention should be given to the strategies adopted in this area for NPD (VAYVAY; CRUZ-

CUNHA, 2016). After all, marketing resources often reflect the ability of companies to differentiate their products and services from competitors and create brands to improve performance (BUCCIERI; JAVALGI; CAVUSGIL, 2020). There can be process improvements in the areas of quality and waste reduction that are essential for successful NPD acceleration (KESSLER; BIERLY, 2002).

The Integration category stood out most in this research as having the greatest number of citations, which was characterized as a coherent result. Since it is a costly and potentially erroneous task, many companies recognize the need to seek outside knowledge when introducing a new product (GRANER; MISSLER-BEHR, 2015). With the advent of ecosystems, the company can connect with a wide range of networks at each stage of product development (Lin et al., 2013). Due to the evolution of the open innovation paradigm and digital technologies, organizations can integrate with customers, suppliers, and other companies more efficiently and strive for excellence in internal communication and functional integration (OKE; IDIAGBON-OKE, 2010). As explained by Pesch et al. (2015, p.14), “Communication style diversity improves a creative environment which itself is a breeding ground for innovation”. In NPD, there must be complementarity of knowledge, that is, low degrees of redundancy of knowledge and skills for product development, making integration between strategic partners more efficient (YAO et al., 2013).

Some capabilities can also be evaluated based on the development of new technologies to improve their execution, such as the “communication” capability when using big data, and the “product testing” capability with the development of “machine learning.” Facilitating project coordination and execution results in TTM reduction (OKE; IDIAGBON-OKE, 2010). Few results were obtained about how the characteristics of the product affect development time. There are propositions that technological novelty and complexity may affect this relationship, but this needs to be further studied, particularly in the context of innovative products. There are key distinctions between innovative and non-innovative products, suggesting that their performance determinants may also be different (KACH; AZADEGAN; DOOLEY, 2012b). One area that can give rise to this type of research is that of early-stage companies with innovation-based business models, i.e., start-ups (SIMON; LEKER, 2016).

When reviewing the 88 articles, over 25 years of research on TTM reduction were evaluated. This significant amount of content allowed us to explore beyond the previously mentioned factors and find research opportunities that have not yet been explored. To identify these shortcomings in the field, a temporal assessment of the documents was chosen. The papers were organized by publication year, and the sample covered documents from 1992 to 2017.

Then, the purpose and future research proposals of each paper were tabulated. With this information, it was possible to evaluate year over year which proposals had been executed by subsequent studies. The result of this process was a list of proposals that have not yet been executed; that is, they have the potential to be investigated by other researchers. This group of open research questions can be characterized as a research agenda for this topic, as described in Table 3.6.

Table 3.6 - Research agenda

Gaps	References
- How does the relationship between TTM reduction and the distribution of decision making power for different types of decisions occur? - Does decentralization or centralization influence the TTM reduction? (A longitudinal study is suggested.)	38
- Do firms that put more effort into innovative products have managers who are more sensitive to the potential for delays, putting more emphasis on reducing cycle time? - Is the increased focus on innovative products positively correlated with the decision to acquire the necessary technologies from outside suppliers?	47
- Does product quality, customer satisfaction, or new product creativity measure the effects of market orientation on the speed of innovation and performance of new products?	57
- Is the relationship between R&D and marketing more important in NPD than R&D and information technology (IT)?	85
- What is the effect of team design on the different stages of the NPD process?	36
- How effective are autonomous teams in developing new business?	66
- How can managers strengthen the functional effects of and deal with the dysfunctional effects of communication style and age diversity? - Are there mediatory and contextual variables that shape and explain the effects of divergent communication styles in NPD?	74
- Do team culture values have a direct effect on team learning and time-to-market?	55
- What are the differences behind the successes and failures of a project? (Explore rival explanations). - How does NPD high innovation speed relate to project success? - How does outsourcing influence high-speed NPD?	60
- How do startups build their assets and competencies? How do these dynamics influence the NPD processes? - When is the speed of innovation appropriate, and what happens when innovation is accelerated in startups?	40
- What is the impact of NPD practices on the success of startup companies? - What factors influence the adoption of stricter structures as startups grow and evolve?	67
- How can the use of big data support accelerated innovation?	84
- How do innovation ecosystems affect accelerated NPD?	86

3.5 Conclusions

In this study, we assessed 25 years of NPD literature to organize and extract relevant implications from scientific content published about the factors that influence the TTM reduction. By exploring this context, we provided a systematic review of drivers and capabilities involved in this process, as well as important insights into their attributes, relationships and benefits for companies' performance. After all, when it comes to NPD, there is not one single possible path (MORGAN; ANOKHIN; WINCENT, 2019). Several nuances of this process such as the characteristics of the company, product, team, and environment in which the company operates should be considered when planning the introduction of a new product to the market.

This approach should the time-to-market literature and help managers to make the right decisions in their new product developmental process. As described during the study, this theme gains even more relevance in the face of periods of market instability and uncertainties, such as, for example, in the current crisis caused by COVID-19 in which innovation, and consequently encouraging new product development, play an important role in recovering social and economic consequences (CHESBROUGH, 2020; KUCKERTZ et al., 2020).

The two research questions proposed at the beginning of the study were answered. The evolution of the theme was described based on the evaluation of four elements extracted from the 88 papers: year of publication, research method, country researched and industrial sector. The bibliometric analysis is summarized in Figure 3.2. The implementation characteristics were evaluated by extracting six elements. Five drivers with the potential to motivate companies to reduce their TTM were found, as shown in Table 3.2. Nineteen capabilities allowing this reduction was also identified, which were grouped into five categories, as shown in Table 3.3. The relationship between the capabilities was analysed using a network generated from a cross citation matrix (Figure 3.3). Capabilities attributes were extracted as shown in Table 4. The TTM reduction was pointed out as responsible for providing benefits in operational (Table 3.5) and business (Figure 3.4) performance. To synthesize the information collected, a theoretical model was proposed (Figure 3.5). Our data analysis draws some managerial implications that should be seen by managers and policymakers as indications and trends. And as another theoretical contribution, we list 20 research question proposals (Table 3.6), which characterizes a research agenda proposal on this theme.

This study may have limitations, especially regarding the collection of papers, as this was restricted to only two databases, and the strings used for the searches. We sought to minimize such constraints by choosing the largest databases in terms of content (CHADEGANI et al., 2013) and by performing a strategic crossover of the selected keywords. Consequently, some of the research gaps proposed may have already been answered by studies that were not observed in this analysis. Future empirical studies may explore the proposed model in different sectors to and for different countries. This study detected regions where there are no studies on NPD; investigations in these locations could improve the development and implementation of private and public policies. A longitudinal approach to holistically analyzing the application of these factors in a company may also prove relevant. Therefore, the fine-tuning of the theoretical model represents a promising area for future conceptual and empirical research.

4 UNVEILING THE RELATIONSHIP BETWEEN DRIVERS AND CAPABILITIES FOR REDUCING TIME-TO-MARKET IN START-UPS: A MULTI-METHOD APPROACH

In this chapter, the map of the relationship between the drivers and capabilities for reducing TTM in startups is developed. For this, the preliminary list of drivers and capabilities identified in the Systematic Literature Review was validated for start-ups in consultation with experts. The Interpretive Structural Modelling (ISM) method was used to develop a hierarchical model, and the analysis of the dependence and driving power of such drivers and capabilities was performed by Fuzzy MICMAC (Matriced' Impacts Croise's Multiplication Applique'e a' un Classement). Besides, this chapter was published in the International Journal of Production Economics (https://doi.org/10.1016/j.ijpe.2020.108018).

4.1 Introduction

Time-based competition, the fast-follower strategy, a rapid product development cycle, and first-mover advantage are all strategies pursued by companies in recent decades that highlight the importance of innovation and new product development (NPD) speed (CARROLL; CASSELMAN, 2019). This scenario is even more evident in times of crisis, such as the current COVID-19 pandemic, where the economic and social demands for innovation stimulate fast NPD (CHESBROUGH, 2020; KUCKERTZ et al., 2020). NPD is the entire process of bringing a product to market, starting with recognising a marketing opportunity and ending with a product launch (CHEN; DAMANPOUR; REILLY, 2010b), and the primary performance metric of this process is time-to-market (CANKURTARAN; LANGERAK; GRIFFIN, 2013).

Previous research has attempted to find solutions to reduce time-to-market (TTM), resulting in different lists of factors that present inconsistent empirical results despite previous efforts to systematise them (CHEN; DAMANPOUR; REILLY, 2010b; CANKURTARAN; LANGERAK; GRIFFIN, 2013). Even with the growing interest in research on innovation strategies, such as the development of new products, the existing literature focuses more on the NPD process, that is, the mechanism by which it operates, and very few studies explore how the environmental mechanism affects the process (SUN; LIU, 2020). It is in this context that the work is inserted. Based on the Dynamic capabilities theory, this study uses the term "capabilities" as the structural aspects, i.e., a grouping of resources (physical, human and/or organisational), knowledge and skills to solve technical problems, interacting with the external environment to create sustained competitive advantage in companies (SUNDER M; L.S; MARATHE, 2019). Therefore, these contextual aspects serve as motivators for such internal changes in organisations; in this study, they will be called "drivers". The research gaps mentioned above are even more relevant to the perspective of start-ups. After all, every start-up founder has to go through an NPD process, whether it is formalised or not (TRIPATHI et al., 2019). However, there is a relative scarcity of empirical research addressing issues related to TTM reduction, its assumptions, structure, and use in start-ups. In particular, the use and effects of drivers and capabilities for reduced TTM must be adequately addressed for these companies since their structure depends inherently on developing their product (EDISON et al., 2018).

This study's purpose is to identify and present the relationship between drivers and capabilities for reduced TTM in start-ups. As a starting point, a systematic literature review (SLR) was developed, which resulted in a set of five drivers and nineteen capabilities subsequently validated for start-ups by practical and academic experts. The interactions between these drivers and capabilities, as well as the strength of driving and dependence power of these relationships, were proposed using a combination of interpretive structural modelling (ISM) and Fuzzy MICMAC (Matriced' Impacts Croise's Multiplication Applique'e a' un Classement) analysis. Given the strong association between the survival of start-ups and their performance in quickly developing new products (MARION; FRIAR; SIMPSON, 2012), the contribution of our research is to deploy a structured approach to identify and analyse these drivers and the capabilities to reduce the TTM of start-ups. This contribution corresponds to the proposal made by Ghezzi and Cavallo (2020) in a recent study, in which they suggest that it is worth investigating how NPD is performed in start-ups. According to these authors, it is necessary to investigate the peculiarities of these companies regarding the approaches and tools adopted, in addition to their business models, to take advantage of their agile and lean emerging practices. This structure brings relevant propositions about this complicated and risky period for start-ups to introduce a new product on the market, where there is a very little data and also provides researchers, practitioners and policymakers with a much more efficient roadmap to bring products to market faster and improve companies' performance. The structure of this chapter is as follows: section 4.2 includes the conceptual background that supports this research. Section 4.3 presents the research method adopted, whereas the results are presented in section 4.4 Section 4.5 includes the discussion, and section 4.6 draws the conclusions and implications of the study.

4.2 Conceptual background

This section presents the conceptual basis concepts for TTM and the importance of its reduction in NPD. We also present the conceptual basis for start-ups and the peculiarities of this type of organisation.

4.2.1 Reducing time-to-market in NPD

Time-to-market is defined as the time that elapses from the beginning of an idea's generation until its introduction in the market (CANKURTARAN; LANGERAK; GRIFFIN, 2013), and it is one of the most critical measurements of NPD performance (FENG et al., 2014). NPD is widely cited in management literature as a source of competitive advantage (SÁNCHEZ; PÉREZ, 2003; TAN; ZHAN, 2017). Studies propose that the faster a company completes the NPD, the more likely it is to outperform its competitors, and cost benefits can be achieved because resources are used more creatively and efficiently (AFONSO et al., 2008; TAN; ZHAN, 2017). As a result, companies are increasingly reconsidering the fundamental ways in which they can reduce the TTM, and researchers have sought to investigate several factors that may influence this time (CHEN ET AL., 2005; DE TONI AND MENEGHETTI, 2000; SERHAN ET AL., 2015).

Some studies examine the project team's structure, focusing on factors such as leadership, experience and empowerment for reducing time (SWINK, 2003; STRANG, 2010). Others emphasise the strategy, arguing that top management support, an emphasis on speed and clarity of objectives provide guidelines for such a reduction (KESSLER; BIERLY; GOPALAKRISHNAN, 2000; PARRY et al., 2009; CARBONELL; ESCUDERO, 2010). Integration is also cited with potential for this purpose, and it can be accomplished with several company stakeholders (such as suppliers, customers, other companies, consultancies, universities, government institutions, among others) promoting the establishment of innovation networks (ELVERS AND SONG, 2016; KONG ET AL., 2015; MORITA ET AL., 2018). Some researchers have assessed the influence of structural elements of the process itself, such as levels of standardisation, characteristics of the project scope, test applications and recurrent use of simulation tools (BECKER; SALVATORE; ZIRPOLI, 2005; BREWER; ARNETTE, 2017)). Characteristics of the product being developed have also been studied as potential influencers of time, such as technological complexity and the degree of novelty (CARBONELL; RODRIGUEZ, 2006; KACH; AZADEGAN; DOOLEY, 2012).

Despite the empirical attempts to study elements that influence this time, the models that integrate these elements and evaluate their interrelationships are scarce in the literature, especially when the moderation of the company's environment is added (CHEN et al., 2010). However, a good NPD process must be adaptable to the company's characteristics to provide a more efficient roadmap for companies to bring products to market faster, improve the use of their scarce resources and present a better performance (ZHAN et al., 2017).

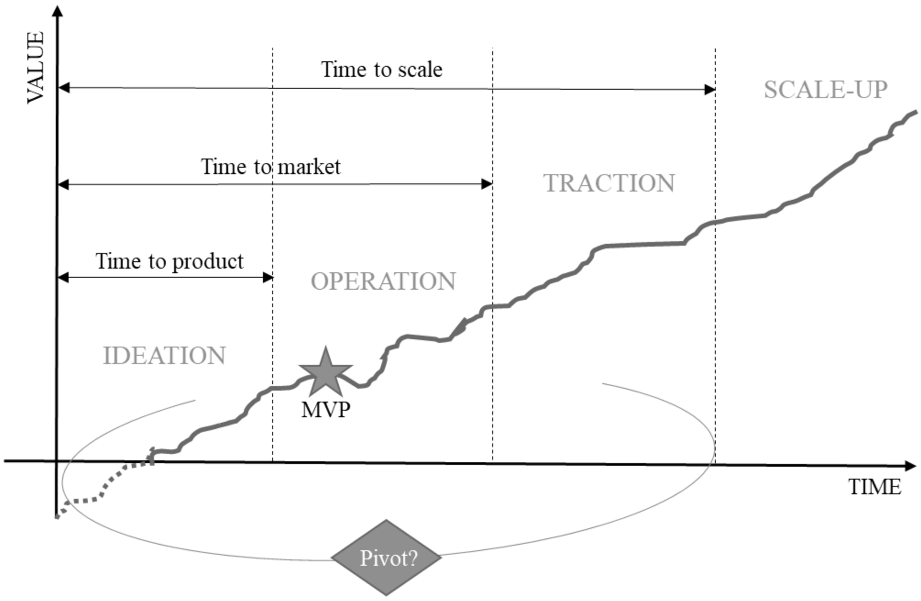
4.2.2 Start-ups

Start-ups are notable examples of the race against time in the NPD process (CARROLL; CASSELMAN, 2019). The term "start-up" used in this paper was coined in Silicon Valley in the US and refers to the most extreme examples of project organisations, where every individual in the company, regardless of his or her role, is linked by a single project – the growth of the new company and the creation of its products (MARION; FRIAR; SIMPSON, 2012). In other words, they are companies that necessarily go through a development process from the idea to the business. Therefore, there are four stages of start-up development (TRIPATHI et al., 2019):

- **Ideation:** the newly created company does not yet have much market or customer data to prove that its products will be successful;
- **Operation:** the company has performance data and metrics, that the team and investors can react against;
- **Traction:** during this time for the company's scalability, the focus should be on the demand growth and the infrastructure needed to meet this expansion. New rounds of an investment may be needed at this stage;
- **Scale-up:** at this stage, the company has reached maturity and has a sustainable business model with revenue growth for consecutive years.

The perception of time during this process follows a simple logic marked by pre-determined deliveries. Figure 4.1 shows the different time denominations according to the respective deliveries with emphasis on developing the minimum viable product (MVP) and the concept of the pivot. The MVP consists of a product with the minimum characteristics to make it viable (marketable), whereas the practice of "pivoting" refers to the possibility of changing the strategy without changing the view (TRIPATHI et al., 2019). These two concepts together are characterised as a central element in the literature of start-ups, referring to a development model widely adopted by this type of company today, the Lean Startup (RIES, 2011; BLANK, 2013). Lean thinking is compatible with fast NPD because it seeks to provide companies with methods that are powerful enablers for shortening TTM and improving performance (MARODIN et al., 2018).

Figure 4.1 - Stages of startup development



Source: Developed by authors

For NPD management in start-ups, it is essential to emphasise that research in this area is growing. As Carroll and Casselman (2019, p. 766) explain, "methodologies to optimise this process are continuously revised, combining concepts from different fields (…). This ranges across such diverse approaches as Lean startup, Agile movement, Extreme programming and Lean user experience". All of this demand occurs because start-ups lack the resources of an established technology company and must move forward in the organisational emergency process while developing new products. One way to manage resource shortages is by launching the new product as quickly as possible, so the entrepreneur can generate cash flow, gain financial independence and establish legitimacy (STAYTON; MANGEMATIN, 2019).

4.2.3 Research gap

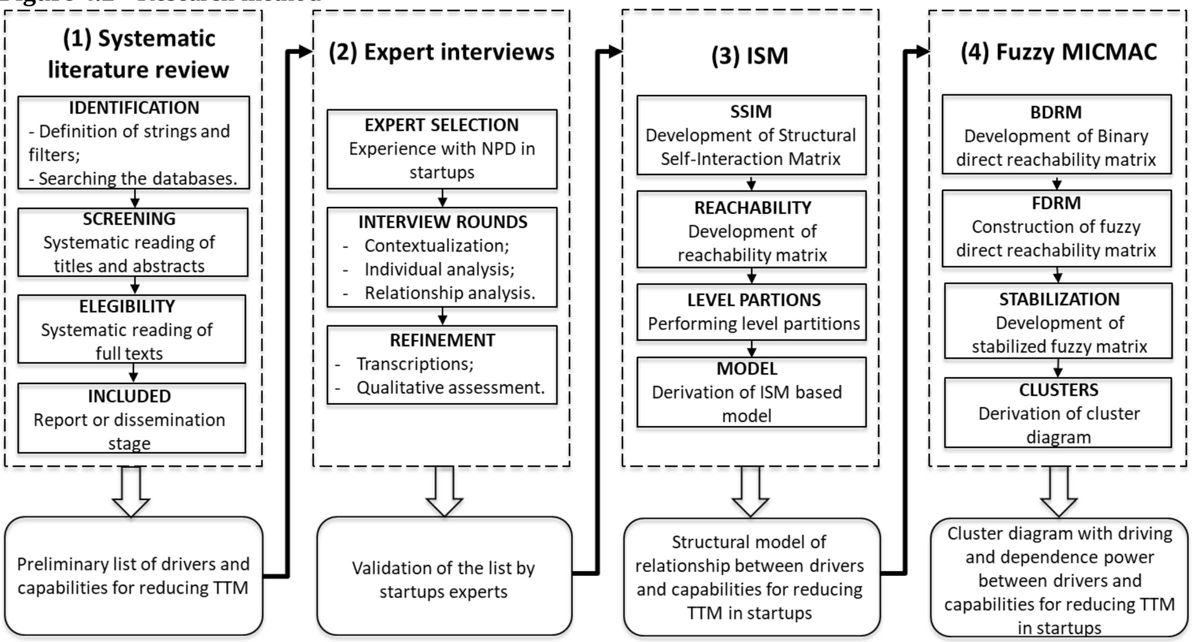
Several practices at start-ups have evolved and created characteristics that are adapted to these companies (SIMON; LEKER, 2016). However, these nuances are largely dissociated from their underlying roots in the broader management literature (CONTIGIANI;

LEVINTHAL, 2019). Moreover, literature analysis indicates that there is no study performed to identify and systematically assess several drivers and capabilities that influence the TTM for start-ups. Therefore, there is no clear roadmap from prior studies to help managers reduce TTM in these companies. It is precisely this gap that this research aims to mitigate. To ensure the practical relevance of the roadmap, inputs from practitioners working at start-ups were used to identify dominant influences between drivers and capabilities.

4.3 Research method

The design of this research consists of a multi-method approach. Initially, to generate the preliminary list of drivers and capabilities, traditional NPD literature was consulted through a systematic literature review (SLR). Expert interviews were conducted to validate this list from an empirical perspective. After all, the performance of an expert in the area of the phenomenon being modelled is of fundamental importance for collaborating in the construction of the pertinence functions for description of entries (GANGA; CARPINETTI; POLITANO, 2011). From these data, a structural model was developed to identify the relationship between drivers and capabilities for reducing TTM by ISM approach. Finally, a cluster diagram showed the drivers and dependence power between them by Fuzzy MICMAC. The next subsections describe the steps of each of the applied methods, as summarised in Figure 4.2.

Figure 4.2 - Research method



Source: Developed by authors

4.3.1 Systematic literature review (SLR)

The preliminary list of drivers and capabilities for reduced TTM used in this study was derived from an SLR supported by the filtration procedure proposed by Moher et al. (2009) and the use of content analysis technique, which is a traceable and replicable method for analysing data and identifying concepts. For this, the first step was the definition of scope, which consisted of identifying papers dealing with time-based competition, new product development and start-ups. We made an initial search combining these three themes in two databases, Scopus and Web of Science, and the response was only 14 papers. Therefore, we decided to expand our search to identify the largest possible number of capabilities and drivers that were studied in the traditional literature of NPD and only then to refine these results from the perspective of startups through expert interviews. For this expansion, keywords and their synonyms related to time in the development of innovative products were used including the following: (1) “time-based competition”; (2) “time” AND “new product development”; (3) “time” AND “innovation”; (4) “time” AND “new product development” AND “innovation”; (5) “agil*” AND “new product development” AND “innovation”; (6) “speed” AND “new product development” AND “innovation”. Scopus and Web of Science were used to search for papers. These databases were selected because they more widely cover the selected research areas and have effective search refinement tools (CHADEGANI et al., 2013). Filters were applied for the document format (articles published in journals), language (English) and the topic areas (engineering, social science, business research and decision science). No filter was applied to the year of publication. And this initial search in the databases resulted in 757 papers through the pre-established strings.

It was from this greater number of studies found in the traditional literature of NPD that the filtering procedure was applied, the following criteria for inclusion and exclusion of papers were established: (1) consistency with the scope; and (2) containing the description of any driver and/or capability for reducing TTM. Thus, the screening process began, which consisted of a systematic reading of titles and abstracts using the inclusion and exclusion criteria. The papers selected in this step proceeded to the eligibility process, when a systematic reading of full texts occurred. Thus, 88 papers are selected for the report/dissemination stage. Finally, for the derivation of the list of drivers and capabilities, content analysis technique was applied with the NVivo software.

4.3.2 Expert interviews

Refinements with experts were conducted to validate the preliminary list identified in the SLR from an empirical perspective of start-ups. Rounds of semi-structured interviews were performed, and this data collection was discontinued after theoretical saturation seemed to have been reached; that is, new insights into the phenomena being examined were no longer gained. The experts were divided into two groups: practitioners and academics. Practitioners were chosen because they held senior management positions and were involved in different areas of the start-up, which would provide a broad view and knowledge of the NPD process. As for academic specialists, the basic requirements were to present projects and academic publications related to NPD and/or innovation in recent years.

This knowledge was necessary for this study to eliminate those whose background was not relevant to start-ups. Information about the 8 practitioners (represented by the letter P) and 6 academics (represented by the letter A) who participated in this study are presented in Table 4.1. Each interview lasted an average of 40 minutes to 1 hour. The final number of experts interviewed in this study was 14 due to the sample closure due to theoretical saturation, that is, there was a suspension of inclusion of new participants when the data obtained started to present, in the researcher's evaluation, a certain redundancy or repetition, no more contributing significantly to the improvement of theoretical reflection based on the data being collected. The use of this technique is already widespread in operations management, and has been applied in recent studies (TRIPATHI et al., 2019; KUCKERTZ et al., 2019). Studies using similar expert panel-based methodologies have proven that the number of senior experts chosen is an acceptable number for such studies, as shown in Table 4.2 through a comparison between the numbers of experts used in recent papers published in high impact factor journals.

The interview procedure was developed in three steps: contextualisation, individual analysis and relationship analysis. In the contextualisation, the purpose of the interview was shown, and the specific application to start-ups was emphasised. The preliminary list was presented, and the interviewee was asked about his/her experiences with NPD and his/her general perceptions about the importance of drivers and capabilities. In the individual analysis, the interviewee answered whether he/she agreed with the influence of each driver and capability in reducing TTM. The answer to this question would launch a discussion that would or would not lead to a change in the preliminary list. Therefore, the expert was also asked about the necessity of adding other driver or capability in the list. Finally, in the relationship analysis, each interviewee was asked about possible interactions between drivers and capabilities. At this stage, a structural self-interaction matrix (SSIM) was completed. All interviews were audio-recorded and transcribed, and these matrixes were filled out for further analysis.

Table 4.1 - Detail of expert interviews

Expert	Summary of expertise	P	A
#e1	PhD in Industrial Engineering, he is a professor with over 26 years of experience in the areas of quality and product development.		X
#e2	PhD in Industrial Engineering, he is a professor with over 12 years of experience in the areas product-service system, servitisation and customer experience.		X
#e3	PhD in Industrial Engineering, he is a professor with over 10 years of experience in the areas of product innovation and customer integration.		X
#e4	PhD in degree in Industrial Engineering, he is a professor with over 26 years of experience in the areas of technological innovation and organisational behaviour.		X
#e5	PhD in degree in Industrial Engineering, she is a professor with over 27 years of experience in the areas of entrepreneurship, technological innovation and intellectual property.		X
#e6	PhD in Development and Environment, he is a professor with 7 years of experience in the areas of product and process design.		X
#e7	Co-founder of a wind farm operational management startup founded in 2016.	X	
#e8	Chief operating officer of ideas laboratory that was founded in 2016.	X	
#e9	Co-founder and partner of a delivery startup that was founded in 2013.	X	
#e10	Head of product and innovation for a startup specialising in customer experience, he founded two other startups that have been discontinued.	X	
#e11	Chief technical officer and co-founder of a legislative monitoring startup founded in 2016.	X	
#e12	CEO of a subscription club startup with pet products founded in 2014.	X	
#e13	Founder and chief technical officer of a startup for financing of suppliers of large companies founded in 2016.	X	
#e14	Co-founder and chief operating officer of an innovation centre in Brazil founded in 2017.	X	

Table 4.2 - Comparison of the number of respondents in previous studies

References	Academics	Practitioners	Total
Kumar et al. (2016)	3	4	7
Adebanjo, Laosirihongthong and Samaranayake (2016)	-	-	9
Ruiz-Benitez, López and Real (2017)	0	15	15
Ghode, Yadav and Soni (2020)	2	3	5
Average	3	8	9

4.3.3 ISM methodology

The methodological steps followed in this stage were proposed by Muruganantham et al. (2016). The ISM model represents a finite set of nn elements in a system represented by SS = ($s_1, \dots, s_i, \dots, s_n$).$s_1, \dots, s_i, \dots, s_n$). SSIM is built on contextual relationships of element pairs (s_i s_i and s_j)s_j), which means that one element leads to another or impacts a measure of performance. In this way, the experts were asked to fill in the pair relationship between system elements in an SSIM 24*24. Therefore, we provided them with the following four symbols:

V: Element *i* leads to/ facilities element *j*.
A: Element *j* leads to/ facilities element *i*.
X: Element *i* and *j* are mutually interdependent.
O: No relationship between elements *i* and *j*.

The SSIM is then transformed into the initial reachability matrix, which expresses the existence of a relationship between two elements. This transformation is accomplished by translating the symbols into binary numbers according to the following rules:

(1) If (i, j) entry in SSIM is V, then (i, j) entry in the Reachability matrix becomes 1 and (j, i) entry becomes 0.
(2) If (i, j) entry in SSIM is A, then (i, j) entry in the matrix becomes 0 and (j, i) entry becomes 1.
(3) If (i, j) entry in SSIM is X, then (i, j) entry in the matrix becomes 1 and (j, i) entry also becomes 1.
(4) If (i, j) entry in SSIM is O, then (i, j) entry in the matrix becomes 0 and (j, i) entry also becomes 0.
(5) Diagonal elements are assigned 1 as both i and j are the same.

The final reachability matrix is developed based on a transitivity condition; that is, if element A is related to element B and element B is related to element C, then necessarily element A is related to element C. It is noted that the accessibility matrix converts subjective data into quantitative values. The accessibility matrix obtained is partitioned into different levels, which are assigned based on the driving force calculated in the SSIM. This level partition is used as the basis for developing the ISM model because the ISM hierarchy is built by placing the drivers and capabilities with the same level of reachability and intersection at the same level of the matrix. From the final reachability matrix, the structural model is generated. If there is a relationship between the element *i* and *j*, then the relationship is shown by an arrow that points from *i* and *j*.

4.3.4 Fuzzy MICMAC

The ISM model evaluates the relationships between two drivers and capabilities in a binary way. However, the influence of one driver or capability over another can have different intensities. To assess this degree of belonging among the driver or capability, Fuzzy MICMAC was used. This analysis has been used in addition to ISM due to its characteristics that allow the fuzzification of the intensity of the relationship between two factors through the frequency of response from specialists. For this, the initial reachability matrix is the starting point for identifying and fuzzifying the direct relationship between drivers and/or capabilities. To obtain the BDRM, interactions between the drivers and capabilities are referred from the initial reachability matrix and all diagonal entries are replaced by zero. The strength of drivers' and capabilities' impacts were described as a qualitative consideration on a 0-1 scale, which is demonstrated in Table 4.3 together with the assignment rule used for establishing the fuzzy-based relationship.

Table 4.3 - Fuzzy scale and assignment rule for defining the strength of antecedent**s**

Strength	**Value assigned**	**Number of experts agreed that the factor *i* drive factor *j***
No	0	None
Weak	0.25	1 – 5
Medium	0.5	5 – 9
Strong	0.75	9 – 13
Very strong	1	13 and above

These values are superimposed on the initial reachability matrix resulting in the Fuzzy Direct Reachability Matrix. Different types of fuzzy compositions could be used to determine the strength of the fuzzy indirect relation from element *i* to *j* (e.g., max-min, max-product and max-average). In this study, the max-min composition is the most suitable since the minimum strength must be the maximum of all possible minimal impacts from *i* to *j*. Matrix multiplication is calculated using the rule described below to achieve the fuzzy MICMAC stabilised matrix.

$$T = U.V = \max n\ [\min(x_{in}, y_{nj})]$$

Here, $U = x_{in} U = x_{in}$ and $V = y_{nj} V = y_{nj}$.

The Fuzzy MICMAC stabilised matrix was obtained using the MATLAB program. To determine the driving power, all row entries of the possibility of interaction are added, whereas the addition of column entries provides the dependence power. It is emphasized that the driving power implies how much one variable drives the other variable, i.e., variables with greater driving power are the cause for various other variables; while the dependency power means that the variable depends on others, i.e., variables with greater dependence power are greatly affected by many variables (MURUGANANTHAM et al., 2016). Finally, further analysis with the aid of the MICMAC approach is depicted with the help of a cluster diagram with four clusters demonstrating autonomous, dependence, linkage and drive power.

4.4 Results

A multi-method approach was adopted in this research. Therefore, the application of each method presented a specific result but complementary to each other. The following will be discussed in this section: (1) preliminary list of drivers and capabilities; (2) validation by experts; (3) ISM results; and (4) Fuzzy MICMAC results.

4.4.1 Preliminary list of drivers and capabilities

The initial search in the databases resulted in 757 papers through the pre-established strings. By excluding duplicate documents between databases and applying the screening process, (i.e., performing a systematic reading of the titles and abstracts using the inclusion and exclusion criteria), 223 papers remained for the next step. In the eligibility process, with a full reading of the texts, only 88 papers were selected to compose the final sample for the review. From this final sample, content analysis of the papers was completed. In this step, excerpts were identified throughout the texts that indicated a driver and/or capability that influenced the reduction of TTM according to the authors. Each identified section was coded with the aid of Nvivo software. With this process, a list of 5 drivers and 19 capabilities was identified, which is presented in Table 4.4. The notations adopted in this research to refer to each driver and capability, as well as their definitions and references from the papers that cited them in the SLR, are also described in this table.

Table 4.4 - Notation, description and references for each driver and capability for reduced TTM

Capabilities	#	Description	References
Cross-functional team	T1	Level of profiles and competencies diversification on the company's NPD team.	2, 8, 11, 14, 26, 27, 29, 30, 34, 36, 45, 46, 47, 50, 51, 53, 67, 72, 78
Team experience	T2	Level of knowledge or learning obtained through practice of professionals.	36, 40, 66
Team empowerment	T3	Level of grant by the company of individual power to perform activities and make decisions during the process.	1, 9, 12, 37, 38, 39, 53, 58, 60, 66
Leadership	T4	Level of command and influence over the behaviours and attitudes of the development team.	1, 24, 26, 27, 37, 53, 54, 60, 84, 86
Learning	T5	Set of formal and informal knowledge, which allows the organisation to create its own management models.	13, 17, 14, 25, 32, 48, 53, 55, 57, 65, 61, 63, 84, 85, 86
Organisational culture	T6	Set of values, beliefs and standards adopted by the organisation.	12, 19, 32, 34, 55, 65
Management strategies	T7	Set of strategies adopted by the company to coordinate the team in the execution of tasks and the capture of results	9, 12, 35, 37, 53
Marketing strategies	T8	Set of strategies adopted by the company to create, communicate, deliver and exchange offers that have value for customers, partners and society in general.	15, 32
Quality strategies	T9	Set of strategies adopted by the company to achieve the objectives set by the quality policy.	9, 15, 19, 46, 49, 73, 85
Functional integration	T10	Level of approximation of the different functional areas of the company, within a perspective of cooperation.	1, 4, 5, 6, 7, 8, 10, 11, 12, 14, 18, 19, 20, 23, 24, 25, 29, 30, 32, 38, 42, 43, 45, 49, 53, 54, 59, 61, 64, 72, 73, 75, 76, 83, 84, 85, 86, 87
Customers integration	T11	Set of cooperation actions between customers and the company to understand the needs of consumers and translate them into product requirements.	1, 2, 6, 14, 16, 25, 29, 30, 34, 43, 45, 53, 62, 69, 70, 80, 81, 82, 86
Suppliers integration	T12	Set of cooperation actions between suppliers and company to define the design of a product together.	6, 11, 14, 18, 22, 25, 28, 29, 30, 34, 43, 45, 52, 53, 68, 70, 71, 73, 77, 79, 83, 84, 88
Others integration	T13	Set of cooperation actions between the company and other institutions, to use assistance and/or information for support or research during the NPD.	29, 40, 49, 56, 76
Standardisation	T14	Set of systematic actions adopted to define and use standards in the NPD process.	5, 11, 20, 21, 30, 39, 44, 53, 67, 73, 78, 83
Communication	T15	Set of actions adopted to facilitate and clarify communication between individuals involved in the NPD.	7, 14, 16, 22, 25, 29, 31, 49, 52, 56, 57, 61, 63, 68, 71, 74, 76, 78, 84, 86, 88
Product testing	T16	Set of actions adopted by the company to evaluate, proving and or validating certain product characteristics and performances.	2, 3, 11, 12, 33, 42, 73
Testing frequency	T17	Periodicity of product testing.	12, 15
Project content	T18	Set of actions adopted to structure the steps that need to be taken to complete the project.	12, 14, 24, 29, 47
Technological complexity	T19	Level of difficulty for acquisition of aspects and elements integrated into the product.	41, 53, 64, 68, 78
Drivers	**#**	**Description**	**References**

Competitive intensity	T20	A large number of competitors, competitive product inputs and the threat of substitutes has a wide impact on project decisions.	1, 7, 11, 15, 25, 35, 36, 48, 52, 57, 58, 59, 60, 61, 62, 71, 77, 79, 83, 88.
Uncertainty	T21	A multidimensional construct associated with the inability to predict the impact of environmental change and the consequences of a choice of response.	2, 11, 20, 23, 24, 25, 27, 29, 35, 36, 38, 45, 48, 49, 52, 53, 55, 58, 62, 63, 64, 65, 71, 77, 78, 79, 80, 83.
Technological turbulence	T22	Markets with high technology changes rates tend to encourage companies to accelerate NPD to keep up with the competition.	2, 6, 11, 22, 23, 25, 37, 42, 45, 47, 49, 52, 57, 58, 59, 61, 63, 64, 68, 69, 71, 81, 84, 86.
Time-sensitive	T23	In trying to attract increasingly sensitive customers, companies are looking to increase the number of products launched at a rapid pace.	14, 27, 48, 49, 69.
Innovation ecosystems	T24	Innovative market testing environment, where organisations combine their individual offering into a coherent customer-focused solution.	84, 86

Notes: 1. (MABERT; MUTH; SCHMENNER, 1992); 2. (KARAGOZOGLU; BROWN, 1993); 3. (TRYGG, 1994); 4. (KRISHNAN; EPPINGER; WHITNEY, 1995); 5. (CARTER; MELNYK; HANDFIELD, 1995); 6. (PRAGMAN, 1996); 7. (WILLIS, 1998); 8. (HARDAKER, 1998); 9. (SIM; CURATOLA, 1999); 10. (NARAHARI; VISWANADHAM; KUMAR, 1999); 11. (JAYARAM; VICKERY; DROGE, 1999); 12. (KESSLER; CHAKRABARTI, 1999); 13. (LYNN; SKOV; ABEL, 1999); 14. (DE TONI; MENEGHETTI, 2000); 15. (ROSAS-VEGA; VOKURKA, 2000); 16. (KRAEMER; DEDRICK; YAMASHIRO, 2000); 17. (KESSLER; BIERLY; GOPALAKRISHNAN, 2000); 18. (DROGE; JAYARAM; VICKERY, 2000); 19. (TENNANT; ROBERTS, 2001); 20. (TATIKONDA; MONTOYA-WEISS, 2001); 21. (LUKAS; MENON; BELL, 2002); 22. (PRIMO; AMUNDSON, 2002); 23. (KESSLER; BIERLY; GOPALAKRISHNAN, 2000); 24. (SWINK, 2003); 25. (RONDEAU; RAGU-NATHAN; VONDEREMBSE, 2003); 26. (VALLE; AVELLA, 2003); 27. (BSTIELER; GROSS, 2003); 28. (PETERSEN; HANDFIELD; RAGATZ, 2003); 29. (SÁNCHEZ; PÉREZ, 2003); 30. (DROGE; JAYARAM; VICKERY, 2004); 31. (YANG, 2004); 32. (MENON; LUKAS, 2004); 33. (BECKER; SALVATORE; ZIRPOLI, 2005); 34. (KODAMA, 2005); 35. (Chen et al., 2005); 36. (CARBONELL; RODRIGUEZ, 2006); 37. (ALLOCCA; KESSLER, 2006); 38. (JIAN’AS; BEI, 2007); 39. (BARCZAK; SULTAN; HULTINK, 2007); 40. (HEIRMAN; CLARYSSE, 2007); 41. (RAMACHANDRAN; KRISHNAN, 2008); 42. (DERELI; BAYKASOĞLU; BÜYÜKÖZKAN, 2008); 43. (CHI-JYUN CHENG; SHIU, 2008); 44. (BARCZAK; HULTINK; SULTAN, 2008); 45. (VALLE; VÁZQUEZ-BUSTELO, 2009); 46. (SUN; ZHAO; YAU, 2009); 47. (PARRY et al., 2009); 48. (JOHNSON; PICCOLOTTO; FILIPPINI, 2009); 49. (FEKRI; ALIAHMADI; FATHIAN, 2009); 50. (PARK; LIM; BIRNBAUM-MORE, 2009); 51. (MINGUELA-RATA; ARIAS-ARANDA, 2009); 52. (LIN, 2009); 53. (Chen et al., 2010); 54. (STRANG, 2010); 55. (AKGUN et al., 2010); 56. (OKE; IDIAGBON-OKE, 2010); 57. (CARBONELL; ESCUDERO, 2010); 58. (DAYAN; BASARIR, 2009); 59. (MILLSON; WILEMON, 2010); 60. (KACH; AZADEGAN; DOOLEY, 2012); 61. (Lin et al., 2012); 62. (TSINOPOULOS; AL-ZU’BI, 2012); 63. (Chen et al., 2012); 64. (EVANSCHITZKY et al., 2012); 65. (AKGÜN et al., 2012); 66. (PATANAKUL; CHEN; LYNN, 2012); 67. (MARION; FRIAR; SIMPSON, 2012); 68. (DANESE; FILIPPINI, 2013); 69. (LIN et al., 2013); 70. (FENG et al., 2014); 71. (ZHAO; CAVUSGIL; CAVUSGIL, 2014); 72. (AL SERHAN; JULIAN; AHMED, 2015); 73. (GRANER; MISSLER-BEHR, 2015); 74. (PESCH; BOUNCKEN; KRAUS, 2015); 75. (KONG et al., 2015); 76. (VEZZETTI; ALEMANNI; MORELLI, 2016); 77. (CHIANG; WU, 2016); 78. (CIARAPICA; BEVILACQUA; MAZZUTO, 2016); 79. (VAYVAY; CRUZ-CUNHA, 2016); 80. (ELVERS; SONG, 2016); 81. (CHANG; TAYLOR; META-ANALYSIS, 2016); 82. (SIMON; LEKER, 2016); 83. (BREWER; ARNETTE, 2017); 84. (ZHAN et al., 2017); 85. (ETTLIE; TUCCI; GIANIODIS, 2017); 86. (TAN; ZHAN, 2017); 87. (GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017); 88. (ZHANG; WANG; GAO, 2017).

