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Start-ups: Integrating product, market and supply chain decisions to build-up market entry capabilities

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Abstract

Start-ups are new ventures created to introduce new products and services to the market. They are an important part of the world economic system since start-ups lead the introduction of many innovations into the market and contribute to job generation. While searching for their business model, start-ups constantly adapt to new markets and customer needs, which leads to changes in product features and internal operations. The importance of product adaptation to market needs has been emphasized in entrepreneurship literature. On the other hand, operations management literature recognizes the important role of product design in shaping a firm's supply chain. Therefore, studying the integration of product, market and supply chain decisions to build-up market entry capabilities in start-ups seems to be a prominent area of research. The present study contributes to this area of research by proposing a framework of product, market and supply chain decisions for start-ups. In addition, it carries out a multiple case study to develop insights on how start-ups may use the proposed framework to develop their market entry capabilities.

Keywords: Product - Market - Supply Chain framework, Start-ups, Market entry capabilities, Case Study Research

1. Introduction

One of the fundamental characteristics of the modern world is the rapid pace at which consumer trends change and evolve. This creates a challenge for companies that seek to take advantage of this change to gain a competitive advantage over their competitors, frequently by introducing new products to the market (Christopher, 2006). As introducing a new product into the market is a complex and risky task, companies take actions to reduce their time-to-market while at the same time maintaining costs low and the right quality (Fine, 2005).

The literature already presents two different frameworks to guide managers in the decisions towards new product introduction. First, the technology – product – market (TPM) framework from the entrepreneurship literature aims at helping managers establishing the logical links between technical capabilities and enduring customer needs by means of the product attributes (Markham, 2002; Markham and Kingon, 2004). Still, once in the market, start-ups need to develop rapidly the capabilities to create and scale their resources, routines and reputation

(3R's) (Joglekar and Lévesque, 2013). Therefore, a second framework from the field of operations management, that aims at helping managers to align the design of product, process, and supply chains (three-dimensional concurrent engineering, 3DCE), could in fact be of help to address this challenge (Fine, 1998). However, individually, these frameworks fail to address in a comprehensive way the fundamental needs of start-ups: while 3DCE helps design the product and process to meet future supply chain opportunities and threats, it lacks guidelines regarding the interplay between market characteristics and operational decisions. On the other hand, while TPM can take a certain technology and assist in finding different products and market needs for that technology, it lacks on helping start-ups make strategic operations decisions based on their product and market.

The fact that around 80% of already financed start-ups fail (Shikhar Ghosh, 2012) opens the need for a more integrative framework, which can connect the product and market concerns while at the same time regard supply chain as a strategic enabler for the company scale-up. Therefore, this research makes use of the Product-Market-Supply Chain Framework (P-M-SC) (Tedim et al., 2015) to explore how start-ups integrate product, market and supply chain decisions to build-up market entry capabilities. In fact, the P-M-SC framework mainly seeks to help companies overcome the challenges after having their proof-of-concept validated and commercial interest tested. At that point, most start-ups need to scale-up their operations, attract more investment to answer market needs and become an established company in order to assure firm survival (Vohora et al., 2004). Consequently, the research question guiding this work is: How do start-ups integrate product, market and supply chain decisions?

The remainder of the paper is organized as follows. Section 2 reviews the TPM and 3DCE frameworks to arrive at a detailed presentation of the P-M-SC framework. Section 3 explains the case research method used in this research, section 4 details the within-case analysis and section 5 discusses the results of the cross-case analysis. Finally, section 6 concludes the paper including some limitations and suggestions for future research.

2. Theoretical Background

"If one does not know to which port one is sailing, no wind is favorable."

Lucius Annaeus Seneca

In this fast-paced world, every company faces great challenges derived from the ever-changing needs of the customers and the alterations to the commercial and social environment itself. However, in the case of startups this is even more severe, as dealing with the changes of the outside environment very often means that startups also have to change their internal operations (Kickul, 2011; Vohora et al., 2004). In the first few months or years of a start-up, as it still thrives to understand and test its business model, there is a great need of a list of "good

practices" and strategies to find out analytically the best decisions to take and how to measure their success (Joglekar and Lévesque. 2013). This is even more prominent in the technological sector, in which very often a simple consumer market or business model appears out of thin air by a technological breakthrough of scientific discovery (Markman et al., 2005).

