


Technology-based Entrepreneurial Opportunity Discovery and Development: A Comparative Case Study Research in Three Latin American Countries

*Ricardo Arechavala-Vargas** 

*Alexandra Donado-Mercado*** 

*Viridiana Núñez-López**** 

*María Fernanda Andrés***** 

* Universidad de Guadalajara, Zapopan Jalisco, México
E-mail: arechavala@alumni.stanford.edu

** Universidad Santiago de Cali, Santiago de Cali, Colombia. E-mail
E-mail: alexandra.donado00@usc.edu.co

*** Universidad de Guadalajara, Zapopan Jalisco, México
E-mail: viridiana.nunez@ucea.udg.mx

**** Universidad Nacional del Litoral, Santa Fé, Argentina
E-mail: mfandres@fce.unl.edu.ar

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ABSTRACT

Technology-based entrepreneurs in Latin America face different institutional environments and have less access to knowledge and to technological resources than those in industrialized economies. Opportunity discovery and construction therefore follow also different paths. Results from a set of parallel case studies in Argentina, Colombia and Mexico, explore some differences in terms of the role of available technological and market knowledge, and in terms of the entrepreneur's background. It also explores strong similarities among these countries' economic development, their R&D infrastructure, and their institutional environments. These

similarities shape similar patterns in their entrepreneurs' endeavours. These patterns have important public policy implications for promoting innovation in transitional economies.

KEYWORDS: Entrepreneurial opportunity; Technology-based firm, Latin America.

1. Introduction

Entrepreneurship research has grown in the last few decades. Its importance is frequently underscored because of its impact on employment growth, competitiveness improvement and economic growth (BLOCK; FISCH; VAN PRAAG, 2017; GONZÁLEZ-PERNÍA; JUNG; PEÑA, 2015; LEDERMAN; MESSINA; PIENKNAGURA; RIGOLINI, 2014; SARASVATHY, 2001), among other things. The number of entrepreneurial ventures is often used as an indicator of economic well-being (MITCHELL; SMITH; SEAWRIGHT; MORSE, 2000).

Ample literature has been published about how entrepreneurs discover and enact business opportunities in industrialized economies (BLOCK; FISCH; VAN PRAAG, 2017; CHOI; SHEPHERD, 2004; COOPER; PARK, 2008; DAVIDSSON; HONIG, 2003; DAVIDSSON; WIKLUND, 2009; RERUP, 2005; SHANE, 2000; SHANE; VENKATARAMAN, 2000). Also, there is a prolific literature on the development of regional innovation systems, industrial districts, innovative milieu, or innovation clusters, where the role of knowledge-based entrepreneurship is central. This literature includes research on the processes through which technology-based firms attract and develop a talent pool and human capital that shares significant explicit and tacit knowledge about technological resources and about the technology commercialization process (LONGHI, 1999; HARRISON; COOPER; MASON, 2004; KEEBLE; LAWSON; MOORE; WILKINSON, 1999). In those contexts, this knowledge is channelled to entrepreneurs and new technology-based firms through incubators and other organizations (COOPER; PARK, 2008).

In developing countries, however, entrepreneurship has been researched to a far lesser extent, even though some reports document the fact that entrepreneurship processes in them have clear differences with respect to the way in which they occur in industrialized economies (BRUTON; AHLSTROM; PUKY, 2009; BRUTON; DESS; JANNEY, 2007; BRUTON; RUBANIK, 1997; GONZÁLEZ-PERNÍA;

JUNG; PEÑA, 2015). Among those differences, for example, is the fact that in emerging economies institutional frameworks are less mature and not as solid, R&D infrastructure is less developed, the availability of knowledge is less, and therefore knowledge-intensive entrepreneurship is less likely and weaker than in more advanced economies (GONZÁLEZ-PERNÍA; JUNG; PEÑA, 2015).

This research is focused in Latin America, who still struggles in developing the right set of institutions and programs to support new technology-based firms (AROCENA; SUTZ, 2001; CIMOLI; KATZ, 2003; KATZ, 2001). In Latin America factors behind long-run economic growth and sustainability have not shown a significant impact in total factor productivity. Prevalent entrepreneurship is still mostly need-based and low-growth (GRAZZI; PIETROBELLI, 2016). As a result, the region as such is lagging behind in the transition from efficiency-driven entrepreneurial activity into innovation-driven entrepreneurship (AMORÓS; CRISTI, 2008; AMORÓS; FERNÁNDEZ; TAPIA, 2012; CASAS; GORTARI; SANTOS, 2000; SUTZ, 2000), a fact that hinders competitiveness of countries in the region in the global knowledge economy. Because of this lag, some studies have emphasized the need for more research in Latin American countries that enable policy makers make better decisions regarding entrepreneurship performance assessment (ÁLVAREZ; GRAZZI, 2018; KANTIS; FEDERICO, 2012) and that improve policies that encourage growth-oriented entrepreneurship (MANCILLA; AMORÓS, 2012; KANTIS; FEDERICO; ANGELELLI; IBARRA, 2016). There is also a need for detailed studies that profile successful entrepreneurs (ÁLVAREZ; GRAZZI, 2018) and the conditions that enable better performance of young innovative firms (KANTIS, 2004; KANTIS; FEDERICO; ANGELELLI; IBARRA, 2016; ÁCS; AMORÓS 2008).

In this research successful entrepreneurial cases are used with the aim of contributing to the body of literature on technology-based entrepreneurship in emerging economies, focusing on the identification of the origins of knowledge used in opportunity identification, and in the process the entrepreneur conducts in order to consolidate his venture. Research questions that this study deals with are: Which knowledge sources does the entrepreneur use to discover the opportunity? How does the entrepreneur obtain further knowledge that is needed as the opportunity is realized? What kinds of obstacles are faced? How are they overcome?

With this aim we use eighteen technology-based successful entrepreneurship cases in three Latin-American countries: Argentina, Colombia, and Mexico, with six cases each. The kind of entrepreneurship cases used is the one regarded by the World

Bank as “linked to high growth”, “high level”, or “transforming” entrepreneurship. This entrepreneurship has a high growth potential, in contrast to those whose only objective is self-employment, or whose growth potential is low (LEDERMAN et al., 2014). According to the World Bank, when a firm concurs to export markets it accounts to good performance.