4.4.2 List validation by experts

Following the description of the research method, we present the results of the 3 steps performed during the list’s validation by experts: contextualisation, individual analysis and relationship analysis. The 14 experts agreed with the 24 items on the list for the context of start-ups. When performing the individual analysis, some experts suggested adding information regarding some tools and methods used by start-ups to obtain each capability. The relationship between each of these mentioned tools and methods and the 19 capabilities can be seen in Table 4.5. This information was presented for the interviews in the next step of this research, relationship analysis, to provide them with more accurate information about the capabilities. This information made it easier for the experts to present their opinions about the relationship between the capabilities and drivers.

Table 4.5 - Tools and methods for implementing capabilities in start-ups suggested by experts

Capabilities	Tools and methods used by startups
T1, T3, T10	Squad model
T4	Mentoring and Ambidextrous leadership
T2, T5	Business intelligence and Gamification
T6	Lean thinking and Fail fast
T7	Lean Startup, Kanban, Scrum and Design thinking
T8	Crowdfunding, AARRR (Pirate metrics), Growth hacking and Inbound Marketing
T9	OKRs and Business intelligence
T11, T12	UX design, Multichannel customer service and engagement tool, Product roadmap and Business intelligence
T13	Proof of concept (POC)
T14	Kanban and Scrum
T15	Full transparency
T16, T17, T19	MVP, A/B test and Wizard of Oz
T18	Product roadmap, Kanban and Scrum

4.4.3 ISM results

Fourteen SSIMs were developed using the relationship analysis from the experts' opinions. The unified SSIM is shown in Table 4.6. The initial reachability matrix developed is shown in Table 4.7, and the final reachability matrix is shown in Table 4.8. The level partition is shown in Table 4.9. The structural model consists of a directed graph and is shown in Figure 4.3.

4.4.4 Fuzzy MICMAC results

The Fuzzy MICMAC starts from a binary direct reachability matrix; the one developed in this study is shown in Table 4.10. These values are superimposed, resulting in the Fuzzy Direct Reachability Matrix, which is shown in Table 4.11. Then, matrix multiplication following the rule described in the research method results in the Fuzzy MICMAC stabilised matrix shown in Table 4.12. As the main product of the application of this method, Figure 4.4 shows the cluster diagram that elucidates the driver and dependence powers between the drivers and capabilities studied.

4.5 Discussion

As demonstrated during this study, theory and practice are dissociated in the universe of start-ups (CONTIGIANI; LEVINTHAL, 2019). To establish the applicability of the drivers and capabilities identified in the literature for startups, a more in-depth discussion was conducted with experts. This refinement provided methodological robustness to the research. As described in the research design, all interviews were recorded and later transcribed verbatim, and the quotations that appear in this section are from those transcripts.

Analysing together the ISM model (Figure 4.3) and the cluster diagram from the Fuzzy MICMAC (Figure 4.4), we can see that the 5 identified drivers of reducing TTM in start-ups are positioned in the lowest levels of Figure 4.3 and are also classified as “driving factors” by the MICMAC approach. Therefore, “competitiveness”, “uncertainty”, “technological turbulence”, “time-sensitive” and “innovation ecosystem” influence all of the capabilities in the system significantly. They act as significant motivators for start-ups to accelerate their NPD.

Table 4.6 - Structural self-interaction matrix

#	T24	T23	T22	T21	T20	T19	T18	T17	T16	T15	T14	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
T1	A	O	A	A	A	A	V	V	V	V	V	X	X	X	X	V	V	A	A	X	A	A	A	X
T2	A	X	A	A	A	A	X	V	V	V	V	V	V	V	V	V	V	V	A	X	A	X	X	
T3	A	O	A	A	A	V	V	V	V	V	V	V	V	V	V	V	V	A	A	V	A	X		
T4	A	A	A	A	A	A	A	V	V	V	V	V	V	V	V	V	V	A	A	X	X			
T5	A	X	A	A	A	X	X	V	V	V	V	A	X	A	V	V	V	A	A	X				
T6	X	V	A	A	X	V	V	V	V	X	V	X	X	A	V	V	V	X	X					
T7	A	A	A	A	A	V	V	V	V	V	V	V	V	V	V	V	X	X						
T8	A	A	A	A	A	A	A	V	O	X	O	O	X	V	O	X	X							
T9	A	A	A	A	A	V	X	V	V	O	V	V	V	V	V	X								
T10	A	A	A	A	A	A	V	V	V	X	V	V	V	X	X									
T11	A	A	A	A	A	V	V	V	V	X	V	O	X	X										
T12	A	A	A	A	A	V	V	V	V	X	V	X	X											
T13	A	A	A	A	A	V	V	O	O	X	V	X												
T14	A	A	A	A	A	A	A	V	V	X	X													
T15	A	A	A	O	A	O	A	O	O	X														
T16	A	A	A	A	A	V	A	V	X															
T17	A	A	A	A	A	V	A	X																
T18	A	A	A	A	A	A	X																	
T19	A	A	A	A	A	X																		
T20	A	A	A	A	X																			
T21	A	A	A	X																				
T22	X	A	X																					
T23	A	X																						
T24	X																							

Table 4.7 - Initial Reachability Matrix

#	T24	T23	T22	T21	T20	T19	T18	T17	T16	T15	T14	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
T1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1
T2	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1
T3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1
T4	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1
T5	0	1	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	0	1	1
T6	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
T7	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
T8	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0
T9	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0
T10	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1
T11	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	1	1	0	0	0	1
T12	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	1
T13	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0	1	1	0	0	0	1
T14	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
T15	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0	0
T16	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T17	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T18	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	0	1	1	0	1	0
T19	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	1
T20	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T21	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T22	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T23	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0
T24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 4.8 - Final Reachability Matrix

#	T24	T23	T22	T21	T20	T19	T18	T17	T16	T15	T14	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
T1	0	1*	0	0	0	1*	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1*	0	1*	1
T2	0	1	1*	1*	1*	1*	1	1	1	1	1	1	1	1	1	1	1	1	1*	1	1*	1	1	1
T3	0	1*	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1*	1	1	1
T4	0	1*	0	0	0	1*	1*	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1	1	1	1
T5	0	1	1*	1*	1*	1	1	1	1	1	1	1*	1	1*	1	1	1	1*	1*	1	1	1*	1	1
T6	1	1	1*	1*	1	1	1	1	1	1	1	1	1	1*	1	1	1	1	1	1	1	1	1	1
T7	1*	1*	0	0	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1
T8	0	0	0	0	0	1*	1*	1	1*	1	1*	1*	1	1	1*	1	1	1	1*	1*	1*	1*	0	1*
T9	0	0	0	0	0	1	1	1	1	1*	1	1	1	1	1	1	1	1*	1*	1*	1*	0	1*	1*
T10	0	0	0	0	0	1*	1	1	1	1	1	1	1	1	1	1*	1*	0	1*	1*	1*	0	1*	1
T11	1*	1*	0	0	1*	1	1	1	1	1	1	1*	1	1	1	1*	1*	1*	1	1	1*	1*	1*	1
T12	1*	1*	0	0	1*	1	1	1	1	1	1	1	1	1	1*	1*	1	1*	1	1	1*	1*	1*	1
T13	1*	1*	0	0	1*	1	1	1*	1*	1	1	1	1	1*	1*	1*	1*	1*	1	1	1*	1*	1*	1
T14	0	0	0	0	0	0	0	1	1	1	1	1*	1*	1*	1*	0	1*	0	1*	0	0	0	0	0
T15	1*	1*	0	0	1*	1*	1*	1*	1*	1	1	1	1	1	1	1*	1	1*	1	1*	1*	1*	1*	1*
T16	0	0	0	0	0	1	1*	1	1	0	1*	0	0	0	1*	0	1*	0	0	1*	1*	0	1*	1*
T17	0	0	0	0	0	1*	1*	0	0	0	1*	0	0	0	1*	0	1*	0	0	1*	1*	0	1*	1*
T18	0	1*	0	0	0	1*	1	1	1	1	1	1*	1*	1*	1*	1	1	1*	1*	1	1	1*	1	1*
T19	0	1*	0	0	0	1	1	1*	1*	1*	1	1*	1*	1*	1	1*	1	1*	1*	1	1	1*	1	1
T20	1*	1*	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T21	1*	1*	0	1	1	1	1	1	1	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T22	1	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T23	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1	1	1*	1	1*
T24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

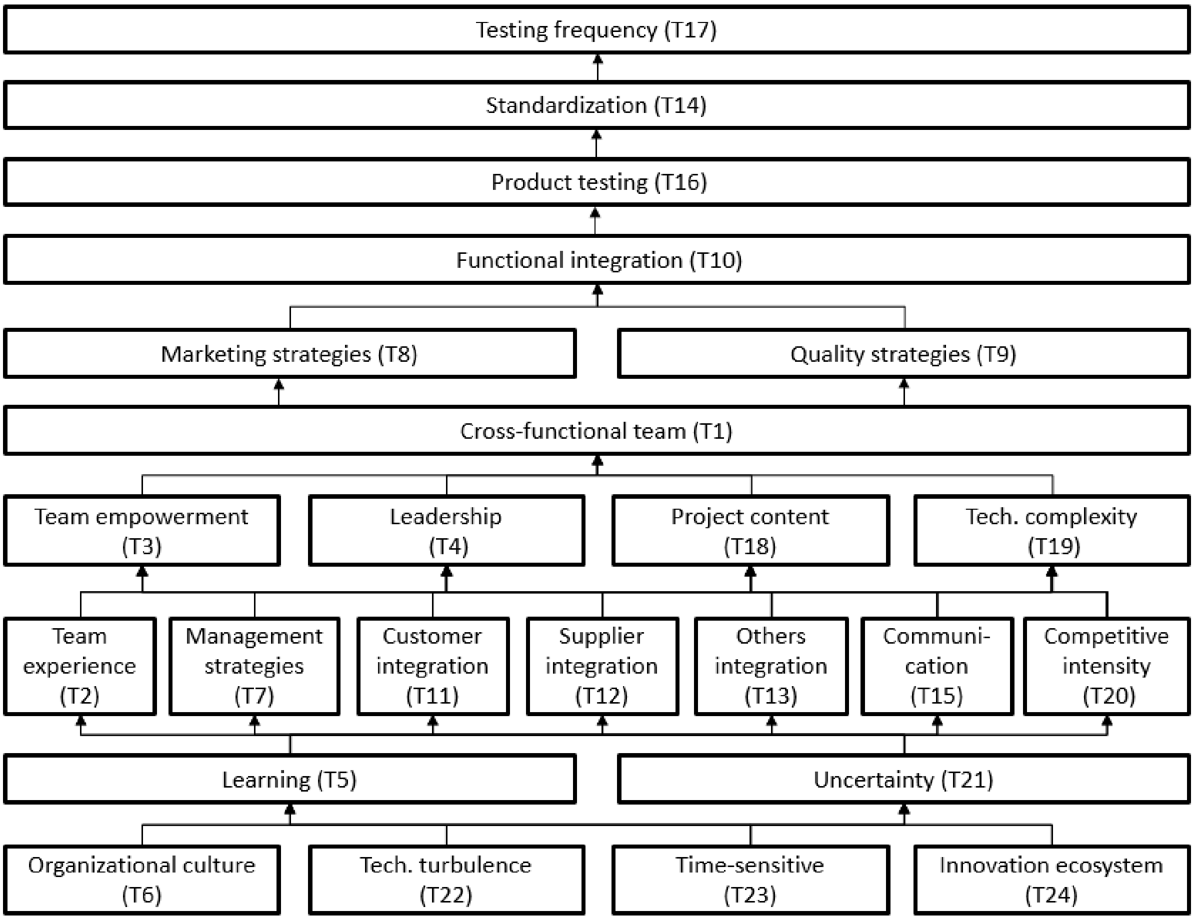
Table 4.9 - Level partitions table

#	Reachability set	Antecedent set	Intersection	Level
T1	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 4, 5, 7, 8, 9, 10, 12, 13, 15, 16, 17, 18, 19, 23	6
T2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23	8
T3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23	2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24	2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 15, 18, 19, 23	7
T4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 23	7
T5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23	9
T6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	10
T7	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 18, 19, 20, 23, 24	8
T8	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	5
T9	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 18, 19	5
T10	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	4

T11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 23, 24	8
T12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 23, 24	8
T13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 23, 24	8
T14	6, 8, 10, 11, 12, 13, 14, 15, 16, 17	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	6, 8, 10, 11, 12, 13, 14, 15, 16, 17	2
T15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 23, 24	8
T16	1, 2, 4, 5, 8, 10, 14, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24	1, 2, 4, 5, 8, 10, 14, 16, 18, 19	3
T17	1, 2, 4, 5, 8, 10, 14, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24	1, 2, 4, 5, 8, 10, 14, 18, 19	1
T18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 23	7
T19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 23	7
T20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24	2, 5, 6, 7, 11, 12, 13, 15, 20, 21, 22, 23, 24	2, 5, 6, 7, 11, 12, 13, 15, 20, 23, 24	8
T21	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24	2, 5, 6, 21, 22, 23, 24	2, 5, 6, 21, 23, 24	9

T22	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	2, 5, 6, 22, 23, 24	2, 5, 6, 22, 23, 24	10
T23	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24	1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 15, 18, 19, 20, 21, 22, 23, 24	10
T24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	6, 7, 11, 12, 13, 15, 20, 21, 22, 23, 24	6, 7, 11, 12, 13, 15, 20, 21, 22, 23, 24	10

Figure 4.3 - Developed ISM model



Source: Developed by authors

The expert interviews confirmed the importance of such drivers. In this paper, we consider the definition of uncertainty presented by Chen, Reilly and Lynn (2012), These authors consider uncertainty to be a multidimensional construct composed of two dimensions: novelty and turbulence (dynamism). They classify uncertainty into four types: technological newness, refers to the extent to which new technology or new manufacturing processes are used in an NPD process; technological turbulence, refers to the rate of change associated with new product technology in an industry; market newness refers to the extent to which the new product is targeted at unfamiliar markets compared with users of past products; and market turbulence refers to the rate of change in the composition of customer need and preferences. Thus, technological uncertainty includes technological newness and turbulence; and market uncertainty includes market newness and turbulence.

Table 4.10 - Binary direct reachability matrix

#	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24
T1	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
T2	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	0
T3	1	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
T4	1	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
T5	1	1	0	1	0	0	0	1	1	1	0	1	0	1	1	1	1	1	1	0	0	0	1	0
T6	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1
T7	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
T8	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0
T9	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0
T10	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0
T11	1	0	0	0	1	1	0	0	0	1	0	1	0	1	1	1	1	1	1	0	0	0	0	0
T12	1	0	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0
T13	1	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0
T14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
T15	0	0	0	0	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
T16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
T17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
T18	0	1	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
T19	1	1	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
T20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
T21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0
T22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
T23	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

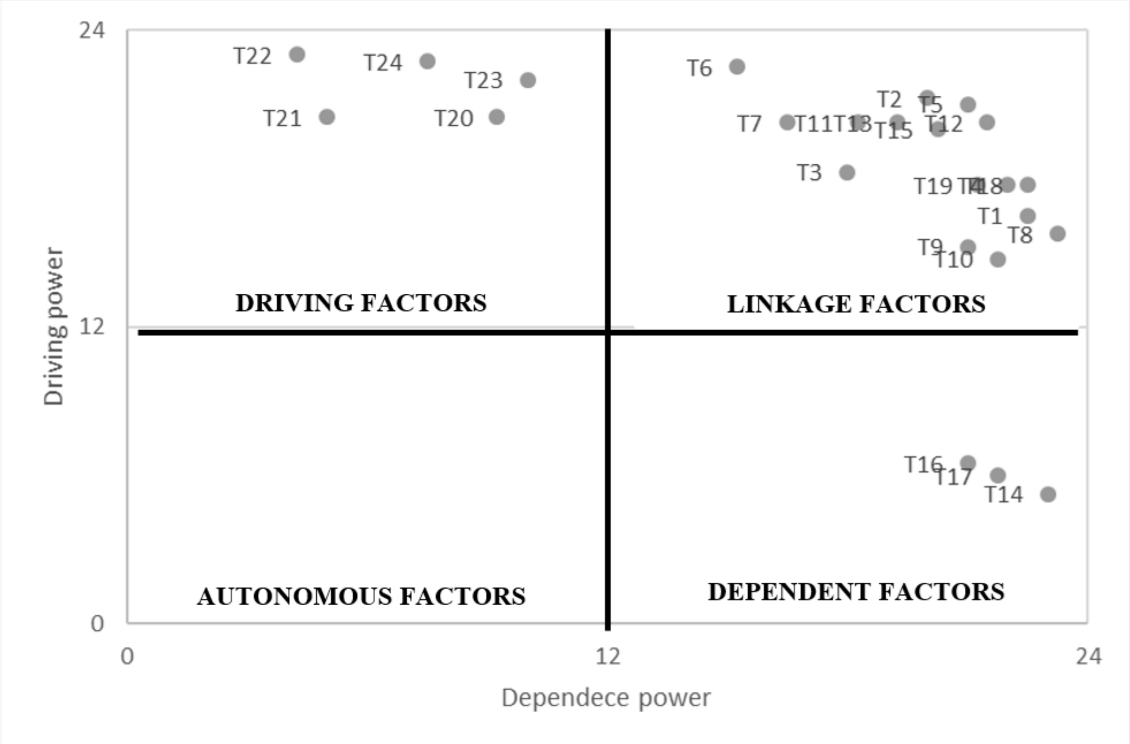
Table 4.11 - Fuzzy Direct Reachability Matrix

#	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24
T1	0	0	0	0	0,8	0	0	1	1	0,8	0,5	0,8	0,8	1	1	0,8	0,8	0,8	0	0	0	0	0	0
T2	0,8	0	1	0	1	0	0,8	1	1	1	0,8	1	0,8	1	1	1	1	0,8	0	0	0	0	0,5	0
T3	1	0,8	0	0	1	0	0	1	1	1	0,8	1	0,8	1	1	0,8	0,8	0,8	0,5	0	0	0	0	0
T4	1	1	0,8	0	1	0	0	1	1	1	0,8	1	0,8	0,8	1	1	1	0	0	0	0	0	0	0
T5	0,8	0,8	0	0,5	0	0	0	0,8	1	1	0	0,8	0	1	0,8	1	1	1	1	0	0	0	0,5	0
T6	1	1	1	1	1	0	1	0,8	1	1	0	1	1	1	1	0,8	0,8	1	1	0,5	0	0	0,5	0,8
T7	1	0	1	1	0,8	0,8	0	1	1	1	1	1	1	1	0,8	0,8	1	0,8	0,8	0	0	0	0	0
T8	0	0	0	0	0	0	0,5	0	1	0	0,8	1	0	0	0,8	0	0,5	0	0	0	0	0	0	0
T9	0	0	0	0	0	0	0	1	0	0,8	0,8	0,8	0,8	1	0	1	1	0,8	0,8	0	0	0	0	0
T10	0,5	0	0	0	0	0	0	0	0	0	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,5	0	0	0	0	0	0
T11	0,8	0	0	0	0,8	0,8	0	0	0	0,5	0	0,8	0	1	0,5	1	1	0,5	0,8	0	0	0	0	0
T12	1	0	0	0	0,8	0,8	0	0,5	0	0	0,8	0	0,8	1	0,8	1	1	0,5	0,5	0	0	0	0	0
T13	1	0	0	0	0,8	0,8	0	0	0	0	0	0,8	0	0,8	0,8	0	0	0,5	0,5	0	0	0	0	0
T14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0,8	1	0	0	0	0	0	0	0
T15	0	0	0	0	0	0,5	0	0,5	0	0,5	0,5	0,8	0,3	1	0	0	0	0	0	0	0	0	0	0
T16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,8	0	0,5	0	0	0	0	0
T17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0	0	0	0	0
T18	0	0,8	0	1	0,8	0	0	0,8	1	0	0	0	0	0,8	0,8	0,8	1	0	0	0	0	0	0	0
T19	0,8	0,8	0	1	0,5	0	0	1	0	0,5	0	0	0	0,5	0	0	0	1	0	0	0	0	0	0
T20	0,5	0,8	0,8	0,8	0,8	0,5	1	1	0,8	0,8	0,8	0,8	1	1	0,5	0,8	0,8	1	1	0	0	0	0	0
T21	0,5	1	1	0,8	0,8	0,8	0,8	0,8	0,5	0,8	0,8	0,8	0,8	0,5	0	0,8	0,8	1	1	0,8	0	0	0	0
T22	0,8	1	1	0,8	1	0,8	0,8	1	0,5	0,8	0,8	0,8	0,8	0,8	0,5	0,8	0,5	1	1	1	1	0	0	0,8
T23	0	0,5	0	0,5	0,5	0	0,8	1	0,5	0,8	0,8	0,8	0,8	0,8	0,5	0,8	0,8	0,8	1	1	0,8	0,8	0	0
T24	0,8	0,8	0,5	0,5	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	1	0,5	0,5	0,5	0,5	1	1	0,8	0,8	1	1	0

Table 4.12 - Fuzzy MICMAC stabilised matrix

#	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	Row total
T1	1	0,8	0	1	0,8	0,8	0,5	1	1	1	0,8	1	0,8	1	0,8	1	1	1	1	0	0	0	0,5	0	16,5
T2	1	0,8	1	1	1	0,8	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	0,8	0,8	0,5	0	21,25
T3	1	0,8	1	1	1	0,8	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	0	0	0	0,5	0	18,25
T4	1	0,8	1	0,5	1	0,8	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	0	0	0	0,5	0	17,75
T5	1	1	1	1	1	0,8	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	1	0,8	0,8	0,5	0	21
T6	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,8	1	1	0	22,5
T7	1	1	1	1	1	0,8	1	1	1	1	0,8	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,25
T8	1	0	1	1	0,8	0,8	0	1	1	1	1	1	1	1	0,8	1	1	0,8	0,8	0	0	0	0	0	15,75
T9	1	0,8	0	1	0,8	0,8	0,5	1	1	0,5	0,8	1	0,8	1	0,8	1	1	1	0,8	0	0	0	0	0	15,25
T10	1	0,8	0	1	0,8	0,8	0	1	1	0,8	0,8	0,8	0,8	1	1	1	1	0,8	0,8	0	0	0	0	0	14,75
T11	1	1	1	1	1	0,8	1	1	1	1	0,8	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,25
T12	1	1	1	1	1	0,8	1	1	1	1	0,8	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,25
T13	1	1	1	1	1	0,8	1	1	1	1	0,8	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,25
T14	0	0	0	0	0	0,5	0	0,5	0	0,5	0,5	0,8	0,3	1	0	0	0,8	0	0,5	0	0	0	0	0	5,25
T15	1	1	1	1	1	0,8	1	0,8	1	1	0,8	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20
T16	0,8	0,8	0	1	0,5	0	0	1	0	0,5	0	0	0	0,5	0	0	0	1	0,5	0	0	0	0	0	6,5
T17	0,8	0,8	0	1	0,5	0	0	1	0	0,5	0	0	0	0,5	0	0	0	1	0	0	0	0	0	0	6
T18	1	1	1	0,5	1	0,5	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	0	0	0	0,5	0	17,75
T19	1	1	1	1	1	0	0,8	1	1	1	0,8	1	0,8	1	1	1	1	1	1	0	0	0	0,5	0	17,75
T20	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,5
T21	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	0,5	0	0	0,5	0,8	20,5
T22	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	0,8	0,8	1	1	0,8	23
T23	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0,5	0,8	22
T24	1	1	1	1	1	0,8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,8	0,5	0,8	22,75
Column total	23	20	18	22	21	15	17	23	21	22	18	22	19	23	20	21	22	23	21	9,3	5	4,3	10	7,5	426

Figure 4.4 - Cluster diagram from the Fuzzy MICMAC



Source: Developed by authors

Several experts have emphasized external uncertainties as a factor that affects the speed of NPD, especially concerning the market structure in Brazil, that is, market uncertainties. After all, market uncertainty can take the form of market complexity, instability or unpredictability and changes in market structure (JAWORSKI; KOHLI, 1993). About this, a representative from an innovation centre said: "*The legal structure is different in each country. In Brazil, if the person fails in the legal person, he goes bankrupt in the physical person too. The person can no longer get bank credit, cannot get money to start over. In the USA, for example, if he* (CHEN; REILLY; LYNN, 2012) *started a company and he goes bankrupt, he is bad at the legal person, but that does not affect the physical person*".

Another expert highlights the role of the innovation ecosystem and its relation to the NPD speed: "*at the beginning of the company, what sustained us was to be inserted in an innovation network that gave us access to public notice to encourage RandD in companies, so we managed to earn a good amount of money to finance our development*". Some comments also emphasise the dynamic condition that companies must have to adapt to the specificities of the external environment in which they operate: "*all the models that exist in the country imitate Silicon Valley, but our country has a* *different reality! Opening a company here is very difficult, raising money is different, bureaucracies are different, training itself is different"*. In this context, some studies have sought to understand the moderating effects of drivers for reducing TTM in other sectors such as metal products, machinery and electronic equipment (BREWER; ARNETTE, 2017; LIU et al., 2020).

Vargo et al. (2020) show the importance of the formation of ecosystems for the process of developing new products by presenting a structure that does not favour an actor as an innovator/ producer and another as adopter/ consumer, but considers all actors as integrators of resources and diffusion as a critical part of innovation processes. Sun et al. (2019) assess the impacts of the innovation ecosystem on venture capital (VCs), and propose an important relationship between the existence of ecosystems and the time-to-market of the companies inserted in it. The authors suggest that without strong legal and economic institutions, VCs will find it difficult to play a catalytic role in promoting local innovation as they do in developed markets, and without the existence of this incentive for investment, companies have greater difficulty in quickly delivering new products to the market. Recent studies on startups also point out how positive this relationship can be, Tripathi et al. (2019, p. 77) states “A suitable ecosystem is needed to nurture a startup from its product conception stage, in which an ideal MVP is created, until the product is mature enough to be launched in the market”. According to these authors, this greater support not only facilitates product development, but also encourages rapid delivery to the market, since there are more effective stakeholders in this development. Kuckertz et al (2020) highlights the role of ecosystems for startups in times of crisis, such as that of the current COVID-19 pandemic. According to these authors, countries that have established resilient business ecosystems will be able to resume their pre-crisis level of activity more quickly than those that have not, and that startups will rely heavily on the support of their entrepreneurial ecosystem to manage the crisis.

Figures 4.3 and 4.4 also show a group of three dependent capabilities that have weak driving and strong dependence power. They exhibit the attributes of output variables within the entire system, as seen in Figure 4.3 (they are positioned in the last three levels of the ISM model). These capabilities are “product testing”, “standardisation” and “testing frequency”. All of them are technical procedures highly dependent on other capabilities. This result shows that these capabilities must be developed after all of the other capabilities have been implemented. Therefore, they represent a high level of maturity towards the reduction of TTM in start-ups. During the expert interviews, the necessity of improving such capabilities became evident. Discussing the importance of product testing, one manager said: *"When we put it on the market, people were interested but there much trouble using the interface. Furthermore, we did not know that because we hadn't even tested it before. Moreover, it was a bad decision"*.

In this context, much attention should be paid to the company's image when carrying out tests in the market. Controlling such aspects is mandatory. According to another expert: *"You can calculate how much it will cost you if things get off track. And to control the company's image issue, you mature this product on a small scale; then you will gain confidence and give vent to it. After this, you adopt another growth curve, much more aggressive now, much more confident about it"*. The literature highlights this practice, showing that in the past, innovations took months if not years to be perfected because companies only presented the product to the final consumer when they believed that the product was complete. At start-ups, it is common practice to test the product in various interactions with the market (experimentation), making it possible to get the innovation into the consumer's hands faster (MARODIN et al., 2018; CARROLL; CASSELMAN, 2019). In this context, a method widely used to improve this capability is the development of MVP, which consists of an early version of a new product that allows a start-up to collect a meaningful degree of learning about customers with the least effort (EDISON et al., 2018; CONTIGIANI; LEVINTHAL, 2019). Moreover, experts discussed the need to standardise processes to achieve time savings. One expert stated: *"So, even if you're going to do something complex, you break the scope into tiny pieces.* Another manager even suggested the use of methodologies to standardise the process and its direct relationship with speed*: "what could most influence the speed is to work with some agile system. For example, sprint guarantees you a weekly delivery rate"*. This discussion is in line with suggestions in the literature. After all, lead times are a result of a process, and therefore making changes and simplifications in the process directly affects the reduction of TTM (BREWER; ARNETTE, 2017; CARTER et al., 1995; CHEN et al., 2010).

The third group of capabilities is composed of 16 capabilities placed in the cluster of linkage factors. These capabilities are highly influential and highly dependent (i.e., a small modification in any capability will quickly affect the others). By analysing the position of these capabilities in the ISM model (Figure 4.3), it is possible to notice that organisational culture and learning have the most significant influence on the others. Decisions about external integrations (customers, suppliers and other institutions) in the NPD process, accompanied by the efficiency of the communication process, formulations of the management strategy and team experience, are determinants of the definitions about leadership, team empowerment, project content, and technological complexity of the product. Once these structural factors of the project have been defined, the multidisciplinary level of the team can be determined, thus formulating the quality and marketing strategies of the project. The definition of these strategies influences the degree of functional integration of the team.

The importance and synergy between these capabilities for start-ups were also evident in expert interviews. The role of team capabilities in reducing TTM was a consensus among respondents, which is demonstrated in the following comments: *"I didn't understand anything about the market, so the first product that we started to build, I worked 6 months, and I had to throw it away because when I learned how things worked, I saw that it wouldn't work"* and *"We do a nice job, but I think if we had more experience we could have shortened the way".* These results provide more empirical evidence concerning the importance of the team's learning and experience in start-ups (LYNN; SKOV; ABEL, 1999; KESSLER; BIERLY; GOPALAKRISHNAN, 2000; CONTIGIANI; LEVINTHAL, 2019). The lack of a team´s experience highlights the need to obtain a cross-functional team to add as much knowledge as possible to solve the same problem. Another manager noted: *"you have to build a team. This team has to be multidisciplinary. This is mandatory in start-ups".* This requirement is even more evident at start-ups once these organisations present a high level of specialisation. As mentioned by another manager: *"The hacker is responsible for programming, the hipster who is responsible for the design, and the hustler who evaluates experiences".* The importance of having a representative from each functional area in the development team is evidenced in studies such as Edison et al. (2018), Park et al. (2009), and Valle and Avella (2003). The alignment of people's different cultures also appears as a challenge for start-ups. One respondent noted: *"We have very different profiles in the team and this is even a challenge for us, for people to align everyone's culture [...]. I think are three factors: each city already has its own culture; the academic formation; and even for the position they occupy in the company".* Some comments even correlate this factor as a barrier to effective integration with other institutions: *"I don't know if it is the culture that is brought* *into the various federal universities, but there is no integration with the market".* Another expert stated: *"they work in a more bureaucratic way and even this language that does not match much, it is easier to establish partnerships with other companies. Therefore, there is a need for greater adherence and alignment in the beliefs and values that circulate within companies to achieve better organizational performance., One of the methodologies that can assist companies in this alignment is Lean Thinking, as a way of guiding the entire organization in favor of the search for innovation and waste reduction. (Edison et al., 2018). This importance of having a consistent organizational culture throughout the company has already been evidenced in previous studies, such as those by Buccieri et al. (2020) and Menon and Lukas (2004).*

The role of integration capabilities has also been widely discussed. The importance of integrating customers as soon as possible is very evident in the literature (Chang et al., 2016; Elvers and Song, 2016; Lin et al., 2013) and is also confirmed by start-up experts*: "you know that the prototype is going to be criticised, you know that it's not good commercially speaking, but it's better that way, listening to the customer sooner"*. Nevertheless, a difficulty regarding the integration with the supplier is elucidated: *"I think maybe even the name 'supplier' is not very suitable, it is more about services, and many share the revenue with us, so the mentality is a little different".* Another expert explains that: *"in a software company, the maximum opening will be what they [suppliers] will give to anyone, which is the release of some API, so they let you integrate some things"*. This is interesting evidence about the peculiarities of start-ups because the traditional NPD literature encourages the search for integration with suppliers (VAYVAY; CRUZ-CUNHA, 2016; MORITA; MACHUCA; PÉREZ DÍEZ DE LOS RÍOS, 2018).

The relationship between product characteristics, such as technological complexity, and reduced TTM may be one of the justifications for why most start-ups have software as a product. In this respect, a manager stated: "*Today it is complicated not to think about software because hardware without software intelligence becomes just an electronic component. Thus, you become an electronic components factory. For you to gain market differential, you need to add a little intelligence to this hardware".* Still, about this differential of start-ups based on the product characteristics, an expert highlights the demand for the degree of novelty*: "when analysing the auto industry, for example, it works in very small increments, right? The car has been the same for how* *many decades, you know? This doesn't exist for start-ups, they need to earn their place, totally based on their product, on their value; otherwise, it dies right there".* Some studies have also attempted to assess the effects of technological complexity on reducing TTM in different sectors (CARBONELL; RODRIGUEZ, 2006; VALLE; VÁZQUEZ-BUSTELO, 2009).

In the field of strategy, the need to establish right prior marketing strategies is evident, as one of the managers mentioned: *"our audience was B2B [business to business], but we realised this late when we looked at the details of the operation".* Another manager discussed marketing capabilities more specifically from a financial point of view: *"the investment is considerable in the beginning, so if you are not sure in terms of pricing, value generation, sales process, you will suffer a lot".* The literature clarifies that companies must improve the elements of the marketing mix to give better responses to the market (KONG et al., 2015; GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017). Several interviews addressed management strategies, shedding light on a possible different mindset that start-ups should adopt, mainly related to the possibility of making mistakes and pivoting. About this, a manager said: *"Start-up is a mentality, very much based on the experience with the customer, and the possibility of errors, of pivoting and of always being analysing, remodelling".* Another manager agreed when sharing his experience: *"When you don't have that mindset, you think very early on that you have made an irrecoverable mistake. After a while, I had access to the culture of start-ups, and today we already think that it will go wrong".* Nevertheless, despite this management strategy based on "fail faster" or "die fast", the financial factor seems to mediate this relationship. According to one manager: *"this ability to take loss-based risks will go along as your pocket is full or empty. Because of a lot of radical innovation in the world, with real disruption, if you look at the history of the founders, many of them were in difficulties. They had no margin for error".* This strategic orientation of NPD projects reflects how top management promotes a favourable climate to facilitate initiation of new ideas and possible changes to the project. Few studies address this issue directly (Chen et al., 2010; Ettlie et al., 2017), and thus this represents an opportunity for future studies.

Lastly, it is also interesting to notice that any driver or capability was found in the "autonomous factors" cluster of Figure 4.4. The factors falling in this cluster are considered to be out of the system; that is, these factors do not have any significant effect on the analysed phenomenon. These results support the list of drivers and capabilities selected for the study and indicate that all play a significant role in reducing TTM at start-ups.

4.6 Conclusion

Reduced TTM is indispensable in environments of high novelty and technological turbulence (CHEN et al., 2012), particularly in times of crisis, such as the current COVID-19 pandemic, when the market's time sensitivity is even higher (CHESBROUGH, 2020; KUCKERTZ et al., 2020). Accordingly, this study aims to assess the relationship between drivers and capabilities for reducing TTM in a type of company with business models based on innovation and development of new products, the start-ups. For this, a multi-method approach was developed to generate a set of results relevant to the managerial and theoretical field.

Firstly, the SLR provided a list of drivers and capabilities indicated in the literature with the potential to reduce time-to-market (Table 4.4). The development of rounds of expert interviews allowed the refinement and the validation of such a list for start-ups. The data obtained in the expert interviews were also evaluated using the ISM approach to provide a structural model that demonstrates the relationship between drivers and capabilities (Figure 4.3). Finally, a Fuzzy MICMAC analysis was performed, which resulted in the driver power-dependence matrix (Figure 4.4). This matrix provides insights to top management to understand the relative importance and interdependence among drivers and capabilities for reducing TTM in start-ups. These findings underscore the interaction among dynamic capabilities, organisation structure, and the business environment. Therefore, our key contribution is to expand the theory of time-to-market reduction considering the environmental dynamism, with the identification of the drivers, as well as its relationship with the company's capabilities. Likewise, this provides a roadmap that integrates and extends such concepts from a managerially relevant perspective derived from a theoretical conceptualisation.

4.6.1 Theoretical contributions

The results of our study support previous research that suggests TTM reduction is positively associated with NPD performance. To this end, the present paper not only pointed out factors but also showed the strength and power of capabilities and drivers in contributing to the NPD process as key contingencies of an effective TTM reduction implementation. While prior research has been highlighting the importance of time-to-market reduction, some significant differences with the present study are observed, as shown in Table 4.13. Two meta-analytic reviews that describe factors that affect NPD speed are found. Chen et al. (2010) focuses only on the firm's capabilities, disregarding contextual aspects (drivers), which the present study considers. Cankurtaran et al. (2013) already consider some contextual aspects; however, the present study adds two drivers, "innovation ecosystem" and "time-sensitive". Neither review presents the driving power or dependence between these factors, while the present study presents a matrix of this relationship. Additionally, they use the meta-analysis method and do not focus on any specific industry sector. This study validates drivers and capabilities for the peculiarities of start-ups using experts. Therefore, the first theoretical contribution of this study is to advance the growth of the literature by mitigating these gaps.

As a second theoretical contribution, this study has explored the application of the combined method with the ISM approach (Figure 4.3) and Fuzzy MICMAC (Figure 4.4) analysis on NPD research. With that, our study was also able to show in the proposed model the relationships between capabilities and drivers, which is both theory-informed and empirically grounded. Both the ISM and MICMAC analysis are mixed methods of qualitative and quantitative components. The comparison of capabilities and drivers is qualitative, and the transitivity check and hierarchical partitioning are quantitative. Therefore, the study helps to explore the drive-dependence relationship among the capabilities and drivers, which is an important knowledge for operation management research. This result offer scholars’ empirical information regarding already discussed, but less frequently tested, the relationship between capabilities and drivers in the NPD process. After all, it is only after understanding which external aspects, and in which order, affect the development of which capabilities the most that it is possible to structure a better roadmap for companies to exploit their resources and focus on their critical capabilities.