Previous literature has tried to understand how start-ups behave, how their environment works and why they are different from established companies (Vohora et al., 2004). In the case of technological start-ups, some of this initial literature focuses mainly on the challenge of finding existing consumer needs that may be addressed by the technological advances (thus creating a market), and in the subsequence process of creating and developing a product based in that technology, that can effectively fill the needs of that specific market (Markham, 2002).

The Technology – Product – Market framework or TPM (Markham, 2002) addresses this problem by guiding managers in the process of discovering products that can be based on a certain technology and consumer needs (markets) that may be filled by those products (Figure 1). By identifying and analyzing the right market for a specific product, further specification for the product attributes is expected to arise. In the case that those attributes are impossible to achieve with the current research, they will certainly guide the technology development in the path of unveiling those lacking characteristics.

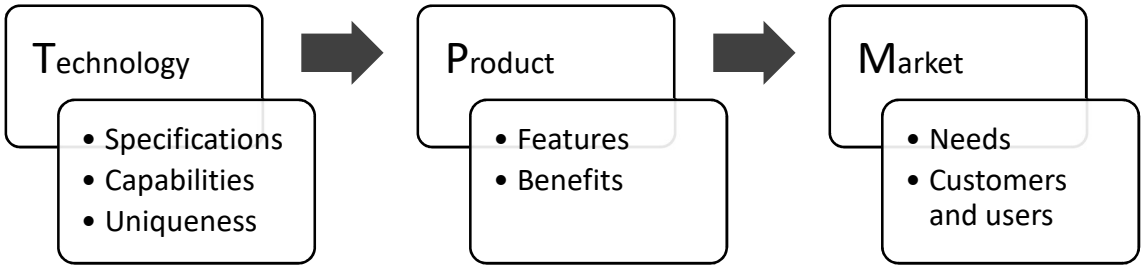

Figure 1 Technology – Product – Market framework (adapted from Markham, 2002)

The Product - Process - Supply Chain framework (or three-dimensional concurrent engineering, 3DCE) on the other hand, aims at helping managers to integrate their product and process development process with the design of the supply chain network and configuration (Fine, 1998; Marsillac and Roh, 2014). By integrating supply chain design with product and process design, companies are able to speed up their new product introduction process and avoid future setbacks (Figure 2).

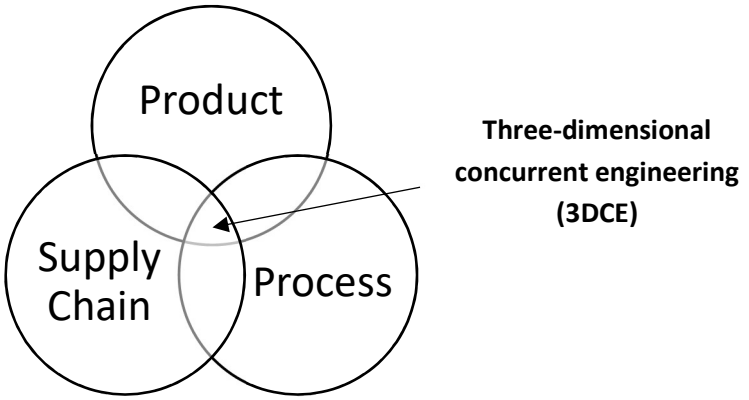

Figure 2 Product – Process – Supply Chain framework (adapted from Fine, 2006)

Start-ups in the growth or scale-up phase (Joglekar and Lévesque, 2013) have their focus no longer in the technology development, but in acquiring resources and continuously re-configuring them along their market discovery process (Vohora et al., 2004). Furthermore, typically start-ups focus on their core competencies related to product and market and build up strategic partnerships with suppliers to whom they subcontract the manufacturing processes (Barros and Claro, 2012; Tedim et al., 2015). Therefore, it seems adequate to consider the Product – Market - Supply Chain framework to assist start-ups in their decisions during the scale-up phase (Figure 3).