The research focus here is the process of discovery/enactment of an entrepreneurial opportunity within the *inception stage* (KANTIS; FEDERICO, 2012), and the role that knowledge and previous work experience has in developing the envisioned opportunity (FEDERICO; KANTIS; RIALP; RIALP, 2009). It is, thus, within the domain of opportunity-based entrepreneurship and, more specifically, within the literature on technology-based firm endeavors, in the Latin American context, in order to better explain their difference with respect to technology-based firms in more industrialized economies. Even though the issue of technology-based entrepreneurship may overlap with that of early internationalization entrepreneurship, and TBF's tend to internationalize early, the focus of this research deals specifically with the first of these phenomena.

This paper is organized as follows: after this introduction, the second section presents the analytical framework used. The third part describes the research method used. The fourth section presents results obtained, and the fifth section presents the discussion. Finally, the sixth section presents the conclusions and this study's contribution to the specialized literature on technology entrepreneurship in Latin America.

2. Analytical framework

Opportunities do not present themselves in a *prepackaged form* (VENKATARAMAN, 1997). Entrepreneurial opportunity discovery, development and exploitation may become itself a learning process that goes beyond the first entrepreneurial endeavour (RERUP, 2005; WANG; CHUGH, 2014). In such a process, knowledge plays a key role.

2.1 Knowledge

The role of knowledge is obviously important for any enterprise (whether traditional or technology-based). In technology (or knowledge) – based firms, however, knowledge gives rise to, and shapes, the opportunity itself. Since technology-based opportunities

frequently arise on the basis of technologies that enable product or service better specifications than those already available in the market, both technological knowledge (ADOMAKO; DANSO; BOSO; NARTEH, 2018; CHOI; SHEPHERD, 2004) and market knowledge are critical in order to perceive the opportunity and to launch the enterprise (CHOI; SHEPHERD, 2004).

The literature on entrepreneurship frequently addresses knowledge that the entrepreneur possessed before discovery of the opportunity, and used in recognizing it, as “prior knowledge”, mainly following Shane’s (2000) seminal work on this issue. Other studies have corroborated Shane’s findings on the sources of prior knowledge, starting from academic training (KOELLINGER, 2008), and work experience (ALVAREZ; BARNEY, 2007).

Prior knowledge can come from academic experience (BLOCK; FISCH; VAN PRAAG, 2017), previous entrepreneurial experience (DAVIDSSON; HONIG, 2003), experience from having owned a firm (BLOCK; FISCH; VAN PRAAG, 2017), or close friendship with businessmen (DAVIDSSON; HONIG, 2003).

Once the opportunity has been identified however, its exploration and exploitation in any single entrepreneurial endeavour will require an evolving set of skills and knowledge, as opportunity exploration calls for more knowledge than was initially envisioned (WASDANI; MATHEW, 2014; WOOD; PEARSON, 2009).

Even more than in established firms, the technology-based entrepreneur requires the ability to identify a problem that can be solved with available resources (of which technological knowledge is a vital component); the ability to identify and solve unforeseen problems that rapidly arise is also indispensable, as well as the ability to gather the knowledge needed to solve them. A significant agility in the ways those problems are solved is also important. In the manner proposed by Zahra and his group (ZAHRA; SAPIENZA; DAVIDSSON, 2006), the entrepreneur needs to quickly develop and master dynamic capabilities (TEECE, 2007; TEECE; PISANO; SHUEN, 1999; WINTER, 2003) in order for the endeavour to succeed, a feat that requires a steep learning curve, and the rapid identification and acquisition of relevant knowledge.

The opportunity realization process may become iterative, as knowledge and insights gained through initial work enable the entrepreneur to explore, learn, and sometimes radically change the nature of the opportunity initially envisioned (ALDRICH; YANG, 2014; GEORGE; PARIDA; LAHTI; WINCENT, 2016; WASDANI; MATHEW, 2014).

2.2 Adaptation to Environmental Conditions

As the entrepreneur builds on the initial opportunity discovery, new available sources of knowledge needed to achieve evolving goals must rapidly be identified. Networks are in themselves a means to access knowledge (OWEN-SMITH; POWELL, 2004; POWELL; KOPUT; SMITH-DOERR, 1996; SALAVISA; SOUSA; FONTES, 2012) and technological capabilities, which are a key resource in technology-intensive entrepreneurial projects (HAEUSSLER; PATZELT; ZAHRA, 2012). Links with universities and public research labs are among the more common links in these networks, particularly in more advanced economies, where technological business opportunities exist in a crowded space knowledge creating institutions coexist with venture capital and other facilitating organizations (ÁCS; VARGA, 2005).

More sources of further knowledge along opportunity realization come to bear as the entrepreneur initiates the new venture. In trying to configure those resources available, different configurations will be tried naturally, and the entrepreneur will realize along the way that more knowledge is needed. An important component of these configurations is, by necessity, the incorporation of new members into the new organization. Human resources become part of the team, growing the organization's capabilities (ALVAREZ; BARNEY, 2007). Particularly as the entrepreneur enlists help in building the new venture, the possibility will be present to further develop knowledge resources used to exploit the opportunity.

3. Methodology

In order to answer the research questions of this study eighteen in-depth interviews were conducted with successful technology-based entrepreneurs in three Latin American countries: Argentina, Colombia, and Mexico, in the period 2014 - 2016. The interview guide is included as an Appendix. In order for the case studies to be comparable, entrepreneurs and their firms were selected only if their founders created them based on a knowledge-intensive business opportunity within the previous five years. Table 1 presents the industry sectors which their firms operate. Cases are coded with two letters: one for firm id, and one for its country.