Another contribution of this study is related to the refinement of the theoretical model carried out by experts for the context of startups. These organizations are different in their approach and adoption of NPD best practices, which has several theoretical implications. Unlike traditional companies, startups are already born with innovation as the basis of the business model, often because they have scarce resources, the way of dealing with time is already different for these organizations. For example, while traditional NPD literature points to the need to form cross-functional teams, startups seek to fill that need with temporary hiring of virtual teams or with founders who played various roles during development to reduce the capital cost structure. Besides, startups have more fluid, less structured NPD processes than proposed by the literature. After all, the focus is less on managing processes and more on managing objectives, which in this case is to always put the first product on the market as quickly as possible. Therefore, when comparing the innovation processes of these companies with the traditional ones, several substantial differences are noted. And this study contributes to the literature by highlighting these discussions about this type of organization.

Table 4.13 - Comparison of results of the present study with prior studies in the literature

Research studies	Focus of study	Number of factors	Methodology used
Present study	Assess the relationship between drivers and capabilities to reduce time-to-market, and validate them for startups.	24	Multi-method approach (SLR + Expert interview + ISM + Fuzzy MICMAC)
Chen et al. (2010)	Assess the relationship between NPD speed and its antecedents and groups it into four categories: strategy, project, process and team.	17	Meta-analytic review
Cankurtaran et al. (2013)	Evaluate the link between NPD speed and new product success at a more granular level. Specifically, it considers the relationship with different dimensions of success.	42	Meta-analytic review

4.6.2 Managerial contributions

Apart from the above-mentioned benefits, this study provides clear managerial implications for startups that reduce or wish to reduce the time-to-market of your NPD process. First, the proposed model indicates capabilities that managers can improve that will lead to TTM reduction. This structured model is validated by the opinion of experienced experts, including practitioners who shared their real cases in their companies. This can be used as a proof of concept that will encourage managers to reduce TTM to make better decisions and redesigning their NPD process more efficiently. Second, the results of this study revealed some drivers and capabilities that should receive careful attention to reduce TTM. Adopt management strategies aligned with an organizational culture focused on competition based on time, as well as stimulate the integration processes with other actors in the supply chain allied with a good capacity for absorbing knowledge generated by good communication channels and team experience proved to be central factors in dealing with external uncertainties in a time-sensitive market. Third, this research reaffirmed the importance of aspects external (drivers) to the organization in reducing TTM. This analysis of the company's interaction with the external environment has been increasingly recognized in recent operations management literature, with theoretical propositions such as dynamic capabilities. Fourth, some tools and methods used by start-ups are also indicated during the study (Table 5) and may serve as a basis for management decision making. Besides, the study provides the relationship between drivers and capabilities and also categorises them based on their driving and dependence power. Overall, managers and policymakers may utilise the developed ISM model to build a valid solution to improve companies' innovation capacity. It is implied that a systematic policy on fast NPD will help organisations to achieve various sustainable benefits.

4.6.3 Limitations and future research directions

Our study has some limitations that suggest avenues for future research. First, some drivers and capabilities may not have been considered, which may have a significant impact in different countries´ contexts. Some drivers were even proposed by some experts, but they were not added to the final model, such as the institutional void and the legal inefficiency of some countries to promote innovation. This is because these drivers were referred by a single specialist and/or were not directly cited in the researched literature. However, we pointed out this limitation in our study and the opportunity to develop a more appropriate investigation of these factors. Future studies can be carried out to mitigate this gap, such as a comparison between developed and developing countries to investigate the differences in practitioners' perceptions.

Second, the study presents a subjective analysis, and any bias by the person judging the drivers and capabilities will influence the findings. Studies in the form of case studies are suggested to identify appropriate strategies to implement and/or improve the suitability of each capability, future research could potentially use the insights of this paper to explore the causal and dependencies between the drivers and capabilities by performing a survey in start-ups and/or different contexts. Such studies can make different inferences when analysing the data, dividing the responding companies by size, revenue model, stages of development, target market and level of experience of the team. After all, some capabilities can have different results depending on these possible control variables. For example, although differences regarding the company's size has not been evaluated in the present study, size is an interesting perspective to understand our results since our population (startups) is composed of, mainly, small and medium-sized companies.

In general, small and medium-sized companies lack resources and managerial skills. However, some capabilities can be more easily developed by these companies, such as the ability to "communicate". After all, given the smaller size, some companies need less complex tools to maintain the transparency of daily activities and information sharing (PESCH; BOUNCKEN; KRAUS, 2015). This may be evidence that it is necessary to add some mediating and moderating variables to the analysis, one of which is "company size". In the same vein, large companies may have more resources to develop integration activities with the supply chain (KONG et al., 2015) and testing of products on the market (MARODIN et al., 2018). Such characteristics can infer different results of business performance. Empirical studies are more likely to carry out such analyses and the results can also be validated using a Structural Equation Modeling (SEM) approach.

5 TIME-TO-MARKET REDUCTION IN START-UPS: DEVELOPMENT AND VALIDATION OF A MEASUREMENT SCALE

This chapter reports the development and validation of multi-item measurement scales to reflect the multidimensional construct of reducing time-to-market in startups.

5.1 Introduction

“New product development is a complex and risky task (Chen, Reilly, and Lynn 2012, p. 291). Several factors may influence this process and generate success or failure for this initiative. The dynamic capabilities view (DCV) suggests that a company may fail to modify its resources or capabilities in response to a change in the external environment, such as competitive intensity and technological turbulence (BUCCIERI; JAVALGI; CAVUSGIL, 2020; SCHRIBER; LÖWSTEDT, 2020). As a result, a capacity once an asset can become a liability if it is inappropriate for the product development project (TATIKONDA; MONTOYA-WEISS, 2001). To remain competitive in an uncertain environment, companies need to provide the desired value proposition in the shortest possible time before their main competitor does. Thus, the speed with which new products are developed and inserted into the market, e time-to-market (TTM) reduction,, is the key to obtaining better results in terms of customer base and financial measures (WU; LIU; SU, 2020).

External aspects motivators (drivers) and the adoption of capabilities for reducing TTM can be measured by multi-item scales. The existing literature discusses these factors in a fragmented way. Some studies present instruments to measure TTM reduction influenced by suppliers and customers involvement (MENON; LUKAS, 2004; FENG et al., 2014; MORITA; MACHUCA; PÉREZ DÍEZ DE LOS RÍOS, 2018), leadership (SWINK, 2003; PARRY et al., 2009; ZAECH; BALDEGGER, 2017), learning (JOHNSON; PICCOLOTTO; FILIPPINI, 2009; LEATHERBEE; KATILA, 2020) and even external environmental aspects such as competitive intensity (LIN; HUANG; CHIANG, 2012) and market uncertainty (CANKURTARAN; LANGERAK; GRIFFIN, 2013). The influence of these drivers and capabilities for reduced TTM can be measured by integrating these existing measures. However, these modified multi-item scales must go through a new and rigorous process of testing reliability and validity to ensure they measure the reducing TTM (FORZA, 2002).

The NPD literature lacks construct development and measurement validation regarding the concept of TTM reduction, especially in start-ups. These companies have outstanding characteristics such as focusing on product development (usually a single product), innovation and high time pressure (HEIRMAN; CLARYSSE, 2007; TRIPATHI et al., 2019). In this regard, the primary purpose of the present study is to formulate and validate a multi-dimensional and hierarchical scale about the TTM reduction concept in start-ups. For this, the study will start from the constructs identified and validated by Mota et al. (2021) to reduce TTM in start-ups, which are divided into factors that motivate (drivers) and allow (capabilities) this reduction. These authors define 24 constructs. Therefore, it is necessary to generate measurement items for each construct to revisit the NPD literature. Then the Q-sort procedure was conducted to refine the items. Furthermore, with the data obtained from the survey of 191 start-up managers, the Exploratory Factor Analysis was completed to determine the factor structure of the TTM reduction. In addition, unidimensionality, reliability, convergent and discriminant validity were evaluated to prove the construct's accuracy, reaffirming its reliability and validity.

This study aims to contribute to the research field by developing a new multi-item measurement for the TTM reduction in start-ups. These companies are at the forefront of developing innovative products and are highly important to the world economy (HEIRMAN; CLARYSSE, 2007; KUCKERTZ et al., 2020). Also, they have unique operating characteristics (TRIPATHI et al., 2019). Therefore, creating valid and reliable scales is also essential due to the scarcity of studies in this type of company, so that the instrument developed can serve as a basis for future empirical studies. The implications of this study can help make the TTM reduction a strategic weapon for start-ups to deal with the different conditions of uncertainty to which they are subjected.

The chapter is structured as follows. After outlining the conceptual background of TTM reduction, the employed qualitative methods for refining and validating the scale are described in detail. Next, the results are exposed and discussed to demonstrate the psychometric properties of our multi-item scale reflecting the TTM reduction dimensions. Finally, we offer theoretical and practical implications associated with measuring time-to-market reduction, as well as proposals for future research.

5.2 Time-to-market reduction concept

The term "time-to-market" is already consolidated in the operations management literature and refers to the period between the generation of the idea and the launch of the product on the market, encompassing concept generation, product planning, advanced planning, engineering of product, process engineering and pilot execution deadlines (DE TONI; MENEGHETTI, 2000). Time-to-market, product development time, innovation time and speed-to-market also denote the same concept (CANKURTARAN; LANGERAK; GRIFFIN, 2013).

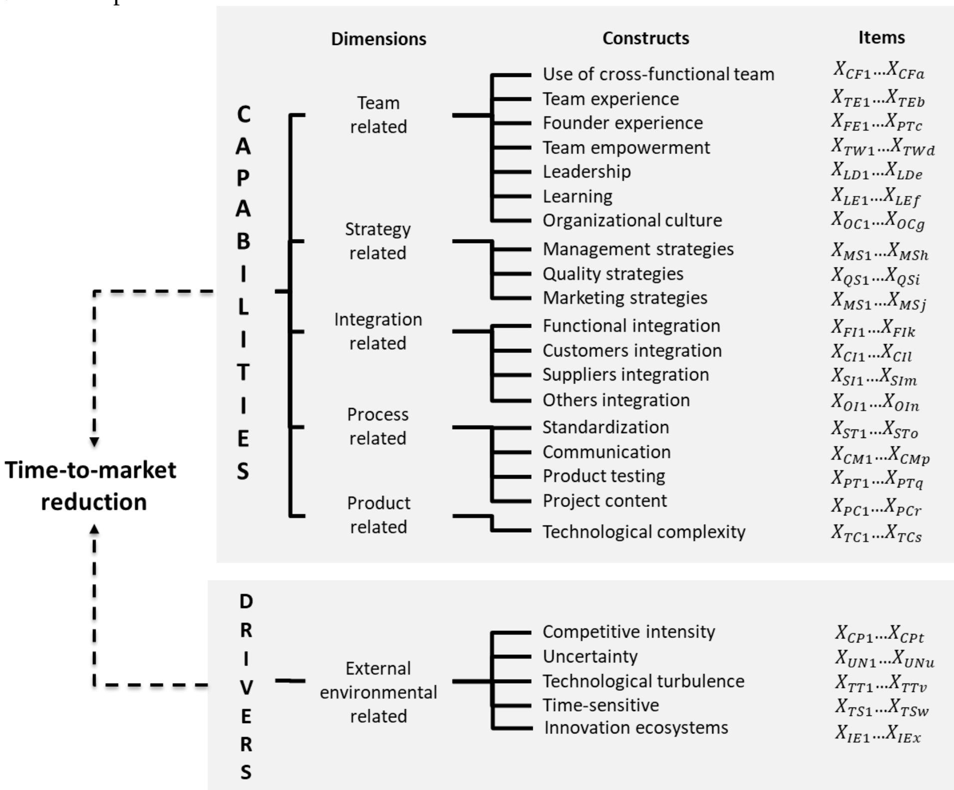
Due to the increasingly short life cycles, studies of the effects of the early introduction of new products on the performance of companies has advanced in the past two decades (GRIFFIN, 1997; AFONSO et al., 2008; GUPTA; FERNANDEZ-CREHUET; HANNE, 2020). Previous research suggests that reduced time-to-market or increased speed-to-market may produce advantages or benefits for pioneering companies regarding the market performance of a new product (MILLSON; WILEMON, 2010; ZHANG; WANG; GAO, 2017). Some organisational practices are facilitators and suppressors of the potential benefits of reduced cycle times in product development (TATIKONDA; MONTOYA-WEISS, 2001). A large flow of academic research has been dedicated to identifying the drivers of faster product development and their respective individual relationships to performance (CANKURTARAN; LANGERAK; GRIFFIN, 2013). Lukas, Menon and Bell (2002) suggest that these practices should be studied in groups instead of individual items, since these approaches are not separate but work together.

Although many argue that faster NPD is associated with the success of the new product, some researchers and professionals also advocate a more balanced trade-off between TTM reduction and performance (Chen, Reilly, and Lynn 2012). Some studies warn of the possible "dark side" of reducing TTM. From this perspective, the focus has been on the possible adverse effects on development costs and quality (SUN; ZHAO; YAU, 2009; LIN; HUANG; CHIANG, 2012). Chen, Reilly and Lynn (2012) emphasise that diseconomies of time compression can fundamentally result in the limits of the human capacity for information processing. Some studies deepen their analysis, such as Lukas, Menon and Bell (2002), which assess the impacts on human resources, such as organisational stress. Therefore, these studies point out that speed is not necessarily desirable in all conditions.

Propositions about the mediating and moderating role of variables linked to growth stage, product life cycle, consumer behaviour and competitive context have emerged in the literature (TATIKONDA; MONTOYA-WEISS, 2001). In addition to much research about the NPD performance drivers having been disconnected and lacking concise conclusions about which factors should require more attention, the object of study in these researches has been the traditional manufacturing industries leaving some types of companies with the scarcity of information, such as start-ups. Although a recent study, Gupta, Fernandez-Crehuet and Hanne (2020) refers to time-to-market in start-ups, this is not the main objective of their research, which aims to explain the strategies adopted by software start-ups to faster innovation in the value proposition through the ongoing involvement of freelancers and how they overcome challenges arising from associations. Given the imprecision of previous studies concerning TTM reduction and assuming that studying TTM requires scrutiny of the underlying dimensions that reflect such a concept, we used multi-dimensional constructs proposed by Mota et al. (2021) as a basis to develop the conceptual model of this research (Figure 1).

The TTM reduction constructs proposed by Mota et al. (2021) were based on an extensive literature review and expert validation through a multi-method data analysis with the ISM approach and Fuzzy MICMAC. Therefore, the constructs that will be analysed are divided into capabilities (the structural aspects, i.e., a grouping of resources, knowledge and skills to solve technical problems, interacting with the external environment to create sustained competitive advantage) and drivers (contextual aspects that serve as motivators for such internal changes in companies) for TTM reduction. A total of 24 constructs were used to measure this concept divided into six dimensions: related to team, strategy, integration, product, process and external environment.

Figure 5.1 - Conceptual model of TTM reduction dimensions

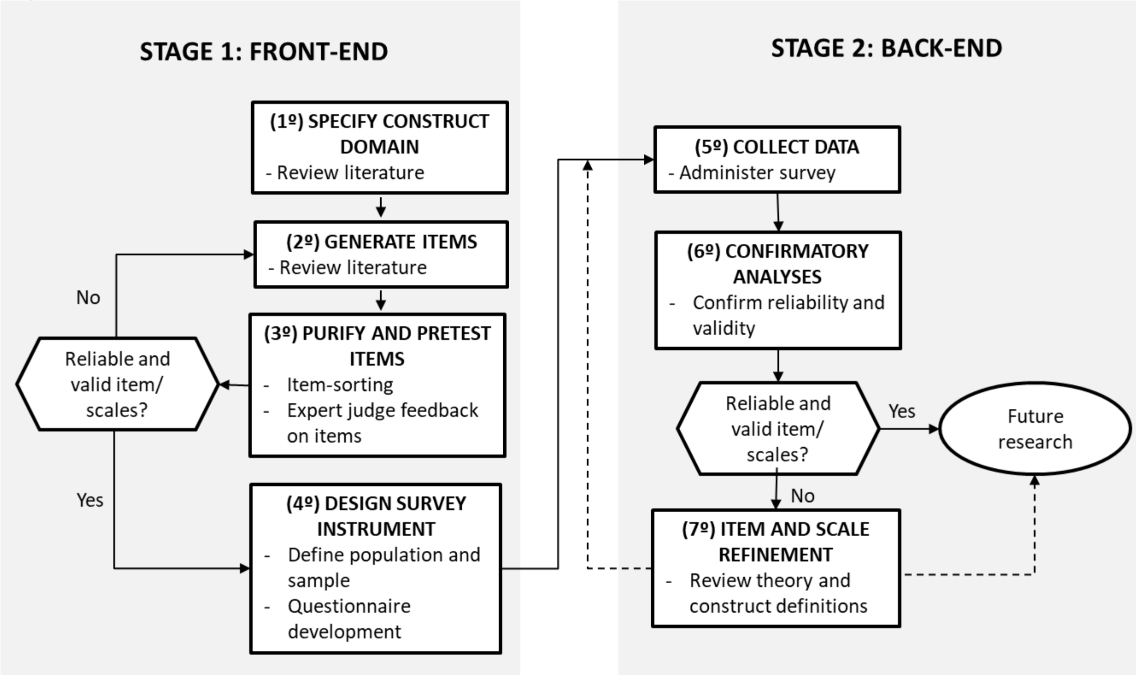


Source: Adapted from Mota et al. (2021)

5.3 The time-to-market reduction scale: development and validation method

The scales used in this study were adapted for start-ups using a two-stage approach, adapted from Churchill Jr. (1979) and Menor and Roth (2007), illustrated in Figure 2. In the first stage, which is called the ‘‘front-end’’, the reliability and validity of the experimental measurement item were determined using several rounds of item classification performed by judges (NPD experts). In the second stage, or ‘‘back-end’’, item measurement properties and new multi-item scales are demonstrated by applying confirmatory analyses on survey data collected from start-up managers.

Figure 5.2 - Two-stage approach for new measurement development



Source: Adaptation of Churchill (1979) and Menor and Roth (2007)

5.3.1 Stage one: item-sorting analyses

To develop the best measures, the first step is to specify the domain of the construct, that is, to outline what will be included in the concept definition and what will be excluded. This study considered the TTM reduction constructs proposed by Mota et al. (2021), but made two changes. The construct "team experience" was subdivided to encompass the experiences of the start-up's founders, given the level of influence of this factor on these companies' product development, and the constructs of "product testing" and "test frequency" were merged into a single construction given its closeness of definition. Therefore, the conceptual model used in this study maintains the same amount of constructs and dimensions as the previous model. In the second step, items that capture the domain as specified must be generated. For this, the NPD literature was revisited to identify assertions used in previous studies in the area. Thus, at the end of these two steps, 6 dimensions, 24 constructs and 83 items were used to measure this concept. Definitions of the constructs, items and references used are presented in Appendix A.

In the third step, these constructs and their items were purified and refined to provide greater reliability and validity to the TTM reduction measurement instrument. For this, four rounds of an item classification exercise were administered to an independent judges sample. Item classification analysis used was proposed by Menor and

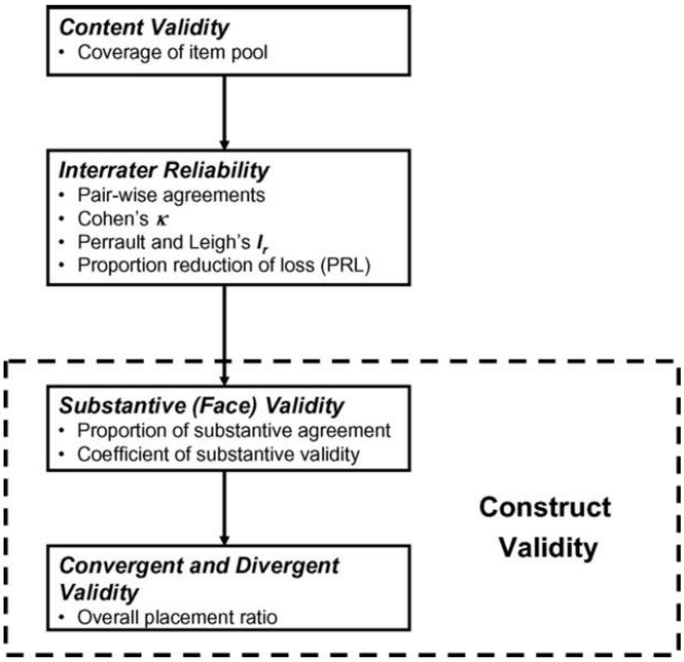
Roth (2007) as an alternative to traditional Q-sorting (McKeown and Thomas, 1988), and its steps are described in Figure 3. Each judge received the definition of constructions and a random list of a set of items sent using the Survey Monkey platform. According to the definitions, the judges selected the construct that each item represented. To analyse the data obtained, three reliability estimators between evaluators were used, namely:

- *Interjudge agreement percentage:* refers to the proportion of peer agreements in the item classifications made between judges for the total number of possible peer judgments in each round. Following Menor and Roth (2007), we used this measure together with other reliability measures.
- *Cohen's k:* The Cohen of k is a conservative estimator, which when greater than 0.65 indicates an appropriate agreement between judges, meaning that the agreement is due to more than chance (MOORE; BENBASAT, 1991).
- *Perreault and Leigh's* I_r*:* indicates that when less than 0.8 or 0.7 in exploratory work, corrective adjustments must be made at the beginning of the research process (PERREAULT; LEIGH, 1989).

Also, two estimators (the proportion of substantive validity and the coefficient of nouns) were used to assess the substantive validity of the measurement items, that is, to verify how well the measurement item reflects the construct of interest (ANDERSON; GERBING, 1991). The proportion of substantive validity ranges from 0 to 1, so the higher the value, the greater the substantive validity. The coefficient of substantive validity varies from -1 to 1, with more positive values indicating greater substantive validity (ANDERSON; GERBING, 1991).

The above estimators were used to improve the multiple-item scale to measure TTM reduction with each new round. Finally, to assess the number of items correctly placed in a construct, the Overall positioning rate (OPR) was used. In this metric, constructs that have a value greater than 75% of "correct" placement of items within them can be considered as having a high degree of construct validity (MOORE; BENBASAT, 1991).

Figure 5.3 - Front-end stage: measurement item sorting analyses



Source: Menor and Roth (2007)

5.3.2 Stage two: survey analyses

In the back-end stage, the objective was to confirm the reliability of the measurement and validity of the multi-item scale using an analysis of survey data on a large sample. The sampling frame consisted of 1952 Brazilian start-ups selected from the Brazilian Association of Startups (ABStartups). The unit of analysis in this research is the NPD process, which for being start-ups, was defined as the main innovative product developed and launched by the company in recent years. Attempts were made to contact each of the institutions in the sample. We sought to contact founders, co-founders, CEOs, senior operations and product executives, who were selected as appropriate key informants who could accurately portray efforts of the NPD to their respective institutions. The questionnaire containing these measurement items (APPENDIX C), plus other NPD-related questions, was sent out to these critical informants and over 3 months. The application period coincided with the COVID-19 pandemic, which caused serious economic losses in several countries. Therefore, in order to stimulate responses and also help several families who were in a situation of poverty we offer a donation (APPENDIX D) to a non-governmental organization upon completion of the survey, as recommended by

Azadegan et al. (2013).A total of 225 answered the questionnaire, representing a 12% response rate. After removing answers from unengaged responses, 191 responses remained.

Most companies were from the IT and telecommunications sector (17%), followed by real estate (15%) and education (14%). The companies were at different stages of development: ideation (3.5%), operation (30.3%), traction (35.2%) and scale-up (29.4%). Moreover, they had different sizes: 1 to 10 employees (53.5%), 11 to 50 employees (29.5%), 50 to 100 employees (10.7%) and more than 100 employees (6.2%). Most respondents were founders or co-founders of companies (73%). Furthermore, the time of work experience in start-ups was reported by respondents as less than 3 years (21%) and more than 3 years (79%).

5.4 Results and discussions

Given the number of steps necessary to comply with the rigour of the research method used, we present the results achieved divided into a front-end with the item-sorting exercise and the back-end with the survey applied to startup managers. After completing all the steps necessary to develop the scale, it was possible to identify a model that fit with the theory. We also discussed in subsections 5.4.3 and 5.4.4 the unconfirmed driver and capability items and presented the final version of the scale.

5.4.1 Item-to-factor sorting results

In the first three rounds, convenience samples from operations management graduate students and professors from the same university were used in each round, with 17, 15 and 26 respondents, respectively. The selection criteria of these judges were that they had prior knowledge about product development. The fourth round used 23 experts in NPD as judges. The selection criteria for this second sample type were the authors of research papers in the area. Table 5.1 shows that the process of review and refinement at each round progressively increased the values of the estimators. After all, we reviewed the measurement items and/or the definitions of the constructs that did not have adequate estimators at each round. Despite the notable improvement in the indicators at each round, as in the study by Menor and Roth (2007), the results in the round with professional judges differed significantly from academic judges concerning this specific type of cognitive exercise. Therefore, we conducted a fourth round, where we could provide a more rigorous test for the adequacy of construct definitions and measurement items.

Table 5.1 - Comparison of interrater reliability and validity estimators

Reliability and Validity Estimators	First Round [a]	Second Round	Third Round	Third Round
Interjudge agreement percentage (%)	36 – 62	41 – 59	46 – 62	52 – 71
Cohen's k	0,33 – 0,60	0,39 – 0,59	0,44 – 0,60	0,49 – 0,70
Perreault and Leigh's, Ir	0,39 – 0,78	0,61 – 0,75	0,66 – 0,77	0,69 – 0,86
Proportion of substantive validity (p_{sa})	0,57	0,60	0,66	0,78
Coefficient of substantive validity (c_{sv})	0,30	0,35	0,47	0,63
Overall Placement Ratio (OPR)	54%	59%	58%	75%

[a] Independent samples of n judges per sorting round: round 1, n = 17; round 2, n = 15; round 3, n = 26; round 4, n = 23.

The average score percentages of agreements among judges were 48, 49, 56, and 66% for rounds 1–4, respectively. However, there are no established standards for evaluating adequate percentages of the agreement due to the simplicity of this measure, this statistic is usually reported as a baseline and is used in conjunction with other reliability measures, such as in the Perrault and Leigh Ir calculation. According to these measures, our results from the first three rounds needed improvement, which only proved to be satisfactory in the fourth and final rounds. These same results were supported by Cohen's k, which is generally considered a conservative estimator of inter-rater reliability.

The main changes made to the scale in this first phase were in the name of some constructs to make them more specific. As in the case of the construct "uncertainty" which could have several dimensions, but for the context of our study it was specified as "market uncertainty". A similar logic was applied to the constructs of "leadership" and "learning", where there was a need to specify the type that best suited the context of start-ups, thus opting for "transformational leadership" (ZAECH; BALDEGGER, 2017) and "learning by doing" (LEATHERBEE; KATILA, 2020), respectively.

Changes of the same type occurred in nine other constructs, as following: organisational culture, management strategies, quality strategies, marketing strategies, functional integration, others integration, standardisation, project content and technological complexity. These constructs were renamed, respectively, to agile mindset, strategic orientation, quality management, dynamic marketing, inter-functional integration, other partnerships, process formalisation, project structure, product innovativeness.

In refining our measurement scales based on previous estimators, determining which items or definitions to review depended on two measures of substantive validity: the substantive validity ratio (p_{sa}) and the substantive validity coefficient (c_{sv}). Items with acceptable p_{sa} and csv were retained in the fourth round. Given the number of items analysed in this study, the specific p_{sa} and c_{sv} values for each item in each round are not presented in this chapter but are available upon request. To finalise the front-end, as shown in Table 5.2, we evaluated the convergent and discriminant validity of the measurement items. For this, the overall placement rate (OPR) was used, which provides evidence of item classification errors. Therefore, the items were evaluated in each round until the OPRs of the constructs exceeded 75%. As a result of our analysis in this item cleansing, 74 measurement items that capture the six dimensions of TTM reduction were retained for stage two.

Table 5.2 - Overall Placement Ratios to each construct

Constructs		First Round	Second Round	Third Round	Fourth Round
TR	Use of Cross-functional team	41%	45%	58%	75%
	Team experience	67%	84%	96%	83%
	Founders experience	94%	90%	100%	100%
	Team empowerment	88%	80%	64%	83%
	Transformational leadership	82%	85%	74%	83%
	Learning-by-doing	47%	47%	69%	80%
	Agile mindset	35%	39%	21%	58%
SR	Strategic orientation	35%	35%	35%	52%
	Dynamic marketing	12%	20%	55%	61%
	Quality management	100%	95%	70%	91%
IR	Inter-functional integration	18%	60%	50%	65%
	Customers integration	76%	80%	65%	74%
	Suppliers integration	100%	85%	69%	100%
	Other partnerships	71%	85%	63%	83%
PCR	Process formalization	0%	0%	48%	67%
	Communication	47%	68%	54%	78%
	Product testing	76%	78%	54%	61%
	Project structure	6%	28%	22%	57%
PDR	Product innovativeness	56%	65%	39%	87%
EER	Competitive intensity	82%	95%	74%	100%
	Market uncertainty	18%	27%	58%	70%
	Technological turbulence	53%	53%	42%	60%
	Time sensibility	35%	30%	44%	61%
	Innovation ecosystems	59%	44%	63%	65%
	Average	54%	59%	58%	75%

5.4.2 *Measurement scale refinement results*

Confirmatory factor analysis was applied to the 74 items to assess measurement scale unidimensionality, reliability and convergent and discriminant validity for the six dimensions of TTM reduction. Table 5.3 shows the fit indices for each of the dimensions. Note that all χ^2values were non-significant, demonstrating the consistency of the data and the overall goodness of fit. To ensure these results, incremental adjustment measures were examined., The criteria for unidimensionality were accepted once values greater than 0.90 were found.

Table 5.3 - Unidimensionality and reliability analyses of TTM reduction scales

TTM reduction construct dimension	Items	χ^2 (p-values)	GFI^a	NNFI^a	CFI^a	CR ^{b}	AVE ^{c}
TR	22	405,386 (0,000)	.99	.99	.99	.95	.59
SR	11	125,684 (0,000)	.99	.99	.99	.95	.68
IR	11	157,517 (0,000)	.99	.99	.99	.93	.62
PCR	15	101,081 (0,199)	1.00	1.00	1.00	.95	.65
PDR	3	422,362 (0,000)	1.00	1.00	1.00	.76	.57
EER	12	200,509 (0,000)	.97	.96	.96	.88	.42

^{a} Goodness-of-fit index (GFI), non-normed fit index (NNFI), and comparative fix index (CFI) values equal or exceeding .90 indicate strong scale unidimensionality.
^{b} Composite reliability (CR) values equal to or exceeding .70 indicate strong scale reliability
^{c} The average variance extracted (AVE) values equal to or exceeding .50 indicate that the measures are reflective of the construct.

The reliability of the composite construct was assessed for each dimension, and all exceeded the standard of 0.70 suggested (BAGOZZI; YI, 1988), indicating that these indicators are sufficient in their representation of their respective constructs. The extracted mean-variance values were also evaluated and reported in Table 4. Except for the construct related to the external environment (ERR), all values exceeded the suggested value of 0.50 (FORNELL; LARCKER, 1981), indicating that a large amount of variance is captured by each construct rather than due to measurement error. Despite this, as this is an exploratory study, and the value of 0.42 was very close to the standard, we decided to keep the construct up to this stage and deepen the analysis.

The convergent validity was evaluated from the magnitude and sign of the factor loadings of the measurement items. Most items showed statistical significance ($p < 0.05$) and standardised loadings (▪) values above the common threshold of 0.70, indicating a positive correspondence between the constructs and their indicators (HAIR et al., 2014).

These results corroborate the substantive validity obtained in the item sorts and are shown in Table 4.

Some items that had standardized loading values below 0.70 or correlation values greater than 0.70 with another item (HAIR et al., 2014) were removed. After this removal, the reliability and validity estimators of the constructs, CR and AVE, remained satisfactory. When assessing whether items have higher loads in their original constructs than in other constructs, the discriminating validity of the constructs is determined (HAIR et al., 2014). Table 5 shows that the stroke of all constructs was greater than their correlation with other constructs. Cross-loads, determined by exploratory Structural equation modeling (MARSH et al., 2013), also indicated good discriminant validity as seen in Table 6. Therefore, since the construct's discriminant validity was considered satisfactory, no further scale refinement was performed. One of the constructs, competitive intensity, had all its items excluded. Therefore, it was also eliminated from the scale.

Table 5.4 - Validity and reliability estimators and descriptive statistics

Measurement items	Original			After Refinement					
	AVE	CR	·	AVE	CR	·	t value	Mean	Std. Dev.
TEAM RELATED (TR)	0,587	0,956		0,587	0,956				
Use of cross-functional team									
TEAM1. There was an effort to involve a cross-functional team in the generation and selection of ideas for a new product.			0,725			0,729	Ref	5,068	1,903
TEAM2. Our company has adopted a pre-defined development team configuration, such as the Squad model (which separates team members into small multidisciplinary groups with specific goals).			0,685			0,683	18,368	4,293	2,219
Team experience									
TEAM3. Our team members had worked in research and development before.			0,630			0,644	16,135	4,770	2,041
TEAM4. Our team members had prior knowledge of the market context in which the company operates.			0,654			0,657	16,345	4,262	1,967
TEAM5. Our team members had prior technological knowledge.			0,733			0,733	16,322	5,539	1,837
Founders experience									
TEAM6. Our founders had worked in research and development before			0,551			0,559	11,568	4,796	2,216
TEAM7. Our founders had prior knowledge of the market context in which the company operates.			0,579			0,586	12,509	5,241	2,009
TEAM8. Our founders had prior technological knowledge.			0,703			0,705	14,354	5,162	2,080
Team empowerment									
TEAM9. Our company provided the self-administration resources that the development team needed.			0,822			0,816	20,143	5,309	1,769
TEAM10. Our team members were empowered to make most of the decisions that impacted the project.			0,692			0,692	14,867	5,105	1,861
TEAM11. Our project manager had the autonomy to determine the format, changes and schedule goals.			0,792			0,789	19,912	5,372	1,862
Transformational leadership									
TEAM12. Our team leader built trust, inspired power and pride and went beyond his own individual interests for his team.			0,846			0,852	22,912	5,524	1,785
TEAM13. Our team leader acted with integrity, talked about his values and beliefs, focused on a desirable vision and considered the moral and ethical consequences of his actions.*			0,775			-	-	-	-

TEAM14. Our team leader behaved in such a way as to motivate the people around him, giving meaning and challenge to his team's work.			0,895			0,896	22,134	5,408	1,804
TEAM15. Our team leader encouraged his team to be innovative and creative by questioning assumptions, reformulating problems and approaching old situations in new ways.			0,875			0,876	21,659	5,581	1,736
TEAM16. Our team leader paid attention to the needs of each member of the achievement and growth team, acting as a coach or mentor.			0,826			0,831	22,356	4,932	1,920
Learning-by-doing									
TEAM17. Most of the lessons learned pre-launch were incorporated into the product for a full-scale launch.			0,870			0,864	20,996	5,471	1,849
TEAM18. Lessons and problem solving took place trying many solutions in the hope of coming up with a good one.			0,832			0,826	21,142	5,094	1,947
TEAM19. Lessons and problem solving occurred by testing hypotheses using a controlled variation of activities and context.			0,841			0,840	20,797	5,115	1,840
Agile mindset									
TEAM20. Our company has values and beliefs based on continuous adaptation, behaviour change, growth and development of people.			0,866			0,863	20,490	5,738	1,755
TEAM21. Our company's principle is to achieve enterprise-wide agility.			0,801			0,798	18,679	5,356	1,889
TEAM22. Our company's principle is the continuous delivery of a valuable product in short intervals.			0,736			0,735	17,712	5,288	1,863
STRATEGY RELATED (SR)	0,682	0,947		0,669	0,944				
Strategic orientation									
STRA1. Our company adopted flexible strategies that could be modified in response to changes in project context and progress. *			0,892			-	-	-	-
STRA2. Our company adopted a strategy of giving formal rewards to employees who met their expected time performance by setting explicit time goals.			0,708			0,727	Ref	3,356	2,236
STRA3. Our company made efforts to set clear project goals for team members.			0,902			0,925	21,514	4,571	2,126
STRA4. Our strategic planning foresees the use of planning approaches specially designed to help us reduce time-to-market (such as Lean startup/ Scrum/ Kanban/ Design thinking).			0,840			0,835	19,508	4,702	2,200
Dynamic marketing									
STRA5. Our marketing team used technologies that allowed us to systematically collect and store our customers' information.			0,833			0,842	23,568	4,021	2,067
STRA6. Our marketing team used technologies that allowed for systematic communication with every customer.			0,846			0,862	21,180	4,147	2,132

STRA7. Our marketing team systematically monitored the level of our customer satisfaction.			0,805			0,822	21,482	4,016	2,168
STRA8. Our marketing team was able to change operating procedures quickly to adjust to changes in the market.			0,819			0,818	20,346	4,366	2,037
STRA9. Our marketing team made use of strategies such as Inbound marketing, AARRR metrics and/or Growth hacking.			0,804			0,807	21,222	3,969	2,280
Quality management									
STRA10. Our company used quality management tools such as value analysis, continuous improvement and implementation of the quality function (QFD).			0,752			0,768	23,812	3,366	2,078
STRA11. Our company has established effective metrics to measure the improvement in our product quality.			0,865			0,875	23,279	4,152	1,998
INTEGRATION RELATED (IR)	0,616	0,930		0,584	0,906				
Inter-functional integration									
INTE1. Project activities were overlapped (performed concurrently) to a great degree.			0,862			0,682	Ref		
INTE2. There was a high degree of cooperation among multiple functions and interaction among NPD team members. *			0,895			-	-	-	-
Customer integration									
INTE3. Our customers were actively involved in our product development process.*			0,830			-	-	-	-
INTE4. Our company developed continuous improvement programs that directly involved our customers.			0,806			0,852	17,457	4,136	2,234
INTE5. Our company used approaches to integrate customers in the development of the new product, such as the UX experience / Product roadmap / Business experience.*			0,848			-	-	-	-
Suppliers integration									
INTE6. Our suppliers were actively involved in our product development process.			0,699			0,758	16,026	3,712	2,107
INTE7. There was an extensive formal assessment of the supplier's capacity and performance before the decision to involve him in this project.			0,780			0,840	18,463	3,607	2,142
INTE8. Our company developed continuous improvement programs that directly involved our suppliers.			0,791			0,854	19,314	3,466	2,161
INTE9. There was a lot of direct communication between our company and the supplier's company during the project.			0,785			0,842	19,149	4,251	2,198
Other partnerships									
INTE10. Our company has developed collaboration agreements with universities and/or research institutes.			0,563			0,602	9,972	2,958	2,224
INTE11. Our company has developed collaboration agreements with other companies to develop and/or market products.			0,717			0,774	15,706	4,257	2,338

PROCESS RELATED (PCR)	0,649	0,953		0,640	0,940				
Process formalization									
PROC1. Our company adhered to formal project management procedures.			0,829			0,644	Ref	4,063	2,127
PROC2. Our company sought to standardize inputs (resources, inputs and raw materials) as much as possible.			0,825			0,844	23,132	4,288	2,158
PROC3. Our company made use of methods to standardize the NPD process, such as Scrum or Kanban.			0,799			0,817	22,264	4,335	2,324
Communication									
PROC4. Our company has adopted a common database to facilitate information sharing among all members involved in the process.			0,798			0,815	19,894	4,728	2,294
PROC5. Communication between team members often took place in informal meetings.			0,738			0,747	16,720	4,628	2,128
PROC6. The information shared among the team members was very useful for the project.			0,909			-	-	-	-
Product testing									
PROC7. Our team performed the prototype test with consumers. *			0,825			-	-	-	-
PROC8. Our team performed test marketing/ trial selling before launching the product. *			0,840			-	-	-	-
PROC9. Our company used specific tools to test the prototype, such as A/B tests or Wizard of Oz.			0,822			0,844	22,517	3,665	2,311
PROC10. A high frequency of prototyping and testing was required, or a high number of iterations of a redesign before stabilization.			0,766			0,781	19,169	4,147	2,215
Project structuring									
PROC11. Our product development process was structured to designate members who had a full-time commitment to the project.			0,827			0,849	22,411	4,377	2,244
PROC12. Our product development process was structured to designate co-located teams, meaning team members performed their activities in the same physical space.			0,611			0,634	12,803	3,131	2,335
PROC13. Our product development process was structured by complex activities (high technical difficulty) and/or with new technologies for our company.			0,807			0,826	19,551	4,508	2,264
PROC14. Our product development process was structured to follow a roadmap with measurable milestones.			0,877			0,913	25,549	4,330	2,133
PROC15. Our product development process was structured to have team members who would stay on the project until completion.			0,771			0,797	22,230	4,335	2,290
PRODUCT RELATED (PDR)	0,570	0,765		0,569	0,764				
Product innovativeness									