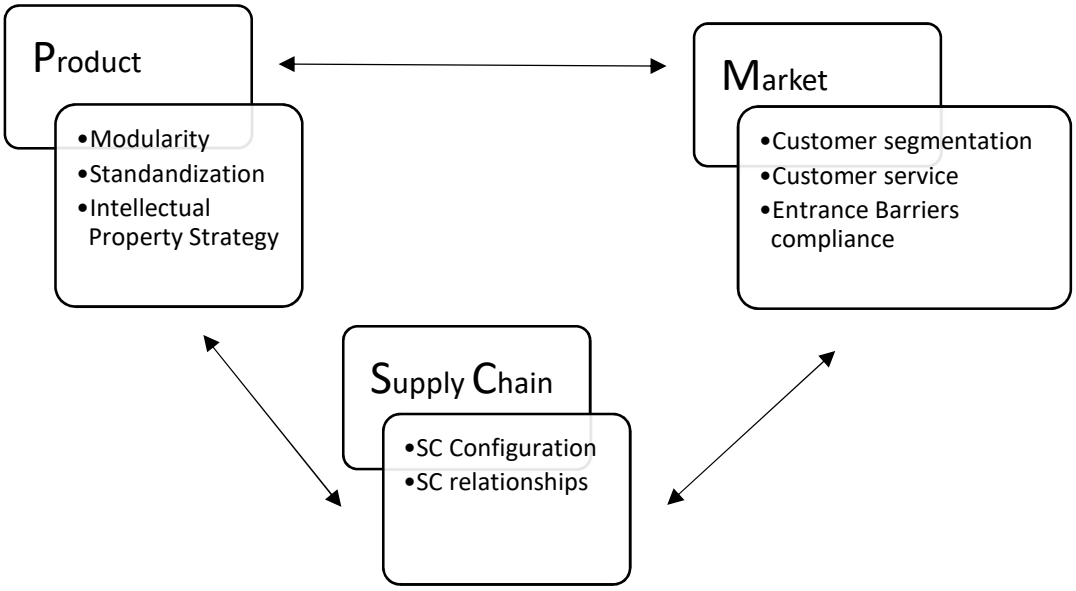

Figure 3 Product – Market – Supply Chain framework

The Product – Market - Supply Chain framework helps start-ups integrating the following decisions:

Product

- Modularity: How may we design a product in modules of components that reduce product development time (thus keeping costs down), increase time to market, reduce the overall complexity and reduce the dependence from suppliers? (Droge et al., 2012; Khan et al., 2012; Marsillac and Roh, 2014; Park et al., 2009)
- Standardization: Did we use as much as possible standard components in order to reduce product complexity, lower supplier lead times, and minimize the risk of stock disruptions? (Ulrich and Eppinger, 2000; Khan et al., 2012)
- Intellectual Property Strategy: Do we have an IP strategy to protect our innovation from replication by others? (Pitkethly, 2001; Reitzig, 2004)

Market

- Customer segmentation: How did we segmented and prioritize the markets in order to better reach each customer target? How did the overall supply chain adapt to each specific segment requirements? (Osterwlader and Pigneur, 2010; Osterwalder et al, 2014)
- Customer service: Do we take advantage of possible revenue streams by offering the clients additional services after the sale? Are we creating established feedback loops, so we can notice product problems and user trends as fast as possible? (Osterwlader and Pigneur, 2010; Osterwalder et al, 2014)
- Entrance Barriers Compliance: Are we identifying the barriers and requisites needed for each market? Do we have a plan on how to surpass them? (Sweet and Maggio, 2015; Doruk and Soylemezoglu, 2014)

Supply Chain

- Supply chain configuration: Are we defining the right supply chain partners? Is subcontracting the production the best option, and if so, who has the responsibility for the detailed engineering? (Jafarian and Bashiri, 2014; Fine, 2006)
- Supply chain relationships: Do we need to maintain an inventory to meet customers' demands, and if we do, where should it be and to whom should it belong? Are we making the right agreements with our partners (Lambert et al, 2004; Saccani and Perona, 2007)

3. Research Method

The Product – Market - Supply Chain framework presented in section 2 was applied in an exploratory case research (Yin, 2003; Voss et al., 2002) in order to understand how start-ups

integrate product, market and supply chain decisions. Given that the unique challenges of technological start-ups vary greatly with their geographical environment (namely funding, production and sales channels), this study considers Portuguese technological start-ups only. Portugal is an adequate environment to study start-ups because it has been building a tech ecosystem and has today a large number of start-ups, incubators, and acceleration programs (Farmbrough, 2018; Hinchliffe, 2018; Ruivo, 2018).

The unit of analysis of the case research is the technology-based start-up and the data collection method used was structured interviews (N=7) with start-ups founders and C-level managers (Table 1). Since the main goal is to study how start-ups integrate different decisions to overcome the scale-up phase, the cases selected are companies that are at the scale-up phase or had already passed it.