TABLE 1
Industry sectors of firms participating in this research

Firm	Industry	Country
EA	Solar energy	Argentina
CA	Software	
IA	Irrigation sensors in agriculture	
KA	Software	
LA	Biotechnology	
TA	Cattle raising app	
CC	Electronics	Colombia
GC	Software	
IC	IT	
MC	Hardware and software	
NC	Electronic labeling	
RC	Digital imaging	
BM	Financial services	Mexico
IM	Health biotechnology	
KM	Functional foods	
LM	Health biotechnology	
NM	Electronics	
UM	Human and animal health	

Content analysis of interview transcripts was done using NVivo 11 Pro qualitative analysis software. Coding is based on the theoretical categories explained above. Inductively discovered categories were also used when the variables of interest were found to be in close relationship with the research focus. The Grounded Theory (CORBIN; STRAUSS, 1990; EISENHARDT; GRAEBNER, 2007; GLASER; STRAUSS, 1967) approach was used at this exploratory stage, in order to generate empirically testable theory for future research. The Grounded Theory approach seeks to explain as well as describe phenomena. In our content analysis, references (interview fragments) are used not only to identify variable relationships, but to explain the how and why those relationships hold in the cases studied.

From the specialized literature, as described above, table 2 presents the analytical categories that were used to code the interviews.

Table 2
Analytical categories

<p>Knowledge sources in opportunity identification</p>	<p>Work experience Academic training Market knowledge Entrepreneurial experience</p>
<p>Knowledge sources in opportunity realization</p>	<p>Business and professional network External collaborations with laboratories and universities Entrepreneurial team Business model adaptation</p>

Coding was done under the assumption that change and variability is inherent in the processes we study, so we seek to describe, understand, and explain variable relationships in terms of the role they play in the entrepreneurial discovery process itself. In doing so, this analysis aims to identify *patterns* in those variable relationships, and to build theory from them. Patterns are identified through a process of systematic comparisons to highlight similarities and differences among cases. Although we use coding categories derived from research on technology-based firms in high-technology contexts, we seek to document the specific differences that the process exhibits in contexts where knowledge resources, networks, and infrastructure, are less abundant.

Following the *Grounded Theory* approach, our sampling proceeds on theoretical grounds: cases are selected where instances of technology-based entrepreneurial opportunities are being followed, as we seek to study interviewees' accounts of their discovery process.

4. Results

4.1 Opportunity Recognition: Knowledge Sources

Different sources of knowledge were found among Latin American entrepreneurs participating in this study:

Work experience enables the identification of market needs, leading to the identification of the opportunity.

The idea for our firm's business came up originally while working in another business, in a different firm that we had at the time. We used to sell publicity to

small businesses; we needed to collect our fees through credit card and, realising how complicated it was to obtain a traditional bank terminal, we decided to develop a more convenient solution. (BM)

Academic or scientific training itself, however, may also enable the entrepreneur to identify business opportunities. It may be pre graduate or post graduate training, even in the absence of work experience:

(The business idea) came from talks between a cousin and me. He had created a firm, and things had gone well for him. When I graduated, there was a recession, I searched for a job, but I ended studying for a specialty diploma. Once I finished, my cousin and I talked. He raised the possibility of starting a business instead of searching for a job. That's when we explored markets and began to look for an interesting niche, where I could use my engineering knowledge. (NM)

I finished my Ph.D. in Europe [...] and came back to my country. Being here, I approached several universities just to see what was going on, and how the academic environment was like. But I noticed, rather, that I would have more impact if I created my own company and started to work with all these academic institutions and research laboratories in order to bring things out to market, that would really have an impact in society. (IM)

We also find that the source of knowledge may be a combination of the two already discussed: **academic training and work experience**. Both of the following interviewees have an academic training, as well as plentiful job experience in MNC's:

[...] we have more than twenty years' experience in telecommunications, [...] working for MNCs most of the time. [...] What you see is always that MNCs develop technologies. Colombia is a country that is a technology consumer. In other words, in Colombia nothing is done, not even a computer. We are end users, but here we have specific needs and, being specifically Colombian needs, the [market] volume is not large, and a MNC will not produce, for example, a thousand units of something that is specific for Colombia. [...] We would say: 'this solution is expensive, but it addresses the client 100 percent'. So that's when we said: 'Let's do something that is niche-specific, let's solve a problem'. We did an analysis and said: 'This is the client's more interesting need, and it may generate an income for us'. From there we started a development, and a firm. (CC)

I worked for several years for a pharmaceutical MNC in the animal health segment. [...] I worked with them for about half the time in R&D, and the rest of the time in marketing. [...] For six years I worked in an environment where I was starting to master the technological and the business sides. [...] One day I came up with an idea for a product that would significantly increase efficiency, and in fact I brought it up with the company. The idea went all the way up to Germany and came back, and the answer was: no. It was out of the company's main focus. At that stage I would not stand it anymore, because I could not do (within the company) things that I knew they could be done [...] I quit the firm. [...] I decided that I would start up a firm where we could begin to develop technologies where I could see that an opportunity existed, and where big pharma would not be interested, because of the market niche would still be very small. (UM)

Academic background by itself may be enough to discover an opportunity, if market knowledge helps in the identification of a specific need (BLOCK; FISCH; VAN PRAAG, 2017). In Latin America, technology entrepreneurs will tend to spot an opportunity when they know that in industrialized economies technologies are being exploited, which are still underdeveloped in their own countries.