PROD1. The technology adopted in the product developed by our company is innovative.			0,750			0,761	Ref	5,152	1,733
PROD2. The product developed by our company has introduced many completely new features to the market.			0,799			0,803	6,618	5,220	1,550
PROD3. The product developed by our company has high complexity (due to several product functions; degree of less standardized and interconnected parts; the complexity of design; and/or the size of the project's budget).			0,713			0,695	6,127	5,440	1,675
EXTERNAL ENVIRONMENTAL RELATED (EER)	0,418	0,878		0,418	0,859				
Competitive intensity									
ENVI1. The product developed by our company faced a high level of competition from similar products.*			0,645			-	-	-	-
ENVI2. Our competitors were relatively small or weak companies.*			0,232			-	-	-	-
Market uncertainty									
ENVI3. The environment in which our company operated was highly uncertain because our customers' preferences change a lot over time.			0,631			0,659	Ref	3,225	1,831
ENVI4. The environment in which our company operated was highly uncertain because customers tend to be looking for new products all the time.			0,693			0,749	10,995	3,377	1,879
Technological turbulence									
ENVI5. The technology used in this product was rapidly changing.			0,699			0,718	10,133	3,869	1,997
ENVI6. Due to the high rates of technological advances in the industry, a large number of new products were constantly emerging.			0,742			0,750	11,308	3,812	1,972
ENVI7. The environment in which our company operated was highly uncertain about technological changes.			0,709			0,732	10,367	3,812	1,932
Time sensitivity									
ENVI8. Our customers tended to look for new products constantly.			0,726			0,717	10,623	4,026	2,027
ENVI9. Our customers are willing to pay a higher price for shorter delivery times. *			0,611			-	-	-	-
Innovation ecosystems									
ENVI10. The environment in which we operate provides financial incentives, such as venture capital, to motivate local entrepreneurs to focus on risky technological development. *			0,560			-	-	-	-
ENVI11. The environment in which we operate has facilitated and intermediary institutions to assist in the product development process. *			0,680			-	-	-	-
ENVI12. The environment in which our company operated had a group of organizations that interact symbiotic to create an ecosystem that increases the survival of the companies included in it.			0,670			0,630	7,667	3,209	2,031

***** eliminated during item refinement.

Table 5.5 - Discriminant validity: Square root of AVE on diagonal

Constructs	TR	SR	IR	PCR	PDR	EER
TR	**0,767**					
SR	0,657	**0,830**				
IR	0,659	0,781	**0,789**			
PCR	0,682	0,810	0,782	**0,795**		
PDR	0,301	0,228	0,238	0,358	**0,754**	
EER	0,151	0,316	0,414	0,492	0,231	**0,709**

Table 5.6 - Cross loadings

Constructs	**Manifest variables**	**TR**	**SR**	**PCR**	**EER**	**IR**	**PDR**
PDR	PROD1	0,085	0,033	0,248	0,135	-0,198	**0,417**
	PROD2	0,153	-0,006	0,230	0,144	-0,207	**0,242**
	PROD3	-0,029	-0,059	0,356	0,100	-0,082	**0,422**
EER	DRIV3	-0,082	-0,029	0,084	**0,663**	0,094	-0,128
	DRIV4	-0,056	-0,097	0,138	**0,686**	0,185	0,061
	DRIV5	-0,010	0,225	-0,076	**0,703**	-0,030	0,039
	DRIV6	0,004	0,111	0,005	**0,625**	0,117	0,001
	DRIV7	0,019	0,034	0,248	**0,488**	-0,073	-0,050
	DRIV8	0,039	0,024	0,149	**0,591**	-0,028	-0,128
	DRIV12	0,031	0,309	-0,126	**0,396**	0,070	0,034
TR	TEAM1	**0,623**	0,282	-0,077	-0,026	-0,068	-0,006
	TEAM2	**0,472**	0,246	-0,049	0,126	-0,004	-0,023
	TEAM3	**0,511**	0,044	-0,052	-0,073	0,162	0,254
	TEAM4	**0,468**	0,000	-0,033	0,083	0,292	0,152
	TEAM5	**0,603**	0,034	0,203	-0,032	-0,139	0,189
	TEAM6	**0,521**	-0,051	-0,028	-0,048	0,097	0,379
	TEAM7	**0,591**	0,053	-0,115	0,017	0,095	0,196
	TEAM8	**0,613**	0,041	0,046	-0,105	-0,012	0,383
	TEAM9	**0,750**	-0,023	0,150	0,012	-0,019	-0,040
	TEAM10	**0,694**	-0,022	-0,015	0,014	0,132	0,134
	TEAM11	**0,798**	-0,081	0,024	0,017	0,049	0,056
	TEAM12	**0,901**	-0,039	-0,012	0,076	0,000	-0,014
	TEAM14	**0,879**	-0,057	0,055	0,017	0,045	-0,101
	TEAM15	**0,892**	-0,072	0,033	0,122	0,020	-0,025
	TEAM16	**0,750**	0,137	-0,100	0,066	0,067	-0,019
	TEAM17	**0,794**	0,015	0,075	-0,063	0,020	0,060
	TEAM18	**0,560**	0,127	0,109	-0,040	0,096	0,122
	TEAM19	**0,714**	0,037	0,082	-0,031	0,062	0,004
	TEAM20	**0,877**	0,039	0,044	-0,042	-0,079	-0,160
	TEAM21	**0,742**	0,123	0,014	-0,020	-0,105	-0,224
	TEAM22	**0,768**	0,002	0,005	0,054	-0,040	-0,164
SR	STRA2	0,009	**0,538**	0,060	-0,042	0,128	-0,140
	STRA3	0,124	**0,565**	0,216	-0,081	0,098	0,023
	STRA4	0,170	**0,490**	0,252	-0,100	-0,039	-0,146
	STRA5	-0,043	**0,954**	-0,041	0,090	-0,079	0,049
	STRA6	-0,058	**0,847**	0,003	-0,040	0,116	0,050
	STRA7	-0,059	**0,831**	0,053	-0,069	0,049	0,090
	STRA8	0,060	**0,651**	0,127	-0,033	0,052	0,069
	STRA9	-0,035	**0,872**	0,015	-0,006	-0,077	0,039
	STRA10	0,018	**0,599**	0,022	0,036	0,138	-0,149
	STRA11	0,076	**0,590**	0,243	0,000	0,015	-0,023
IR	INT1	-0,007	0,205	0,043	0,265	**0,348**	0,278
	INT4	0,098	0,246	0,161	0,043	**0,396**	-0,083

	INT6	0,045	0,075	0,049	0,038	**0,734**	0,087
	INT7	0,045	0,395	0,089	0,067	**0,397**	-0,057
	INT8	0,066	0,266	0,018	0,043	**0,652**	-0,200
	INT9	0,021	0,059	0,241	-0,020	**0,703**	-0,012
	INT10	-0,022	0,038	0,223	-0,016	**0,389**	0,032
	INT11	0,096	0,293	0,087	0,021	**0,385**	0,035
PCR	PROC1	-0,049	0,115	**0,728**	0,041	0,085	-0,011
	PROC2	0,065	0,041	**0,736**	-0,168	0,070	-0,090
	PROC3	0,023	0,420	**0,484**	0,114	-0,211	-0,190
	PROC4	0,022	0,263	**0,477**	0,099	0,055	-0,045
	PROC5	0,057	-0,035	**0,592**	0,088	0,154	0,075
	PROC9	0,016	0,351	**0,417**	0,096	0,029	-0,151
	PROC10	0,027	0,092	**0,584**	0,106	0,039	0,191
	PROC11	0,055	0,067	**0,756**	-0,027	-0,025	-0,066
	PROC12	-0,073	-0,028	**0,536**	-0,023	0,205	-0,006
	PROC13	0,042	0,018	**0,710**	0,143	0,006	0,226
	PROC14	-0,023	0,259	**0,696**	-0,044	0,010	0,070

5.4.3 Non-confirmed TTM reduction items

After the item-sorting exercise and the CFA using response data from startup managers, among the 83 items included at the beginning of the survey, 21 were not confirmed during the validation process. They are TEAM 2, TEAM3, TEAM15, TEAM20, TEAM21, TEAM24, TEAM26, TEAM29, STRA1, INTE2, INTE3, INTE5, PROC7, PROC8, PROC9, ENVI1, ENVI2, ENVI7, ENVI10, ENVI11, ENVI12. Some qualitative reasons for this non-confirmation are described below.

TEAM 2 and TEAM 3 refer to having experience working in cross-functional teams and having the ability to complement the tasks of other team members, respectively. This need for a creative climate and broad communication and cooperation between functions for successful innovation is highlighted in the literature (CIARAPICA; BEVILACQUA; MAZZUTO, 2016b). However, despite being consistent with the construct they were inserted, these items also have a solid relationship with another construct, the team experience. Something similar happened with TEAM24 in the "learning-by-doing" construct. In this case, the assertion measured the same as other assertions of the same construct, and therefore, it was also eliminated. The experts understood that the way lessons are learned in organizations are already being measured by other items in this construct, such as TEAM22 and TEAM23.

TEAM15 refers to the transformational leadership characteristics present in the organization, more specifically to the leader's behaviour when acting with integrity and communicating beliefs and values. Transformational leaders explore new ways of working, seek opportunities in the face of risk, prefer effective responses to efficient responses, and are less likely to support the status quo. These are fundamental characteristics for companies with their business model based on innovation, such as startups (ZAECH; BALDEGGER, 2017). However, when evaluating the answers given by managers, it was unanimous in indicating the existence of this type of leadership in these organizations. Given the similarity of responses, this variable was not significantly explanatory for the time-to-market reduction model. Therefore, this construct may continue to be measured by the remaining items.

Concerning the learning construct, TEAM20 (about the act of re-examining the value of information collected in previous studies) and TEAM21 (about the training received to face technological and market challenges) may have been excluded by experts for similar reasons. Although the importance of activities related learning has already been demonstrated in previous studies in large companies (LUKAS; MENON; BELL, 2002; SCHRIBER; LÖWSTEDT, 2020), they may not be consistent with the structure of start-ups. Involved in highly dynamic environment, startups need to iterate on business ideas until they can make a solid decision about them. To this end, they apply various learning-by-doing methods that test potential alternatives before choosing, most notably categorized as trial-and-error, bricolage, and experimentation approaches (LEATHERBEE; KATILA, 2020). A famous methodology widely used by startups that serves as an example of mixing these methods is the lean startup (RIES, 2011; BORTOLINI et al., 2018; LEATHERBEE; KATILA, 2020)

In the culture construct, TEAM26 was also excluded. This item referred to the mindset of treating failure as a learning opportunity. This has been discussed in the management literature, more specifically in innovative companies, and is strongly linked to the pivoting concept used by startups. Pivoting is related to a change of strategy without a change of vision. That is, the vision is assumed to remain relatively fixed, while the strategy used to implement that “vision” is expected to change through the execution of a series of pivots based on feedback gained from product market activity (CONTIGIANI; LEVINTHAL, 2019). This item did not converge in the experts' judgment, which may indicate a lack of understanding of the assertion or even the fact that this concept is still nebulous in business practice. After all, the paradigm of the search for success is powerful in traditional organizations, so the possibility of failure is not well regarded and always avoided. The understanding that failing and failing fast can be positive for the company still needs to be further debated and tested among scholars and practitioners. The waste reduction paradigm in TEAM29 also did not converge and was excluded. However, in this case, a possible cause was its strong relationship with another construct related to processes.

In the strategy construct, only one item was excluded in the back-end stage, the STRA1 referring to the adjustments of the strategy in response to changes in the context. The behaviour of the managers' responses made the variable not significant to explain the model's relationships. One possible reason is that the assertion is quite general so that the construct can be better measured by the remaining items that compose it. Something similar happened with INTE2 about the high degree of cooperation and interaction between team members. Both the adaptation of strategies and the high cooperation in the NPD team are essential for the excellent functioning of organizations. Moreover, despite the indication in the literature of these items for the reduction of TTM, the behaviour of the responses did not make these items significantly explanatory for the model. It is emphasized that this does not affect the scale since other items in these same constructs can better measure these issues.

On the other hand, particular practices were also possible reasons for excluding items. This was the case for the excluded items in the customer integration constructs (INTE3 and INTE5) and product tests (PROC7, PROC8, PROC9). When evaluating the managers' answers, it was noticed that the average of the answers were low, indicating a low degree of implementation of these capabilities. This may indicate a non-application of these practices to startups or, more specifically, Brazilian startups sampled for this research. The degree of implementation of capabilities can be the focus of future studies on this research topic.

One of the gaps that the present research intends to mitigate is in the construction of a scale of the internal aspects (capabilities) of the organizations that allow the reduction of time-to-market and the aspects of the external environment (drivers) that motivate it. Some items related to the environment were also tested, and six were excluded. The first two excluded items (ENVI1 and ENVI2) also eliminated the construct related to them, competitive intensity. This result needed to be analyzed in more depth by experts. A low average was noted when checking the managers' responses, an interesting fact given the construct in question. The answers indicated that although the market was not composed only of small or weak companies, they did not promote a high level of competition from similar products. Because they are start-ups, this phenomenon can find a theoretical basis.

Start-ups have their business models based on innovation, the main strategy adopted is differentiation. Startups seek to navigate blue oceans, a recent management concept that defines the creation of new market spaces, rather than competing within exisiting ones (CARTON, 2020). In other words, these companies seek to develop products with differentials that allow them to operate in markets with few competitors. Despite the high risks associated with these strategies, the gains of pioneering in a market justify this search by companies. Therefore, despite competitive intensity being a construct present in most models that consider external environmental variables, this variable was excluded from our model because it used a specific type of organization that work with innovation. It should be noted that further empirical tests on the performance level of this construct in these companies may be necessary in future research.

ENVI7 refers to the number of ideas for new products that could be generated given the technological turmoil of the industry in which the company was inserted. The experts did not consider this item sufficiently valid to measure its respective construct, given the existence of other items with better adherence. Therefore, this item was deleted at the front-end stage. The ENVI10 regarding the possibility of customers paying higher prices for faster delivery of products was excluded in the next stage considering the managers' responses. This variable may be conditioned to some control variables, such as the target market of the companies and the level of innovativeness of the product. This generates a future research direction that can be empirically tested.

Finally, ENVI11 and ENVI12 related to the innovation ecosystems construct were excluded in the last stage of the research. These items refer to the existence of financial incentives and intermediary institutions in the environment in which the companies would be inserted, which would facilitate the NPD process. As stated by Tripathi et al. (2019, p. 77), "a suitable ecosystem is needed to nurture a startup from its product conception stage, in which an ideal MVP is created, until the product is mature enough to be launched in the market". The average managers' responses to these items are very low, which removed the items from the model. This also opens up the possibility of further investigation, since there is an indication that the environment where the companies studied are inserted lacks incentives for innovation. After all, emerging markets such as Brazil have weak property rights regimes, corrupt political and legal governance and market failures. These weak institutions create unstable and uncertain environments for innovation activities, discouraging the entry of new entrepreneurs (Sun et al. 2019). This hypothesis, however, will need to be tested with more empirical studies since it is not the objective of scale development and measurement research to assess the degree of implementation of the evaluated factors.

5.4.4 Confirmed TTM reduction items and final scale

The result of this approach to develop and validate a multi-item measurement scale is a hierarchical factorial structure to represent the concept of TTM reduction with 23 constructs and 62 items (see Table 7), each of which uses a seven-point Likert response scale anchored in (1) strongly disagree with (7) strongly agree. This scale can be used to assess which capabilities and drivers of TTM reduction are implemented and are most effective in start-up configurations.

Concerning the team-related capabilities dimension, we sought to evaluate several aspects of how the start-ups organise their teams to develop their products. After all, project teams must be able to utilize information and correct product-related issues better to achieve superior business results in the markets (AKGÜN et al., 2012b). The capabilities that were evaluated in this category were pointed out in previous studies as capable of contributing to the TTM reduction. Therefore, the NPD team structure adopted (VALLE; AVELLA, 2003; PARK; LIM; BIRNBAUM-MORE, 2009), the level of experience (TSINOPOULOS; AL-ZU'BI, 2012; TRIPATHI et al., 2019) of those involved, the ability to make decisions autonomously (MARION; FRIAR; SIMPSON, 2012), the type of leadership (BASS, 1995; ZAECH; BALDEGGER, 2017) and learning (LYNN; SKOV; ABEL, 1999; KESSLER; BIERLY; GOPALAKRISHNAN, 2000) adopted and the organizational mindset (CARROLL; CASSELMAN, 2019; FERREIRA; COELHO, 2020) were considered.

Strategy-related capabilities were also selected, considering that when establishing the criteria to be used to prioritize projects and allocate resources, a clear NPD strategy can help reduce conflict between key stakeholders and facilitate the product definition process. As such, it can speed up NPD processes and reduce TTM. In this study, three perspectives of strategy previously mentioned in the literature were considered as facilitators of this reduction:

(i) strategic orientation, since the companies that develop a superior strategic orientation of all their members reach, consequently, better levels of performance of their activities (FERREIRA; COELHO, 2020);

(ii) dynamic marketing, most appropriate for startups as it gives them the ability to systematically solve problems, shaped by their propensity to sense opportunities, make timely strategic decisions, and purposefully create, extend, or modify their resource bases (BUCCIERI; JAVALGI; CAVUSGIL, 2020);

(iii) quality management, after all, when quality tools are applied to the NPD, they enable the continuous improvement of processes and a more remarkable adaptation of production to customer requirements, thus reducing the time of placing the product and its acceptance in the market. (Sun, Zhao, and Yau 2009; Lin, Huang, and Chiang 2012).

Regarding the integration-related capabilities dimension, four dimensions are evaluated. The first is inter-functional integration, which refers to the extent of functional interdependency among organizational activities (MENOR; ROTH, 2007). External relations have also been added, such as customers' integration, after all, the proactive determination of customer requirements and a commitment to meeting those requirements makes it more difficult for competitors to intervene and improves timely responsiveness. Therefore, customer insights provide essential inputs to the innovation process. The importance of supplier integration was also considered, after all, as Primo and Amundson (2002, p. 34) state, "the general view is that project development times and project costs are reduced due to the supplier participation". Finally, possibilities for other partnerships while developing new products with startups are elucidated. Partnerships can be important to accelerate the product development process for startups with limited resources, particularly in activities that require specialized knowledge and are difficult to outsource (HEIRMAN; CLARYSSE, 2007). In this type of integration with startups, two types stand out: partnerships with private companies; and partnerships with universities and research institutes.

Issues specifically related to the process are also on the final scale. Issues specifically related to the process are also on the final scale. In this dimension, the formalization of the procedures adopted is measured. After all, contingency theory suggests that companies that compete with the NPD must configure your design effort through standardization to reduce costs, improve quality, improve flexibility, and leverage suppliers' capabilities to innovate within the constraints of current inputs (BREWER; ARNETTE, 2017b). Similarly, the level of detail of the scope and structure of the project can also directly impact development time (KESSLER; CHAKRABARTI, 1999; CARBONELL; RODRIGUEZ, 2006). How the communication between the members of the NPD occurs is also relevant since different communication behaviours can lead to multiple interpretations of a situation that allow reinterpretation processes such as sense making through which team members can gain insights and develop new solutions, collaborating with the innovation process (PESCH; BOUNCKEN; KRAUS, 2015). In addition, the way product tests are performed also need to be evaluated since the literature points out that when companies adopt an aggressive posture in the product testing stages, it leads to better time performance (KONG et al., 2015). However, it is important to note that for startups, given their scarce resources and innovative products, special attention must be paid to eliminating redundant steps, avoiding delays, and accelerating customer feedback (DROGE; JAYARAM; VICKERY, 2000; GHEZZI; CAVALLO, 2020).

The product-related capability that interferes in reducing TTM that was added to the scale was the innovativeness of the product. The products developed by startups must be distinguished by their degree of innovation because products that differ in innovation go through different types of innovation processes, incorporate different types of task demands, and therefore require different management approaches (Lin et al. 2013). Thus, product innovativeness is seen as a vital construct in innovation management. This construct states that the more innovative the new products are, the slower the speed of innovation and vice versa (Lin, Huang, and Chiang 2012).

Besides assessing capabilities, it is crucial to consider that the requirements of agility are, therefore, context-sensitive. In the case of startups, companies that are inserted in an extremely uncertain environment due to the search for innovation in their business models, the organizational theory that best suits their behaviour and interaction with the external environment is the theory of dynamic capabilities (TEECE; PETERATD; LEIH, 2016). The environment considered by this theory became known as VUCA – volatility, uncertainty, complexity and ambiguity (BENNETT; LEMOINE, 2014) and demands dynamic behaviour from the companies that are part of it. In order for the developed instrument to capture these interactions, four constructs measure the aspects related to the external environment in our final scale: market uncertainty (DAYAN; BASARIR, 2009), technological turbulence (ZHAO; CAVUSGIL; CAVUSGIL, 2014), time-sensitive (CHEN; REILLY; LYNN, 2012) and innovation ecosystem (Sun et al. 2019).

Table 5.7 - Final TTM reduction constructs and items

Construct Name	Construct definition	Multi-item scales
Use of cross-functional team	The ability to gather a team with members of several functional areas	There was an effort to involve a cross-functional team in the generation and selection of ideas for a new product.
		Our company has adopted a pre-defined development team configuration, such as the Squad model (which separates team members into small multidisciplinary groups with specific goals).
Team experience	The degree to which team members have previous experience on R&D, market and technological aspects of product development	Our team members had worked in research and development before.
		Our team members had prior knowledge of the market context in which the company operates.
		Our team members had prior technological knowledge.
Founders experience	The degree to which the founder has previous experience in R&D, market and technological aspects of product development.	Our founders had worked in research and development before.
		Our founders had prior knowledge of the market context in which the company operates.
		Our founders had prior technological knowledge
Team empowerment	The degree to which the members of the project team can make their own decisions.	Our company provided the self-administration resources that the development team needed.
		Our team members were empowered to make most of the decisions that impacted the project.
		Our project manager had the autonomy to determine the format, changes and schedule goals.
Transformational leadership	The ability of the team leader to explore new ways of working, to seek opportunities in the face of risk, to prefer effective responses to efficient responders and to be less likely to support the status quo.	Our team leader built trust, inspired power and pride and went beyond his own individual interests for his team.
		Our team leader behaved in such a way as to motivate the people around him, giving meaning and challenge to his team's work.
		Our team leader encouraged his team to be innovative and creative by questioning assumptions, reformulating problems and approaching old situations in new ways.
		Our team leader paid attention to the needs of each member of the achievement and growth team, acting as a coach or mentor.
Learning-by-doing	The ability of the project team to continually obtain and/or create knowledge through experimentation, bricolage and/or trial-and-error.	Most of the lessons learned pre-launch were incorporated into the product for a full-scale launch.
		Lessons and problem solving took place trying many solutions in the hope of coming up with a good one.
		Lessons and problem solving occurred by testing hypotheses using a controlled variation of activities and context.
Agile mindset	The ability to develop beliefs and attitudes that affect all aspects of the behaviours and actions that support innovation and fast responsiveness during the NPD process.	Our company has values and beliefs based on continuous adaptation, behavior change, growth and development of people.
		Our company's principle is to achieve enterprise-wide agility.
		Our company's principle is the continuous delivery of a valuable product in short intervals.

Table 5.7 – Final TTM reduction constructs and items (continued)

Construct Name	Construct definition	Multi-item scales
Strategic orientation	The ability to establish fundamental innovation and time-to-market reduction criteria and policies concerning the direction and objectives of a project.	Our company adopted a strategy of giving formal rewards to employees who met their expected time performance by setting explicit time goals.
		Our company made efforts to set clear project goals for team members.
		Our strategic planning foresees the use of planning approaches specially designed to help us reduce time-to-market (such as Lean startup/ Scrum/ Kanban/ Design thinking).
Dynamic marketing	The ability to respond and develop efficient multifunctional business processes to create and deliver customer value in response to market changes.	Our marketing team used technologies that allowed us to systematically collect and store our customers' information.
		Our marketing team used technologies that allowed for systematic communication with every customer.
		Our marketing team systematically monitored the level of our customer satisfaction.
		Our marketing team was able to change operating procedures quickly to adjust to changes in the market.
		Our marketing team made use of strategies such as Inbound marketing, AARRR metrics and/or Growth hacking.
Quality management	The ability to manage organizational processes enabling the improvement of products and services, seeking to ensure the satisfaction of customers' needs.	Our company used quality management tools such as value analysis, continuous improvement and implementation of the quality function (QFD).
		Our company has established effective metrics to measure the improvement in our product quality.
Inter-functional integration	The ability to integrate and co-order different functional areas.	Project activities were overlapped (performed concurrently) to a great degree.
Customers integration	The ability to engage customers during the NPD process.	Our company developed continuous improvement programs that directly involved our customers.
Suppliers integration	The ability to engage suppliers during the NPD process.	Our suppliers were actively involved in our product development process.
		There was an extensive formal assessment of the supplier's capacity and performance before the decision to involve him in this project.
		Our company developed continuous improvement programs that directly involved our suppliers.
		There was a lot of direct communication between our company and the supplier's company during the project.
Other partnerships	The ability to develop a partnership with other institutions (universities, other companies and research institutes during the NPD process).	Our company has developed collaboration agreements with universities and/or research institutes.
		Our company has developed collaboration agreements with other companies to develop and/or market products.

Table 5.7 – Final TTM reduction constructs and items (continued)

Construct Name	Construct definition	Multi-item scales
Process formalization	The ability to use rules and standard procedures in the NPD process.	Our company adhered to formal project management procedures.
		Our company sought to standardize inputs (resources, inputs and raw materials) as much as possible.
		Our company made use of methods to standardize the NPD process, such as Scrum or Kanban.
Communication	The ability to formal and informal sharing of meaningful and timely information among members.	Our company has adopted a common database to facilitate information sharing among all members involved in the process.
		Communication between team members often took place in informal meetings.
		The information shared among the team members was very useful for the project.
Product testing	The ability to test the market acceptance of the product on time.	Our company used specific tools to test the prototype, such as A/B tests or Wizard of Oz.
		A high frequency of prototyping and testing was required, or a high number of iterations of a redesign before stabilization.
Project structuring	The ability to structure and define the scope of the project.	Our product development process was structured to designate members who had a full-time commitment to the project.
		Our product development process was structured to designate co-located teams, meaning team members performed their activities in the same physical space.
		Our product development process was structured by complex activities (high technical difficulty) and/or with new technologies for our company.
		Our product development process was structured to follow a roadmap with measurable milestones.
		Our product development process was structured to have team members who would stay on the project until completion.
Product innovativeness	The ability to develop a product with a significant degree of novelty for the company and the market.	The technology adopted in the product developed by our company is innovative.
		The product developed by our company has introduced many completely new features to the market.
		The product developed by our company has high complexity (due to several product functions; degree of less standardized and interconnected parts; the complexity of design; and/or the size of the project’s budget).
Market uncertainty	Degree of ambiguity about the type and extent of customer needs that can be satisfied.	The environment in which our company operated was highly uncertain because our customers' preferences change a lot over time.
		The environment in which our company operated was highly uncertain because customers tend to be looking for new products all the time.
Technological turbulence	Rate of change associated with new product technology in the industry.	The technology used in this product was rapidly changing.
		Due to the high rates of technological advances in the industry, a large number of new products were constantly emerging.
		The environment in which our company operated was highly uncertain about technological changes.
Time sensitivity	Degree of market sensitivity to the frequency of introducing or modifying	Our customers tended to look for new products constantly.

	products and delivery speed and punctuality.	
Innovation ecosystems	Degree of insertion in supportive environments for innovation, including legal and economic institutions and professional business intermediaries.	The environment in which our company operated had a group of organizations that interact symbiotic to create an ecosystem that increases the survival of the companies included in it.

5.5 Conclusion

Of everything we spend, the most expensive is time. In the context of companies that have their business model based on innovation, such as start-ups, this rule is even more evident. Several methodologies can be found in the operations management literature to speed up their processes, however, how to integrate the different internal aspects (capabilities) and external conditions (drivers) to reduce start-ups' time-to-market remains a gap. To resolve this issue requires we first have valid and reliable measures of time-to-market reduction constructs. The present study attempts to promote the development of theory and understanding of this critical concept in NPD through the conceptual development and empirical validation of a set of multi-item scales that reflect drivers and capability of TTM reduction and, in doing so, provide a likely answer to the above question.

Although the TTM reduction has been investigated in previous studies, a statistically valid scale for its measurement has not been found. In this chapter, we create an instrument that uses 6 constructs of the first order related to - team, strategy, integration, process, product, and external environment. This scale measures the TTM reduction, using a scale of 62 items. For this, we use a two-phase approach where we assess our proposed measurement items' provisional reliability and validity through an iterative process of rating items on a nominal scale based on judgments. In the second stage, using confirmatory factor analysis, we evaluate the model according to unidimensionality, reliability and convergence and discriminant validity. Using two different data samples allowed us to perform rigorous statistical analyses, which refined individual item measurements and multi-item scales. Therefore, our results offer the potential for good insights into the research and practice of NPD.

5.5.1 Theoretical implications

In so doing, we make four main theoretical contributions. First, this study advanced the concept of time-to-market reduction by developing a multi-dimensional higher-order model for start-ups and its measurement validation. Our contribution explicitly expands the dimensions of suggested capabilities to reduce TTM beyond traditional constructs, integrating new dimensions such as transformational leadership, learning by doing, agile mindset and dynamic marketing. Second, few studies assess and integrate the different dimensions (internal and external) in the company that can influence the time-to-market. This is the first study to establish the empirical relationship between drivers associated with the VUCA environment (BENNETT; LEMOINE, 2014) and time-to-market reduction capabilities in start-ups. Third, this research is especially relevant to improving NPD efforts for start-ups. After all, it is the first study dedicated explicitly to reducing time-to-market in these companies. Until then, studies on this topic were directed at industries and/or small and medium-sized companies. Consequently, this instrument intends to contribute to researchers who aim to identify which capabilities and drivers for TTM reduction are most effective in start-ups. Furthermore, as a fourth possible contribution to scholars, this study employs a rigorous stepwise method including structured item generation, expert panels, surveys, and statistical analysis to propose a new robust scale.

5.5.2 Managerial implications

Managers can use the scale developed in this study to assess the performance of new product development processes by developing capabilities that reduce time-to-market. The proposed scale can serve as a diagnostic tool to map the implementation of TTM mitigation capabilities to identify what kind of capabilities are most widely implemented, which need more attention or which new ones can be implemented. After all, if the company does not have the necessary capabilities, this can be rectified through interventions in the NPD process and organisational structure. The scale can also be used to assess the level of specific environmental conditions that can encourage start-ups' NPD processes to accelerate. Thus, companies can later define new NPDs strategies based on this diagnosis.

Our proposed scale provides insights so that managers have a basic understanding of the elements that influence time-to-market reduction and possible ways to nurture these elements within the organisation. In addition, the conceptual model can be helpful for managers as it considers behavioural aspects, such as agile mindset, transformational leadership and learning by doing, which can facilitate the sustainability of this type of organization.

Our proposed scale also provides managers with an instrument containing a set of the necessary background when start-ups intend to accelerate their product development process. Companies that have already accelerated the NPD can use the instrument to assess and monitor its implementation. This allows companies to track whether they are improving. The instrument can also be used as a tool to identify opportunities for improvement, allowing companies to improve performance and competitiveness. After all, companies can use our scale as a benchmarking tool to compare the implementation of capabilities between companies belonging to the same and/or other sectors.

5.5.3 Limitations and future research proposals

This study is subject to limitations that can serve as topics for future research. A limitation of this study is that the development of this instrument occurred through the focus on start-ups. However, it can be potentially valuable for other sectors operating under different contingency factors. Besides, this instrument needs more tests in a larger sample of start-ups to present a better empirical validation in different contexts that these companies may be inserted. Although we believe that similar uses of this TTM reduction measure may be found in other types of companies, future research should examine the generalizability of this measure and the possibility of complementary multi-dimensional constructs.

The current scale of time-to-market reduction was built on the experience of Brazilian start-up managers; therefore, scale is subject to national cultural bias. A better understanding of its widespread use could be obtained by replicating this scale in other national contexts. In addition, our study retrospectively captured managers' perceptions of product development at their companies. Future studies can employ longitudinal data to understand the effect of the constructs at various points in time.

6 THE EFFECT OF REDUCING TIME-TO-MARKET ON START-UPS PERFORMANCE

This chapter describe the development of a survey, which sought to investigate the impact of reducing time-to-market on start-ups performance. Besides, this stage of the research also verifies the degree of adoption of capabilities for reducing TTM in start-ups, evaluate the impact of drivers on the adoption of capabilities for reducing TTM, and analyze the impact of the adoption of each capability on the reducing TTM.

6.1 Introduction

Adaptation is the keyword in the business environment. In relatively stable and predictable environments, companies develop core competencies; while in highly changing and unpredictable environments, companies must adapt and upgrade their resources to develop more effective dynamic capabilities (TEECE, 2012; BUCCIERI; JAVALGI; CAVUSGIL, 2020). Nowadays, "faced with rapid changes in available production technology and highly dynamic market competition, firms have increasingly placed new product development (NPD) capability as a core competency and strategic imperative" (Chiang and Wu, 2016, p. 248). After all, developing the right product and delivering it on time to the market has been the differential of leading companies worldwide (ZHANG; WANG; GAO, 2017). Furthermore, "time to market is widely recognized as an important attribute of strong innovators to gain competitive advantages, particularly in fast-cycle industries" (TAN; ZHAN, 2017, p. 571). Companies such as startups, which have their business model based on innovation and inserted in an environment of high uncertainty, deserve greater attention because analysis of these newly created companies generates different difficulties since they present high failure rates (SIMON; LEKER, 2016). In agreement, Marion and Simpson (2012, p. 640) state, "understanding NPD practices in the context of new ventures is fundamental to entrepreneurial management knowledge".

Despite the consensus of this approach, implementing the NPD process is a complex and risky task regardless of the economic sector (ZHAO; CAVUSGIL; CAVUSGIL, 2014). It is not easy to determine which drivers and capabilities lead to the new product development (NPD) success (CIARAPICA; BEVILACQUA; MAZZUTO, 2016b). After all, "different types of product development within different tasks and regulatory environments influence the level of need for speed and its relative utility" (MENOR; ROTH, 2007, p. 219).

Many NPD studies with heterogeneous and sometimes even contradictory findings call for ways to synthesize and generalize about the key factors to reduce time and improve performance. “While the effects of one individual method on NPD performance have been analyzed in various studies, little attention has been so far paid to the effect of the combined application of multiple methods” (GRANER; MISSLER-BEHR, 2015). When looking for empirical studies that evaluate this union, the situation becomes even more critical once because, besides the scarcity, there is not much evidence of the “how” to reduce time-to-market (TTM) and speed up the NPD process.

Startups were chosen as a focus group of this study because these companies are considered to be efficient data sources to understand the trends of new developments. After all, startups often push the borders of technology and business innovation (SIMON; LEKER, 2016). Building on the dynamic capabilities view (DCV), we empirically examine the relationships among drivers and capabilities of TTM reduction in start-ups' performance. The aim is to answer four research questions: (1) What is the degree of implementation of capabilities for reducing TTM in the startups? (2) What is the impact of drivers on the implementation of capabilities for reducing TTM? (3) What is the impact of the implementation of capabilities in reducing TTM in startups? (4) What is the impact of reducing time-to-market on startup performance?

While startups have lacked a unifying theoretical direction, dynamic capabilities have gained momentum in recent years as theoretical lenses within this area (MITRĘGA, 2020; POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020). However, research that explores startup-specific dynamic capabilities, background, and performance results are just beginning to emerge. That is, our understanding of how these start-ups nurture and utilize dynamic capabilities is still limited (Weerawardena et al., 2015; Zahra et al., 2006). Scholars ask for more empirical research regarding the dynamic capabilities of startups (BUCCIERI; JAVALGI; CAVUSGIL, 2020; MITRĘGA, 2020; POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020). Thus, a theoretical model was validated statistically through data obtained from a survey applied in a sample of 192 startups managers. Data analysis was performed using Structural Equation Modeling (SEM). Moreover, in addition to achieving the proposed objective, this study assessed the degree of adoption of TTM reduction capabilities in start-up companies, analyzed the impact of drivers on the implementation of TTM reduction capabilities and examined the impact of adopting capabilities in the reduction of TTM. For managers, our findings can contribute by pointing to the possibility that certain drivers and capabilities can improve NPD time and suggesting some reservations regarding other less successful methods. For researchers, this study extends previous research on TTM reduction. After all, in addition to evaluating drivers and capabilities from a holistic approach, the target audience is a type of organization that has been neglected in the literature (MARION; FRIAR; SIMPSON, 2012), the startups.

The remainder of the chapter is organized as follows: First, we develop a theoretical framework and offer a discussion of the hypothesis and research model. Next, explanations of the research method are provided. All measures and estimates of the structural equation model are presented, followed by the analysis and discussion of the results. In the last section, we conclude the research by arguing the theoretical and managerial implications, the study limitations and future research.

6.2 Theoretical background, literature review and development of hypothesis

6.2.1 Time-based competition

"In the 1980s, quality was the model to follow in terms of competitive strategy; however, more recently, time-based competition has emerged as the winning strategy" (ROSAS-VEGA; VOKURKA, 2015, p. 157). Faced with technological advances and the shortening of product life cycles, companies need to develop their products faster and faster if they want to obtain competitive advantages. Delaying the introduction of new products to the market can have serious financial consequences, reducing market share and losing customers. Nevertheless, "NPD teams need to balance how fast they want to go with how fast they can go" (CHEN et al., 2012, p. 291). Companies need to find a synergy between time-based strategies and the limits of their customers' ability to absorb the new products developed. "Implementing a time-based strategy is not as simple as adding more resources, slipping the key steps, or rushing the NPD process" (CHEN et al., 2010, p.19). Therefore, the time-based competition strategy depends on how it will develop its internal aspects (capabilities) and directly affect the company's performance in the market (LIN; HUANG; CHIANG, 2012). Based on this theory, the first four hypotheses of this research about the TTM reduction on startups was formulated.