Table 1 General data regarding the startups interviewed in the study

Case Study	Market	Interviewee position	Number of employees	Year of Foundation
A	Location Trackers	COO	10	2014
B	Medical Equipment	CTO	10	2012
C	Clinical Analysis	COO	8	2011
D	Gases Emission Reduction	CEO	15	2009
E	Wearables (medical)	CEO	15	2010
F	Wearables (medical)	COO	8	2007
G	Wearables (medical)	COO	19	2013

Table 2 presents the interview protocol used. Interviews took place between 2015 and 2016 and had a duration of approximately 40 minutes each. They were recorded, transcribed and coded in order to carry out the analysis in the light of the P-M-SC framework.

Table 2 - Structured interview protocol

Dimension	Questions	References
Product Design		
	Do you make use of modular configuration in your products? Why? What are the advantages?	Droge et al., 2012; Khan et al., 2012;
	At which level do you use modular configuration? (system, subsystem)	Marsillac and Roh, 2014; Park et al., 2009;

Module Configuration Strategy	How did you surpass problems related with the modules compatibility?	Ulrich and Eppinger, 2000; Khan, 2012; Pitkethly, 2001; Reitzig, 2004
	How modular configuration have influence in your supply chain? In each way is this configuration of benefit for your customers?	
Standard vs Customized Components / Products	Do you use customized or standard components? Why?	
	Do you take into account the customer preferences even with standard components?	
	The customization of your product has affected your supply chain? Why? What are you doing to increase customer acceptance of your customized products?	
Strategic Management of IP	How did you protect the intellectual property of your product?	
	Why have you decided to protect your product?	
	How did you manage the IP rights with your partners?	
Market		
Customer Segment Definition	What are your customer segments? (geographic, jobs to be done)	Osterwlader and Pigneur, 2010; Osterwalder et al, 2014; Sweet and Maggio, 2015; Doruk and Soylemezoglu, 2014
	How did you prioritize them?	
	How has your customer segment influenced your supply chain? (suppliers and distribution channels)	
Customer Service	What are the services that your company provide to the customer after selling the product?	
	Are these services provided at a local or global level? How they influence the supply chain? How did you have feedback from your costumers regarding your after selling services?	
Entrance Barriers Compliance	What kind of barriers did you have to deal with and how did you surpass them?	
Supply Chain		
Supply Chain Configuration	What are your main supply chain partners? How did you find them? (suppliers, customers, service providers)	Jafarian and Bashiri, 2014; Fine, 2006; Lambert et al, 2004; Saccani and Perona, 2007
	Do you subcontract the production? If yes, who has the responsibility of functional specification and detailed engineering?	
	What is the counterfeiting between your product IP and subcontracting?	
Supply Chain Management	Do you maintain inventory? To whom does it belong to? Why?	
	How did you build partnerships?	
	What kind of contractual agreements do you have with your supply chain partners? (short, long-term, arms length, strategic)	

The analysis of the raw data was performed in two steps:

- Within-case analysis, detailed analysis of each case, looking for insights into the main categories of product, market and supply chain decisions (section 4),
- Cross-case analysis, comparison of the findings of all cases to find patterns and commonly used strategies and their respective contribution to build market-entry capabilities (section 5).

4. Within-case analysis

This chapter presents the results from the within-case analysis (Tables 3, 4 and 5). By presenting the start-ups' decisions, we aim at shedding some light on the types of strategies start-ups pursue.

Table 3 Results for Product Design

Product Design			
Code	**Module Configuration Strategy**	**Standard Vs Customized Components/Products**	**Strategic Management of IP**
A	No module configuration	Standard to reduce complexity, but clients can choose basic features (e.g. colors)	Patent pending, to create value for investors. Partners have no access to confidential details.
B	No module configuration (abandoned due to compatibility issues between suppliers).	Standard, clients can't choose any feature	Blackbox product implementation. Partners have no access to confidential details but sign Non-Disclosure Agreement (NDA).
C	No module configuration	Customized for the critical component, standard for the rest, features can't be chosen by clients, but we previously determined based on extensive market research	Patent pending, to avoid replication. Partners have access to confidential details and sign NDA.
D	No module configuration (in the process of implementing)	Standard (for low minimum quantities) and customized (higher delivery dates), clients can choose basic features (e.g. visual finishing of the product)	Patent pending, to avoid replication and to create value for investors. Partners have access to bits of confidential details, don't sign any NDA
E	Uses module configuration (to be able to choose from a bigger pool of suppliers at lower prices). Had some problems with managing the delivery dates for different suppliers	Customized for the critical component, standard for the rest, clients can choose from three different types of models	Patent pending, to create value for investors. Partners don't sign any NDA
F	Uses modular configuration (since the beginning the product was design to be an integration of existing modules)	Standard, clients can choose some basic features	No patent. Partners have access to confidential details but sign NDA.
G	No general modular configuration (just the power plug can be sourced as a module)	Only customized components (standard do not fit the need), clients can't choose any feature (because of minimum quantities orders)	Patent pending, to create value for investors and avoid replication. Partners do not have access to confidential details but sign NDA.