[...] what we had seen is that, first, renewable energies in other places were much more developed, and that there was a lot of academic knowledge here, but nothing came out of it that would make its way into the real world. [...] People would tell us: 'I want to install renewable energy in my home' [...] so we assumed a need existed [...] so we ended up quitting the job we had, to dedicate ourselves completely to this firm. (EA)

Our firm [...] originated as I was working on my doctoral dissertation, and I am thesis director for graduate students in computing engineering, and these kids, in the same subject as my PhD, tell me: "But, could this be done in Argentina?" (And I would say:) "Yes, this is feasible, but we need to create a working team." (IA)

Opportunity recognition may rely on **knowledge of the availability of technological solutions** that are not necessarily part of the entrepreneur's background and work experience. Previous **entrepreneurial experience**, and close contact with other businessmen (DAVIDSSON; HONIG, 2003), or experience as a business owner (BLOCK; FISCH; VAN PRAAG, 2017), are important in discovering technological business opportunities:

I choose correctly, I think, those people whom I befriend, and I have learned a lot from them. [...] My friends are over 60, on average. I am 38, and I tend not to befriend people my age. I learn a lot from older people, about how they manage their businesses, about how they achieve stability, and about their successes. I think that has been key. [...] I met a person that told me about the project, and I found it very interesting. [...] That business came with a lot of future possibilities. [...] So, I started to attend scientific conferences, without being myself in that business sector. I had a construction enterprise, and I have always dedicated myself to building projects, and to other activities that have nothing to do with health. [...] I started investing up to 10 percent of the firm's stocks and ended up being a partner owning 50 percent. [...] In the end I split from the firm and started my own business. (LM)

4.2 Opportunity Realization: Additional Knowledge and Adaptation to Environmental Conditions

In realizing the opportunity, two major issues can be identified. The first one is the need for further knowledge needed as new implications in the firm's business plan are identified. This new knowledge is sought by building collaboration with researchers in universities and public laboratories, or by hiring highly qualified personnel. The second issue is the need to change the business model, in order to adapt the nascent venture to environmental conditions.

In the search for needed knowledge, links with universities and public research laboratories may be developed.

We started to collaborate with the Industrial Technology National Institute, with the Research and Development in Energy Centre, which helped us quite a lot [in developing a proof of concept product], with the Science and Technology Ministry, with other universities, and we started to become somewhat of a reference in the field. (EA)

We started empirically, with no critical mass. First, [in order to develop our product] we approached the National Nutrition Institute, looking for Dr. [...] who at the time was the maximum authority in Latin America in the subject of probiotics. We sought people who had a name in the field [...] as we began to know about bacteria and nutrition, we started joint development efforts with different research

centres in the field. And so, our network kept growing, until we reached people in Germany, Brazil, and universities in the US and other countries. (KM)

Currently, what we are doing is to establish alliances and partnerships, a big agreement with the Agriculture and Livestock National Technology Institute, about a couple of months ago, in order to develop technologies used by the Institute for monitoring cultivars as well as livestock, and they are going to validate the technology. (IA)

[...] so then I approached the state university, with its researchers, because I knew the kind of services they could provide me, because what is important is to go and talk with them, and see what they have, and join them into the project that I already had in mind. The same happened with the (public research centre), I had a need, and I approached them, and then, because of those relationships, we started new collaborations with other private and foreign universities, through a colleague of mine, from England. (IM)

4.2.1 Hiring of Highly Skilled Personnel

Whether or not entrepreneurs have themselves academic training, their search for more knowledge will naturally drive them to hire people with the necessary talent and skills:

[...] we hire people that has experience and expertise, a certain profile, and an interest in the area. We seek experts that may help us. (NM)

I started to hire highly trained personnel, young scientists with a passion for what they were doing, with the background that I needed [...] (a recent hire) had the right background, she had worked with materials and biomaterials, she was working with new materials, she was a chemical engineer, with plenty of experience in laboratories. ‘Come for an interview’, I told her, and she came, and she has all the capabilities that I need [...] (IM)

4.2.2 Changing the Business Model

In a fashion similar to what happens in industrialized countries the business model initially envisioned may radically change as the entrepreneur explores and

tests different courses of action (ALDRICH; YANG, 2014; GEORGE; PARIDA; LAHTI; WINCENT, 2016; WASDANI; MATHEW, 2014). In emerging economies, entrepreneurs may find specific reasons to change their business models along the way. They may find that their available resources are not enough for their initial design, that the process is too slow, or that they need to address a different market, for example.

We realise that we cannot go from development to delivery, because it is very costly to go through hardware and software development, it wasn't strategic. [...] All the research is very interesting, but long range [...] so we changed [...] so we changed the way we do things, where developments take six months to a year, we need to have something new to sell because, otherwise, we cannot subsist. [...] What we do is to build a series of strategic alliances with big firms, manufacturers, where they commit to large scale production and commercialization, and we continue to do the engineering, and therefore we do not currently have any direct employees. (IA)

In those first years I realized that dealing with final customers was something that took too much time, a lot of dedication and, at least in the local context, was not appreciated. So, then I found someone who could go and do that work [...] I found that we felt more comfortable being only software engineers. (CA)

Initially, we aimed at the pharmaceutical industry, but it is difficult, because obviously you need to have a certified manufacturing plant, and a lot of legal issues that cannot be accomplished in a day's work. Our start-up and growth strategy has been, in as long as we are able to reach our initial goals in the pharmaceutical industry, to live with this, to find out which business is more viable in a day to day basis. And that's where the cosmetics and nutraceutical products' business came along. (LA)

As with every entrepreneurial endeavour, as one gets going, the impulse is to shoot at everything. The customer comes and says: "What do you have?" And I would say: "What do you need?" And I would go every which way. We started developing software, to provide equipment, and to look into electrical issues, data issues... we would shoot at everything. But then, as years have gone by, we have come to identify ourselves. We cannot know everything, we have to specialize [...] We are currently focusing on projects that aim to improve the quality of life at the base of

the pyramid [...] issues that are not on either the public or the private sector's sight [...] However, as we have needed to generate monthly cash flow, we have come to define certain products that we can move very quickly [...] we are moving a lot of professional equipment for call centers, offices [...] totally automated equipment that will not hurt your hearing. They have a lot of technology, they are somewhat expensive, but they sell very, very well. (IC)

[...] with our business model, which we changed, since before we used to sell equipment, and we decided to stop doing it, because the market, even though they rely on the information, it is very difficult that they would invest in the equipment, so we said: "Ok, let us change the business model. Let's not sell the equipment, let us sell the service, and let the equipment be ours." (MC)

But business models may change also because more ambitious or profitable opportunities are identified along the way, that call for specific sets of learning abilities and absorptive capacity:

At first, the business idea was only to be a cell bank and to charge only for keeping the cells in store, but we felt uneasy from knowing that more elaborated treatments were working in other places globally, and that here in Mexico they weren't being done, or that applications for the cells of the kind that we were keeping (blood cells) was very limited, and it bothered me [...] We attended scientific conferences, and there I learned that other cell types were easier to work with, that it was a universal model, that they were cells that were not compromised by immunological rejection [...] they had a wider application range, they could be industrialized, as opposed to the blood cells we used initially [...] Currently, our business model is the large scale production of cells to use them as a treatment option. [...] Because of the cell production process, a by-product is a cell line that can be used in cosmetics, which can be more easily commercialized, with wider margins. We are working strongly with that product line now, in order to generate income, but we know that the medium and long term project must continue to be the cells. (LM)

Change in business models may be called upon the need for sources of income in the short run, in order to support the exploitation of a more ambitious opportunity:

At first, I really wanted to build a product from scratch, a bone implant from start to market in little time, but I realised that, because of regulations and everything, it

was going to take a little more time. Then, at the same time that I am developing an implant, I am developing other things [that will generate cashflow] on the basis of the same technology that, even though they have a lot to do with health, they are not directly implants [...]. (IM)

The business model may also need to be revised upon finding that the initial product or concept is not well accepted in the market.

We started everything with the idea of a product, specifically for the animal health market. Our original idea was that we would develop the product, we would manufacture it, and we would sell it to producers here in Mexico, regionally. It didn't work because producers do not buy from national small firms, much less when they are composed of only four people! So, we changed our business model, and we thought: "If producers only buy from big pharma, join forces with one of them so that it sells them." We got [a big MNC]. We changed the business model. We own the technology, we would manufacture the product, and they would sell it nationally and internationally. Then we got interested also in the human health market. So, we changed our business model: we are not a product company, we are a technology firm: we develop technology to solve problems. So, we changed our business model, where now we identify problems, we tie them to technologies that we can develop, and we develop and launch them together with someone else. So, it worked, but we found out that it was not a clever idea to leave all of the market in the hands of a third party, so we now participate also, seeing how we can capture more of the product's value. So, we change the business model: now we have a hybrid one: for very big clients, such as the government and international organizations, we sell to them ourselves. For others, we develop strategic alliances for those markets that are more difficult to enter, where a larger sales force is needed. (UM)

Finally, business models will easily change as international markets become a natural growth possibility, because of the innovative and technological component of the product or service offered:

[...] although we think of taking what we do to the United States, because we sincerely believe that, in technology, we do not have to feel envy of anyone, our initial goal is to work in Latin America. (CC)

[...] it is the first product we launch, and it is already in fourteen countries, including Japan and Russia. (UM)

[...] from the beginning we started out in the United States, because it is easier there [than in Mexico]. Before incorporating our firm in Mexico, we did so in the United States. [...] At first the idea was to seek bigger margins, and the biggest margins are in the United States. What we develop we develop in Mexico. (NM)

We have competition in some countries, even though applications are similar, we aim at specific markets. Almost all our competition is focusing in big fields, with a lot of money, but those are few [...] generally, those are all in the United States and Europe, but they are very few. There are a lot that are industrial, and that is where they are all fighting each other, but I go for all of the others. (TA)

The first service we sold was the development of a nutraceutical product for a firm in India. Afterwards, we started to sell some services locally and, together with that, some exports arose, mainly to Israel, Iran, Vietnam, China, Colombia, Mexico, Germany, and the two that arose just this week, to Spain and Poland. (LA)

(Our clients) soon realized that it was better to work with our information than to work with the conventional one [...] we know that it has a very interesting growth potential [...] we currently have already a presence in Uruguay and in Mexico. (RC)

5. Discussion

Even though role of prior knowledge sources in opportunity identification and realization has been documented in industrialized countries, the corresponding processes in emerging economies tend to differ significantly. In industrialized economies, the agglomeration of technology firms develops a pool of talented people that share technological skills, as well as explicit and tacit knowledge about what a process of technology commercialization entails. In such environments, collaboration networks increase the possibilities of combining complementary skills in discovering new technology-based business opportunities. In developed economies, networks are already well developed, and they are themselves a means

to access knowledge and technological capabilities, a key resource in technology-intensive entrepreneurial projects.

As shown, in Latin America it has been found that opportunity recognition is dependent on knowledge gained from less-structured sources of knowledge available to the entrepreneur: in countries of the region entrepreneurs discover opportunities relying more on individual knowledge available from personal background. Opportunity identification tends to arise more from personal knowledge, derived from academic or work backgrounds (such as experience in working for MNC's, for example) that are not shared by many people or organizations locally.

However, in a fashion similar to that which has been documented for industrialized economies, the discovery and realization of a technology-based opportunity is not a single step process. In realizing the opportunity, Latin American entrepreneurs will need to reassess their knowledge stock, as they find out that available resources and market conditions call for changes in their business model, which in turn will call for further knowledge acquisition. Since knowledge and technology infrastructure are not as abundant and widely available as in industrialized economies, their search for needed knowledge will require them to build alliances and collaboration links that were not present before.

Another fact that has been found is that it is frequently the case that technology entrepreneurs must fall back from their initial idea into less demanding business models that will generate cashflow in the short term, in order to compensate for a smaller availability of resources, as compared to what entrepreneurs in industrialized economies have at their disposal (such as angel and venture capital, for example, that are very scarce in Latin American countries).

It has also been found that business models may change to become more ambitious, in order to address international market opportunities, in which case alliances and collaboration will be sought at both the national and the international level, in order to acquire needed knowledge. Even though they may not work with high technology or frontier knowledge, technology-based firms in Latin America may find their business opportunities closely grounded in global markets from their very initial stages.

6. Conclusion

Even though seldom do Latin American technology-based firms use or develop high technology, and they may more frequently rely on published research, or in

technologies already in use in other contexts, opportunity discovery is not usually a single event, but a gradual, iterative, process that continually calls for new knowledge. The entrepreneur's knowledge stock is frequently only enough to initially identify a potential opportunity, and this knowledge is seldom sufficient to set up an entrepreneurial endeavour and to ensure its viability. The opportunity initially envisioned is often a moving target that requires a steep learning curve in order to focus the opportunity with ever increasing clarity. Typically, technology-based firms from industrialized economies start from a newly developed technology, whether from public or university laboratories or from R&D labs in large corporations. In such cases, opportunity discovery and construction tend to start as a technology push process: the technology gives rise to an opportunity that must find its way to markets. In the case studies conducted for this research, opportunities tend to arise more from market needs for which available technologies can serve in building a solution, but where more knowledge needs to be acquired along the way, as the new venture repeatedly redefines its business model to be able to exploit opportunities with the resources available.