6.2.1.1 The degree of TTM reduction capabilities implementation in start-ups

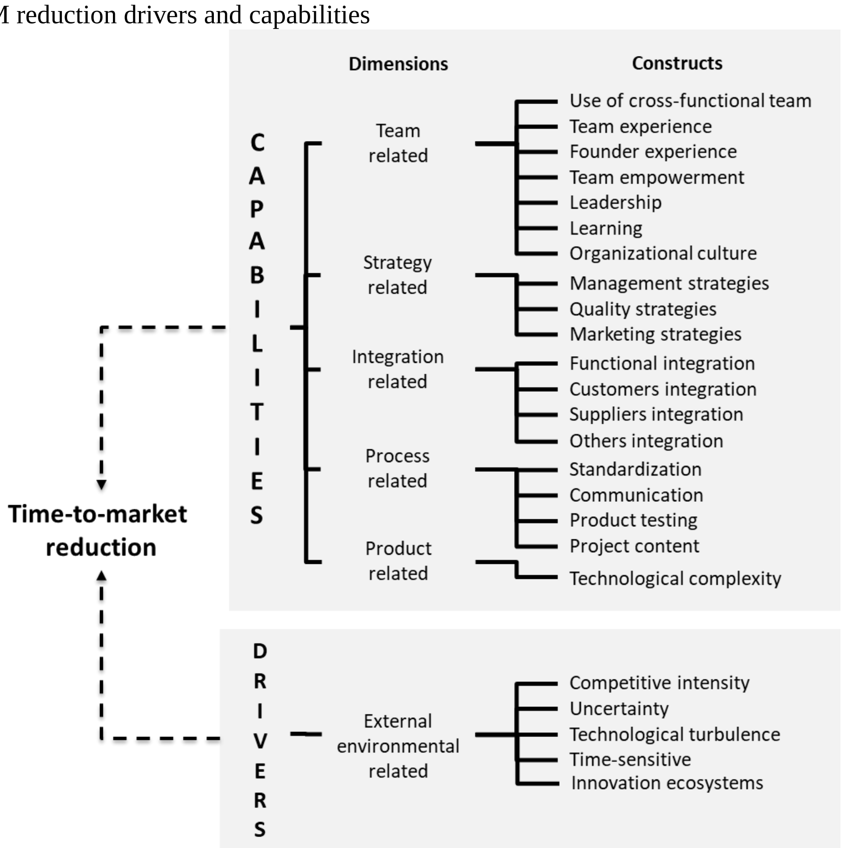
Mabert, Muth and Schumenner developed one of the first studies found in the NPD time literature. The authors report results from a comparative case study of six NPD projects and identify those elements important to product introduction lead time and how they are influenced by a customer and organizational and technical factors. Since then, several studies have sought to evaluate different internal factors (capabilities) that could influence this time differently. For example, some studies focus their efforts on evaluating which characteristics of the project team could have influenced (LYNN; SKOV; ABEL, 1999; DAYAN; BASARIR, 2009; AKGÜN et al., 2012b; PESCH; BOUNCKEN; KRAUS, 2015); there were also assessments on the interference of different types of integrations, such as suppliers, customers and other companies (PETERSEN; HANDFIELD; RAGATZ, 2003; ELVERS; SONG, 2016; GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017a); as well as the role of strategy (SWINK, 2003; PARRY et al., 2009), process (KARAGOZOGLU; BROWN, 1993; TATIKONDA; MONTOYA-WEISS, 2001; BSTIELER; GROSS, 2003; ZHAN et al., 2017) and the complexity of the product being developed (CARBONELL; RODRIGUEZ, 2006; VALLE; VÁZQUEZ-BUSTELO, 2009). Nevertheless, these studies showed that researches evaluate these factors in a fragmented way, few efforts have been made for a more holistic analysis as Chen et al. (2010), who developed a systematic review with a significant number of factors that influence TTM, but this a 10-year lag where several technological changes took place, including the boom in the emergence of companies such as startups. Therefore, this present study focuses on 24 constructs regarding TTM reduction drivers and capabilities (Figure 6.1) proposed by Mota et al. (2021), whose definitions can be seen in Appendix A. The authors identified these constructs through an extensive and updated literature review, and validated them for the start-up context through experts' interviews following the rigor of a multi-method approach.

Although the discussions found in the literature treat the constructs separately, this process deserves holistic and integrated analyses. After all, "NPD performance is not improved by using just one NPD practice more extensively, or better, but by using a number of them more effectively simultaneously" (SÁNCHEZ; PÉREZ, 2003, p.59). As Graner and Mißler-Behr (2015, p. 9) claim, "the use of methods in NPD correlates positively to successful project performance. Although, individual methods differ regarding their effectiveness". Therefore, despite categorising the 19 capabilities into 5 categories according to their organizational dimension (team, strategy, integration, process and product), in the present research, these capabilities are grouped in the same theoretical model. Following this structure, the first research hypothesis is also subdivided into these categories:

H1a. The team-related capabilities implementation positively impacts the TTM reduction.

H1b. The strategy-related capabilities implementation positively impacts the TTM reduction.
H1c. The integration-related capabilities implementation positively impacts the TTM reduction.
H1d. The product-related capabilities implementation positively impacts the TTM reduction.
H1e. The process-related capabilities implementation positively impacts the TTM reduction.

Figure 6.1 – TTM reduction drivers and capabilities



Source: Adaptation from Mota et al. (2021)

Developing the right capabilities allows new companies to perceive and respond to changing market conditions and operational or strategic crises thus improving the likelihood of sustaining their growth and maximizing their objectives. Capabilities cannot be bought; they are created and developed over time by organizational processes adopted by start-ups (POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020). However, startups can have difficulties getting resources in the initial phases since the company that works with innovation needs to convince employees, investors and other strategic partners about the execution of a particular idea. Thus, its activities are subject to a high degree of uncertainty, making its structure more complex. Moreover, assuming that the company's performance is not determined by the absolute availability of resources, but by the companies' capabilities to use their resources to produce innovative products for their markets (ALJANABI, 2020), the second research hypothesis is:

H2. Startups implement capabilities for reducing TTM in a fragmented way.

6.2.1.2 The effect of the reducing TTM in the start-ups' performance

There is a positive association in the literature between reducing TTM and improving performance (KRAEMER; DEDRICK; YAMASHIRO, 2000; YANG, 2004; KONG et al., 2015). When talking about the NPD performance, there is a direct reference to evaluate three aspects: operational (SERHAN et al., 2015; ZHANG; WANG; GAO, 2017), financial (TENNANT; ROBERTS, 2001; LIN; HUANG; CHIANG, 2012; BREWER; ARNETTE, 2017b) and marketing performance (CHANG; TAYLOR; META-ANALYSIS, 2016; SIMON; LEKER, 2016). TTM reduction has been implemented in several sectors (TATIKONDA; MONTOYA-WEISS, 2001; JOHNSON; PICCOLOTTO; FILIPPINI, 2009b; FENG et al., 2014; CHIANG; WU, 2016) to improve companies' performance (CHEN; REILLY; LYNN, 2005; AFONSO et al., 2008). Nevertheless, understanding how the TTM reduction affects start-up performance is limited (MARION; FRIAR; SIMPSON, 2012; MOTA et al., 2021). Some market variables can moderate the effect of this relationship. More experienced companies, with longer operating times in the market, may benefit more from this shortening of the NDP process. In addition, the type of market in which the company operates can generate different types of gains to accelerate this delivery of new products. In this way, both the scale of the company's operation (that is, having a national or multinational operation) and the target market being individuals and/or companies can also moderate this relationship. Given these different perspectives, two more hypotheses emerge:

H4. The TTM reduction positively impacts start-ups' performance.

H5. The level of experience and operating market moderates the relationship between TTM reduction and start-ups' performance.

6.2.2 Dynamic capabilities view

Startups are a unique data source for understanding new product development trends. After all, they are companies that invest their creative work, time and money to detect and implement a market opportunity, which often goes beyond the boundaries of technology and business innovation (SIMON; LEKER, 2016). However, startups have to deal with the environmental dynamism that forces them to adapt their business model to the volatile environment in which they operate to sustain their competitive advantage (GHEZZI; CAVALLO, 2020). Therefore, in the perspective of analyzing product development in startups, the best theoretical lens that can be used is the Dynamic-capability view (DCV) (POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020).

"Dynamic capabilities is the framework that can help guide managers concerning when and how to manage under deep uncertainty" (Teece et al., 2016, p.32). As stated by Teece (2012, p.1), "Dynamic capabilities are higher-level competencies that determine the firm's ability to integrate, build, and reconfigure internal and external resources/competencies to address, and possibly shape, rapidly changing business environments". Therefore, the dynamic capabilities vision sought to identify the sources of value creation (and its capture) in Shumpetian environments where competition existed based on innovation, predatory pricing practices, and the "creative destruction" of their competencies (Sunder et al., 2019). The average time that companies can sustain competitive advantage has decreased over time, suggesting that in a hypercompetitive or high-speed environment, companies find it more difficult to obtain long-term competitive advantage (BARRETO, 2010).

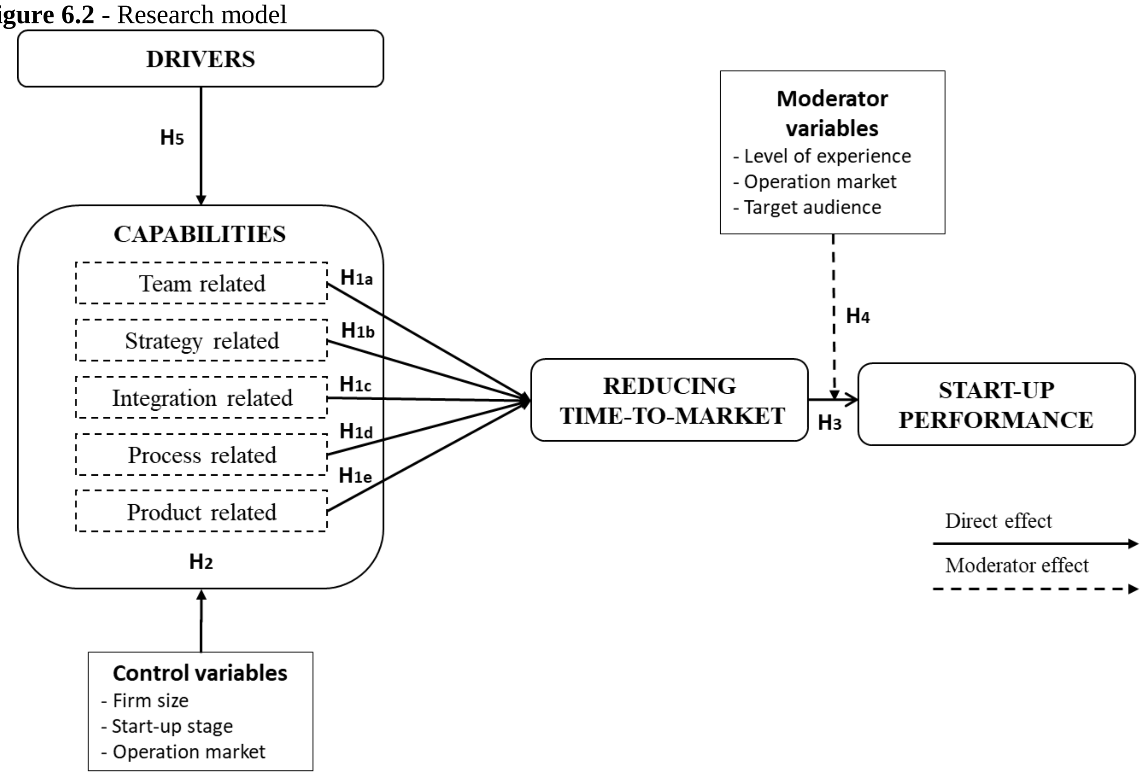
6.2.2.1 The effect of drivers in the TTM reduction capabilities

When an organization wants to reduce TTM, it must go beyond management issues and assess the factors central to its business strategy (MENOR; ROTH, 2007). "NPD strategy should be based on a thorough analysis of the characteristics of markets in which new products will be sold. After all, it is more important to execute a time-based strategy in an unfamiliar emerging, or fast-changing market than in a familiar, existing, and stable market" (CHEN et al., 2005, p. 209). Therefore, several authors have noted that new product development is a prototypical dynamic capability and have placed innovation as the cornerstone capabilities" (MCKELVIE; DAVIDSSON, 2009, p. 4). When discussing the effects of dynamic capabilities, Teece (2012, p.1) states that they determine the speed and degree to which the company's particular resources can be aligned and realigned to match the needs and opportunities of the business environment to generate sustained abnormal (positive) returns. "Dynamic capabilities propounds that, in regimes of deep uncertainty such as those which characterize sectors of the economy experiencing rapid change, management must prime the organization for sensing, seizing, and transforming, and marry the right strategy to the firm's capacity to be agile" (TEECE et al., 2016, p.32). The DCV suggests that external environment aspects (drivers) also interact with these capabilities developed by organizations (SUNDER M; L.S; MARATHE, 2019; FERREIRA; COELHO, 2020). After all, "dynamic capabilities are not only treated as the leverage of internal business processes, e.g. within an internal R&D function but also as a strategic tool to shape the portfolio of external relationships and use them" (MITRĘGA, 2020, p. 193). Given this theoretical perspective, we use the dynamic-capability view in this study to support our last hypothesis:

H5. Drivers impact the TTM reduction capabilities implementation in startups

Based on the literature review, the research model (Figure 6.2) was developed to illustrate the main elements investigated in this study and the hypotheses stated.

Figure 6.2 - Research model



Note: dashed line box represents lower order constructs.

6.3 Research method

This study aims to evaluate the relationship between the drivers and capabilities (independent variables) that impact the reducing TTM (dependent variable) and the start-up performance (dependent variable). Thus, with a large number and variety of companies studied, it is intended to generalize the results obtained and allow future replications by using more quantitative research methods. The constructs to be studied need a retrospective analysis of organizational events. The performance of companies can only be evaluated after the facts have occurred, so observational is more appropriate than experimental research in this case. Thus, we used survey research with managers and CEOs from start-ups with experience in product development.

6.3.1 Measures and questionnaire development

Under the recommendations of Forza (2002), the survey questionnaire was designed. Therefore, the question formulation was considered, and the instrument's language was checked to be consistent with the respondent's understanding. To test the hypotheses of the research model, the variables studied should represent well the construct to be measured. After all, only with quality in the measurement, it is possible to express the cause and effect relationship between variables. Therefore, this instrument was developed using an initial set of constructs proposed by Mota et al. (2021) and items developed and validated in the scale measurement methodology proposed by Menor and Roth (2007).

This step used a set of measures previously applied in empirical studies of the literature, so it is necessary to submit these items to validity and reliability assessments. For this, the item-sorting exercise was used with a group of 81 judges with prior knowledge about product development. Each judge received a list of random items and definitions of the constructs via web and was invited to relate the items to the constructs that have the highest correspondence. Four rounds of this exercise were necessary to achieve satisfactory results. Each round was analyzed using six estimators: (i) the interjudge agreement percentage; (ii) the Cohen's k; (iii) the Perreault and Leigh's Ir; (iv) the proportion of substantive validity; (v) thecoefficient of substantive validity and, (vi) the overall placement ratio. The final instrument used 62 items to measure TTM reduction in startups (See Appendix A), and a large sample of 190 startups was used to confirm the reliability and validity of the scale.

Finally, to achieve the objective of the present study, final research was applied with 164 respondents, who were asked about their level of agreement to each of the 19 capabilities and 5 drivers of TTM reduction, using a seven-point Likert scale range from (1) strongly disagrees to (7) strongly agree. They also answered questions about six control variables (firm size, stage of startup, level of experience, operation market, revenue model and target audience). Data were analyzed using statistical techniques and Partial Least Square

Structural Equation Modeling (PLS-SME), whose results are presented in section 6.4 - Data analysis.

6.3.2 Sample selection and data collection

The study population consisted of startups in Brazil, a large and dynamic emerging market. These criteria led to a non-random choice of companies for research, a commonly used strategy in other exploratory studies (SHAH; WARD, 2007; TORTORELLA et al., 2016). The sample frame with 1952 companies was created from the authors' enterprise network (e.g. LinkedIn) and the Brazilian Startup Association (ABStartup). The survey was hosted at an online survey platform. An invitation e-mail containing a link to the online questionnaire (see Appendix A) including a cover letter (see Appendix B) explaining the purpose of the study and assuring confidentiality and the benefit of receiving a summary of the survey results was sent.

Survey data were collected for 3 months. A total of 225 questionnaire responses were received, but only 192 were complete. After excluding outliers, the final sample was 164. Regarding sample characteristics, most respondents were founders or co-founders (73.2%), with more than 3 years of start-up experience (78.5%). Table 6.1 illustrates this information. This gives the study a satisfactory level of analysis since the respondents followed the product development process since its ideation and are experienced professionals in the specific context of these innovative companies.

Table 6.1 - Sample characteristics (n = 164)

Demographics	**%**	**Demographics**	**%**	**Demographics**	**%**
Sector		*Maturation stage*		*Startup size*	
IT and communication	17.39	Ideation	2.48	1-10 employees	57.76
Education	14.29	Operation	29.81	11-50 employees	27.33
Finances		Traction	39.13	50 - 100 employees	9.32
Health and well-being		Scale	28.57	>100 employees	5.59
Communication and Media					
Internet		*Respondent's experience*		*Acting time*	
Agribusiness		< 3 year	18.63	< 1 year	4.35
Industry		> 3 years	*81.37*	1 - 3 years	35.40
Retail and wholesale				3 - 5 years	32.30
E-commerce		*Respondent's role*		> 5 years	27.95
Civil construction		Founder/ Co-founder	77.64		
Logistics		Director / CEO	19.88	*Market*	
Tourism		Manager / Coordinator	8.69	National	27.95
Events		Others	7.45	Multinational	72.05

Gamers	
Others*	

* such as energy, engineering, sports and the environment.

6.3.3 Data analysis

The data were analyzed to evaluate the four hypotheses through the use of technical statistics and Modeling Structural Equations of Partial Minimum Square (PLS-SME), which is a useful technique for testing predictive relationships in exploratory research (WOLD, 1989; LATAN; NOONAN, 2017; HENSELER, 2021) as in our study. Friedman Two-way ANOVA was used to assess differences in the degree of implementation of capabilities, and to assess their respective association with some control variables Kruskal-Wallis was applied. Lastly, Partial Least Square-Structural Equation Modeling (PLS-SEM) technique was used to examine the reduction of TTM and the path relationships hypothesized in this study.

6.4 Results

6.4.1 Assessing the high-order constructs (HOCs)

The model simultaneously maps the lower constructs (i.e., the 19 capabilities and 5 drivers) and a higher-level construct (i.e., the 6 categories related to – team, strategy, integration, process, product and external environment. This reduces the number of relationships in the structural model, creating a PLS path model that is more parsimonious and easier to apprehend. Initially, the validity and reliability of the measurement model were analyzed as proposed by Peng and Lai (2012). For this, confirmatory factor analysis was used. Fornell and Larcker (1981) criteria were used to test the convergent validity. Therefore, the extracted mean-variance (AVE) was used, which measures the amount of variance captured by the construct to the amount of variance due to measurement error, and was also evaluated using the magnitude and sign of the standardized factor loadings (λ). With the composite reliability values (CR), the reliability was evaluated to verify if the measurement items represent their respective constructs sufficiently.

The constructs exceeded the recommended values of reliability and convergent validity estimators (i.e, AVE > 0.5, $\lambda > 0.7$ and CR > 0.7) (HAIR et al., 2009). For this, a refinement was performed on the items that make up each construct, and those with VIF > 4 were excluded from the model following Myers and Montgomery (2002). This generated the exclusion of 13 items are: Team13, Stra1, Inte2, Inte3, Inte5, Proc6, Proc7, Proc8, Driv1, Driv2, Driv9, Driv10, Driv11. The results before and after refinement are illustrated in Table 6.2.

Table 6.2 - Validity and reliability of the research model constructs

Measurement items	Original			After Refinement						
	AVE	**CR**	**λ**	**AVE**	**CR**	**λ**	**z value**	**Mean**	**Std. Dev.**	**VIF**
TEAM RELATED (TR)	0,597	0,959		0,770	0,957					
Use of cross-functional team										
Team1			0,734			0,737	Ref	5,037	1,920	1,587
Team2			0,673			0,670	18,002	4,262	2,223	1,396
Team experience										
Team3			0,626			0,640	16,054	4,738	2,053	1,995
Team4			0,651			0,657	16,596	4,230	1,971	1,661
Team5			0,739			0,738	16,549	5,508	1,863	1,653
Founders experience										
Team6			0,557			0,566	11,762	4,764	2,227	1,650
Team7			0,598			0,602	13,120	5,209	2,028	1,439
Team8			0,712			0,716	14,873	5,131	2,097	2,012
Team Empowerment										
Team9			0,822			0,816	20,562	5,277	1,792	1,793
Team10			0,700			0,702	15,026	5,073	1,879	1,893
Team11			0,797			0,794	20,227	5,340	1,885	2,287
Transformational Leadership										
Team12			0,855			0,853	23,252	5,492	1,812	2,330
Team13			0,820			-	-	5,885	1,770	-
Team14			0,894			0,896	22,613	5,377	1,828	3,005
Team15			0,873			0,874	22,029	5,550	1,764	2,766
Team16			0,826			0,830	22,701	4,901	1,935	2,285
Learning-By-Doing										
Team17			0,876			0,871	21,595	5,440	1,874	2,453
Team18			0,837			0,834	21,798	5,063	1,964	1,922
Team19			0,838			0,838	21,283	5,084	1,859	2,198
Agile Mindset										
Team20			0,872			0,865	21,176	5,707	1,785	2,721
Team21			0,814			0,810	19,240	5,325	1,911	2,456
Team22			0,749			0,747	18,161	5,257	1,884	2,029
STRATEGY RELATED (SR)	0,687	0,948		0,818	0,938					
Strategic Orientation										
Stra1			0,898			-	-	4,880	2,006	-
Stra2			0,710			0,356	Ref	3,325	2,226	1,722
Stra3			0,902			0,938	31,453	4,539	2,134	2,116
Stra4			0,842			0,848	21,821	4,670	2,210	1,757
Dynamic Marketing										
Stra5			0,835			0,856	27,505	3,990	2,067	3,231
Stra6			0,847			0,873	28,288	4,115	2,134	2,714
Stra7			0,808			0,837	25,557	3,984	2,168	2,442

Stra8			0,828			0,837	24,538	4,335	2,042	1,774
Stra9			0,803			0,818	24,236	3,937	2,279	2,558
Quality Management										
Stra10			0,751			0,778	20,978	3,335	2,068	1,619
Stra11			0,872			0,895	29,884	4,120	2,000	2,216
INTEGRATION RELATED (IR)	0,621	0,931		0,775	0,903					
Inter-Functional Integration										
Inte1			0,863			0,420	Ref	4,660	2,043	2,055
Inte2			0,904			-	-	5,063	2,129	1,561
Customer Integration										
Inte3			0,835			-	-	4,382	2,168	1,744
Inte4			0,814			0,882	20,892	4,105	2,236	1,874
Inte5			0,851			-	-	4,356	2,259	1,897
Suppliers Integration										
Inte6			0,702			0,775	17,653	3,681	2,102	1,908
Inte7			0,785			0,863	21,830	3,576	2,136	1,841
Inte8			0,794			0,875	22,339	3,435	2,153	2,307
Inte9			0,789			0,861	21,987	4,220	2,201	2,449
Other Partnerships										
Inte10			0,562			0,611	10,269	2,927	2,209	1,231
Inte11			0,716			0,788	16,969	4,225	2,341	1,332
PROCESS RELATED (PCR)	0,654	0,954		0,794	0,939					
Process Formalization										
Proc1			0,830			0,417	Ref	4,031	2,127	1,870
Proc2			0,830			0,856	23,192	4,257	2,162	1,517
Proc3			0,795			0,820	21,493	4,304	2,329	1,478
Communication										
Proc4			0,806			0,830	20,000	4,696	2,304	1,275
Proc5			0,743			0,761	18,078	4,597	2,137	1,186
Proc6			0,914			-	-	5,073	2,218	-
Product Testing										
Proc7			0,830			-	-	4,518	2,238	-
Proc8			0,841			-	-	3,749	2,238	-
Proc9			0,825			0,855	22,502	3,634	2,306	1,739
Proc10			0,773			0,796	19,978	4,115	2,217	1,356
Project Structuring										
Proc11			0,834			0,866	22,692	4,346	2,249	1,671
Proc12			0,611			0,640	12,382	3,110	2,336	1,448
Proc13			0,811			0,836	20,062	4,476	2,271	1,357
Proc14			0,878			0,924	26,547	4,298	2,137	1,924
Proc15			0,775			0,806	20,708	4,304	2,295	1,705
PRODUCT RELATED (PDR)	0,582	0,773		0,762	0,772					
Product Innovativeness										
Prod1			0,770			0,782	Ref	5,120	1,754	1,791
Prod2			0,819			0,824	8,117	5,188	1,575	1,155
Prod3			0,695			0,673	6,911	5,408	1,702	1,155

EXTERNAL ENVIRONMENTAL RELATED (EER)	0,425	0,882		0,714	0,862					
Competitive Intensity										
Driv1			0,644			-	-	3,576	1,980	-
Driv2			0,277			-	-	2,791	1,902	-
Market Uncertainty										
Driv3			0,621			0,646	Ref	3,194	1,818	1,675
Driv4			0,686			0,734	11,145	3,346	1,868	1,501
Technological Turbulence										
Driv5			0,724			0,749	10,213	3,838	1,995	1,510
Driv6			0,742			0,753	11,382	3,780	1,969	1,519
Driv7			0,709			0,734	11,118	3,780	1,929	1,195
Time Sensitivity										
Driv8			0,729			0,725	10,795	3,995	2,027	1,306
Driv9			0,655			-	-	3,220	1,851	-
Innovation Ecosystems										
Driv10			0,571			-	-	2,812	1,929	-
Driv11			0,656			-	-	3,199	1,966	-
Driv12			0,674			0,648	7,912	3,178	2,018	1,177
TIME-TO-MARKET (TTM)	0,572	0,819		0,756	0,818					
Ttm1			0,821			0,818	Ref	4,529	1,734	2,138
Ttm2			0,704			0,715	9,762	4,545	1,899	1,838
Ttm3			0,729			0,709	7,021	4,440	1,991	1,455
Ttm4			0,766			0,776	10,261	3,953	1,964	1,544
PERFORMANCE (PERF)	0,647	0,921		0,804	0,921					
Perf1			0,702			0,709	Ref	3,906	1,974	1,610
Perf2			0,867			0,870	17,638	4,518	2,087	2,528
Perf3			0,761			0,755	16,110	3,832	2,098	1,319
Perf4			0,565			0,570	9,469	3,414	1,987	1,089
Perf5			0,870			0,876	17,436	4,387	2,028	3,073
Perf6			0,886			0,883	16,706	4,220	2,011	2,554
Perf7			0,823			0,820	14,836	4,948	1,975	2,020
Perf8			0,901			0,893	15,455	4,995	1,929	2,417

* p value < 0.05

6.4.2 Assessing the reflective measurement model

A reflexive hierarchical component model was constructed to analyze the effect of drivers and capabilities on the TTM reduction and their respective effects on startups' performance. Initially, a comparison of the AVE (average variance extracted) of each factor with its shared variance (square correlation) and with each of the other constructs was used to assess discriminant validity (FORNELL; LARCKER, 1981). All AVE values are greater than the square of the correlation between all possible pairs of constructs so that they meet the established criteria, as shown in Table 6.3. Furthermore, as can be seen in Table 6.4, the factor loading for each item in its intended construct was greater than its cross-loads in all other constructs (HAIR et al., 2014).

Table 6.3 - Discriminant validity

	TR	SR	IR	PCR	PDR	EER	TTM	PERF
TR	**0,770**							
SR	0,662	**0,818**						
IR	0,685	0,770	**0,775**					
PCR	0,681	0,781	0,667	**0,794**				
PDR	0,333	0,249	0,262	0,363	**0,762**			
EER	0,175	0,329	0,425	0,496	0,257	**0,714**		
TTM	0,343	0,326	0,271	0,248	0,323	0,125	**0,756**	
PERF	0,361	0,392	0,455	0,575	0,459	0,493	0,366	**0,804**

Table 6.4 - Cross-loading analysis

	PERF	TTM	DRIV	TR	SR	IR	PCR	PDR
Perf 1	**0,581**	0,323	0,182	-0,019	-0,124	-0,071	0,016	0,048
Perf 2	**0,842**	0,173	0,035	-0,040	0,035	-0,043	-0,010	0,013
Perf 3	**0,438**	0,161	0,196	-0,126	0,020	0,045	0,038	0,175
Perf 4	**0,258**	0,111	0,183	-0,134	-0,051	0,100	-0,012	0,232
Perf 5	**0,893**	0,008	0,041	0,002	0,050	0,026	-0,044	0,009
Perf 6	**0,837**	0,042	0,019	-0,024	-0,020	0,145	0,014	-0,027
Perf 7	**0,691**	-0,043	0,058	0,053	-0,059	-0,098	0,147	0,210
Perf 8	**0,742**	0,017	0,043	-0,008	0,010	-0,007	0,134	0,120
TtM1	0,145	**0,568**	0,008	-0,015	-0,057	0,032	-0,037	0,017
TtM2	0,037	**0,666**	-0,052	0,031	-0,052	-0,029	-0,141	0,100
TtM3	0,100	**0,503**	-0,085	-0,049	0,138	0,080	-0,143	0,034
TtM4	0,121	**0,627**	-0,024	-0,022	-0,055	0,036	-0,117	0,061
Driv3	-0,123	0,129	**0,753**	-0,066	-0,124	0,034	0,046	0,032
Driv4	-0,040	-0,041	**0,736**	-0,051	-0,153	0,172	0,002	0,132
Driv5	0,237	-0,174	**0,688**	0,089	0,202	-0,062	-0,167	0,003
Driv6	0,204	-0,210	**0,637**	0,128	0,103	0,103	-0,082	-0,067

Driv7	-0,021	0,237	**0,528**	-0,006	-0,067	-0,083	0,143	0,126
Driv8	0,109	0,088	**0,603**	0,091	-0,043	-0,035	0,101	-0,067
Driv12	0,128	0,002	**0,374**	0,030	0,234	0,079	-0,163	0,049
Team 1	0,060	0,137	-0,070	**0,485**	0,296	0,031	-0,003	0,111
Team 2	-0,119	0,090	0,182	**0,418**	0,229	0,046	0,030	0,060
Team 3	-0,045	-0,112	-0,094	**0,364**	0,100	0,262	-0,060	0,277
Team 4	-0,020	0,019	0,073	**0,376**	-0,005	0,307	-0,080	0,225
Team 5	0,009	-0,083	-0,044	**0,482**	0,124	-0,036	0,206	0,291
Team 6	0,038	-0,108	-0,143	**0,378**	0,011	0,247	-0,106	0,302
Team 7	0,116	-0,022	-0,061	**0,433**	0,100	0,214	-0,114	0,163
Team 8	0,128	-0,014	-0,215	**0,392**	0,086	0,159	-0,045	0,376
Team 9	-0,007	0,071	0,007	**0,612**	0,050	0,089	0,218	0,116
Team 10	0,123	-0,047	-0,056	**0,530**	0,036	0,260	-0,005	0,170
Team 11	0,048	0,010	-0,037	**0,620**	0,003	0,164	0,057	0,179
Team 12	-0,003	0,091	0,056	**0,712**	0,039	0,097	0,053	0,162
Team 14	0,040	0,114	0,015	**0,713**	0,016	0,129	0,134	0,086
Team 15	0,000	0,054	0,112	**0,716**	0,014	0,100	0,090	0,173
Team 16	-0,021	0,108	0,051	**0,568**	0,159	0,138	-0,016	0,179
Team 17	0,025	0,157	-0,113	**0,557**	0,055	0,152	0,095	0,246
Team 18	0,059	0,156	-0,079	**0,365**	0,116	0,221	0,069	0,246
Team 19	0,022	0,144	-0,035	**0,527**	0,065	0,149	0,103	0,193
Team 20	-0,046	0,222	-0,036	**0,691**	0,094	0,019	0,202	0,052
Team 21	0,037	0,356	-0,030	**0,580**	0,097	-0,035	0,176	-0,020
Team 22	0,038	0,259	0,016	**0,593**	0,010	0,042	0,143	0,012
Stra 2	0,027	0,161	0,017	0,004	**0,428**	0,182	0,122	-0,048
Stra 3	-0,029	0,056	-0,015	0,079	**0,489**	0,206	0,257	0,135
Stra 4	-0,070	0,272	-0,029	0,104	**0,394**	0,043	0,347	0,045
Stra 5	0,008	0,107	0,103	-0,034	**0,789**	0,023	0,045	0,080
Stra 6	0,037	0,094	-0,009	-0,060	**0,687**	0,228	0,059	0,053
Stra 7	0,117	0,044	-0,045	-0,057	**0,696**	0,122	0,065	0,132
Stra 8	0,145	-0,023	-0,026	0,074	**0,571**	0,172	0,150	0,044
Stra 9	0,029	0,066	0,023	-0,021	**0,746**	0,006	0,091	0,082
Stra 10	-0,072	0,251	0,111	-0,014	**0,442**	0,189	0,094	0,007
Stra 11	0,038	0,190	0,050	0,031	**0,475**	0,106	0,248	0,108
Inte1	0,098	-0,057	0,014	0,085	0,209	**0,335**	0,325	0,136
Inte4	0,104	0,259	0,063	0,021	0,250	**0,342**	0,164	-0,016
Inte6	-0,016	-0,003	0,099	-0,055	-0,006	**0,806**	-0,023	0,085
Inte7	0,055	0,104	0,127	-0,011	0,277	**0,454**	0,080	0,039
Inte8	0,052	0,232	0,126	0,001	0,112	**0,702**	0,043	-0,145
Inte9	0,071	0,046	0,066	-0,055	-0,023	**0,762**	0,158	0,028
Inte10	0,002	0,037	0,041	-0,082	-0,026	**0,457**	0,137	0,083
Inte11	0,009	-0,001	0,077	0,047	0,220	**0,459**	0,084	0,069
Proc 1	-0,003	0,067	0,168	-0,053	0,088	0,145	**0,582**	0,191
Proc 2	0,187	0,094	-0,069	0,089	0,042	0,153	**0,620**	-0,001
Proc 3	0,074	0,085	0,217	0,143	0,389	-0,171	**0,508**	-0,091
Proc 4	0,239	-0,143	0,161	0,146	0,270	0,126	**0,435**	-0,087
Proc 5	0,111	-0,093	0,153	0,071	-0,031	0,243	**0,459**	0,121
Proc 9	0,064	0,201	0,186	0,023	0,264	0,075	**0,383**	0,006

Proc 10	0,095	-0,008	0,128	-0,035	0,081	0,152	**0,382**	0,290
Proc 11	0,220	0,128	0,060	0,082	0,053	0,056	**0,596**	0,033
Proc 12	0,012	0,083	0,087	-0,084	-0,058	0,264	**0,371**	0,108
Proc 13	0,091	-0,118	0,190	0,017	0,055	0,127	**0,458**	0,333
Proc 14	0,090	0,031	0,060	-0,019	0,244	0,089	**0,530**	0,215
Proc 15	0,093	-0,025	0,013	-0,025	0,028	0,158	**0,570**	0,213
Prod 1	0,102	0,125	0,054	-0,174	0,010	-0,184	-0,100	**0,785**
Prod 2	0,007	0,348	0,098	-0,114	-0,070	-0,200	-0,036	**0,643**
Prod 3	0,011	-0,063	0,072	-0,186	-0,037	-0,027	0,058	**0,636**

6.4.3 Estimating the model and hypotheses testing

PLS-SEM was used to estimate research model relationships and test hypotheses 1, 3 and 5. Figure 6.3 presents the result of these relationships. By evaluating the relationships between drivers and capability categories, the highest path coefficient (β) was 0.948 between drivers and integration-related capabilities, while the lowest was 0.367 between drivers and product-related capabilities. The relationship between each category of capabilities and TTM reduction was also tested. The highest coefficient value in these relationships was between TTM reduction (R^2 = 0.552) and integration-related capabilities (0.455), while the lowest was with process-related capabilities (-0.213). The relationship between the TTM reduction and the start-ups' performance was also evaluated, which presented a high coefficient of 0.781 (R^2 = 0.745). These relationships were statistically significant at a p-value <0.05 (see Table 6.5). A good model fit is established since the model has significant path coefficients and acceptably (moderate) R-square value. The findings confirm the effect between these constructs therefore the three hypotheses can be accepted. A more in-depth discussion of these results is presented in section 6.5.

Figure 6.3 - Generated hierarchic structural model with drivers and capabilities

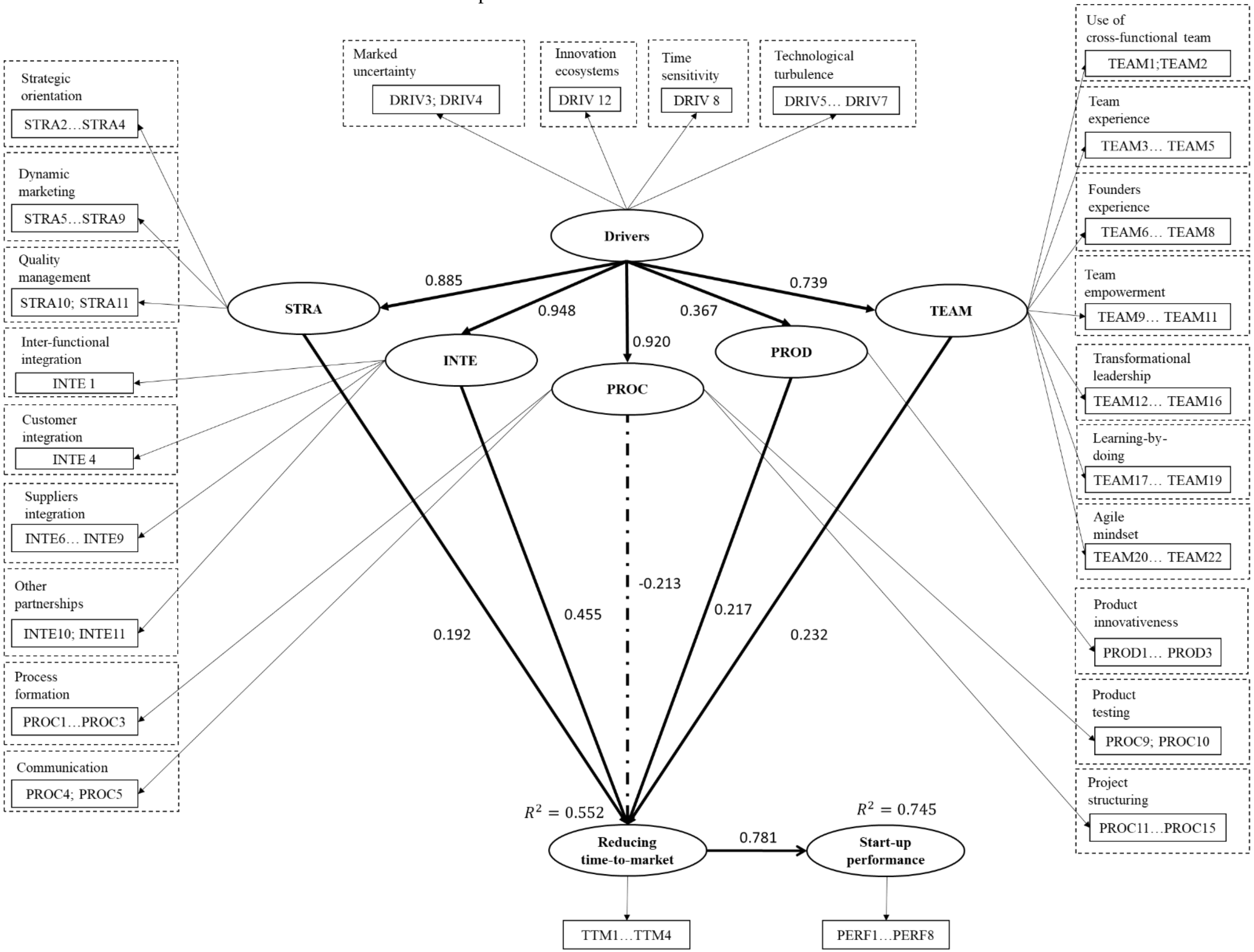


Table 6.5 - Significance analysis of the structural model relationship

Relation	Path	P value
Drivers ▪ Team-related capabilities	0.739*	0.000
Drivers ▪ Strategy-related capabilities	0.885*	0.000
Drivers ▪ Integration-related capabilities	0.948*	0.000
Drivers ▪ Process-related capabilities	0.920*	0.000
Drivers ▪ Product-related capabilities	0.367*	0.000
Team-related capabilities ▪ TTM reduction	0.232*	0.010
Strategy-related capabilities ▪ TTM reduction	0.192*	0.040
Integration-related capabilities ▪ TTM reduction	0.455	0.000
Process-related capabilities ▪ TTM reduction	-0.213	0.132
Product-related capabilities ▪ TTM reduction	0.217	0.002
TTM reduction ▪ Start-ups' performance	0.781	0.000

*sig.<0.05

Hypothesis 2 (Start-ups implement TTM reduction capabilities in a fragmented way) was supported by using a nonparametric test for k related samples (Friedman two-way ANOVA test). The results show a difference in the degree of adoption of TTM reduction capabilities as a 5% significance level ($\chi^2 = 1720.4; df = 61; p = 0.000$) (see Table 6.2). 22 of the 62 items were adopted by the majority of the respondents with a median equal to 6. 18 are related to the team, one is related to integration, two to process and one to the product. On the other hand, some TTM reduction capabilities are limited adopted in the start-ups. 17 items had a median less than 4.0. Furthermore, a Friedman test was employed to compare the degree of adoption of the capabilities within each of the 24 constructs. Table 6.6 summarizes the results. All constructs presented differences between the degree of adoption of the practices that represent them, as a 5% significance level. These results show that hypothesis 1 can be accepted once the adoption of TTM reduction capabilities in the start-ups occurs in a fragmented manner.