Table 4 Results for Market

Market			
Code	**Customer Segment Definition**	**Customer Service**	**Entrance Barriers**
A	USA, Canada, Asia and Europe. Preference for big uniform markets (same regulations).	No after sales service. Feedback on the customer obtained automatically by built-in hardware	Certification, educate and recruit distributors, obtain funding for hardware
B	World (no geographic segment) as suppliers dictate most product design chooses	Aftersales service. No feedback loop implemented.	Prove the concept to investors, educate users, find suppliers for small/flexible production batches
C	USA and Europe. Preference for early adopter markets	Aftersales service. Feedback on the customer by a post-sales inquiry	Educate users, finding early adopters in Europe
D	Brazil, Malaysia, Europe, USA. Preference for markets with incoming or recent regulations change	No after sales service (product requires no maintenance and has a long life). Feedback on the customer by a post-sales inquiry	Educate users, some markets require same-country manufacture of goods (difficulty in maintaining production quality overseas)
E	Netherlands, Portugal. Preference for small and compact markets, where they may become market leaders, which would serve as a model for other markets.	Aftersales service. No feedback loop implemented.	Educate users, surpass existing alternatives
F	Africa and Brazil.	After sales service for consumables sales. Possible to integrate upsell more products that integrate with the first one.	Educate users, finding the right partners
G	USA, China and Europe. Preference for early adopters' markets and high potential markets.	The product itself is structured as a service with a periodic fee. Feedback loop implemented built-in the software.	Certification, local laws that force companies to produce in the same country as the sales, find the right partners

Table 5 Results for Supply Chain

Supply Chain		
Code	**SC Configuration**	**Supply Chain Management**
A	Production is subcontracted. Main partners: assembly and critical components supplier.	No inventory. Discovered partners based on company members previous experience, made a strategic agreement with main partners and arms length with the rest.
B	Production is subcontracted (for cost and time savings). Main partner: Supplier of the finished product (does detailed engineering, produces and delivers packaged).	No Inventory. Discovered partners in industry fairs, made a strategic agreement with the main partner and arms length with the rest.
C	Production in-house (currently testing alternatives). Main partners: critical component supplier and academia (for scientific knowledge)	No inventory. Discovered partners based on company members previous experience and company market recognition, made a strategic agreement with the main partners and arms length with the rest.
D	Production is subcontracted. Main partners: local manufacturing suppliers (in each country)	No inventory. Prefers partners with an engineering team to help with the design. Makes long-term partnerships with manufacturers (to avoid IP infringement).
E	Production is subcontracted. Main partners: Distributer in the Netherlands (in the past a worker paid by the company was even placed there with the sole purpose of product introduction)	Inventory inside the company headquarters. Made a strategic agreement with the main partner and arms length with the rest.
F	Production is subcontracted. Main partners: integration/assembly supplier.	Inventory inside the company headquarters. Discovered partners based on geographical proximity and company market recognition. Made strategic agreements with the main partner and arms length with the rest.
G	Production is subcontracted. Main partners: critical components, packing and local distributor.	Component inventory in the packing partners, belonging to the company. Discovered partners based on company market recognition.

The results above will be subject to more in-depth analysis and discussion in the next section.

5. Cross-case analysis

This chapter presents the results obtained from the cross-case analysis. The discussion is aligned with the strategy outlined in the previous chapter, i.e. examine the operations strategy choices and capture strategies regarding product, market and supply chain decisions. The results of the cases will be critically discussed within the methodology and framework proposed and presented above.

5.1.Product design

5.1.1. Module Configuration Strategy

Clearly not all companies used modular configuration, a feature that can lead when used correctly, to product complexity reduction and the possibility to implement late customization thus increasing flexibility (Fixon, 2005). In some cases, companies reported being in the process of modularization, which indicates that start-ups in the scale-up phase are still evolving their product design to be integrated with supply chain design.