As the entrepreneur finds out that the initially available knowledge is insufficient to build the opportunity into a viable business, other knowledge sources will be sought. Along the way, necessary alliances and collaboration with researchers in universities or public research laboratories will be sought, bringing into the entrepreneurial team other members with the knowledge needed. If the entrepreneurial team includes several members, some or most of them will rapidly acquire the necessary skills to identify, gather and assimilate new knowledge.

A noticeable difference in the cases studied, with respect to typical technology-based firms from industrialised countries, is that usually the entrepreneur has more business experience and market knowledge than scientific or technological expertise. They tend to acquire and develop their technological capabilities usually by building alliances and partnerships with universities and other knowledge sources. To this aim, the entrepreneur will have to undertake an active role in creating the necessary networks, since usually in Latin America these networks are relatively weaker and less dense in comparison with their counterparts in more developed economies. The networks and alliances may very well be local or international, but in time they may grow into strong networks and partnerships.

Technology-based firms in our study seem to have stronger market knowledge, but their marketing capabilities are usually insufficient, especially when they enter global markets in their initial stages. In that case, they may seek to build

partnerships with MNCs in order to more rapidly and successfully commercialize their technologies.

Latin American innovative entrepreneurs tend to find opportunities in relatively small niches that are not strongly contested by incumbent or high technology firms. Because of this, and since the technologies they use tend to be relatively available in their environment, establishing and protecting intellectual property rights is less important than in technology-based firms from industrialized economies. Academic entrepreneurs who commercialize high technology developments are relatively few, so there is less interest in patenting and in defending intellectual property rights.

Nevertheless, technological knowledge gives Latin American entrepreneurs an advantage in detecting, assessing and pursuing business opportunities, even though the level or the novelty of the technology they master may not be the highest. Technology entrepreneurs of countries in the region are still able to identify market needs that are not yet being satisfied with available technologies, and to exploit them ahead of others.

Thus, our research contributes to the specialized literature by spelling out part of the processes through which knowledge intensive firms arise in emerging economies, where scientific and technological resources are not as munificent, and where institutional contexts are weaker than in industrialized economies. Evidence is also provided of the ways in which opportunity recognition tends to be closely associated with early internationalization, but this finding must be validated and further explored by more research in countries of the region.

For private and public policy efforts to promote and support knowledge-based firm occurrence and growth in Latin American countries, a critical issue is to strengthen public and private research and development infrastructure. It might be not as important to have high technology infrastructure as it is to be able to build and support networks that facilitate access to available knowledge, including organizations that facilitate collaboration in open innovation networks. Mentoring programs that support commercialization capability building for global markets would also enhance the firms' viability and international competitiveness.

References

- ÁCS, Z.; AMORÓS, J. Entrepreneurship and Competitive Dynamics in Latin America. *Small Business Economics*, v. 31, n. 3, p. 305-322, 2008.
- ÁCS, Z.; VARGA, A. Entrepreneurship, Agglomeration and Technological Change. *Small Business Economics*, v. 24, n. 3, p. 323-334, 2005.
- ADOMAKO, S.; DANSO, A.; BOSO, N.; NARTEH, B. Entrepreneurial Alertness and New Venture Performance: Facilitating Roles of Networking Capability. *International Small Business Journal: Researching Entrepreneurship*, v. 36, n. 5, p. 453-472, 2018.
- ALDRICH, H.E.; YANG, T. How do Entrepreneurs Know What to Do? Learning and Organizing in New Ventures. *Journal of Evolutionary Economics*, v. 24, n. 1, p. 59-82, 2014.
- ALVAREZ, S.A.; BARNEY, J.B. Discovery and Creation: Alternative Theories of Entrepreneurial Action. *Strategic Entrepreneurship Journal*, v. 1, n. 1-2, p. 11-26, 2007.
- ÁLVAREZ, R.; GRAZZI, M. Innovation and entrepreneurship in Latin America: What do we know? What would we like to know? *Estudios de Economía*, v. 45, n. 2, p. 157-171, 2018.
- AMORÓS, J.E.; CRISTI, O. Longitudinal Analysis of Entrepreneurship and Competitiveness Dynamics in Latin America. *International Entrepreneurship and Management Journal*, v. 4, n. 4, p. 381-399, 2008.
- AMORÓS, J.E.; FERNÁNDEZ, C.; TAPIA, J. Quantifying the Relationship between Entrepreneurship and Competitiveness Development Stages in Latin America. *International Entrepreneurship and Management Journal*, v. 8, n. 3, p. 249-270, 2012.
- AROCENA, R.; SUTZ, J. Changing Knowledge Production and Latin American Universities. *Research Policy*, v. 30, n. 8, p. 1221-1234, 2001.
- BLOCK, J.H.; FISCH, C.O.; VAN PRAAG, M. The Schumpeterian Entrepreneur: A Review of the Empirical Evidence on the Antecedents, Behaviour and Consequences of Innovative Entrepreneurship. *Industry and Innovation*, v. 24, n. 1, p. 61-95, 2017.
- BRUTON, G.D.; AHLSTROM, D.; PUKY, T. Institutional Differences and the Development of Entrepreneurial Ventures: A Comparison of the Venture Capital Industries in Latin America and Asia. *Journal of International Business Studies*, v. 40, n. 5, p. 762-778, 2009.
- BRUTON, G.D.; DESS, G.G.; JANNEY, J.J. Knowledge Management in Technology-Focused Firms in Emerging Economies: Caveats on Capabilities, Networks, and Real Options. *Asia Pacific Journal of Management*, v. 24, n. 2, p. 115-130, 2007.