We also control the degree of capabilities implementation to compare different startup sizes, start-up stages and operating markets. We employed Kruskal-Wallis tests to check their association with the degree of adoption of TTM reduction capabilities in startups (see Table 6.7). Company size was measured as the number of employees in the start-up and grouped into three categories: small companies (between 1 to 50 employees), medium companies (between 51 and 100 employees) and large companies (above 100 employees). Most of the start-ups in the sample are small (83,6%), followed by medium (11,1%), and by large (5,3%). The five capabilities' mean adoption rates (mean rank) were significantly different at the 0.05 confidence level, being most of them related to the team (three of them). The other two are capabilities related to the process (two of them) (see Table 6.7).

Table 6.6 - The degree of implementation of TTM reduction capabilities among start-ups

Construct	Item code	Mean	Median	Std. Dev.	Min.	Max.	Frequency						
TEAM (Mean = 5,18; Median = 6; Std. Dev. = 1,96)	Team 1	**5,05***	6	1,91	1	7	22	5	8	23	35	49	52
	Team 2	4,28	5	2,22	1	7	40	16	12	24	26	35	41
	Team 3	4,76	5	2,05	1	7	24	13	13	25	31	36	52
	Team 4	4,26	4	1,98	1	7	24	20	25	33	31	27	34
	Team 5	**5,52***	6	1,85	1	7	16	6	8	6	34	43	81
	Team 6	**4,78***	6	2,22	1	7	31	13	10	20	23	34	63
	Team 7	**5,22***	6	2,02	1	7	22	6	7	24	25	33	77
	Team 8	**5,14***	6	2,09	1	7	22	10	9	20	30	22	81
	Team 9	**5,29***	6	1,78	1	7	16	1	10	27	33	43	64
	Team 10	**5,09***	6	1,87	1	7	19	10	5	18	38	57	47
	Team 11	**5,37***	6	1,88	1	7	15	10	7	14	33	41	74
	Team 12	**5,51***	6	1,80	1	7	15	4	7	16	30	43	79
	Team 13	**5,9***	7	1,76	1	7	16	3	3	4	10	58	100
	Team 14	**5,4***	6	1,82	1	7	15	6	6	19	36	38	74
	Team 15	**5,56***	6	1,76	1	7	14	3	8	15	26	51	77
	Team 16	4,93	5	1,93	1	7	18	10	16	26	32	38	54
	Team 17	**5,46***	6	1,87	1	7	17	5	9	11	25	53	74
	Team 18	**5,08***	6	1,96	1	7	19	10	10	21	32	41	61
	Team 19	**5,10***	6	1,85	1	7	17	6	13	22	38	42	56
	Team 20	**5,71***	6	1,78	1	7	16	1	6	10	26	43	92
	Team 21	**5,34***	6	1,90	1	7	19	5	6	18	31	43	72
	Team 22	**5,27***	6	1,88	1	7	19	6	4	22	29	52	62
STRA (Mean = 4,13; Median = 4; Std. Dev. = 2,17)	Stra 1	**4,88***	5	2,01	1	7	25	8	11	19	41	38	52
	Stra 2	3,36	3	2,24	1	7	66	27	12	23	19	21	26
	Stra 3	4,55	5	2,14	1	7	34	9	11	30	30	33	47
	Stra 4	**4,67***	5	2,22	1	7	36	10	9	18	27	42	52
	Stra 5	4,01	4	2,07	1	7	41	14	18	31	38	24	28
	Stra 6	4,13	4	2,13	1	7	38	15	20	29	31	24	37
	Stra 7	4,01	4	2,17	1	7	48	10	15	30	30	32	29
	Stra 8	4,35	5	2,05	1	7	35	13	5	36	37	37	31
	Stra 9	3,94	4	2,28	1	7	53	15	15	17	27	35	32
	Stra 10	3,37	3	2,07	1	7	57	27	20	24	26	24	16
	Stra 11	4,14	4	2,01	1	7	34	14	21	31	38	28	28
INTE (Mean = 4,07; Median = 4; Std. Dev. = 2,26)	Inte 1	4,66	5	2,05	1	7	29	9	15	20	36	43	42
	Inte 2	**5,07***	6	2,13	1	7	31	4	5	17	28	42	67
	Inte 3	4,40	5	2,17	1	7	35	15	16	21	27	39	41
	Inte 4	4,12	5	2,25	1	7	49	10	14	21	32	32	36
	Inte 5	4,36	5	2,27	1	7	42	12	13	20	27	34	46
	Inte 6	3,70	4	2,11	1	7	48	24	16	27	28	31	20
	Inte 7	3,60	4	2,14	1	7	57	16	17	29	32	19	24
	Inte 8	3,45	3	2,16	1	7	59	24	20	20	25	25	21
	Inte 9	4,23	4,5	2,21	1	7	39	14	22	22	25	30	42
	Inte 10	2,94	2	2,21	1	7	88	22	13	14	19	18	20
	Inte 11	4,23	5	2,34	1	7	49	15	8	13	32	34	43

* p value < 0.05

Table 6.6 - The degree of implementation of TTM reduction capabilities among start-ups (continued)

Construct	Item code	Mean	Median	Std. Dev.	Min.	Max.	Frequency						
PROC (Mean = 4,24; Median = 5; Std. Dev. = 2,28)	Proc 1	4,05	4	2,13	1	7	44	14	12	32	30	35	27
	Proc 2	4,26	5	2,17	1	7	40	13	13	26	30	36	36
	Proc 3	4,31	5	2,32	1	7	48	8	11	23	26	29	49
	Proc 4	**4,71***	6	2,31	1	7	39	11	6	15	25	37	61
	Proc 5	4,60	5	2,13	1	7	32	11	12	21	38	31	49
	Proc 6	**5,08***	6	2,22	1	7	36	3	3	11	27	43	71
	Proc 7	4,53	5	2,25	1	7	39	8	18	13	30	35	51
	Proc 8	3,77	4	2,24	1	7	55	17	16	21	31	23	31
	Proc 9	3,65	4	2,31	1	7	60	22	14	18	23	24	33
	Proc 10	4,13	4	2,23	1	7	41	16	24	20	22	31	40
	Proc 11	4,35	5	2,25	1	7	43	11	11	20	32	34	43
	Proc 12	3,12	2	2,32	1	7	86	18	10	19	15	19	27
	Proc 13	4,49	5	2,26	1	7	39	13	12	16	25	41	48
	Proc 14	4,31	5	2,14	1	7	38	13	12	26	33	37	35
	Proc 15	4,31	5	2,29	1	7	47	10	9	20	28	37	43
PROD (Mean = 5,25; Median = 6; Std. Dev. = 1,68)	Prod 1	5,14	5	1,75	1	7	9	14	10	25	41	40	55
	Prod 2	5,21	5	1,57	1	7	6	7	15	27	45	45	49
	Prod 3	**5,41***	6	1,69	1	7	6	11	11	23	32	40	71

* p value < 0.05

There were six capabilities whose adoption greatly differed depending on the start-up stage (see Table 6.7). Four start-ups stage were considered according to the level of maturity (TRIPATHI et al., 2019; MOTA et al., 2021), they are: ideation, the company still does not have much market or customer data to prove that its products will be successful; operation, the company has performance data and metrics to which staff and investors can react; traction, the focus is on the demand growth and the infrastructure needed to meet this expansion; and scale-up, the company has reached maturity and has a sustainable business model with revenue growth for consecutive years. Most of companies surveyed are in the traction stage (39,13%), followed by operation stage (29,81%), scale-up stage (28,57%) and ideation stage (2,48%). The mean rank of six capabilities was significant, two of them related to the team, one related to strategy, one related to integration, and two related to the process.

The last control variable analyzed was the operating market. Most startups surveyed operate on a global scale (72,05%), while 27,95% operates only in the national market. In this category of analysis, we observed significant data. The mean rank of ten capabilities was significant, four of them related to the team, one related to integration, two related to process, and three related to the product.

Table 6.7 – The effect of control variables in the degree of adoption of TTM reduction capabilities among start-ups

CAPABILITIES	**START-UP SIZE**					**START-UP STAGE**						**OPERATING MARKET**			
	Small	**Medium**	**Large**			**S1**	**S2**	**S3**	**S4**			**Nat.**	**Mult.**		
	MR.	MR.	MR.	χ^2	p-value	MR.	MR.	MR.	MR.	χ^2	p-value	MR.	MR.	χ^2	p-value
Team 1	81,36	87,35	67,94	2,85	0,24	**68,75**	**74,11**	**93,51**	**70,73**	**10,11**	**0,04***	**76,17**	**93,46**	**4,70**	**0,03***
Team 2	76,04	82,58	97,33	4,18	0,12	72,88	76,05	82,21	83,77	2,65	0,62	77,96	88,84	1,83	0,18
Team 3	84,73	77,86	72,31	1,69	0,43	85,5	83,97	85,43	73,15	4,91	0,30	**75,51**	**96,14**	**5,97**	**0,01***
Team 4	84,55	76,82	74,92	1,34	0,51	105,24	82,50	82,79	75,27	2,11	0,72	77,99	88,77	1,78	0,18
Team 5	80,10	83,63	79,65	0,22	0,90	79,88	81,47	85,65	75,92	4,41	0,35	80,42	82,50	0,07	0,79
Team 6	81,15	90,28	63,39	5,44	0,07	92,13	67,27	86,38	87,96	8,13	0,09	78,59	87,20	1,16	0,28
Team 7	76,06	84,78	93,21	3,27	0,20	91	68,29	85,29	86,22	6,34	0,18	78,13	88,40	1,72	0,19
Team 8	80,03	87,52	72,79	1,82	0,40	83,5	73,36	84,67	85,22	5,24	0,26	**77,15**	**90,92**	**3,13**	**0,08***
Team 9	82,82	80,02	75,72	0,50	0,78	92,88	72,34	91,25	73,66	7,82	0,10	78,17	88,30	1,65	0,20
Team 10	87,10	77,54	63,89	5,51	0,06	116,75	79,05	84,73	75,94	5,05	0,28	78,54	87,32	1,23	0,27
Team 11	**88,53**	**79,54**	**54,50**	**11,18**	**0,00***	107,88	77,84	84,19	76,49	3,62	0,46	80,69	81,79	0,02	0,89
Team 12	81,41	83,82	74,23	0,75	0,69	86	70,29	90,15	77,99	6,79	0,15	78,71	86,90	1,11	0,29
Team 14	82,21	83,02	72,60	1,01	0,60	87,25	76,06	88,69	73,94	4,81	0,31	78,71	86,90	1,10	0,29
Team 15	82,08	82,95	73,23	0,89	0,64	112,63	82,28	82,9	73,33	4,69	0,32	77,63	89,67	2,41	0,12
Team 16	86,76	77,23	65,58	4,53	0,10	95,25	75,68	87,3	77,47	3,34	0,50	78,01	88,71	1,79	0,18
Team 17	80,48	88,50	69,27	2,96	0,23	99,38	74,28	86,75	77,35	4,29	0,37	77,20	90,70	3,14	0,08
Team 18	80,68	86,02	73,04	1,30	0,52	84,63	71,59	91,86	74,28	8,10	0,09	77,60	89,60	0,85	0,36
Team 19	85,34	77,85	69,96	2,49	0,29	81,38	71,59	89,9	77,21	6,25	0,18	**76,10**	**93,60**	**8,67**	**0,00***
Team 20	**77,80**	**95,08**	**67,60**	**7,55**	**0,02***	77,13	71,17	90,66	77,29	6,84	0,14	77,85	89,11	2,22	0,14
Team 21	**80,17**	**93,80**	**60,75**	**8,66**	**0,01***	**75,13**	**64,71**	**99,77**	**71,42**	**20,88**	**0,00***	80,79	81,54	0,01	0,92
Team 22	77,93	89,52	77,25	2,18	0,34	90,88	70,87	88,13	79,57	5,60	0,23	78,16	88,31	1,65	0,20
Stra 2	82,73	74,39	86,42	1,38	0,50	88,13	72,09	85,02	84,56	2,96	0,56	81,05	80,87	0,00	0,98
Stra 3	87,55	71,11	73,73	4,58	0,10	70,13	76,84	88,28	76,44	2,72	0,61	77,98	88,79	1,81	0,18
Stra 4	81,26	80,73	80,50	0,01	1,00	**69,75**	**66,13**	**92,21**	**80,59**	**10,61**	**0,03***	81,48	79,76	0,05	0,83
Stra 5	83,96	77,50	75,94	0,93	0,63	59,88	77,66	85,01	79,3	3,76	0,44	82,37	77,46	0,37	0,54
Stra 6	86,02	73,13	75,95	2,68	0,26	58	79,19	83,67	79,83	3,16	0,53	81,47	79,80	0,04	0,84
Stra 7	83,40	75,16	82,42	0,99	0,61	75,5	76,46	87,33	78,63	3,24	0,52	81,22	80,44	0,01	0,92

Stra 8	85,80	80,38	63,54	4,52	0,10	88,25	73,40	91,21	73,46	6,27	0,18	80,94	81,14	0,00	0,98
Stra 9	77,60	87,70	81,88	1,45	0,48	65	74,46	84,59	85,15	3,19	0,53	80,98	81,04	0,00	0,99
Stra 10	85,12	72,09	81,38	2,39	0,30	82,63	75,93	87,1	76,11	4,71	0,32	80,29	82,83	0,10	0,75
Stra 11	81,19	80,11	81,40	0,03	0,99	72,62	74,03	87,45	78,56	4,67	0,32	80,56	82,14	0,04	0,84
Inte 1	86,48	76,66	67,73	3,78	0,15	95,62	74,97	86,07	79,88	2,97	0,56	79,45	84,99	0,48	0,49
Inte 4	76,94	84,41	90,48	1,99	0,37	**73,25**	**61,99**	**90,77**	**87,05**	**12,25**	**0,02***	80,53	82,21	0,04	0,83
Inte 6	87,74	72,01	71,38	4,70	0,10	98,5	79,07	85,45	74,9	2,25	0,69	78,93	86,34	0,84	0,36
Inte 7	81,88	83,95	72,19	1,09	0,58	86,25	70,74	83,83	85,65	5,30	0,26	78,01	88,71	1,75	0,19
Inte 8	86,97	73,20	72,15	3,71	0,16	72,88	79,14	85,78	75,53	3,86	0,42	78,49	87,47	1,23	0,27
Inte 9	87,28	71,43	74,21	4,18	0,12	65,5	72,23	85,71	83,55	4,68	0,32	78,79	86,70	0,96	0,33
Inte 10	83,96	79,52	72,23	1,35	0,51	99,25	72,41	83,91	83,78	2,95	0,57	**75,47**	**95,24**	**6,18**	**0,01***
Inte 11	83,81	77,61	76,33	0,84	0,66	74,5	85,97	81,62	75,83	1,27	0,87	78,35	87,83	1,39	0,24
Proc 1	80,28	81,95	82,04	0,05	0,97	70	70,56	86,9	83,07	5,92	0,21	75,19	95,98	6,65	0,01
Proc 2	82,61	82,03	72,88	0,89	0,64	71,25	77,22	84,79	79,16	2,86	0,58	75,73	94,58	5,48	0,02
Proc 3	79,79	79,74	88,02	0,67	0,72	82,75	69,57	91,63	76,72	8,30	0,08	78,34	87,87	1,41	0,23
Proc 4	82,46	77,45	81,83	0,38	0,83	**79,5**	**63,83**	**91,41**	**83,32**	**11,62**	**0,02***	78,70	86,93	1,09	0,30
Proc 5	**89,32**	**69,00**	**70,75**	**7,40**	**0,02***	109,25	75,41	89,12	73,47	5,65	0,23	78,50	87,43	1,25	0,26
Proc 9	80,99	75,29	91,50	1,92	0,38	**80,5**	**66,85**	**92,5**	**78,34**	**10,48**	**0,03***	77,78	89,31	2,04	0,15
Proc 10	82,97	83,56	68,69	2,03	0,36	107	74,85	85,9	79,64	4,68	0,32	77,37	90,37	2,60	0,11
Proc 11	**72,75**	**92,22**	**92,38**	**7,16**	**0,03***	72,88	70,23	84,24	86,99	5,51	0,24	78,33	89,88	1,41	0,23
Proc 12	78,90	86,54	78,98	0,90	0,64	112,63	67,58	82,91	87,88	9,39	0,05	78,80	86,68	0,98	0,32
Proc 13	79,87	79,26	88,58	0,79	0,67	96	74,18	79,7	89,61	4,57	0,33	**73,86**	**99,41**	**10,22**	**0,00***
Proc 14	79,50	84,38	80,60	0,34	0,84	65,38	74,80	86,41	82,05	2,83	0,59	**74,38**	**98,06**	**8,66**	**0,00***
Proc 15	80,71	90,61	64,50	5,07	0,08	103,25	71,68	85,89	80,61	5,29	0,26	76,97	91,37	3,22	0,07
Prod 1	80,76	86,74	71,42	1,77	0,41	66,5	82,48	78,21	86,25	4,21	0,38	**72,14**	**103,84**	**15,75**	**0,00***
Prod 2	76,68	91,43	78,62	3,22	0,20	74,12	74,10	78,72	91,39	3,88	0,42	**74,42**	**97,97**	**8,68**	**0,00***
Prod 3	77,52	84,08	88,83	1,51	0,47	89,25	77,88	78,36	88,51	4,06	0,40	**72,39**	**103,19**	**15,39**	**0,00***

MR.: Mean rank.
S1: Ideation; S2: Operation; S3: Traction; S4: Scale-up.
*sig.< 0.05

6.4.4 Moderating effect

We found that implementing some categories of capabilities at a higher rate reduces time-to-market. Our findings show that start-ups improve their performance from this reduction. Our results support previous research that there is a positive relationship between TTM reduction and performance (CANKURTARAN; LANGERAK; GRIFFIN, 2013; FENG et al., 2014; CHANG; TAYLOR; META-ANALYSIS, 2016). To further explore these relationships, we also tested hypothesis 3 whether the level of experience (i.e. the time the company is in operation.), operating market (national or multinational) and target market moderates (business-to-customers - B2C, business-to-business - B2B or business-to-business-to-customers - B2B2C) the relationship. Significant effects were found in the latent performance variable (Table 6.8).

The results show that the level of experience positively moderates the performance indicators. Therefore, the higher the level of experience, the better the performance achieved with the reduction of the TTM (with a significance of 0.03). These findings suggest that experience level is important when implementing TTM reduction capabilities in start-ups. The study also shows that companies that operate on global scale are more benefited in their performance with the reduction of TTM than those that operate on a national scale (with a significance level of 0.01). The target market moderation was not significant for any of the types tested. However, it is suggested that future studies specifically analyze samples with each of these types.

Table 6.8 - The moderator effect of level of experience, operating and target market in start-ups' performance

Relation	Path	p-value
TTM reduction ▪ Start-ups' performance (H4)	0.781	0.000
TTM reduction ▪ Start-ups' performance (Level of experience_Low)	Ref	
TTM reduction ▪ Start-ups' performance (Level of experience_Moderate)	0.263	0.169
TTM reduction ▪ Start-ups' performance (Level of experience_High)	0.474*	0.035
TTM reduction ▪ Start-ups' performance (Operating market_National)	Ref	
TTM reduction ▪ Start-ups' performance (Operating market_Multinational)	0.492*	0.007
TTM reduction ▪ Start-ups' performance (Target market_B2C)	Ref	
TTM reduction ▪ Start-ups' performance (Target market_B2B)	-0.102	0.775
TTM reduction ▪ Start-ups' performance (Target market_B2B2C)	-0.058	0.867

*sig.<0.05

6.5 Discussion and framework proposal

Following the conceptual framework of Mota et al. (2020), which is advanced by our empirical findings, we summarize the results presented in Tables 6.5, 6.6, 6.7 and 6.8, as well as in Figures 6.3. This summary presents an integrated way of how some capabilities implemented by startups have a greater influence on reducing the time-to-market and how some external aspects (drivers) affect this implementation. In addition, the effect of TTM reduction on start-up performance was also tested with their respective moderating variables. The literature supports the results and can be discussed using the DC view, more specifically Teece's (2007) model, given its strong relationship with innovation and, therefore, more suitable for a start-up perspective. Accordingly, using the lens of dynamic capability theory, our research presupposes that startups must develop sensing and seize opportunities to reconfigure the company's assets and intangible resources during its product development process to obtain greater advantages from shortening time to market. That is, different categories of capabilities contribute to the TTM reduction (H1) in different intensities given the micro-foundations of the DC of sensing (i.e., ability to explore the firm's environment to identify opportunities), seizing (i.e., as soon as opportunities are sensed, they must be addressed) and reconfiguration (i.e., to address new opportunities, firms need to reconfigure their resources) (TEECE; PETERATD; LEIH, 2016).

The category that had the greatest intensity concerning the reduction of TTM was the capabilities related to integration. In other words, companies that managed to establish partnerships during their product development process were faster. The NPD literature supports this result (DROGE; JAYARAM; VICKERY, 2004; ELVERS; SONG, 2016) and agrees with the DCV (POLO GARCÍA-OCHOA; DE-PABLOS-HEREDERO; BLANCO JIMÉNEZ, 2020). By better integrating with customers and suppliers, startups improve their sensing capabilities. After all, closer proximity to the consumer allows a better understanding of their demands and requirements through structured feedback rounds. In addition, proximity to the supplier enables the sharing of project risks, greater know-how about developing new technologies and integration with the process. Moreover, by having good functional integration and establishing good external partnerships, such as research institutions and other companies, the company also improves its reconfiguration capabilities (KONG et al., 2015; GONZALEZ-ZAPATERO; GONZALEZ-BENITO; LANNELONGUE, 2017a). After all, with good team synergy, it is possible to establish milestones and achieve more precise goals, in addition to the possibility of raising additional resources with partner companies and thus completing the NPD process more quickly.

Still on the intensity of the relationship between capabilities and TTM reduction, the second category evaluated was related to the team. The efficient structuring of the NPD team with multifunctional, empowered professionals with strong transformational leadership and a culture aligned with agility provides startups with better sensing and seizing capabilities. After all, managerial cognition and human capital have a structuring role in dynamic capabilities (TEECE; PETERATD; LEIH, 2016). The proper choice of skills and abilities of each team member allows the company to better interpret the data collected in the market, better execution of operational activities, and decision-making to respond dynamisms. Furthermore, our results suggest that special attention should be given by these companies when choosing leaders, according to what Kim et al. (2018, p.11) claim "the style of leadership exhibited by team leaders of small- and medium-sized enterprises in information technology has a significant role in explaining organizational variables".

Concernig people, startup founders need to possess an entrepreneurial mindset and characteristics to establish their business in today's highly competitive market. These attributes can also allow them to improvise their minimum viable product (MVP), proposing more or less radical solutions to unmet customer needs (TRIPATHI et al., 2019), thus differentiating their products from those of their competitors and achieving different degrees of innovativeness. This gives entrepreneurs the need for efficient development of sensing characteristics, to understand what is required by customers, and what, despite not yet being demanded, can be disruptive and absorbed by the market. However, also reconfiguration to carry out the necessary experiments and adjustments in the product. Thus, when evaluating the product-related category, it is noted that despite having a positive relationship with the reduction of TTM, it has a low intensity. This agrees with Pesch et al. (2015), who suggest that the search for speed and high product innovativeness can be opposite paths. After all, depending on the complexity of what is being developed, it may take more or less time, and therefore should be evaluated in a more categorized way.

To discuss our findings in the strategy category, we base ourselves on the statement by Teece et al. (2016):

> Dynamic capabilities can be analytically separated from the formulation of strategy but must be congruent with the strategic direction that emerges from the strategy process. A strategy that is consistent, coherent, and accommodating of innovation is just as vital as dynamic capabilities to achieving competitive advantage. Hence, while strategy and capabilities can be analytically separated, as a practical matter they need to be developed and implemented together (Teece et al., 2016, p.18).

These authors found in their studies that innovative companies can be inserted in highly dynamic environments, guided by great technological turmoil and market uncertainties, tend to adopt a greater degree of improvisation in their decisions and have less structured strategies. However, the most successful companies do not have this structure in their operations. Therefore, the authors conclude their findings by suggesting that this distinction of strategy and dynamic capabilities should not be in opposite directions. In the case of the studied startups, we found a positive relationship between the adoption of managerial, quality and marketing strategies. However, the low intensity can be justified by the possible difficulty these companies have encountered in this implementation. A well-aligned strategy allows the company to develop capabilities to capture and reconfigure entrepreneurial opportunities, making the trajectory of individual innovation more efficient (FERREIRA; COELHO, 2020).

An unexpected result was obtained in the process category. Contrary to the traditional NPD literature, startups with a higher degree of formalization of their processes did not obtain greater TTM reductions. On the other hand, this is more in line with innovative entrepreneurship literature in the sense that startups tend to work more in the process of trial and error and a culture of failing fast. In other words, what Bennett and Lemoine (2014) called a mindset of experimentation, fundamental for innovative companies inserted in a more dynamic environment. Moreover, this could be evaluated as a transition element between the seizing and reconfiguration capabilities of these organizations. By working with innovation, startups need to be more flexible than traditional companies to pivot quickly in response to a a significant change in scenario. The elevation of capabilities related to the process tending to a logic of formalization can stifle some company actions to limit it within a temporal perspective. In addition, the search for process standardization itself demands a time that directly interferes with the organization's results. This fact is advantageous for traditional companies, since they may be developing several new products in series, but disadvantageous for innovation companies that look for a disruptive product. Teece et al. (2016, p. 18) justify this by stating that “strong capabilities are never based entirely on routines or rules. One reason is that routines tend to be relatively slow to change. Good managers think creatively, act entrepreneurially, and, if necessary, override routines”.

Along with the impact of each capability category on TTM reduction, we analyze the degree of capabilities implementation by the sample of startups (see Table 6) to test our hypothesis that startups implemented capabilities in a fragmented way (H2). We verified that the capabilities with the lowest implementation were related to strategy and integration with a median 4. When performing a more in-depth analysis within these categories, it is observed that the subcategories of quality management, supplier integration and other partnerships (such as with universities and research institutions) were the ones with the lowest median. The low applicability of these capabilities supports the previous findings of Wu et al. (2020), Kim et al., (2018) and Heirman and Clarysse (2007). First, the NPD literature widely discusses the dual effect of quality and speed (WU; LIU; SU, 2020). Some authors argue that the rigour necessary for the use of quality methods and tools can slow down the NPD process (EVANSCHITZKY et al., 2012), while other authors argue that such methodologies allow for a better translation of customer requirements into product specifications. Therefore they become an NPD facilitator and shorten their time (CHEN; REILLY; LYNN, 2005). For startups during NPD, efficient quality management can help product-market fit, enabling companies to deliver value more quickly to their customers. Given the multiplicity of quality areas within organizations, our result should be evaluated with caution since a specific part of quality management (QFD and metrics) was questioned. Startups may not adopt more formal process and product quality assessment practices; however, this does not imply that they are not developing quality-related practices in their operations. In addition, there may be stages of the NPD in which this capability becomes more active. After all, startups have an intensive learning phase, in which the enterprise seeks to adjust to the product market, and a scaling phase, after obtaining the adjustment to the product market (CONTIGIANI; LEVINTHAL, 2019). This finding suggests that cutting and deepening this issue may bring important insights to these organizations.

The analysis of integration with suppliers in this type of company is also complex. Integration with suppliers is a widespread practice in the product development process. After all, this practice makes it possible to align the different NPD stages, share know-how and even transfer risks through contractual agreements where the payment of parts/subsystems is dependent on the sale of the final products (TEECE; PETERATD; LEIH, 2016). Such practice is widely practised across industries. Although, startups are at a high risk of failure compared to existing companies and lack established channels with suppliers (KIM; KIM; JEON, 2018). Our results prove this with the low implementation of co-development practices with suppliers in the evaluated companies. Still in the integration category, despite recognising the importance of external institutions as partners for organizations learning (Kessler et al., 2000), our results suggest that startups may face some barriers to developing these integrations. Cultural adaptations between those involved must be treated with special care in any integration process. Given the peculiar characteristics of the development of innovative products, which are associated with high risks and uncertainties, research institutions and traditional companies may have more rigid routines and find it challenging to adapt to this context. Previous studies, such as Heirman and Clarysse (2007), suggest that collaborations with private companies and universities can also have adverse effects on reducing TTM in startups. However, as the authors emphasize, this does not mean that working with universities slows down the innovation process; on the other hand, it indicates that this partnership can be more fruitful for startups that require the specialized scientific knowledge of university faculty to remain at the forefront of new technologies. Moreover, collaborations with other companies can be more fruitful in gaining access to complementary resources and capabilities.

Our study also evaluated possible control variables related to capabilities implementation (see Table 7). Most capabilities were implemented to a similar degree across different sizes of companies. However, the differences were more expressive in the capabilities related to the team. Our results suggest that large companies, as expected due to the greater availability of resources, obtained a higher degree of process structuring and a lower degree of implementation of capabilities related to the empowerment of team members and the agile mindset. This supports what has been proposed by (TRIPATHI et al., 2019) that demonstrate the importance of empowerment and the proper mindset for startups, but point to the difficulty of their development. Therefore, the larger the organization, the more complex this development becomes. The company's maturity level, that is, the startup stage, also affected the degree of TTM reduction capabilities implementation, especially the constructs related to team and process. The results indicate that traction-stage companies have implemented a more cross-functional team structuring, agility mindset, a common database use, and prototype testing. This can happen because companies at this stage have already gone through the first rounds of investments and have external actors (such as investors and accelerators) demanding their growth and structuring. Moreover, the last control variable that affected this implementation was the operating market where multinationals, as expected, had a greater concern in implementing capabilities related to the team and the product.

Given previous evidence from the literature in other sectors (CARBONELL; ESCUDERO, 2010), our study sought to empirically contribute by evaluating the effects of TTM reduction on startup performance. For this, the outcomes of the companies in terms of sales, market share and profitability were evaluated. The hypothesis that the reduction had a positive effect on the performance of startups (H3), as expected, was positive, with additional confirmation of its strong correlation intensity. This evidences the good suitability of the model developed with this specific type of company. Comparative studies could be performed using the same scale in other segments to assess the level of correlation. Our findings suggest that there is a strong influence of time reduction with increased consumer satisfaction and increased sales. Demonstrating the benefits of pioneering already pointed out in the literature (TEECE, 2003; MILLSON; WILEMON, 2010; CIARAPICA; BEVILACQUA; MAZZUTO, 2016a). Consequently, improvements in the financial performance of startups that adopted greater TTM reductions, with better rates of return on investments, were also evidenced. However, the item that presented the lowest factor loading in this construct was the reduction in research and development costs. This trade-off between reduced time and costs is also in agreement with previous research (KESSLER; BIERLY; GOPALAKRISHNAN, 2000; SÁNCHEZ; PÉREZ, 2003).

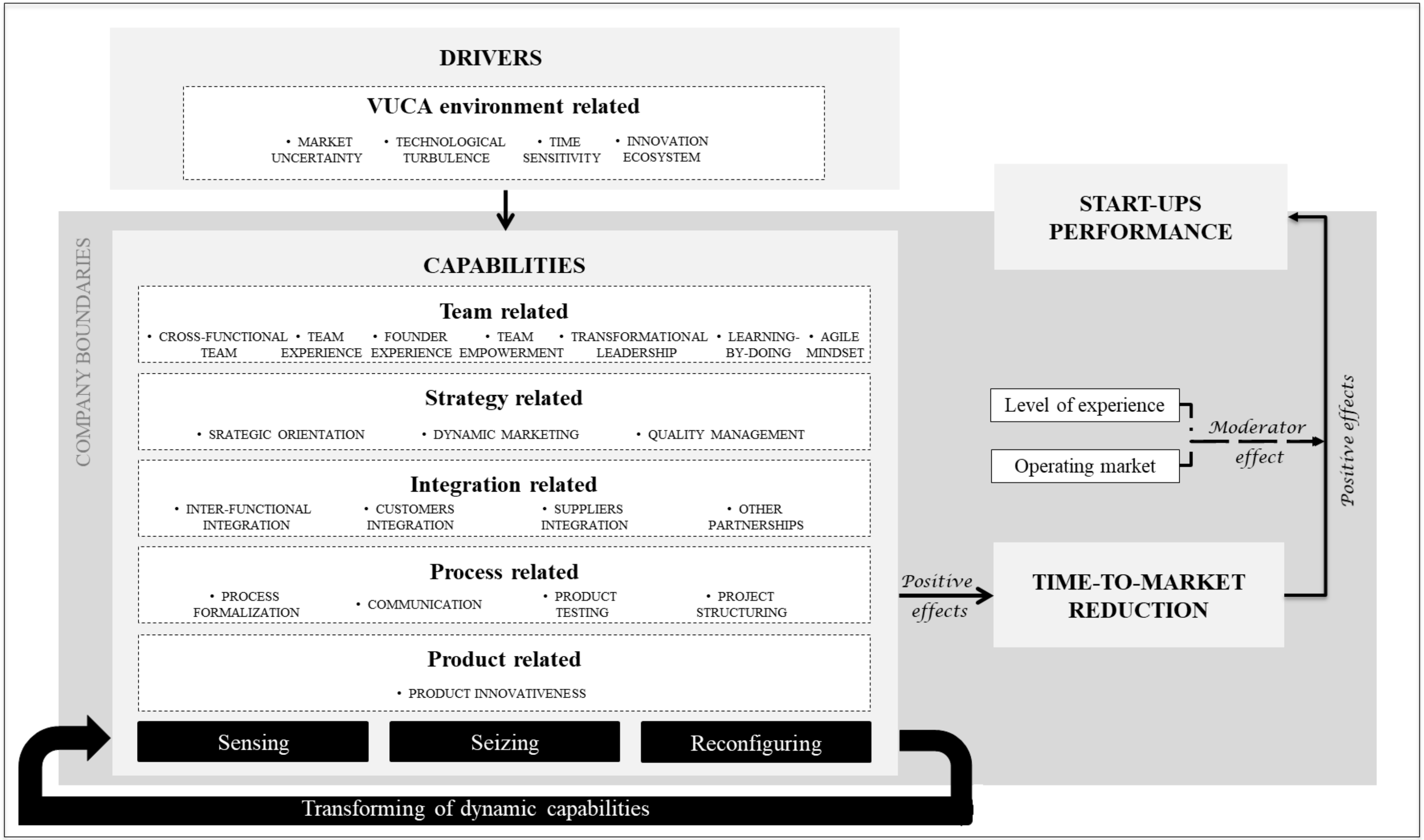
As the focus of this study is on startups, we carried out complementary analyzes on this result but to verify possible variables that moderate this relationship in this type of company (H4). Three variables were tested: experience level (ie, the company's operating time), operating market (national or multinational) and target audience (B2B, B2C or B2B2C). The latter is even suggested by Mitrega (2020) when proposing that future studies evaluate the different capabilities developed by startups that have different target markets. The authors note that B2C and B2B companies develop specific dynamic capabilities dedicated to their areas, such as relational, networking and co-creation capabilities.

Our study did not find empirical evidence that the target market moderates the relationship between TTM and performance despite the theoretical proposition. However, additional studies, more focused on this question, should be developed, including other types of target market such as B2G (business to government). However, our analysis detected moderation of the other two variables. We seek to point out possible causes for this. First, companies operating in multiple markets realized greater performance benefits from lowering TTM. This may have occurred given the complexity of market variables that must be analyzed to expand operations in several countries (Ciarapica et al., 2016). Therefore, the sooner companies sought to deliver their products to different markets and obtain customer feedback, the better their adaptation processes were and, consequently, there was a better performance. Second, the company's long operating time allows it to have a better experience in organization structuring and market reading. This enables more efficient development of staff recruitment, functional integration, leaders with greater market experience, among others. Therefore, when starting a new product development process, the most experienced companies already start from a pre-established structure and are faster and more assertive to optimize the performance achieved.

Employing an acronym for volatility (V), uncertainty (U), complexity (C) and ambiguity (A), experts and leaders claim that we now live in a "VUCA world" (BENNETT; LEMOINE, 2014). Not far from that, startups operate in a dynamic and uncertain context, where the impact of pervasive and cross-functional digital technologies increases the pace of change, leading to significant transformations across multiple industries. Consequently, these companies present the need to align their acquired internal resources with external conditions, requiring idiosyncratic and seemingly divergent approaches and tools that startups can select as needed depending on the direction they intend to take when embarking on their innovation process (GHEZZI; CAVALLO, 2020). As stated by Bennett and Lemoine (2014), "the components of VUCA are often present in some combination". For that reason, our research assumes that a set of aspects external to organizations (here called drivers) interfered in different intensities with the categories of capabilities that the company implements to reduce TTM. This hypothesis (H5) was confirmed in our study. Therefore, the environment variables had a greater influence on the capabilities related to integration and a lesser influence on those related to the product.

This strong relationship about the integration and drivers can be explained by the fact that companies that perceive themselves to be inserted in more uncertain and turbulent environments tend to seek more partnerships that strengthen them to face the risks associated with the innovation process. After all, companies by placing themselves within a network or ecosystem can improve their position and competitive advantage, ensuring a better ability to transfer value to customers. Ghezzi and Cavallo (2020) make an analogy of this to the construction of strong partnerships with a safe house that keeps companies firm amid the winds of change that blow in the sectors. While regarding the decision on the degree of innovativeness of the product that the company will develop is commonly divided into two categories: radical and incremental (LIN et al., 2013). The company's decision on the degree to be adopted depends on market characteristics related to demand and customer requirements. Therefore, the company must assess to what extent the market will well absorb that degree of product innovativeness. However, the environmental variables evaluated in this study, once focused on the motivation to reduce the TTM, do not capture such demand characteristics; therefore, this explains the low correlation found in this category. Lastly, given the complexity of all relationships presented and discussed, we seek to systematize our findings under the lens of dynamic capabilities theory proposing a framework that groups the constructs identified and validated in the research (see Figure 4).

Figure 6.4 - Framework summarizing the findings regarding the role of TTM reduction drivers and capabilities in start-ups' performance



Source: Adapted from NAGEL (2016) and MOTA et al., (2021).

6.6 Conclusion

This study draws on the dynamic capability view to examine how start-ups shape new product development processes and TTM reduction drivers and capabilities to support their performance. Thus, a theoretical model is validated statistically through data obtained from a survey applied in a significant sample of companies. The data analysis is carried out using structural equation modelling (SEM). In this way, the results also allowed us to evaluate the degree of adoption of each set of capabilities with their respective control variables and to evaluate the relationship of the TTM reduction in performance with its moderating variables. Five research hypotheses were tested to provide significant theoretical and managerial contributions.

6.6.1 Theoretical implications

When developing and validating the model we provided at least six contributions to the NPD and start-up literature. First, the literature lacked empirical validation of a multidimensional construction of TTM reduction involving internal and external aspects of companies. Our study applied methodological rigour to achieve this result, starting from a theoretical model derived from a systematic literature review, which underwent a structuring by experts in product development and startup managers, from which a measurement scale was developed that was the data collection instrument of the present study. Second, although the literature has examined the performance results in various industries after implementing some TTM reduction capabilities, we still did not have a clear understanding of how startups, with their innovative business model peculiarities and mindset, develop and sustain such complex resources. By using a significant sample of startups, our study sought to mitigate this gap.