5.1.2. Standard vs Customized Components / Products

The use of standard components may be cheaper due to access to a larger pool of suppliers, require smaller MOQ (minimum order quantities) and reduce supply chain risk due to the higher availability of parts in the market. Still, by using customization start-ups may differentiate from competitors, thus reaching to a larger range of potential markets and clients (sometimes at the cost of supply chain changes). While most cases used standard components (especially for non-critical parts), most companies took inputs from clients regarding their preferences even with standard components, offering some basic choices such as color or product appearance. The critical components were sometimes customized out of necessity, as standard did not meet their product design needs.

5.1.3. Strategic Management of IP

In the information age knowledge travels fast and is more accessible than ever before, which causes industrial secrets to be more at risk if left unprotected. To address this issue, all companies had specific measures intended to avoid unwanted replication from existent or new competitors. To protect their property, companies often recur to patents to create a threat of litigation and black box design to keep confidentiality with certain product treats. Aside from competitors, measures were also taken with partners, avoiding to disclosure key product aspects (sometimes only integrating patent protected parts in-house), and complementing this practice with the signing of NDA's.

5.2.Market

5.2.1. Customer Segment Definition

A startup is per definition an entity with incial limited resources and thus must choose well where to apply their initial efforts and funds to obtain maximum return on investment. A correct definition of customer segments and subsequent prioritization can greatly influence a startup fate. In the majority of cases, companies choose early adopting markets, preferring compact homogenous markets for their initial efforts over sparse ones (for easier market penetration). In one case a company chose a smaller market to serve as a test model for others: gaining the majority of market share and hoping their recently earned brand recognition can spread to other countries with less effort.

5.2.2. Customer Service

While services associated with the sold products consist of a significant part of an established company revenue stream, it can be hard for a startup to have the maturity and means to provide such services. Still, some of the case companies offered customer after sales services (even using them to sell consumables or upsell other products). However, the majority of companies realized the importance of accessing customer feedback and established tools to retrieve feedback from customers (built either in the hardware and software or by the traditional quality and satisfaction inquiries).

5.2.3. Entrance Barriers Compliance

Launching a new product is never easy, as there are several obstacles that new ventures must surpass in order to enter the desired market. The most frequent barriers are certainly related to the need to educate users about the need and features of the new product, as it sometimes competes in the market with well-established alternatives. Other well-known issue regards obtaining the required certification for operating in some markets, finding the right partners (either supplier, distributors or even investors) and in some cases the protectionist's policies that require companies to produce the goods in the same market where they are sold.

5.3.Supply Chain

5.3.1. Supply Chain Configuration

As a new company proves its concept, it must quickly grow if it wants to survive. To do that, it usually chooses to find partners it can trust: either for production or distribution. As the funding is limited, the production is in most cases subcontracted (for money and time savings). Therefore, start-ups main partners are usually related to production: either an assembly/integration supplier or a supplier

of critical components. In one case the company depended heavily from their distributor for almost their entire growth strategy to work, while in another case it was the academia/universities the biggest partners, bringing scientific knowledge and innovation to the startup.

5.3.2. Supply Chain Management

One of the important decisions startups must take is about the type of relationship they should have with their partners, regarding how they choose and find partners, and also relative to other operational aspects such as inventory ownership of components and final goods. Some companies choose to keep inventory (mostly in-house but sometimes in the supplier), with the ownership being always of the company. The decision of partners' selection was in most case companies influenced by the previous experiences of company members, and also by the partner brand and quality recognition on that specific market. With their main partners, start-ups usually established strategic relationships (with a focus on reliability and quality), while with the other suppliers they establish mostly an arms length relationship.

6. Conclusion

While it has been vastly established that individual themes such as product design, supply chain management and market segmentation have a great influence on the success of new product introduction by established companies, only in recent years did literature started to catch up regarding the same issues with startups (Kickul et al., 2011; Joglekar and Lévesque, 2013). Due to the constantly changing environment of start-ups, in our research, more than analyzing each issue separately, we tried to show ways to integrate the various topics together towards achieving competitive advantages, create synergies and improve the survival rate of startups.

It must, however, be noted that there were limitations in this study, especially regarding the number of companies available for study within the chosen subject (start-ups from a tech background), leading to a scarce number of cases considered that surely influenced the variety of the end results.

While it was clear that some case startups generally agree with the best strategies to use (such as with IP protection), there are some cases where the strategies used vary greatly (as for example with the module configuration strategy).

Future research should further analyze the interplay between product, market and supply chain in start-ups decisions by carrying out a longitudinal study of start-ups from the scale-up phase until maturity – or until death. As some startups reported to be in the process of

changing their operations in various aspects it would allow verifying the improvements made by those changes, surely providing useful insights for future strategy definition.

7. Acknowledgments

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