- BRUTON, G.D.; RUBANIK, Y. High Technology Entrepreneurship in Transitional Economies: The Russian Experience. *Journal of High Technology Management Research*, v. 8, n. 2, p. 213-223, 1997.
- CASAS, R.; DE GORTARI, R.; SANTOS, M.J. The Building of Knowledge Spaces in Mexico: A Regional Approach to Networking. *Research Policy*, v. 29, n. 2, p. 225-241, 2000.
- CHOI, Y.R.; SHEPHERD D.A. Entrepreneurs' Decisions to Exploit Opportunities. *Journal of Management*, v. 30, n. 3, p. 377-395, 2004.
- CIMOLI, M.; KATZ, J. Structural Reforms, Technological Gaps and Economic Development: A Latin American Perspective. *Industrial and Corporate Change*, v. 12, n. 2, p. 387-411, 2003.
- COOPER, S.Y.; PARK J.S. The Impact of 'Incubator' Organizations on Opportunity Recognition and Technology Innovation in New, Entrepreneurial High-Technology Ventures. *International Small Business Journal*, v. 26, n. 1, p. 27-56, 2008.
- CORBIN, J.M.; STRAUSS, A. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology*, v. 13, n. 1, p. 3-21, 1990.
- DAVIDSSON, P.; HONIG B. The Role of Social and Human Capital Among Nascent Entrepreneurs, *Journal of Business Venturing*, v. 18, n. 3, p. 301-331, 2003.
- DAVIDSSON, P.; WIKLUND J. Scott A. Shane: winner of the Global Award for Entrepreneurship Research. *Small Business Economics*, v. 33, n. 2, p. 131-140, 2009.
- EISENHARDT, K.M.; GRAEBNER, M.E. Theory building from cases: Opportunities and challenges. *Academy of Management*, v. 50, n. 1, p. 25-32, 2007.
- FEDERICO, J; KANTIS, H.; RIALP, A.; RIALP, J. Does Entrepreneurs' Human and Relational Capital Affect Early Internationalisation? A Cross-regional Comparison. *European Journal of International Management*, v. 3, n. 2, p. 199-214, 2009.
- GEORGE, N.M.; PARIDA, V.; LAHTI, T.; WINCENT, J. A systematic literature review of entrepreneurial opportunity recognition: insights on influencing factors. *International Entrepreneurship and Management Journal*, v. 12, n. 2, p. 309-350, 2016.
- GLASER, B. G.; STRAUSS, A. L. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Transaction Publishers, 1967.
- GONZÁLEZ-PERNÍA, J.L.; JUNG, A.; PEÑA, I. Innovation-Driven Entrepreneurship in Developing Economies. *Entrepreneurship & Regional Development*, v. 27, n. 9-10, p. 555-573, 2015.
- GRAZZI, M.; PIETROBELLI, C. (ed.). *Firm Innovation and Productivity in Latin America and the Caribbean*. The Engine of Economic Development. New York: Inter-American Development Bank, 2016.

HAEUSSLER, C.; PATZELT, H.; ZAHRA, S.A. Strategic Alliances and Product Development in High Technology New Firms: The Moderating Effect of Technological Capabilities. *Journal of Business Venturing*, v. 27, n. 2, p. 217-233, 2012.

HARRISON, R.T.; COOPER, S.Y.; MASON, C.M. Entrepreneurial Activity and the Dynamics of Technology-based Cluster Development: The Case of Ottawa. *Urban Studies*, v. 41, n. 5-6, p. 1045-1070, 2004.

KANTIS, H. (ed.). *Desarrollo Emprendedor: América Latina y la Experiencia Internacional*. Washington, DC: Inter-American Development Bank, 2004.

KANTIS, H.; FEDERICO, J. Entrepreneurial Ecosystems in Latin America: the role of policies. *International Research and Policy Roundtable*. Liverpool: Kauffman Foundation, 2012.

KANTIS, H.; FEDERICO, J.; ANGELELLI, P.; IBARRA-GARCÍA, S. Business Performance in Young Latin American Firms. In: GRAZZI, M.; PIETROBELLI, C. (ed.). *Firm Innovation and Productivity in Latin America and the Caribbean*. New York. Inter-American Development Bank, 2016. p. 167–205.

KATZ, J. Structural Reforms and Technological Behaviour: The Sources and Nature of Technological Change in Latin America in the 1990s. *Research Policy*, v. 30, n. 1, p. 1-19, 2001.

KEEBLE, D.; LAWSON, C.; MOORE, B.; WILKINSON, F. Collective Learning Processes, Networking and 'Institutional Thickness' in the Cambridge Region. *Regional Studies*, v. 33, n. 4, p. 319-332, 1999.

KOELLINGER, P. Why are Some Entrepreneurs More Innovative than others? *Small Business Economics*, v. 31, n. 1, p. 21-37, 2008.

LEDERMAN, D.; MESSINA, J.; PIENKNAGURA, S.; RIGOLINI, J. *El emprendimiento en América Latina: muchas empresas y poca innovación*. Washington, DC: Banco Mundial, 2014.

LLISTERRI, J.; KANTIS, H.; ANGELELLI, P.; TEJERINA, L. *Is Youth Entrepreneurship a Necessity of an Opportunity?* A First Exploration of Household and New Enterprise Surveys in Latin America. Washington, D.C.: Inter-American Development Bank, 2006. (Sustainable Development Department Technical Papers Series).

LONGHI, C. Networks, Collective Learning and Technology Development in Innovative High Technology Regions: The Case of Sophia-Antipolis. *Regional Studies*, v. 33, n. 4, p. 333-342, 1999.

MANCILLA, C.; AMOROS, J.E. La influencia de factores socioculturales en el emprendimiento, evidencia en Chile 2007-2010. *Multidisciplinary Business Review*, v. 5, n. 1, p. 15-25, 2012.