Third, our results show that TTM reduction is relevant and effective for this type of organization since it is proven that the performance of start-ups is positively affected by the implementation of capabilities. Fifth, we examine the effect of variables that moderate this relationship on startups, opening up a valuable field of investigation in the literature on this topic. Sixth, despite the importance of contextualizing competitive environments to establish limits to assess the impact of time-to-market reduction, little was known about how variations in external environments could influence the effectiveness of this reduction to startup performance and how they could generate valuable managerial insights to guide NPD activities. Therefore, our study can contribute to the Dynamic capabilities literature by providing empirical and statistical evidence of the dynamic effects of drivers and capabilities to reduce TTM in startups as well as the control variables related to the capabilities implementation. (company size, startup stage and operation market).

6.6.2 Managerial implications

This paper also has practical implications for managers, as it provides an overview of possible capabilities to be developed in startups that make it possible to reduce TTM. Therefore, these findings can serve as a roadmap for companies in the early stages that are planning their new product development process, but also for companies that are already running their product development processes and intend to accelerate it. In addition, as it is an empirical analysis, the results obtained may serve as a performance comparison with other companies in the Brazilian innovation ecosystem. Finally, the study even provides possible filters for this analysis when considering the control variables, which can be used to identify the categories in which your company is located.

In our study, the theory of dynamic capabilities is supported, as the drivers (external aspects) of the VUCA environment are evaluated. This can serve as an alert to managers to assist them in their decision-making processes with such information about how the environment can affect the NPD process. Therefore, entrepreneurs may find our framework helpful while designing and innovating their NPD process under varying conditions of environmental dynamism and with the startup taking on different roles when confronting these conditions. Lastly, by demonstrating the relationship between the TTM reduction and companies performance, our study can stimulate the acceleration of NPD processes in this environment and corroborate an improvement in the performance of these companies as a whole.

6.6.3 Limitations and future research directions

Notwithstanding several essential insights concerning TTM reduction in the startup context, this study has some limitations that need to be highlighted. First, data were collected only in Brazil, which despite being a significant market and having global startups, makes it impossible to see if cultural values play a significant role in the relationships studied. Future research may re-examine this issue when collecting data using the scale developed in other countries. After all, it would be useful to investigate similarities and differences between the behaviours of startups in different countries. Second, the weak relationship of environmental variables on product innovativeness could be better investigated by dividing the sample into companies that developed radical and incremental innovations, this portrays an exciting direction for future studies already pointed out in our discussions. Third, the need to implement specific capabilities may differ according to the company's target audience. Therefore, we suggest that researchers develop complementary assessments that deepen discussions on such characteristics. Lastly, Finally, it may be interesting for future empirical research to examine the relationship between the categories of capabilities, that is, how they influence each other, and how different combinations of these capabilities might strengthen or weaken the relationship between TTM reduction and performance.

7 CONCLUSION

This study aims to evaluate the potential of startups to align their capabilities with external conditions during the new product development process to obtain performance benefits by reducing time-to-market. In order to achieve this objective, a multi-method approach was adopted and discussed in the course of four chapters of this thesis, as summarized in Table 7.1, as well as demonstrating the main contributions of each stage.

First, a systematic review of the literature was carried out, and described in chapter 3, to analyze the state of art about what are the motivating factors (drivers) and facilitators (capabilities) to reduce TTM. In the 88 reviewed articles, 25 years of research on the topic was evaluated. The results of this study showed that although the number of articles on TTM reduction has been growing in recent years, empirical studies in some countries have not yet been carried out. For most countries in Africa and South America, no studies were found when selecting. The economic and social peculiarities of these regions can bring important evidence about the interference of environmental dynamism in these results (FORBES; WIELD, 2008). Besides, the emphasis on large and traditional companies and neglects the start-ups (SIMON; LEKER, 2016). As a result of this first stage of the research, five drivers were found with the potential to motivate companies to reduce their TTM and nineteen capabilities that allow this reduction, which was grouped into five categories (team, strategy, integration, process and product). The relationship between capabilities was analyzed using a network generated from a cross-quote matrix. The capabilities attributes were extracted and the reduction in TTM was pointed out as responsible for providing several benefits in operational and business performance. To synthesize the information collected, a theoretical model and an agenda for future research were proposed.

The theoretical model developed needed to be refined and validated by experts to better align the information from the traditional NPD literature to the context of startups. The chapter 4 describes a multi-method approach that was adopted involving the ISM approach and Fuzzy MICMAC analysis. As a result, this study managed to assess the relationship between drivers and capabilities to reduce TTM in this specific type of company with business models based on innovation and new product development. Also, it showed that these factors have synergy and can be organized in a structural model that shows the hierarchy between them, indicating which should be developed with priority.

Table 7.1 - Summary of the main implications of each stage of the thesis.

Objectives	Method	Implications
• Consolidate the existing knowledge about TTM reduction and analyze the relevant aspects of their implementation;	Systematic literature review	• We provided a systematic review of drivers and capabilities involved in this process, as well as important insights into their attributes, relationships and benefits for companies' performance. • We list 20 research question proposals (Table 3.6), which characterizes a research agenda proposal on this theme.
• Assess the relationship between drivers and capabilities for reduced TTM in start-ups;	Multi-method approach	• The paper not only pointed out factors but also showed the strength and power of capabilities and drivers in contributing to the NPD process as key contingencies of an effective TTM reduction implementation. • Another contribution of this study is related to the refinement of the theoretical model carried out by experts for the context of startups. These organizations are different in their approach and adoption of NPD best practices, which has several theoretical implications. • Some tools and methods used by start-ups are also indicated during the study (Table 4.5) and may serve as a basis for management decision making.
• Develop new multi-item measurement scales reflecting the TTM reduction in the start-ups;	Survey	• This study advanced the concept of time-to-market reduction by developing a multi-dimensional higher-order model for start-ups and its measurement validation. Our contribution explicitly expands the dimensions of suggested capabilities to reduce TTM beyond traditional constructs, integrating new dimensions such as transformational leadership, learning by doing, agile mindset and dynamic marketing. • This is the first study to establish the empirical relationship between drivers associated with the VUCA environment. • It is the first study dedicated explicitly to reducing time-to-market in these companies. • This study employs a rigorous stepwise method including structured item generation, expert panels, surveys, and statistical analysis to propose a new robust scale.

Table 7.2 - Summary of the main implications of each stage of the thesis (continuation).

Objectives	Method	Implications
• Verify the degree of adoption of capabilities for reduced TTM in the start-ups; • Evaluate the impact of drivers on the adoption of capabilities for reduced TTM in start-ups. • Analyze the impact of the TTM reduction on start-ups performance.	Survey	• This study advanced the concept of time-to-market reduction by developing a multi-dimensional higher-order model for start-ups and its measurement validation. Our contribution explicitly expands the dimensions of suggested capabilities to reduce TTM beyond traditional constructs, integrating new dimensions such as transformational leadership, learning by doing, agile mindset and dynamic marketing. • This is the first study to establish the empirical relationship between drivers associated with the VUCA environment. • It is the first study dedicated explicitly to reducing time-to-market in these companies. • This study employs a rigorous stepwise method including structured item generation, expert panels, surveys, and statistical analysis to propose a new robust scale.

Once validated by experts, the theoretical model made it possible to develop a measurement scale for TTM reduction drivers and capabilities to be used in future empirical research. For the development and validation of this scale, the method proposed by Menor and Roth (2007) was used, in order to review the literature for the generation of items and the two-phase approach development for refinement that made use of the judgment of 83 judges in an item-sorting exercise and, in then a confirmatory analysis of the data on a large sample of 191 startups. This stage resulted in the development and validation of a measurement scale with 62 items and these procedures are described in chapter 5.

This can be used as a tool to identify opportunities for improvement in the process of developing new products, consequently, enhancing the performance and competitiveness of startups. Therefore, in this study, this instrument was used to test five hypotheses regarding the form of implementation of capabilities in startups, to analyze the dynamic effect that environmental aspects (drivers) can have about this implementation; and evaluate the effect of the capabilities implementation on the TTM reduction and its respective effect on the startup performance, moderated by the experience of txhe companies and the operating market. The results showed a fragmented use of these capabilities, by stage of startups, company size and market of operation. Four of the drivers proved to be significant in influencing the implementation of capabilities, excluding the competitive intensity that did not show a direct result in this relationship. In addition, the research confirmed the relevance of implementing capabilities in reducing TTM in startups. Its implementation positively affects the performance of companies. And organizational experience increases the chance of successful TTM reduction as well as operating in multinational markets.

Despite the methodological rigor adopted with this multi-method approach, the extension of the research generated limitations that can be interpreted as possible directions for future studies. In addition to the proposals already described in the course of the chapters, the theoretical model developed can be analyzed in greater depth from a few excerpts. Each category of capabilities can have its effect on the reduction of TTM and performance analyzed separately, and the effect between categories must be measured. This analysis of the categories of capabilities can also allow for a deeper discussion of the different practices inherent to these capabilities, in order to provide important insights into which methods and tools adopted by these companies really contribute to the acceleration of their processes and optimization of their operations. In addition, there is evidence that the results achieved may have greater or lesser relevance depending on the economic sector in which the company operates, as well as the results on the target audience of startups as moderators of the relationship between TTM reduction and performance lack a most significant sample of companies of each type (such as B2B, B2C, B2B2C, B2G).

REFERENCES

AFONSO, P. et al. The influence of time-to-market and target costing in the new product development success. **International Journal of Production Economics**, v. 115, n. 2, p. 559–568, 2008.

AKGUN, A. E. et al. Procedural Justice Climate in New Product Development Teams: Antecedents and Consequences. **Journal of Product Innovation Management**, v. 27, n. 7, p. 1096–1111, 2010.

AKGÜN, A. E. et al. Antecedents and consequences of team sensemaking capability in product development projects. **R and D Management**, v. 42, n. 5, p. 473–493, 2012a.

AKGÜN, A. E. et al. Antecedents and consequences of team sensemaking capability in product development projects. p. 473–493, 2012b.

AL SERHAN, Y. N.; JULIAN, C. C.; AHMED, Z. U. Using time to gain competitive advantage: a framework and analysis of propositions. **International Journal of Commerce and Management**, v. 25, n. 4, p. 456–465, 2015.

ALLOCCA, M. A.; KESSLER, E. H. Innovation Speed in Small and Medium-Sized Enterprises. **Creativity and Innovation Management**, v. 15, n. 3, p. 279–295, 2006.

ANDERSON, J. C.; GERBING, D. W. Predicting the performance of measures in a confirmatory factor analysis with a pretest assessment of their substantive validities. **Journal of Applied Psychology**, v. 76, n. 5, p. 732–740, 1991.

BAGOZZI, R. P.; YI, Y. On the evaluation of structural equation models. **Journal of the Academy of Marketing Science**, v. 16, n. 1, p. 74–94, 1988.

BARCZAK, G.; HULTINK, E. J.; SULTAN, F. Antecedents and consequences of information Ttchnology Usage in NPD: A comparison of dutch and U.S. companies. **Journal of Product Innovation Management**, v. 25, n. 6, p. 620–631, 2008.

BARCZAK, G.; SULTAN, F.; HULTINK, E. J. Determinants of IT usage and new product performance. **Journal of Product Innovation Management**, v. 24, n. 6, p. 600–613, 2007.

BARRETO, I. Dynamic Capabilities: A review of past research and an agenda for the future. **Journal of Management**, v. 36, n. 1, p. 256–280, 2010.

BASS, B. M. Comment: Transformational Leadership. **Journal of Management Inquiry**, v. 4, n. 3, p. 293–297, 1995.

BECKER, M. C.; SALVATORE, P.; ZIRPOLI, F. The impact of virtual simulation tools on problem-solving and new product development organization. **Research Policy**, v. 34, n. 9, p. 1305–1321, 2005.

BENNETT, N.; LEMOINE, G. J. What a difference a word makes: Understanding threats to

performance in a VUCA world. **Business Horizons**, v. 57, n. 3, p. 311–317, 2014.
BLANK, S. Why the lean start-up changes everything. **Harvard Business Review**, v. 91, n. 5, p. 1–15, 2013.
BORTOLINI, R. F. et al. Lean Startup: a comprehensive historical review. **Management Decision**, v. 59, n. 8, p. 1765–1783, 2018.
BREWER, B.; ARNETTE, A. N. Design for procurement: What procurement driven design initiatives result in environmental and economic performance improvement? **Journal of Purchasing and Supply Management**, v. 23, n. 1, p. 28–39, 2017a.
BREWER, B.; ARNETTE, A. N. Journal of Purchasing & Supply Management Design for procurement : What procurement driven design initiatives result in environmental and economic performance improvement ? **Journal of Purchasing and Supply Management**, v. 23, n. 1, p. 28–39, 2017b.
BSTIELER, L.; GROSS, C. W. Measuring the effect of environmental uncertainty on process activities, project team characteristics, and new product success. **Journal of Business and Industrial Marketing**, v. 18, n. 2–3, p. 146–161, 2003.
BUCCIERI, D.; JAVALGI, R. G.; CAVUSGIL, E. International new venture performance: Role of international entrepreneurial culture, ambidextrous innovation, and dynamic marketing capabilities. **International Business Review**, v. 29, n. 2, p. 101639, 2020.
CANKURTARAN, P.; LANGERAK, F.; GRIFFIN, A. Consequences of new product development speed: A meta-analysis. **Journal of Product Innovation Management**, v. 30, n. 3, p. 465–486, 2013.
CARBONELL, P.; ESCUDERO, A. I. R. The effect of market orientation on innovation speed and new product performance. **Journal of Business and Industrial Marketing**, v. 25, n. 7, p. 501–513, 2010.
CARBONELL, P.; RODRIGUEZ, A. I. Designing teams for speedy product development: The moderating effect of technological complexity. **Journal of Business Research**, v. 59, n. 2, p. 225–232, 2006.
CARMEL E. “Time-to-completion in software package startups,” in Proc. 27th. Hawaii **Int. Conf. Syst. Sci**., pp. 498–507, 1994.
CARROLL, R.; CASSELMAN, R. M. The Lean Discovery Process: the case of raiserve. **Journal of Small Business and Enterprise Development**, v. 26, n. 6–7, p. 765–782, 2019.
CARTER, P.; MELNYK, S.; HANDFIELD, R. Identifying the basic process strategies for time- based competition. **Production and Inventory Management Journal**, v. 36, n. 1, p. 65–70, 1995.

CARTON, G. How Assemblages Change When Theories Become Performative: The case of the Blue Ocean Strategy. **Organization Studies**, v. 41, n. 10, p. 1417–1439, 2020.

CHADEGANI, A. A. et al. A comparison between two main academic literature collections: Web of science and scopus databases. **Asian Social Science**, v. 9, n. 5, p. 18–26, 2013.

CHANG, W.; TAYLOR, S. A.; META-ANALYSIS, D. A. The Effectiveness of Customer Participation in New Product. **Journal of Marketing**, v. 80, n. January, p. 47–64, 2016.

CHEN, J.; DAMANPOUR, F.; REILLY, R. R. Understanding antecedents of new product development speed: A meta-analysis. **Journal of Operations Management**, v. 28, n. 1, p. 17–33, 2010a.

CHEN, J.; DAMANPOUR, F.; REILLY, R. R. Understanding antecedents of new product development speed: A meta-analysis. **Journal of Operations Management**, v. 28, n. 1, p. 17–33, 2010b.

CHEN, J.; REILLY, R. R.; LYNN, G. S. New product development speed: Too much of a good thing? **Journal of Product Innovation Management**, v. 29, n. 2, p. 288–303, 2012a.

CHEN, J.; REILLY, R. R.; LYNN, G. S. New product development speed: Too much of a good thing? **Journal of Product Innovation Management**, v. 29, n. 2, p. 288–303, 2012b.

CHEN, J. Y.; REILLY, R. R.; LYNN, G. S. The impacts of speed-to-market on new product success: The moderating effects of uncertainty. **Ieee Transactions on Engineering Management**, v. 52, n. 2, p. 199–212, 2005.

CHESBROUGH, H. To recover faster from Covid-19, open up: Managerial implications from an open innovation perspective. **Industrial Marketing Management**, v. in press, 2020.

CHI-JYUN CHENG, C.; SHIU, E. C. Critical success factors of new product development in Taiwan's electronics industry. **Asia Pacific Journal of Marketing and Logistics**, v. 20, n. 2, p. 174–189, 2008.

CHIANG, I. R.; WU, S. J. Supplier Involvement and Contract Design during New Product Development. **IEEE Transactions on Engineering Management**, v. 63, n. 2, p. 248–258, 2016.

CHURCHILL JR., G. A. A Paradigm for Developing Better Measures of Marketing Constructs. **Journal of Marketing Research**, v. 16, n. 1, p. 64–73, 1979.

CIARAPICA, F. E.; BEVILACQUA, M.; MAZZUTO, G. Performance analysis of new product development projects. **International Journal of Productivity and Performance Management**, v. 65, n. 2, p. 177–206, 2016a.

CIARAPICA, F. E.; BEVILACQUA, M.; MAZZUTO, G. Performance analysis of new product development projects: An approach based on value stream mapping. **International**

Journal of Productivity and Performance Management, v. 65, n. 2, p. 177–206, 2016b.

COLOMBELLI, A.; KRAFFT, J.; QUATRARO, F. Properties of knowledge base and firm survival: Evidence from a sample of French manufacturing firms. **Technological Forecasting and Social Change**, v. 80, n. 8, p. 1469–1483, 2013.

CONFORTO, E. C.; AMARAL, D. C. Agile project management and stage-gate model—A hybrid framework for technology-based companies. **Journal of Engineering and Technology Management - JET-M**, v. 40, n. 2015, p. 1–14, 2016.

CONTIGIANI, A.; LEVINTHAL, D. A. Situating the construct of lean start-up: Adjacent conversations and possible future directions. **Industrial and Corporate Change**, v. 28, n. 3, p. 551–564, 2019.

COOPER, R. G. Predevelopment activities determine new product success. **Industrial Marketing Management**, v. 17, n. 3, p. 237–247, 1988.

COOPER, R. G. Stage-Gate Systems: a new tool for managing new products. **Business Horizons**, n. May-June, p. 44–54, 1990.

COOPER, R. G. **Winning at New Products:** Accelerating the Process from Idea to Launch, 3rd edn. Basic Books, New York. 2008.

COOPER, R. G. What's next? After stage-gate. **Research Technology Management**, v. 57, n. 1, p. 20–31, 2014.

COOPER, R. G. Idea-to-launch gating systems. **Research Technology Management**, v. 60, n. 1, p. 48–52, 2017.

COOPER, R. G.; EDGETT, S. J. Best Practices in the idea-to-launch process and its governance. **Research Technology Management**, v. 55, n. 2, p. 43–54, 2012.

COOPER, R. G.; SOMMER, A. F. The Agile–Stage-Gate Hybrid Model: A Promising New Approach and a New Research Opportunity. **Journal of Product Innovation Management**, v. 33, n. 5, p. 513–526, 2016.

DANESE, P.; FILIPPINI, R. Direct and mediated effects of product modularity on development time and product performance. **IEEE Transactions on Engineering Management**, v. 60, n. 2, p. 260–271, 2013.

DAYAN, M.; BASARIR, A. Antecedents and consequences of team reflexivity in new product development projects. **Journal of Business & Industrial Marketing**, v. 25, n. 1, p. 18–29, 2009.

DE TONI, A.; MENEGHETTI, A. Traditional and innovative paths towards time-based competition. **International Journal of Production Economics**, v. 66, n. 3, p. 255–268, 2000.

DENYER, D.; TRANFIELD, D. Producing a systematic review. In: BUCHANAN, D.; BRYMAN, A. (Ed.). **The sage handbook of Organizational Research Methods**. London: Sage Publications, 2009. p. 671–689.

DERELI, T.; BAYKASOĞLU, A.; BÜYÜKÖZKAN, G. An affordable reverse engineering framework for innovative rapid product development. **International Journal of Industrial and Systems Engineering**, v. 3, n. 1, p. 31–37, 2008.

DROGE, C.; JAYARAM, J.; VICKERY, S. K. The ability to minimize the timing of new product development and introduction: an examination of antecedent factors in the North American automobile supplier industry. **Journal of Product Innovation Management**, v. 17, n. 1, p. 24–40, 2000.

DROGE, C.; JAYARAM, J.; VICKERY, S. K. The effects of internal versus external integration practices on time-based performance and overall firm performance. **Journal of Operations Management**, v. 22, n. 6, p. 557–573, 2004.

EDISON, H. et al. Lean Internal Startups for Software Product Innovation in Large Companies: Enablers and Inhibitors. **Journal of Systems and Software**, v. 135, n. 1, p. 69–87, 2018.

ELVERS, D.; SONG, C. H. Conceptualizing a framework for customer integration during new product development of chemical companies. **Journal of Business & Industrial Marketing**, v. 31, n. 4, p. 488–497, 2016.

ETTLIE, J. E.; TUCCI, C.; GIANIODIS, P. T. Trust, integrated information technology and new product success. **European Journal of Innovation Management**, v. 20, n. 3, p. 406–427, 2017.

EVANSCHITZKY, H. et al. Success factors of product innovation: An updated meta-analysis. **Journal of Product Innovation Management**, v. 29, n. 1994, p. 21–37, 2012.

FEKRI, R.; ALIAHMADI, A.; FATHIAN, M. Predicting a model for agile NPD process with fuzzy cognitive map: The case of Iranian manufacturing enterprises. **International Journal of Advanced Manufacturing Technology**, v. 41, n. 11–12, p. 1240–1260, 2009.

FENG, T. et al. External involvement and firm performance: Is time-to-market of new products a missing link? **International Journal of Production Research**, v. 52, n. 3, p. 727–742, 2014.

FERREIRA, J.; COELHO, A. Dynamic capabilities, innovation and branding capabilities and their impact on competitive advantage and SME's performance in Portugal: the moderating effects of entrepreneurial orientation. **International Journal of Innovation Science**, v. 12, n. 3, p. 255–286, 2020.

FORBES, N.; WIELD, D. Innovation dynamics in catch-up firms: Process, product and proprietary capabilities for development. **Industry and Innovation**, v. 15, n. 1, p. 69–92, 2008.

FORNELL, C.; LARCKER, D. F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. **Journal of Marketing Research**, v. 18, n. 1, p. 262, 1981.

FORZA, C. Survey research in operations management: A process-based perspective. **International Journal of Operations and Production Management**, v. 22, n. 2, p. 152–194, 2002.

GHEZZI, A.; CAVALLO, A. Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches. **Journal of Business Research**, v. 110, n. February 2017, p. 519–537, 2020.

GONZALEZ-ZAPATERO, C.; GONZALEZ-BENITO, J.; LANNELONGUE, G. Understanding how the functional integration of purchasing and marketing accelerates new product development. **International Journal of Production Economics**, v. 193, n. August, p. 770–780, 2017a.

GONZALEZ-ZAPATERO, C.; GONZALEZ-BENITO, J.; LANNELONGUE, G. Understanding how the functional integration of purchasing and marketing accelerates new product development. **International Journal of Production Economics**, v. 193, n. November 2016, p. 770–780, 2017b.

GRANER, M.; MISSLER-BEHR, M. Method Application in New Product Development and the Impact on Product Success. **International Journal of Innovation and Technology Management**, v. 12, n. 04, p. 1550019, 2015.

GRIFFIN, A. PDMA Research on New Product Development Practices: updating trends and benchmarking best practices. **Journal of Product Innovation Management**, v. 14, n. 1, p. 429–458, 1997.

GUPTA, V.; FERNANDEZ-CREHUET, J. M.; HANNE, T. Fostering continuous value proposition innovation through freelancer involvement in software startups: Insights from multiple case studies. **Sustainability (Switzerland)**, v. 12, n. 21, p. 1–35, 2020.

HAIR, J. F. et al. Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. **European Business Review**, v. 26, n. 2, p. 106–121, 2014.

HARDAKER, G. An integrated approach towards product innovation in international manufacturing organisations. **European Journal of Management**, v. 1, n. 2, p. 67–73, 1998.

HEIRMAN, A.; CLARYSSE, B. Which tangible and intangible assets matter for innovation speed in start-Ups? **Journal of Product Innovation Management**, v. 24, n. 4, p. 303–315, 2007.

HUM, S.-H.; SIM, H.-H. Time-based competition: literature review and implications for modelling. **International Journal of Operations & Production Management**, v. 16, n. 1, p. 75–90, 1996.

JAYARAM, J.; VICKERY, S. K.; DROGE, C. An empirical study of time-based competition in the North American automotive supplier industry. **International Journal of Operations & Production Management**, v. 19, n. 10, p. 1010–1034, 1999.

JIAN'AS, C.; BEI, H. Can operational centralization/decentralization accelerate new product development? an empirical evidence from China. In: IEEE International Conference on Grey Systems and Intelligent Services, Nanjing. **Anais**... Nanjing: 2007.

JOHNSON, W. H.; PICCOLOTTO, Z.; FILIPPINI, R. The impacts of time performance and market knowledge competence on new product success: An international study. **IEEE Transactions on Engineering Management**, v. 56, n. 2, p. 219–228, 2009a.

JOHNSON, W. H.; PICCOLOTTO, Z.; FILIPPINI, R. The impacts of time performance and market knowledge competence on new product success: An international study. **IEEE Transactions on Engineering Management**, v. 56, n. 2, p. 219–228, 2009b.

KACH, A.; AZADEGAN, A.; DOOLEY, K. J. Analyzing the successful development of a high-novelty innovation project under a time-pressured schedule. **R and D Management**, v. 42, n. 5, p. 377–400, 2012a.

KACH, A.; AZADEGAN, A.; DOOLEY, K. J. Analyzing the successful development of a high novelty innovation project under a time pressured schedule. **R&D Management**, v. 42, p. 377–400, 2012b.

KARAGOZOGLU, N.; BROWN, W. B. Time-based management of the new product development process. **The Journal of Product Innovation Management**, v. 10, n. 3, p. 204–215, 1993.

KESSLER, E. H.; BIERLY, P. E. Is Faster Really Better ? An Empirical Test of the Implications of Innovation Speed. **IEEE Transactions on Engineering Management**, v. 49, n. 1, p. 2–12, 2002.

KESSLER, E. H.; BIERLY, P. E.; GOPALAKRISHNAN, S. Internal vs. external learning in new product development: effects on speed, costs and competitive advantage. **R and D Management**, v. 30, n. 3, p. 213–224, 2000.

KESSLER, E. H.; CHAKRABARTI, A. K. Speeding up the pace of new product development. **Journal of Product Innovation Management**, v. 16, n. 3, p. 231–247, 1999.

KIM, B.; KIM, H.; JEON, Y. Critical success factors of a design startup business. **Sustainability (Switzerland)**, v. 10, n. 9, p. 1–15, 2018.

KIRK, B. **Accelerating time to market:** Using a next generation innovation framework. Stage-Gate Innovation. SUMMIT, Miami, FL, February 26–28. 2013.

KODAMA, M. How two Japanese high-tech companies achieved rapid innovation via strategic community networks. **Strategy & Leadership**, v. 33, n. 6, p. 39–47, 2005.

KONG, T. et al. Effects of marketing – manufacturing integration across stages of new product development on performance. **International Journal of Production Research**, v. 53, n. 8, p. 2269–2284, 2015.

KÖR, B.; MADEN, C. The Relationship between Knowledge Management and Innovation in Turkish Service and High-Tech Firms. **International Journal of Business and Social Science**, v. 4, n. 4, p. n/a, 2013.

KRAEMER, K.; DEDRICK, J.; YAMASHIRO, S. Refining and extending the business model with information technology: Dell Computer Corporation. **The Information Society**, v. 16, n. 1, p. 5–21, 2000.

KRISHNAN, V.; EPPINGER, S. D.; WHITNEY, D. E. Accelerating product development by the exchange of preliminary product design information. **Journal of Mechanical Design**, v. 117, n. 4, p. 491–498, 1995.

KUCKERTZ, A. et al. Startups in times of crisis – A rapid response to the COVID-19 pandemic. **Journal of Business Venturing Insights**, v. 13, n. 1, p. e00169, 2020.

LEATHERBEE, M.; KATILA, R. The lean startup method: Early-stage teams and hypothesis-based probing of business ideas. **Strategic Entrepreneurship Journal**, v. 14, n. 4, p. 570–593, 2020.

LI, C. Enhancing or inhibiting: The impact of investment in political ties on the link between firm innovation and productivity. **International Business Review**, v. 29, n. 2, p. 101636, 2020.

LIN, M.-J. J.; HUANG, C.-H.; CHIANG, I.-C. Explaining trade-offs in new product development speed, cost, and quality: The case of high-tech industry in Taiwan. **Total Quality Management & Business Excellence**, v. 23, n. 9–10, p. 1107–1123, 2012.

LIN, M. J. J. et al. Customer participation and new product development outcomes: The moderating role of product innovativeness. **Journal of Management and Organization**, v. 19, n. 3, p. 314–337, 2013.

LIN, R. J. Supplier integration and time-based capabilities: An empirical study. **Journal of the Chinese Institute of Industrial Engineers**, v. 26, n. 3, p. 215–227, 2009.

LUKAS, B. A.; MENON, A.; BELL, S. J. Organizing for new product development speed and the implications for organizational stress. **Industrial Marketing Management**, v. 31, n. 4, p. 349–355, 2002.

LYNN, G. S.; SKOV, R. B.; ABEL, K. D. Practices that Support Team Learning and Their Impact on Speed to Market and New Product Sucess. **Journal of Product Innovation Management**, v. 16, n. 1, p. 439–454, 1999.

MABERT, V. A.; MUTH, J. F.; SCHMENNER, R. W. **Collapsing New Product Development Times - 6 Case-StudiesJournal of Product Innovation Management**, 1992.
.

MACPHERSON, A.; JONES, O.; ZHANG, M. Macpherson, Jones, Zhang - 2004 - Evolution or revolution Dynamic capabilities in a knowledge- dependent firm.pdf. **R&D**, v. 34, p. 161–177, 2004.

MARION, T. J.; FRIAR, J. H.; SIMPSON, T. W. New product development practices and early-stage firms: Two in-depth case studies. **Journal of Product Innovation Management**, v. 29, n. 4, p. 639–654, 2012.

MARSH, H. W. et al. Exploratory Structural Equation Modeling : An Integration of the Best Features of Exploratory and Confirmatory Factor Analysis. n. November, p. 1–26, 2013.

MCKELVIE, A.; DAVIDSSON, P. From Resource Base to Dynamic Capabilities : an Investigation of New Firms. v. 20, 2009.

MENON, A.; LUKAS, B. a. Antecedents and outcomes of new product development speed: A propositional inventory germane to marketing. **European Journal of Marketing**, v. 38, n. 1/2, p. 209–223, 2004.

MENOR, L. J.; ROTH, A. V. New service development competence in retail banking: Construct development and measurement validation. **Journal of Operations Management**, v. 25, n. 4, p. 825–846, 2007.

MILAN, E. et al. Exploring the impact of organisational, technological and relational contingencies on innovation speed in the light of open innovation. **Industry and Innovation**, v. 00, n. 00, p. 1–33, 2020.

MILLSON, M. R.; WILEMON, D. the Impact of Changing Markets and Competition on the Npd Speed/Market Success Relationship. **International Journal of Innovation Management**, v. 14, n. 5, p. 841–870, 2010.

MINGUELA-RATA, B.; ARIAS-ARANDA, D. New product performance through multifunctional teamwork: An analysis of the development process towards quality excellence. **Total Quality Management & Business Excellence**, v. 20, n. 4, p. 381–392,

2009.
MITRĘGA, M. Dynamic marketing capability – refining the concept and applying it to company innovations. **Journal of Business and Industrial Marketing**, v. 35, n. 2, p. 193–203, 2020.
MOHER, D. et al. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. **PLoS Medicine**, v. 6, n. 7, 2009.
MOORE, G.; BENBASAT, I. Development of an instrument to measure the perceptions of adopting and information technology innovation. **Information Systems Research**, v. 2, n. 3, p. 192–222, 1991.
MORGAN, T.; ANOKHIN, S. A.; WINCENT, J. Influence of market orientation on performance: the moderating roles of customer participation breadth and depth in new product development. **Industry and Innovation**, v. 26, n. 9, p. 1103–1120, 2019.
MORITA, M.; MACHUCA, J. A. D.; PÉREZ DÍEZ DE LOS RÍOS, J. L. Integration of product development capability and supply chain capability: The driver for high performance adaptation. **International Journal of Production Economics**, v. 200, n. March, p. 68–82, 2018.
MOTA, R. de O. et al. Unveiling the relationship between drivers and capabilities for reduced time-to-market in start-ups: A multi-method approach. **International Journal of Production Economics**, v. 233, n. June 2020, 2021.
NAGEL, C. Behavioural strategy and deep foundations of dynamic capabilities – Using psychodynamic concepts to better deal with uncertainty and paradoxical choices in strategic management. **Global Economics and Management Review**, v. 21, n. 1–2, p. 46–64, 2016.
NARAHARI, Y.; VISWANADHAM, N.; KUMAR, V. K. Lead time modeling and acceleration of product design and development. **IEEE Transactions on Robotics and Automation**, v. 15, n. 5, p. 882–896, 1999.
OECD (2005), "Using Performance Information for Managing and Budgeting", GOV/PGC/SBO, 3, **OECD**, Paris. 2005.
OKE, A.; IDIAGBON-OKE, M. Communication channels, innovation tasks and NPD project outcomes in innovation-driven horizontal networks. **Journal of Operations Management**, v. 28, n. 5, p. 442–453, 2010.
OLOGBO, A. C.; NOR, K. M. Knowledge management processes and firm innovation capability: A theoretical model. **Asian Social Science**, v. 11, n. 18, p. 10–17, 2015.
OZKAN-OZEN, Y. D.; KAZANCOGLU, Y.; KUMAR MANGLA, S. Synchronized Barriers for Circular Supply Chains in Industry 3.5/Industry 4.0 Transition for Sustainable Resource

Management. **Resources, Conservation and Recycling**, v. 161, n. May, p. 104986, 2020.

PARK, M. H. J.; LIM, J. W.; BIRNBAUM-MORE, P. H. The effect of multiknowledge individuals on performance in cross-functional new product development teams. **Journal of Product Innovation Management**, v. 26, n. 1, p. 86–96, 2009.

PARRY, M. E. et al. The impact of NPD strategy, product strategy, and NPD processes on perceived cycle time. **Journal of Product Innovation Management**, v. 26, n. 6, p. 627–639, 2009.

PATANAKUL, P.; CHEN, J.; LYNN, G. S. Autonomous teams and new product development. **Journal of Product Innovation Management**, v. 29, n. 5, p. 734–750, 2012.

PERREAULT, W. D.; LEIGH, L. E. Reliability of Nominal Data Based on Qualitative Judgments. **Journal of Marketing Research**, v. 26, n. 2, p. 135, 1989.

PESCH, R.; BOUNCKEN, R. B.; KRAUS, S. Effects of Communication Style and Age Diversity in Innovation Teams. **International Journal of Innovation and Technology Management**, v. 12, n. 06, p. 1550029, 2015.

PETERSEN, K. J.; HANDFIELD, R. B.; RAGATZ, G. L. A model of supplier integration into new product development. **The Journal of Product Innovation Management**, v. 20, n. 4, p. 284–299, 2003.

POLO GARCÍA-OCHOA, C.; DE-PABLOS-HEREDERO, C.; BLANCO JIMÉNEZ, F. J. How business accelerators impact startup's performance: Empirical insights from the dynamic capabilities approach. **Intangible Capital**, v. 16, n. 3, p. 107–125, 2020.

PORTER, M. E. **Competitive strategy:** techniques for analysing industries and competitors. New York: Free Press, 1980.

PRAGMAN, C. H. JIT II: A purchasing concept for reducing lead times in time-based competition. **Business Horizons**, v. 39, n. 4, p. 54–58, 1996.

PRIMO, M. A. M.; AMUNDSON, S. D. An exploratory study of the effects of supplier relationships on new product development outcomes. **Journal of Operations Management**, v. 20, n. 1, p. 33–52, 2002.

RAMACHANDRAN, K.; KRISHNAN, V. Design Architecture and Introduction Timing for Rapidly Improving Industrial Products. **Manufacturing & Service Operations Management**, v. 10, n. 1, p. 149–171, 2008.

RIES, E. **The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Eric Ries. New York: Crown Business, 2011. 320 pages. US$26.00.** [s.l: s.n.]

RONDEAU, P. J.; RAGU-NATHAN, T. S.; VONDEREMBSE, M. A. The information

systems environment of time-based competitors. **Omega**, v. 31, n. 4, p. 253–268, 2003.
ROSAS-VEGA, R.; VOKURKA, R. J. New product introduction delays in the computer industry. **Industrial Management & Data Systems**, v. 100, n. 4, p. 157–163, 2000.
ROSAS-VEGA, R.; VOKURKA, R. J. New product introduction delays in the computer industry New product introduction delays in the computer industry. **Industrial Management & Data Systems**, v. 100, n. 4, p. 157–163, 2015.
SÁNCHEZ, A. M.; PÉREZ, M. P. Cooperation and the ability to minimize the time and cost of new product development within the Spanish automotive supplier industry. **Journal of Product Innovation Management**, v. 20, n. 1, p. 57–69, 2003.
SCHRIBER, S.; LÖWSTEDT, J. Reconsidering ordinary and dynamic capabilities in strategic change. **European Management Journal**, v. 38, n. 3, p. 377–387, 2020.
SCHUMPETER, J. **The Theory of Economic Development**. Harvard University Press, Cambridge Massachusetts, 1934.
SERHAN, Y. N. Al et al. Using time to gain competitive advantage : a framework and analysis of propositions. 2015.
SIM, K. L.; CURATOLA, A. P. Time-based competition. **International Journal of Quality & Reliability Management**, v. 16, n. 7, p. 659–674, 1999.
SIMON, H.; LEKER, J. Using Startup Communication for Opportunity Recognition — an Approach To Identify Future Product Trends. **International Journal of Innovation Management**, v. 20, n. 8, p. 1640016, 2016.
SMOLNIK, T.; BERGMANN, T. Structuring and managing the new product development process - review on the evolution of the Stage-Gate® process. **Journal of Business Chemistry**, n. 2, p. 41–57, 2020.
STRANG, K. D. Leadership Substitutes and Personality Impact on Time and Quality in Virtual New Product Development Projects. **Journal of Internet Banking and Commerce**, v. 42, n. 1, p. 73–90, 2010.
SUN, H.; ZHAO, Y.; YAU, H. K. The relationship between quality management and the speed of new product development. **TQM Journal**, v. 21, n. 6, p. 576–588, 2009.
SUN, S. L. et al. Venture capital as an innovation ecosystem engineer in an emerging. **International Business Review**, v. 28, n. 5, p. 101485, 2019.
SUNDER M, V.; L.S, G.; MARATHE, R. R. Dynamic capabilities: A morphological analysis framework and agenda for future research. **European Business Review**, v. 31, n. 1, p. 25–63, 2019.
SWINK, M. Completing projects on-time : how project acceleration affects new product

development. **Journal of Engineering and Technology Management - JET-M**, v. 20, p. 319–344, 2003.

TAN, K. H.; ZHAN, Y. Improving new product development using big data : a case study of an electronics company. **R & D Management**, v. 47, n. 4, p. 570–582, 2017.

TATIKONDA, M. V.; MONTOYA-WEISS, M. M. Integrating Operations and Marketing Perspectives of Product Innovation: The Influence of Organizational Process Factors and Capabilities on Development Performance. **Management Science**, v. 47, n. 1, p. 151–172, 2001.

TEECE, D. J. EXPLICATING DYNAMIC CAPABILITIES: THE NATURE AND MICROFOUNDATIONS OF (SUSTAINABLE) ENTERPRISE PERFORMANCE. **Strategic Management Journal**, v. 28, p. 1319–1350, 2007.

TEECE, D. J. Dynamic Capabilities: Routines versus Entrepreneurial Action. **Journal of Management Studies**, v. 49, n. 8, p. 1395–1401, 2012.

TEECE, D. J.; PETERATD, M.; LEIH, S. Dynamic capabilities and organizational agility. **California Management Review**, v. 58, n. 4, p. 13–35, 2016.

TENNANT, C.; ROBERTS, P. A faster way to create better quality products. **International Journal of Project Management**, v. 19, n. 6, p. 353–362, 2001.