- MITCHELL, R.K.; SMITH, B.; SEAWRIGHT, K.W.; MORSE, E.A. Cross-cultural Cognitions and the Venture Creation Decision. *Academy of Management Journal*, v. 43, n. 5, p. 974-993, 2000.
- OWEN-SMITH, J.; POWELL, W.W. The Effects of Spillovers in the Boston Biotechnology Community. *Organization Science*, v. 15, n. 1, p. 5-21, 2004.
- POWELL, W.W.; KOPUT, K.W.; SMITH-DOERR, L. Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, v. 41, n. 1, p. 116-145, 1996.
- PUENTE, R.; ESPITIA, C.G.G.; CERVILLA, M. A. Necessity Entrepreneurship in Latin America: it's not that Simple. *Entrepreneurship and Regional Development*, v.31, n. 9-10, p. 953-983, 2019.
- RERUP, C. Learning from Past Experience: Footnotes on Mindfulness and Habitual Entrepreneurship. *Scandinavian Journal of Management*, v. 21, n. 4, p. 451-472, 2005.
- SALAVISA, I.; SOUSA, C.; FONTES M. Topologies of Innovation Networks in Knowledge-intensive Sectors: Sectoral Differences in the Access to Knowledge and Complementary Assets through Formal and Informal Ties. *Technovation*, v. 32, n. 6, p. 380-399, 2012.
- SARASVATHY, S.D. Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *Academy of Management Review*, v. 26, n. 2, p. 243-263, 2001.
- SHANE, S. Prior Knowledge and the Discovery of Entrepreneurial Opportunities. *Organization Science*, v. 11, n. 4, p. 448-469, 2000.
- SHANE, S.; VENKATARAMAN, S. The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, v. 25, n. 1, p. 217-226, 2000.
- SUTZ, J. The University–industry–government Relations in Latin America. *Research Policy*, v. 29, n. 2, p. 279-290, 2000.
- TEECE, D.J. Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance. *Strategic Management Journal*, v. 28, n. 13, p. 1319-1350, 2007.
- TEECE, D.J.; PISANO, G.; SHUEN, A. Dynamic Capabilities and Strategic Management. In: ZACK, M.H. *Knowledge and Strategy*. Woburn, MA.: Butterworth Heinemann, 1999. –p. 77-116.
- VENKATARAMAN, S. The distinctive domain of entrepreneurship research: An editor's perspective. In: KATZ, J.; R. BROCKHAUS, R. (ed.). *Advances in entrepreneurship, firm emergence, and growth*. Greenwich, CT: JAI Press. 1997. v. 3. p. 119-138.

WANG, C.L.; CHUGH, H. Entrepreneurial Learning: Past Research and Future Challenges. *International Journal of Management Reviews*, v. 16, n. 1, p. 24-61, 2014.

WASDANI, K.; MATHEW, M. Potential for Opportunity Recognition Along the Stages of Entrepreneurship. *Journal of Global Entrepreneurship Research*, v. 4, n. 7, p. 1-24, 2014.

WINTER, S.G. Understanding Dynamic Capabilities. *Strategic Management Journal*, v. 24, n. 10, p. 991-995, 2003.

WOOD, M.S.; PEARSON, J.M. Taken on Faith? The Impact of Uncertainty, Knowledge Relatedness, and Richness of Information on Entrepreneurial Opportunity Exploitation. *Journal of Leadership & Organizational Studies*, v. 16, n. 2, p. 117-130, 2009.

ZAHRA, S.A.; SAPIENZA, H.J.; DAVIDSSON; P. Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda. *Journal of Management*, v. 43, n. 4, p. 917-955, 2006.

Appendix

Interview Guide

1. Can you tell us about your personal, academic and work background?
2. Would you describe for us the process through which your firm originated, starting from the original idea?
3. How has your firm's idea and business model evolved? Which factors or events were responsible for changes in them?
4. Can you tell us about those decisions you made along the way, in order to consolidate your firm (those that you consider critical to its survival and development, for example)?
 - i. What are your current plans in that respect?
 - ii. What is your vision for the firm (Would you sell it. Do you plan to deliver it to your family members? Do you want to see it institutionalized? Would you let it stop entirely?).
5. How did you acquire the personal skills and capabilities that you consider more important in starting and building your firm?
 - i. Which personal capabilities do you consider more important in the technological domain, in building your firm? How did you acquire them?
 - ii. Can you give us an example of those technological capabilities, and the way they were acquired?
6. Can you tell us about what you regard as the main changes that your firm has undergone in its different functional areas (management, marketing, production, finance, human resources and organizational structure)?
7. As time has gone by, which are the most important changes that you have seen in the firm's environment?
 - i. How has your firm been affected by local or national competition?
 - ii. How has it been affected by international competition?
8. Can you describe for us the role that technology plays in your firm?
9. How was the technology that the firm exploits developed?
10. Can you tell us about those technological capabilities that your firm has developed, that you deem most important?
 - i. How did the firm develop those technological capabilities? Please describe an example of them, in as much detail as possible.
11. Which are the management and business capabilities that the firm has developed?
 - i. Of those, which are the most important? How did the firm develop them? Please describe an example, in as much detail as possible.
12. Does the firm hold any patents (or other forms of intellectual property rights, in order to protect the technologies it uses)?
 - i. Which mechanisms and strategies does the firm use in order to protect the competitive advantages derived from those technologies?

13. Does the firm collaborate with other firms or organizations?
 - i. What are the main reasons for collaboration, or to abstain from collaboration?
 - ii. In case they did, how did those collaborations happen? Can you describe an example, in as much detail as possible?
 - iii. If your firm collaborate with other firms or organizations, where are they located?
 - iv. How do you keep in touch with them?
14. Has your firm collaborated with others, in a way that learning occurs for any of them, or for your own firm?
 - i. If it was the case, can you describe for us an an example of how that collaboration arose, and what was learned along the way?
 - ii. Which are the main benefits that you see that arose from that collaboration?
15. Which are the main obstacles that the firm has had to overcome, with regard to its contact with other organizations, in order to succeed?
16. Which are the main external supports that the firm has counted on?
17. How much does the firm spend in R&D yearly?
 - i. Does it have a unit specifically dedicated to R&D?
 - ii. If it has one, how many people work in it?
18. How do you envision your firm in five years? How do you envision it in ten years?



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