TONI, A. De; MENEGHETTI, A. Traditional and innovative paths towards time-based competition. v. 66, p. 255–268, 2000.

TRIPATHI, N. et al. Startup ecosystem effect on minimum viable product development in software startups. **Information and Software Technology**, v. 114, n. January, p. 77–91, 2019.

TRYGG, L. Rapid prototyping-the Swedish industry experience. **International Journal of Human Factors in Manufacturing**, v. 4, n. 3, p. 321–338, 1994.

TSINOPOULOS, C.; AL-ZU'BI, Z. Clockspeed effectiveness of lead users and product experts. **International Journal of Operations and Production Management**, v. 32, n. 9, p. 1097–1118, 2012.

TSINOPOULOS, C.; AL-ZU'BI, Z. Clockspeed effectiveness of lead users and product experts. **International Journal of Operations & Production Management**, v. 32, n. 9, p. 1097–1118, 2012.

UZKURT, C. et al. Role of innovation in the relationship between organizational culture and firm performance: A study of the banking sector in Turkey. **European Journal of Innovation Management**, v. 16, n. 1, p. 92–117, 2013.

VALLE, S.; AVELLA, L. Cross-functionality and leadership of the new product development teams. **European Journal of Innovation Management**, v. 6, n. 1, p. 32–47, 2003.

VALLE, S.; VÁZQUEZ-BUSTELO, D. Concurrent engineering performance: Incremental versus radical innovation. **International Journal of Production Economics**, v. 119, n. 1, p. 136–148, 2009.

VAYVAY, Ö.; CRUZ-CUNHA, M. M. Supplier involvement in new product development: a case study from the semiconductor industry. **E+M Ekonomie a Management**, v. 19, n. 3, p. 123–141, 2016.

VEZZETTI, E.; ALEMANNI, M.; MORELLI, B. New product development (NPD) of 'family business' dealing in the luxury industry: evaluating maturity stage for implementing a PLM solution. **International Journal of Fashion Design, Technology and Education**, v. 10, n. 2, p. 219–229, 2016.

WEERAWARDENA, J. et al. The role of the market sub-system and the socio-technical sub-system in innovation and firm performance: a dynamic capabilities approach. **Journal of the Academy of Marketing Science**, v. 43, n. 2, p. 221–239, 2015.

WERNERFELT, B. The re-source-based view of the firm. **Strategic Management Journal**, v. 5, p. 171–180, 1984.

WILLIS, T. H. Operational competitive requirements for the twenty-first century. **Industrial Management & Data Systems**, v. 98, n. 2, p. 83–86, 1998.

WU, L.; LIU, H.; SU, K. Exploring the dual effect of effectuation on new product development speed and quality. **Journal of Business Research**, v. 106, n. 135, p. 82–93, 2020.

XIA, B.; GUO, J.; FUNG, R. Y. K. Quality investment timing by the startup and the established firm. **Managerial and Decision Economics**, v. 39, n. 3, p. 275–284, 2017.

YANG, J. Knowledge management opportunities for cycle time reduction Jie Yang. **International Journal Innovation and Learning**, v. 1, n. 2, p. 192–207, 2004.

YAO, Z. et al. Knowledge complementarity , knowledge absorption effectiveness , and new product performance : The exploration of international joint ventures in China §. **International Business Review**, v. 22, n. 1, p. 216–227, 2013.

ZAECH, S.; BALDEGGER, U. Leadership in start-ups. **International Small Business Journal: Researching Entrepreneurship**, v. 35, n. 2, p. 157–177, 2017.

ZAHRA, S. A.; SAPIENZA, H. J.; DAVIDSSON, P. Entrepreneurship and dynamic capabilities: A review, model and research agenda. **Journal of Management Studies**, v. 43, n. 4, p. 917–955, 2006.

ZHAN, Y. et al. A big data framework for facilitating product innovation processes. **Business Process Management Journal**, v. 23, n. 3, p. 518–536, 2017.

ZHANG, Y.; WANG, L.; GAO, J. Supplier collaboration and speed-to-market of new products: the mediating and moderating effects. **Journal of Intelligent Manufacturing**, v. 28, n. 3, p. 805–818, 2017.

ZHAO, Y.; CAVUSGIL, E.; CAVUSGIL, S. T. An investigation of the black-box supplier integration in new product development. **Journal of Business Research**, v. 67, n. 6, p. 1058–1064, 2014.

APPENDIX A – Drivers and capabilities for reduced TTM constructs and measurement items

Construct name		Construct definition	Multi-item scales (In our NPD projects considered successful…)	References
CAPABILITIES	Use of cross-functional teams	Level of profiles and competencies diversification on the company's NPD team.	**TEAM1.** There was an effort to involve a cross-functional team in the generation and selection of ideas for a new product.	(PARK; LIM; BIRNBAUM-MORE, 2009; CIARAPICA; BEVILACQUA; MAZZUTO, 2016a)
			~~**TEAM 2.** Our team members had previous experience working in multifunctional teams~~ [a].	
			~~**TEAM 3.** Our team members had an ability to complement other team members tasks.~~ [a]	
			TEAM4. We have a pre-defined team organisation, such as Squad model.	
	Team experience	Level of knowledge or learning gained through team member practice.	**TEAM5.** Our team members have previous R&D experience.	(HEIRMAN; CLARYSSE, 2007; PARK; LIM; BIRNBAUM-MORE, 2009)
			TEAM6. Our team members have previous understanding of the market context in which the business operates.	
			TEAM7. Our team members have previous technological knowledge in developing new products.	
	Founders experience	Level of knowledge or learning gained through founders practice.	**TEAM8.** Our founders have previous R&D experience.	
			TEAM9. Our founders have previous understanding of the market context in which the business operates.	(PARK; LIM; BIRNBAUM-MORE, 2009)
			TEAM10. Our founders have previous technological knowledge in developing new products.	
	Team empowerment	Level of grant by the company of individual power to perform activities and make decisions during the process.	**TEAM11.** Top management provided the self-administration resources the team needed.	(TATIKONDA; MONTOYA-WEISS, 2001; DAYAN; BASARIR, 2009; AKGÜN et al., 2012b)
			TEAM12. Our team members were empowered to make most of the decisions that impacted the project.	
			TEAM13. Our project manager had the autonomy to determine the format, changes and schedule goals.	
	~~Leadership~~ Transformational Leadership	Level of command and influence over the behaviours and attitudes of the development team.	**TEAM14.** Our team leader built trust, inspired power and pride and went beyond his own individual interests for his team.	(BASS, 1995; ZAECH; BALDEGGER, 2017)
			~~**TEAM15.** Our team leader acted with integrity, talked about his values and beliefs, focused on a desirable vision and considered the moral and ethical consequences of his actions.~~ [b]	
			TEAM16. Our team leader behaved in such a way as to motivate the people around him, giving meaning and challenge to his team's work.	
			TEAM17. Our team leader encouraged his team to be innovative and creative by questioning assumptions, reformulating problems and approaching old situations in new ways.	

CAPABILITIES			**TEAM18.** Our team leader paid attention to the needs of each member of the achievement and growth team, acting as a coach or mentor.	
	Learning Learning-by-doing	Set of formal and informal knowledge, which allows the organisation to create its own management models.	**TEAM19.** Most of the lessons learned pre-launch were incorporated into the product for full-scale launch.	(LYNN; SKOV; ABEL, 1999; AKGÜN et al., 2012b; CIARAPICA; BEVILACQUA; MAZZUTO, 2016a; LEATHERBEE; KATILA, 2020)
			TEAM20. The team had the ability to continuously re-examining the value of information collected in previous studies. [a]	
			TEAM21. Team members received training to increase their capacity to face the technological and managerial challenges of this project. [a]	
			TEAM22. Lessons and problem solving took place trying many solutions in the hope of coming up with a good one.	
			TEAM23. Lessons and problem solving occurred by testing hypotheses using a controlled variation of activities and context.	
			TEAM24. Lessons and problem solving occurred by combining existing resources into new ways of solving problems. [a]	
	Organisational culture Agile mindset	Set of values, beliefs and standards adopted by the organisation.	**TEAM25.** Our company has been adapting continuously, changing behaviours, growth and development of people.	(OZKAN-OZEN; KAZANCOGLU; KUMAR MANGLA, 2020) (2020)
			TEAM26. We treat failure as an opportunity to learn, learn from mistakes. [a]	
			TEAM27. We made efforts to have enterprise-wide agility.	
			TEAM28. We made efforts to have continuous delivery of a valuable product in short intervals.	
			TEAM29. Management paradigms for waste reduction, such as lean thinking, were incorporated into the NPD process [a]	
	Management strategies Strategic orientation	Set of strategies adopted by the company to coordinate the team in the execution of tasks and the capture of results	**STRA1.** The team adjusted its strategies in response to changes in the context and progress of the project. [b]	(DAYAN; BASARIR, 2009; AKGUN et al., 2010; CHEN; DAMANPOUR; REILLY, 2010b)
			STRA2. We had formal rewards for time performance, setting explicit time goals or time pressure.	
			STRA3. Management set a clear goal for team members.	
			STRA4. Our strategic planning foresees the used of planning approaches specially designed to help us reducing time-to-market (such as Lean start-up/ Scrum/ Kanban/ Design thinking)	
	Marketing strategies Dynamic Marketing	Set of strategies adopted by the company to create, communicate, deliver and exchange offers that have	**STRA5.** Our company has invested in technology that allows us to systematically collect and store customer information.	(MITRĘGA, 2020)
			STRA6. We have implemented technology that allows for systematic communication with every customer.	
			STRA7. We systematically monitor the level of our customer satisfaction.	

		value for customers, partners and society in general.	**STRA8.** We were able to change our operating procedures quickly to adjust to changes in the market.	
			STRA9. We made use of Crowdfunding/ Inbound marketing/ AARRR metrics/ Growth hacking as a marketing strategy.	
	~~Quality strategies~~ Quality management	Set of strategies adopted by the company to achieve the objectives set by the quality policy.	**STRA10.** We use quality management tools such as value analysis, continuous improvement and quality function deployment (QFD).	(SUN; ZHAO; YAU, 2009)
			STRA11. We have established effective metrics to measure the improvement in the quality of our product.	
	~~Functional~~ Inter-functional integration	Level of approximation of the different functional areas of the company, within a perspective of cooperation.	**INTE1.** Project activities were overlapped (performed concurrently) to a great degree.	(SWINK, 2003; CHEN; DAMANPOUR; REILLY, 2010b)
			INTE2. ~~There was a high degree of cooperation among multiple functions and interaction among NPD team members~~. *b*	
	Customer integration	Set of cooperation actions between customers and the company to understand the needs of consumers and translate them into product requirements.	**INTE3.** ~~Customers' involvement as co-developer of the product was quite significant~~. *b*	(LIN et al., 2013; FENG et al., 2014)
			INTE4. We have continuous improvement programmes that include our key customer.	
			INTE5. ~~We made use of the UX experience/Product roadmap/ Business experience as a way to integrate customers in the development of the new product~~. *b*	
CAPABILITIES	Supplier integration	Set of cooperation actions between suppliers and company to define the design of a product together.	**INTE6.** Our suppliers have been actively involved in our product development process.	(PETERSEN; HANDFIELD; RAGATZ, 2003; DANESE; FILIPPINI, 2013; FENG et al., 2014)
			INTE7. There was an extensive formal assessment of the supplier's capacity and performance before the decision to involve him in this project.	
			INTE8. We have continuous improvement programmes that include our key supplier.	
			INTE9. There was a lot of direct communication between our company and the supplier's company during the project	
	Other partnerships	Set of cooperation actions between the company and other institutions, to use assistance and/or information for support or research during the NPD.	**INTE10.** The company has collaboration agreements with universities and/or research institutes.	(HEIRMAN; CLARYSSE, 2007)
			INTE11. The company has collaboration agreements with other companies to develop or market products.	
		Set of systematic actions	**PROC1.** We adhere to formal project management functions and procedures.	

	Process formalisation	adopted to define and use standards in the NPD process.	**PROC2.** We standardised inputs as much as possible.	(CHEN; DAMANPOUR; REILLY, 2010b; BREWER; ARNETTE, 2017b)
			PROC3. We used tools to standardise the NPD process (such as Scrum or Kanban)	
	Communication	Set of actions adopted to facilitate and clarify communication between individuals involved in the NPD.	**PROC4.** There was a common database, so that all members involved in the process could s5are information immediately.	(DE TONI; MENEGHETTI, 2000; PARK; LIM; BIRNBAUM-MORE, 2009; AKGÜN et al., 2012b)
			PROC5. Team members had informal meetings frequently.	
			PROC6. The information our team members shared was useful.	
	Product testing	Set of actions adopted by the company to evaluate, proving and or validating certain product characteristics and performances.	**PROC7.** ~~Our team performed the prototype test with consumers~~**.** [b]	(LYNN; SKOV; ABEL, 1999; CHEN; DAMANPOUR; REILLY, 2010b; KONG et al., 2015)
			PROC8. ~~Our team performed test marketing/ trial selling before launching the product~~**.** [b]	
			PROC9. ~~The prototype test results, and customer input/reactions to early concepts and launched products were formally recorded.~~ [a]	
			PROC10. Our company used specific tools to test the prototype, such as A/B tests or Wizard of Oz.	
			PROC11. A high frequency of prototyping and testing was required, or a high number of iterations of redesign before stabilisation.	
	Project ~~content~~ structuring	Set of actions adopted to structure the steps that need to be taken to complete the project.	**PROC12.** Projects were assigned members with a full-time commitment to the project.	(KESSLER; CHAKRABARTI, 1999; LYNN; SKOV; ABEL, 1999; CARBONELL; RODRIGUEZ, 2006; ZHAO; CAVUSGIL; CAVUSGIL, 2014)
			PROC13. Projects were executed by co-located teams.	
			PROC14. The NPD process was composed of complex activities (technical difficulty), with new technologies for our company.	
			PROC15. The team followed a clear plan – a roadmap with measurable milestone.	
			PROC16. Team members who were on the team remained on it through completion.	
	~~Technological complexity~~ Product innovativeness	Level of difficulty for acquisition of aspects and elements integrated into the product.	**PROD1.** The technology required to develop this product was new to our company.	(CHEN; REILLY; LYNN, 2005; CHEN; DAMANPOUR; REILLY, 2010b; PESCH; BOUNCKEN; KRAUS, 2015)
			PROD2. This product introduced many completely new features to the market.	
			PROD3. Our product has high complexity (due to a number of product functions; degree of less standardised and interconnected parts; the complexity of design; and/or the size of the project's budget).	
Construct name		**Construct definition**	**Multi-item scales** (In our NPD projects considered successful…)	**References**
DRIVERS	~~Competitive intensity~~	A large number of competitors, competitive product inputs and the threat of substitutes has a	**ENVI1.**~~Our product faced a high level of competition from similar products.~~ [b]	(CARBONELL; RODRIGUEZ, 2006; BREWER; ARNETTE, 2017b)
			ENVI2.~~Competitors were relatively small or weak companies.~~ [b]	

		wide impact on project decisions.		
	Uncertainty	A multi-dimensional construct associated with the inability to predict the impact of environmental change and the consequences of a choice of response.	**ENVI3.** Our customers' preferences changed quite a bit over time.	(DAYAN; BASARIR, 2009; CHEN; REILLY; LYNN, 2012a)
			ENVI4. Customers tended to look for new products all the time.	
	Technological turbulence	Markets with high technology changes rates tend to encourage companies to accelerate NPD to keep up with the competition.	**ENVI5.** The technology used in this product was rapidly changing.	(DAYAN; BASARIR, 2009; ZHAO; CAVUSGIL; CAVUSGIL, 2014)
			ENVI6. It was very difficult to forecast technological developments in our industry.	
			ENVI7. ~~A large number of new product ideas have been made possible through technological breakthrough in the industry.~~ [a]	
			ENVI8. Technology environment was highly uncertain.	
	Time-sensitive	In trying to attract increasingly sensitive customers, companies are looking to increase the number of products launched at a rapid pace.	**ENV9.** Our customers tended to look for new products constantly.	(CHEN; REILLY; LYNN 2012)
			ENVI10. ~~Our consumers are willing to pay a higher price for shorter delivery times.~~ [b]	
	Innovation ecosystems	Innovative market testing environment, where organisations combine their individual offering into a coherent customer-focused solution.	**ENVI11.** ~~The environment in which we operate provides financial incentives, such as venture capital, to motivate local entrepreneurs to focus on risky technological development.~~ [b]	(SUN et al. 2019)
			ENVI12. ~~The environment in which we operate has facilitated and intermediary institutions to assist in the product development process.~~ [b]	
			ENVI13. The environment in which we operate as a group of actors that relate in a symbiotic way to create an ecosystem that increases the survival of companies.	
OTHER VARIABLES	Time-to-market	The time elapsed from business opportunity analysis and concept generation to the introduction of the product to the market	**TTM1.** Senior management was very pleased with the time it took to bring this product to market.	(ZHAO; CAVUSGIL; CAVUSGIL, 2014; PESCH; BOUCKEN, KRAUS, 2015; DAYAN; BASARIR, 2009).
			TTM2. This product was developed and launched faster than what is considered normal and usual for our sector.	
			TTM3. This product was developed and launched faster than the main competitor of a similar product.	
			TTM4. This product was developed and released on or before the original schedule established at the time the project was initiated.	

	Startup performance	Set of results achieved after the development of the startup's main product.	**PERF1.** Our company has gained a significant market share.	(KONG et al., 2015; CHEN; REILLY; LYNN, 2014; FENG et al., 2014; AKGUN et al. 2012)
			PERF2. Our company achieved a significant increase in sales.	
			PERF3. Our company was able to sell the product at a higher price due to the pioneering/inedited nature of the market (premium price).	
			PERF4. Our company has reduced research and development costs.	
			PERF5. Our company has achieved a significant increase in financial performance.	
			PERF6. Our company has seen a significant increase in return on investment.	
			PERF7. Our company has achieved a significant increase in product quality.	
			PERF8. Our company has achieved higher levels of consumer satisfaction.	

a. The assertion was eliminated in the stage Front-end.
b. The assertion was eliminated in the stage Back-end.

APPENDIX B – Cover letter (portuguese version)

UNIVERSIDADE FEDERAL DE SÃO CARLOS – UFSCar
PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA DE PRODUÇÃO

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO – TCLE

O(a) senhor(a) está sendo convidado(a) por pesquisadores da Universidade Federal de São Carlos (UFSCar) para participar da pesquisa "**Os efeitos da redução do tempo de colocação no mercado no desempenho das startups**", a qual tem como objetivo avaliar o impacto da redução do tempo de colocação no mercado no desempenho das startups. O questionário é de questões fechadas e de múltipla escolha, o que facilita o preenchimento e deverá ocorrer entre 15 a 20 minutos.

Ao participar desta pesquisa você também estará ajudando uma campanha nacional de arrecadação para ações emergenciais de enfrentamento à fome, à miséria e à violência na pandemia de COVID-19 no Brasil. Afinal, os **pesquisadores deste projeto estão se comprometendo a doar R$ 5,00 (cinco reais) a cada questionário respondido** para o projeto **"Tem gente com fome"** (https://www.temgentecomfome.com.br/). Os comprovantes da doação, bem como um relatório técnico com a síntese dos principais resultados alcançados na pesquisa, serão enviados por e-mail aos respondentes no final do projeto.

Suas respostas serão tratadas de forma anônima e confidencial, ou seja, em nenhum momento será divulgado seu nome e/ou nome da empresa em qualquer fase do estudo. Os dados coletados poderão ter seus resultados divulgados em eventos, revistas e/ou trabalhos científicos. Somente dados agregados serão informados para garantir que nenhuma informação, que possa constranger você ou sua empresa, seja divulgada.

Sua participação é voluntária, isto é, a qualquer momento o(a) senhor(a) irá decidir se deseja participar e preencher o questionário. Caso desista de participar durante o preenchimento do questionário e antes de finalizá-lo, os seus dados não serão gravados, enviados e nem recebidos pelo pesquisador e serão apagados ao se fechar a página do navegador. Caso tenha finalizado o preenchimento e enviado suas respostas do questionário e após decida desistir da participação, será possível a retirada de suas respostas do banco de dados mediante solicitação ao pesquisador via endereço de e-mail fornecido.

Caso o(a) senhor(a) concorde em participar, a coleta de informações será realizada por meio virtual envolvendo a utilização da internet, composta pelo preenchimento de um questionário sobre o processo de desenvolvimento de produto da empresa (startup) que você está vinculado. O(a) senhor(a) terá acesso às perguntas somente depois que tenha dado o seu consentimento.

A qualquer momento você poderá nos contatar em caso de dúvida ou algum inconveniente que venha ocorrer durante sua participação em nossa pesquisa. O contato poderá ser feito através de e-mail (renatamota.eng@gmail.com).

Com os melhores cumprimentos,

Renata de Oliveira Mota
Doutoranda do Programa de Pós-graduação em Engenharia de Produção
Universidade Federal de São Carlos (UFSCar)

Prof. Dr. Moacir Godinho Filho
Universidade Federal de São Carlos
(UFSCar)

Prof. Dr. Gilberto Miller Devós Ganga
Universidade Federal de São Carlos
(UFSCar)

APPENDIX C – Questionnaire (portuguese version)

Os efeitos da redução do tempo de colocação de produtos no mercado no desempenho das startups

Você está sendo convidado(a) por pesquisadores da Universidade Federal de São Carlos (UFSCar) para participar da pesquisa "Os efeitos da redução do tempo de colocação no mercado no desempenho das startups". Esta pesquisa pretende ter, como participantes, gestores de startups que possuam experiência com desenvolvimento de produto. O questionário é composto por questões fechadas e de múltipla escolha, o que facilita o preenchimento e deverá ocorrer em aproximadamente 15 minutos.

Suas respostas serão tratadas de forma anônima e confidencial, ou seja, em nenhum momento será divulgado seu nome e/ou nome da empresa em qualquer fase do estudo. Para maiores detalhes, acesse o Termo de consentimento livre e esclarecido – TCLE **(**link de acesso ao TCLE**). Ao clicar no botão abaixo, o(a) senhor(a) declara que leu e concordou com o TCLE e concorda em participar.** Em caso de dúvida ou algum inconveniente que venha ocorrer durante sua participação em nossa pesquisa, por favor, entre em contato conosco pelo e-mail: renatamota.eng@gmail.com.

Com os melhores cumprimentos,

Pesquisadores:
Profa. Renata de Oliveira Mota
Prof. Dr. Moacir Godinho Filho
Prof. Dr. Gilberto Miller Devós Ganga

1 / 5 20%

Olá,
Seja bem-vindo(a)! Para começar, precisamos conhecer um pouco mais sobre vocês. Portanto, este primeiro bloco de perguntas é referente a caracterização da empresa e do respondente. Ok?

* Qual é o nome da startup?

* Qual o seu cargo na empresa?
(Mais de uma opção poderá ser selecionada)

- [ ] Fundador ou Co-fundador
- [ ] Diretor
- [ ] Gerente
- [ ] Supervisor ou coordenador
- [ ] Outro (especifique)

* Você possui quanto tempo de experiência profissional em startups?

- ( ) Menos de 3 anos
- ( ) Mais de 3 anos

* Em qual estado está localizada a sede de sua startup?

* A startup possui quanto tempo de atuação?

- ◯ Menos de 1 ano
- ◯ Entre 1 e 3 anos
- ◯ Entre 3 e 5 anos
- ◯ Mais do que 5 anos

* Em qual estágio de desenvolvimento a sua startup se encontra?

- ◯ Ideação
- ◯ Operação
- ◯ Tração
- ◯ Scale-up
- ◯ Outro (especifique)

* A startup possui quantos funcionários?

- ◯ 1 - 10 funcionários
- ◯ 11 - 50 funcionários
- ◯ 50 - 100 funcionários
- ◯ Mais de 100 funcionários

* Qual a atuação de mercado da startup?

- ◯ Multinacional
- ◯ Único país

* Qual(is) o(s) mercado(s) de atuação da startup?

- [ ] Educação
- [ ] Agronegócio
- [ ] Finanças
- [ ] Comunicação e mídia
- [ ] Varejo e atacado
- [ ] Saúde e bem-estar
- [ ] TI e telecomunicações
- [ ] E-commerce
- [ ] Vendas e marketing
- [ ] Gestão
- [ ] Advertising
- [ ] Logística e Mobilidade urbana
- [ ] Eventos e turismo
- [ ] Big data
- [ ] Entretenimento
- [ ] Indústria
- [ ] Construção civil
- [ ] Recursos humanos
- [ ] Imobiliário
- [ ] Meio ambiente
- [ ] Moda e beleza
- [ ] Hardware
- [ ] Direito
- [ ] Energia
- [ ] Cloud computing
- [ ] Games
- [ ] Esportes
- [ ] Segurança e defesa
- [ ] Transportes
- [ ] Seguros
- [ ] Pets
- [ ] CRM
- [ ] Recrutamento
- [ ] Biotecnologia
- [ ] Infantil
- [ ] Nanotecnologia
- [ ] Outro (especifique)

* Qual(is) o(s) público(s)-alvo(s) da startup?

- [ ] B2B
- [ ] B2C
- [ ] B2B2C
- [ ] P2P
- [ ] B2S
- [ ] B2G
- [ ] SaaS
- [ ] Marketplace
- [ ] E-commerce
- [ ] Consumer
- [ ] Hardware
- [ ] Licenciamento
- [ ] Venda de dados
- [ ] API
- [ ] Outro (especifique)

2 / 5 40%

Anter. Próx.

Excelente!

Agora que concluímos o primeiro bloco de questões, gostaríamos que compartilhasse um pouco mais sobre como foi o processo de desenvolvimento de produto em sua startup. Para isso, lembre-se que:

Time-to-market refere-se ao tempo necessário para projetar, aprovar, construir e entregar um novo produto ao mercado.

Portanto, **pedimos que considere esse período específico em sua empresa para responder as próximas questões.** No caso da empresa ter desenvolvido mais de um produto, por favor, considere o produto chave/central/principal desenvolvido pela empresa. Combinado?

* Considerando **o desempenho** alcançado nos últimos anos com o desenvolvimento do produto na empresa, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações.
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
Nossa empresa obteve um significativo aumento na qualidade dos produtos.	○	○	○	○	○	○	○
Nossa empresa obteve uma significativa participação de mercado.	○	○	○	○	○	○	○
Nossa empresa obteve um significativo aumento do desempenho financeiro.	○	○	○	○	○	○	○
Nossa empresa conseguiu comercializar o produto com um maior preço devido ao pioneirismo/ ineditismo no mercado (preço prêmio).	○	○	○	○	○	○	○
Nossa empresa reduziu custos em pesquisa e desenvolvimento.	○	○	○	○	○	○	○
Nossa empresa obteve maiores níveis de satisfação dos consumidores.	○	○	○	○	○	○	○
Nossa empresa obteve um significativo aumento das vendas.	○	○	○	○	○	○	○
Nossa empresa obteve um significativo aumento no retorno sobre o investimento.	○	○	○	○	○	○	○

* Considerando **as características do produto desenvolvido** por sua empresa, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
O produto desenvolvido por nossa empresa teve alta complexidade de desenvolvimento (devido a uma série de funções do produto; grau de partes menos padronizadas e interconectadas; a complexidade do design; e/ou o tamanho do orçamento do projeto).	○	○	○	○	○	○	○
A tecnologia adotada no produto desenvolvido por nossa empresa é inovadora.	○	○	○	○	○	○	○
O produto desenvolvido por nossa empresa introduziu muitos recursos completamente novos no mercado.	○	○	○	○	○	○	○

* Considerando as características do **mercado** em que a empresa atuava durante o processo de desenvolvimento de produto, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
O ambiente em que nossa empresa atuava era altamente incerto quanto às mudanças tecnológicas.	○	○	○	○	○	○	○
O ambiente em que nossa empresa atuava oferecia incentivos financeiros, como capital de risco, para motivar os empresários locais a se concentrarem no desenvolvimento tecnológico de risco.	○	○	○	○	○	○	○

O ambiente em que nossa empresa atuava contava com instituições facilitadoras e intermediárias para nos auxiliar.	○	○	○	○	○	○	○
Nossos clientes exigiam frequentemente o desenvolvimento de novos produtos.	○	○	○	○	○	○	○
Os nossos concorrentes eram empresas relativamente pequenas ou fracas.	○	○	○	○	○	○	○
O ambiente em que nossa empresa atuava era altamente incerto porque as preferências de nossos clientes mudam muito com o tempo.	○	○	○	○	○	○	○
Nossos consumidores estavam dispostos a pagar um preço mais alto por prazos de entrega mais curtos.	○	○	○	○	○	○	○
Devido às altas taxas de avanços tecnológicos no setor, um grande número de novos produtos estavam surgindo constantemente.	○	○	○	○	○	○	○
O ambiente em que nossa empresa atuava contava com um grupo de organizações que se relacionam de forma simbiótica para criar um ecossistema que aumenta a sobrevivência das empresas nele inseridas.	○	○	○	○	○	○	○
O produto desenvolvido por nossa empresa enfrentou um alto nível de concorrência de produtos semelhantes.	○	○	○	○	○	○	○

A tecnologia usada neste produto estava mudando rapidamente.	○	○	○	○	○	○	○
O ambiente em que nossa empresa atuava era altamente incerto porque os clientes tendem a buscar novos produtos o tempo todo.	○	○	○	○	○	○	○

* Considerando o **tempo de colocação no mercado** do produto de sua empresa, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
Este produto foi desenvolvido e lançado dentro ou antes do cronograma original estabelecido no momento em que o projeto foi iniciado.	○	○	○	○	○	○	○
A alta administração ficou muito satisfeita com o tempo que levamos para colocar este produto no mercado.	○	○	○	○	○	○	○
Este produto foi desenvolvido e lançado em menos tempo do que o considerado normal e habitual para o nosso setor.	○	○	○	○	○	○	○
Este produto foi desenvolvido e lançado mais rápido do que o principal concorrente de um produto semelhante.	○	○	○	○	○	○	○

3 / 5 60%

Anter. Próx.

Por favor, conte-nos um pouco mais sobre as pessoas envolvidas no processo de desenvolvimento de produto na sua startup.

* Considerando **a equipe** envolvida no desenvolvimento de produto, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
A maioria das lições aprendidas durante o desenvolvimento do produto foram sistematizadas e incorporadas ao produto final.	○	○	○	○	○	○	○
Os membros da nossa equipe de desenvolvimento já tinham trabalhado com pesquisa e desenvolvimento antes.	○	○	○	○	○	○	○
Nossa empresa adotou uma configuração de equipe de desenvolvimento pré-definida, como por exemplo o modelo Squad (que separa os membros da equipe em pequenos grupos multidisciplinares com objetivos específicos).	○	○	○	○	○	○	○

Nossa empresa buscou envolver uma equipe multifuncional na geração e seleção de ideias para o novo produto desenvolvido.	○	○	○	○	○	○	○
Nosso líder da equipe de desenvolvimento atuou com integridade, focado em uma visão desejável e considerando as consequências morais e éticas de suas ações.	○	○	○	○	○	○	○
O gerente de projeto do desenvolvimento de produto tinha autonomia para determinar o formato, as mudanças e as metas de cronograma.	○	○	○	○	○	○	○

As lições aprendidas e a resolução de problemas durante o desenvolvimento do produto ocorreram por meio da validação de hipóteses e variações controladas de atividades e contextos.	○	○	○	○	○	○	○
Os fundadores da nossa empresa possuíam conhecimentos tecnológicos prévios.	○	○	○	○	○	○	○
Os membros da nossa equipe de desenvolvimento possuíam conhecimentos tecnológicos prévios.	○	○	○	○	○	○	○
Os fundadores da nossa empresa possuíam conhecimentos prévios sobre o mercado em que a empresa opera.	○	○	○	○	○	○	○
Nosso líder da equipe de desenvolvimento se comportou de forma a motivar as pessoas ao seu redor, dando sentido e desafio ao trabalho da equipe.	○	○	○	○	○	○	○
Nossa empresa possui valores e crenças baseados na adaptação contínua, mudança de comportamento, crescimento e desenvolvimento das pessoas.	○	○	○	○	○	○	○
Os membros da nossa equipe de desenvolvimento tinham autonomia para tomar a maioria das decisões que impactaram o projeto.	○	○	○	○	○	○	○

Nosso líder da equipe de desenvolvimento encorajou a equipe a ser inovadora e criativa questionando suposições, reformulando problemas e abordando situações antigas de novas maneiras.	○	○	○	○	○	○	○
Nossa empresa forneceu recursos para a autoadministração de que a equipe de desenvolvimento precisava.	○	○	○	○	○	○	○
Os membros da nossa equipe de desenvolvimento possuíam conhecimento prévio sobre o mercado em que a empresa opera.	○	○	○	○	○	○	○
Os fundadores da nossa empresa já tinham trabalhado com pesquisa e desenvolvimento antes.	○	○	○	○	○	○	○
Nosso líder da equipe de desenvolvimento construiu confiança, inspirou poder e orgulho e foi além de seus próprios interesses individuais em prol da equipe.	○	○	○	○	○	○	○
As lições aprendidas e resoluções de problemas durante o desenvolvimento do produto foram obtidas testando várias soluções com o intuito de encontrar a melhor.	○	○	○	○	○	○	○
Nossa empresa tem como princípio obter agilidade em toda a empresa.	○	○	○	○	○	○	○

Nossa empresa tem como princípio a entrega contínua de um produto valioso em intervalos curtos.	○	○	○	○	○	○	○
Nosso líder da equipe de desenvolvimento prestou atenção às necessidades de cada membro da equipe, atuando como coach ou mentor.	○	○	○	○	○	○	○

4 / 5 80%

Anter. Próx.

Chegamos no último bloco de perguntas, e para finalizarmos, gostaríamos de saber mais sobre estratégias, integrações e especificações do processo adotado neste período de desenvolvimento de produto.

* Considerando **as estratégias** adotadas no período de desenvolvimento do produto, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
Nossa equipe de marketing usou tecnologias que nos permitiram coletar e armazenar sistematicamente as informações de nossos clientes.	○	○	○	○	○	○	○
Nossa equipe de marketing monitorou sistematicamente o nível de satisfação de nossos clientes.	○	○	○	○	○	○	○
Nossa empresa adotou a estratégia de dar recompensas formais aos funcionários que cumprissem o desempenho de tempo esperado, estabelecendo metas de tempo explícitas.	○	○	○	○	○	○	○

Nossa equipe de marketing fez uso de estratégias como Inbound marketing, métricas AARRR e/ou Growth hacking.	○	○	○	○	○	○	○
Nosso planejamento estratégico incluiu o uso de abordagens especialmente projetadas para reduzir o tempo de colocação no mercado (como Startup Lean / Scrum / Kanban / Design thinking).	○	○	○	○	○	○	○
Nossa equipe de marketing utilizou tecnologias que permitiram uma comunicação sistemática com cada cliente.	○	○	○	○	○	○	○
Nossa empresa estabeleceu métricas eficazes para medir a melhoria na qualidade do nosso produto.	○	○	○	○	○	○	○
Nossa empresa adotou estratégias flexíveis que puderam ser modificadas em resposta às mudanças no contexto e andamento do projeto.	○	○	○	○	○	○	○

Nossa equipe de marketing foi capaz de alterar os procedimentos operacionais rapidamente para se ajustar às mudanças no mercado.	○	○	○	○	○	○	○
Nossa empresa buscou definir metas de projeto claras para os membros da equipe.	○	○	○	○	○	○	○
Nossa empresa utilizou ferramentas de gerenciamento de qualidade, como análise de valor, melhoria contínua e implantação da função de qualidade (QFD).	○	○	○	○	○	○	○

* Considerando **as integrações** envolvidas no processo de desenvolvimento do produto, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
Nossa empresa desenvolveu acordos de colaboração com outras empresas para desenvolver e/ou comercializar produtos.	○	○	○	○	○	○	○
Nossa empresa desenvolveu programas de melhoria contínua que envolviam diretamente nossos fornecedores.	○	○	○	○	○	○	○
Houve uma extensa avaliação formal da capacidade e desempenho do fornecedor antes da decisão de envolvê-lo neste projeto.	○	○	○	○	○	○	○
Houve um alto grau de cooperação entre as diversas funções da empresa.	○	○	○	○	○	○	○
Nossa empresa desenvolveu programas de melhoria contínua que envolviam diretamente nossos clientes.	○	○	○	○	○	○	○

Nossa empresa fez uso de abordagens para integrar os clientes no desenvolvimento do novo produto, como por exemplo, a UX experience / Product roadmap / Business experience.	○	○	○	○	○	○	○
As atividades das diversas funções da empresa foram desenvolvidas de forma integrada e simultânea.	○	○	○	○	○	○	○
Nossos fornecedores estavam ativamente envolvidos em nosso processo de desenvolvimento de produtos.	○	○	○	○	○	○	○

* Considerando **o processo** de desenvolvimento de produto em sua empresa e suas características, por favor, indique abaixo o seu nível de concordância com as seguintes afirmações:
Escala de 1 (discordo totalmente) a 7 (concordo totalmente).

	1	2	3	4	5	6	7
O nosso processo de desenvolvimento do produto foi estruturado para ter colaboradores que fossem permanecer no projeto até a conclusão.	○	○	○	○	○	○	○
Nossa equipe realizou testes técnicos do produto diretamente com os consumidores.	○	○	○	○	○	○	○
Nossa empresa buscou padronizar as entradas (recursos, insumos e matéria-prima) tanto quanto possível.	○	○	○	○	○	○	○
Nossa empresa fez uso de métodos para padronizar o processo de NPD, como por exemplo, Scrum ou Kanban.	○	○	○	○	○	○	○
O nosso processo de desenvolvimento do produto foi estruturado para designar equipes co-localizadas, ou seja, os membros da equipe realizaram suas atividades no mesmo espaço físico.	○	○	○	○	○	○	○
Nossa empresa usou ferramentas e métodos específicos para testar o protótipo do produto, como testes A/B.	○	○	○	○	○	○	○
O nosso processo de desenvolvimento do produto foi estruturado para designar membros que tinham um compromisso de tempo integral com o projeto.	○	○	○	○	○	○	○
Nossa equipe realizou testes de marketing / vendas experimentais antes de lançar o produto.	○	○	○	○	○	○	○

O nosso processo de desenvolvimento do produto foi estruturado por atividades complexas (elevada dificuldade técnica) e/ou com tecnologias novas para a nossa empresa.	○	○	○	○	○	○	○
Nossa empresa buscou cumprir com procedimentos formais de gerenciamento de projetos.	○	○	○	○	○	○	○
A comunicação entre os membros da equipe ocorreu, frequentemente, em reuniões informais.	○	○	○	○	○	○	○
As informações compartilhadas entre os membros da equipe foram muito úteis para o projeto.	○	○	○	○	○	○	○
Nossa empresa adotou um banco de dados comum para facilitar o compartilhamento de informações entre todos os membros envolvidos no processo.	○	○	○	○	○	○	○
O nosso processo de desenvolvimento do produto foi estruturado para seguir um roteiro com marcos mensuráveis.	○	○	○	○	○	○	○
Foi necessária uma alta frequência de prototipagem e testes, ou um grande número de iterações de redesenho antes da estabilização do produto.	○	○	○	○	○	○	○

Concluímos!

Muito obrigada por suas respostas!

Caso possua interesse, informe um e-mail para o envio do relatório técnico com os principais resultados do projeto e os comprovantes da nossa doação para a campanha "Tem gente com fome".

Endereço de email

Para um melhor refinamento de nossa pesquisa, gostaria de fazer alguma sugestão?

5 / 5 100%

Anter. Concluído

APPENDIX D – Donation

BONDE

COALIZÃO NEGRA POR DIREITOS

Oi, **Renata**!

Olha a notícia boa: sua contribuição a(o) **Tem gente com fome** foi recebida. Obrigada por acreditar nesse trabalho, seu apoio faz toda a diferença! :)

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Comprovante de Contribuição

Nome do apoiador	Renata de Oliveira Mota
CPF/CNPJ do apoiador	016.787.064-50
Data da confirmação	18/01/2022
Valor da contribuição	1000
ID do apoio	#176641

Dúvidas? Só mandar um e-mail pra: suporte@bonde.org

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